The discovery of a new family Sunopteridae fam. nov. (Insecta: Protorthoptera) from Shaanxi Province, China

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Abstract: The fossil specimens discussed in this paper were collected from the grayish green mudstone and shale in the upper part of Lower Member of Middle Triassic Tongchuan Formation (T₄) in Shaanxi Province, China. Venationary feature correlation with old families and taxonomic discussion show that, among them, one specimen can be assigned to a new family—Sunopteridae fam. nov., which includes a new genus and species and can be referred to Order Protorthoptera Handlirsch, 1906 in taxonomic position, thus belonging to a new member of the Tongchuan Entomossemblage of Shaanxi Entomofauna (belonging to Shaanxi Biota). The discovery of the new family and its new genus and species has certain reference values as follows: ① The discovery of the new family and its new genus and species fills firstly the vacancy in the protorthopterous field of China; ② In the meantime, it fills also the gaps of the valuable Middle Triassic protorthopterous fossil specimens between Late Carboniferous and Late Triassic Epochs in the world; ③ Judging from venationary features and taxonomic position, especially in the course of the formation of the merged vein of M and Cu, it formed a new unique and particular style of merged vein M+Cu. It not only is unique and simple, but also can be distinguished from the above mentioned 10 old families, thus providing important taxonomic evidence.

Key words: Sunopteridae fam. nov.; Middle Triassic Epoch; Tongchuan Formation (T₄) (European Ladinian Stage)

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The fossil insects of the Protorthoptera Handlirsch, 1906 has been studied previously and published a great many papers and monographs, e.g. Carpenter F M[1–3], Fujiiyama I[4], Gorochov A U[5], Handlirsch A[6], Martynov A B[7–8], Riek E F[9], Sharov A G[10–12], Tillyard R J[13–14], Zeuner F E[15] etc. According to their history references of the Protorthoptera, the earliest protorthopterous insects were discovered from Late Carboniferous Epoch (C2) and continued to Late Midtriassic Epoch (T2). The protorthopterous kinds widespread in the world, as in Europe: England, German, France, Holland, Czechoslovakia, Belgium; US-A: Pennsylvania, Arkansas, Kansas, Maryland; South Africa (Natal, Cape of good hope), South American: Argentina, Brazil (Paona basin); Africa (Zaite); Asia: Tongchuan region of Shaanxi Province and Qilian–shan region etc, China, Japan etc.; Australia (N.S.W.). Above mentioned fossil localities in the world, there are at least 60 families of Protorthoptera.

Up to 1982–2007 years, the author has been discovered firstly protorthopterous fossil from Midtriassic Tongchuan Formation (T2f) of Tongchuan region, Shaanxi Province, China and collected a great fossil specimens, including many protorthopterous fossils. Through detailed study and venationary correlation with 10 old families, a special specimen can be established a family—Sunopteridae fam. nov. and referred to Protorthoptera Handlirsch, 1906 in the taxonomic position, in the meantime provided new member for Tongchuan Entomoassemblage of Shaanxi Entomo–fauna(Shaanxi Biota).

A new family, genus and species were reported here.

Holotype specimens are deposited in Beijing Museum of Natural History.

Taxonomic description

Insecta Linne, 1785
Protorthoptera Handlirsch, 1906

1 Sunopteridae fam. nov.

Etymology: Consisting of master of great learning and integrity prof. Dr. Academician Sinica, the late Paleontologist, stratigrapher and Geologist Sun Yun–zhu, especially in commemorate him for make a great contribution on the paleontological, stratigraphical development of China.

Diagnosis: Forewing costal area broader than that of subcostal; Sc long and extended beyond mid-wing and in costal margin; R–term with several terminal branches; Cu merged with M and formed a merged vein –M+Cu near wing base, and then they leave rapidly each other; M forked into MA with 2 branches and MP single; Cu forked later than M, CuA with 3 branches, CuP single; 3 anal veins; A1 closed to Cu.

Important veinationary character: the main venationary characters of the new family can be summarized as follows:

(1)Firstly, MA merged with MP, and formed a main stem of M.

(2)Second, CuA1 merged with CuA2 and formed CuA, then merged once again with CuP and formed main stem Cu.

(3)Third, M merged with Cu and formed a merged vein M+Cu, and the they separated each other.

Comparation: According to above important venationary character of the new family, it can be distinguished from 10 old families (Fig. 1) as follows:

(1)New family is similar to Geraridae (Fig. 1–7) (M+CuA), Narkeminopsis (Fig. 1–8) (M+CuA) but differs only in a special and simple merged vein M+Cu and venationary features and structures. So the new family cannot refer to Atactophilebiidae. They should be established respectively a family(Fig. 1–4).

