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Authors: Nel, André, and Delfosse, Emmanuel

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## A new Chinese Mesozoic stick insect

ANDRÉ NEL and EMMANUEL DELFOSSE

*Renphasma sinica* gen. et sp. nov. is described from the Early Cretaceous Yixian Formation in Liaoning. It has the general habitus of the Mesozoic “stick-insects”, with a short thorax, and broad and long tegmina, as long as the hindwings. Its pattern of tegmina venation is typical of the Mesozoic Phasmatodea, also present in the Eocene stick insect family Gallophasmatidae, viz. archaeorthopteran organisation of median and cubital veins. On the other side it has a vomer typical of modern Phasmatodea, both supporting the hypothesis that the Mesozoic, Cainozoic, and modern stick insects belong to the same clade. The pattern of dark and hyaline spots on the wings of *Renphasma* is probably related to mimicry with plants.

### Introduction

The exact relationships of the Mesozoic taxa currently considered as stick insects has long been debated (Gorochov 2000; Tilgner 2001; Nel et al. 2004; Delclòs et al. 2008). Nel et al. (2010) described *Gallophasma longipalpi*, an Early Eocene stick insect with a pattern of tegmina venation of the same type as those of the Mesozoic “Phasmatodea”, but with body structures characteristic of the modern stick insects (e.g., fusion of metatergum and abdominal tergum 1, correlated with the reduction of abdominal sternum 1 to lateral triangular sclerites), which allowed them to include this fossil, the Mesozoic, and the modern “phasmids” in the same order.

Here we describe a new stick insect from the Early Cretaceous Yixian Formation, of the Liaoning Province, corresponding to a new genus and species. The presence of a vomer and its well-preserved tegmina with the same pattern of venation as *Gallophasma*, both confirms the conclusions of Gorochov and Rasnitsyn (2002) and Nel et al. (2010).

*Institutional abbreviation.*—MNHN, Laboratoire de Paléontologie, Paris.

*Other abbreviations.*—CuA, cubitus anterior, CuP, cubitus posterior; MA, media anterior, MP, median posterior; RA, radius anterior; RP, radius posterior; ScP, subcosta posterior.

### Systematic palaeontology

Family Susumaniidae Gorochov, 1988

Subfamily Susumaniinae Gorochov, 1988

### Genus *Renphasma* nov.

*Type species:* *Renphasma sinica* sp. nov., by monotypy; see below.

*Etymology:* Named after Dr. Ren Dong and *Phasma*. Gender feminine.

*Diagnosis.*—Tegmina RP in a rather distal position, near mid part of wing, with short branches; fork of MA opposite base of RP, with rather long branches, separation of MP from CuA rather far from MP+CuA base; MP forked but with rather short branches.

### *Renphasma sinica* sp. nov.

Figs. 1, 2.

*Etymology:* From Latin *sinica*, China.

*Holotype:* MNHN A31857 (print and counterprint of a male imago).

*Type locality:* Beipiao City, Liaoning Province, China.

*Type horizon:* Lower Cretaceous, Yixian Formation.

*Remark.*—The forewing of this fossil was figured in Nel et al. (2010) but erroneously labelled as coming from the “Lower Cretaceous of Santana Formation, Brazil”.

*Diagnosis.*—As for the genus, plus hind femora of male distinctly broadened.

*Description.*—Body 24.0 mm long; head apparently prognathous, 2.0 mm long, 3.0 mm wide; compound eyes broad, 1.0 mm apart, 1.0 mm diameter; two ocelli visible; pronotum 3.0 mm long, 4.8 mm wide, with anterior margin rounded; thorax 10.0 mm long, 6.0 mm wide; abdomen 12.0 mm long, 3.0 mm wide; cerci curved but without inner tooth, very long but rather narrow, 3.0 mm long; paraprocts 1.0 mm long, a long sclerotised hooked structure seems to correspond to the vomer (see discussion below; Fig. 1).