(2)Compared with Narkeminopsis Whalley, 1979 (Fig. 1–8), Sc very short of Narkeminopsis, main stem of M very long and curved apparently and merged with CuA, and then formed a very short merged vein M+CuA, but then both separated rapidly each other. M and Cu very long and extended to wing base. But above their features of Narkeminopsis distinguished apparently from the new family Sunopteridae fam. nov., because its Sc and R very long, main stem of M
Fig. 1 Important venationary comparision of the new family with 10 old families, especially in the forms and features of various merged of M+CuA[1,6,8,12,14,18]

1–1 Cacurgidae Handlirsch, 911 (merged vein: MP+CuA) 1–6 Heterologellus Schmidt, 1962 (MP+CuA)
1–2 Ampelopteridae Pruvost, 1927 (M+CuA) 1–7 Geraniidæ Scudder, 1885 (M+CuA)
1–3 Omalidæ Handlirsch, 1906 (MP+CuA) 1–8 Narkemiospos Whally, 1979 (M+CuA)
1–4 Atactophlebidae Martynov, 1930 (M+CuA) 1–9 Hapaloteridae Pruvost, 1927 (MP+CuA)
1–5 Pachytylopsidae Handlirsch, 1906 (MP+CuA) 1–10 Stereopteridae Carpenter, 1950 (MP+CuA)
Positive fossil photos of the forewing

Negative fossil photo of the forewing

Fig. 2 Forewing venationary character of *Sunoptera orientalis* sp. nov.
Holotype: THO1–1/089–1(positive); THO1–1/089–2(negative)(conterpart of a same specimen);
(scale bars: 1mm)
very short; M + Cu long; anal area with 3 branches (A1–A3). Thus, all venationary features of both families differ apparently.

(3) Except Atactophlebiidae and Narkemnopsis, there are 8 old families, such as: Cacurgidae (Fig. 1–1), Omaliidae (Fig. 1–3), Pachytylopsidae (Fig. 1–5), Heterologellus (Fig. 1–6), Hapalopteridae (Fig. 1–9), Stereopteridae (Fig. 1–10) respectively with merged vein MP + CuA; Ampelopteridae (Fig. 1–2) with merged vein MP + CuA; Geraridae (Fig. 1–7) with merged vein M + CuA.

Judging from the results of above featural comparison between the new and old families, the new family differs apparently from the old families, so the establishment of a new family is appropriate, and refers to order Protorthoptera Handlirsch, 1906 in taxonomic position.

2 **Sunoptera, gen. nov.**

**Etymology:** See in the "Family Etymology"

**Type species:** *Sunoptera orientalis* sp. nov.

**Diagnosis:** Forewing narrower and longer 3 times than that of wing wide; Sc long, extended beyond midwing, occupy 0.68 of forewing length; Rs arising from R and deviated far from arising base and occupy 0.25 of wing length; Rs forked into anterior (RsA) and posterior (RsP) branches, MA with 3 branches, MP with 2 branches, main stem of M very short and forked into MA with 2 branches and MP single; Cu forked later a little than M, and forked into CuA with 3 branches: CuA1s, CuA1b and CuA2, and CuP single; Anal area with 3 anal veins: A1–A3, A3 closed to Cu, but not coalesced with it. Wingface has not clothed
with colour band or spots.

**Distribution and Geological age:** Tongchuan region of Tongchuan City, Shaanxi Province, China; Midtriassic Tongchuan Formation (T$_4$).

**Comparison:** Up to now this new genus has known one new species.

3 *Sunoptera orientalis* sp. nov. (Fig. 2 and Fig. 3)

**Holotype:** TH01–1/089–1, (positive), −23 (negative).

**Etymology:** From Latin – orientalis or The East.

**Materials:** One right forwing specimen (counterpart), except wing termination damaged, other part and venation preserved well and distinct.

**Description:** Forewing, costal margin gently; terminal part rounded; but wing base shrunk; costal area broader about 2.6 times than that of subcostal; Sc long, occupy 0.68 of forewing length and suddenly upwards curved to wing margin; Rs arising far from R and forked into anterior; RsA with 3 branches and posterior RsP with 2 branches; main stem of M very short, and forked into anterior branch (CuA) and posterior branch (CuP); CuA forked once again into Cu$_{A1}$ and Cu$_{A2}$, CuA$_3$ and CuP only single. Wingface is not clothed with the macula, colour band; CuP coalesced with CuA and formed a merged vein Cu; main stem of Cu longer than that of M; Cu coalesced with M and formed a merged vein M+C, M+C shorter than that of main stem of M, and then they rapidly leave each other and extended respectively wing base. Anal area with 3 anal veins; A$_1$ closed apparently to Cu, but not coalesced with Cu. Wingface has not decorated with colou, sports or colour bands.

**Measurements:** Forewing length about 19.5 mm, wide 6.6 mm.

**Locality and Horizon:** Hejiafang Village of Tongchuan City, Shaanxi Province, China; The specimes are collected from the grayish–green mudstone and shale of the First Fossil Bed, Upper part of the Lover Member, Midtriassic Tongchuan Formation (T$_4$), Corresponded to European Ladinian stage (T$_2$).

**References**