Forewing nearly complete; with a pattern of brown zones and transverse rows of hyaline spots (Fig. 2); 19.3 mm long, 5.4 mm wide; no “precostal” area; concave ScP long and straight, extending 7.1 mm to wing apex; convex RA parallel at length to ScP, with few cross-veins between them; base of RP 7.8 mm of wing base; RP forked, ending 0.5 mm from wing apex; RP and MA well separated, with few cross-veins preserved between them; concavity of RP and convexity of MA weakly pronounced; M and CuA basally fused to R in a common stem; MP+CuA emerges from this stem 1.5 mm from wing base, MA separated from MP+CuA at the same point; fork of MA nearly opposite separation between RA and RP; branches of MA rather long; MP and CuA separated 2.2 mm from their origin; MP weakly concave and forked; CuA clearly convex, simple and straight; concave CuP simple and



Fig. 1. Susumaniid stick insect *Renphasma sinica* gen. et sp. nov., holotype A31857, Beipiao City, China, Lower Cretaceous, Yixian Formation. Photographs of print (A) and counterprint (B).

straight, reaching posterior wing margin, a weak but poorly preserved anterior branch of CuP reaching MP+CuA very near to its base; two simple and straight anal veins, anal area 1.3 mm wide.

Hindwing as long as forewing, with a pattern of colouration similar to that of forewing, but poorly preserved, with only the veins of anterior margin nearly complete (ScP, RA, and RP); ScP and RA simple; RP forked; anal fan only partly preserved.

Legs long, fore femora 5.0 mm long, 0.8 mm wide; tibia 3.5 mm long, 0.5 mm wide; tarsi 2.5 mm long; middle femora 6.0 mm long, 0.5 mm wide; tibia 5.0 mm long, 0.5 mm wide; tarsi 3.5 mm long; hind femora 6.0 mm long, 1.5 mm wide; tibia 6.0 mm long, 0.5 mm wide; tarsi 3.5 mm long; hind femora distinctly broadened; mid and hind tarsi very long; all tarsi five-segmented, with strong claws and an arolia (Fig. 1); mid and hind tibiae folded against femora.

## Discussion

*Renphasma* has the general habitus of the Mesozoic “stick-insects”, with a short thorax, broad and long tegmina, as long as the hindwings, compared to those of the modern stick insects. Following the classification of Gorochov (1994, 2000), *Renphasma* falls in the Susumaniidae: Susumaniinae Gorochov, 1988 for the following characters: reduction of secondary C in forewing; proximal origin of RP, in basal half of wing; RP with two branches, MA and MP with few branches; CuA simple. Gorochov (2000) listed the species of this subfamily: *Palaeopteron* Rice, 1969 (Upper Cretaceous, Labrador, Canada; Rice 1969), *Coniphasma* Birket-Smith, 1981 (Upper Cretaceous, Greenland; Birket-Smith 1981; Kevan and Wighton 1983), *Promastacoides* Kevan and Wighton, 1981 (Palaeocene, south-central Alberta, Canada; Kevan and Wighton 1981, 1983), *Cretophasmomima* Kuzmina, 1985 (Lower Cretaceous, Baissa, Sibe-

ria), *Paraphasmomimella* Kuzmina, 1985 (Lower Cretaceous, Baissa, Siberia), *Eosusumania* Gorochov, 1988 (Lower Cretaceous, Siberia), *Prosusumania* Gorochov, 1988 (Lower Cretaceous, Siberia), *Cretophasmomimoides* Gorochov, 1988 (Lower Cretaceous, Siberia), *Susumania* Gorochov, 1988 (Upper Cretaceous, Siberia), *Kolymoptera* Gorochov, 1988 (Upper Cretaceous, Siberia), *Hagiphasma* Ren, 1997 (Lower Cretaceous, Liaoning province, China), *Aethephasma* Ren, 1997 (Upper Jurassic or Lower Cretaceous?, Hebei province, China), *Orephasma* Ren, 1997 (Upper Jurassic or Lower Cretaceous?, Hebei province, China; Ren 1997).

*Renphasma* differs from *Hagiphasma* from the same outcrop but also from the other Chinese genera *Aethephasma* and *Orephasma* in the base of RP in a more distal position, fork of MA in a more distal position (but opposite base of RP) and with shorter branches, separation of MP from CuA rather far from MP+CuA base (Ren 1997). Another easily visible difference is the flattened femora of *Renphasma*, unlike the narrower ones of these Chinese genera, but this character could well be related to sexual dimorphism, as in the some modern phasmids.

*Eosusumania*, *Prosusumania*, *Susumania*, *Cretophasmomima*, *Cretophasmomimoides*, *Paraphasmomimella*, *Kolymoptera*, *Coniphasma* have a simple MP unlike *Renphasma* (Birket-Smith 1981; Gorochov 1988). *Palaeopteron* has also a simple MA and a simple MP (Rice 1969). The Eocene *Promastacoides albertae* Kevan and Wighton, 1981 has a tegmina venation very close to that of *Renphasma*, especially in the position of the fork between MP and CuA, relative positions of the base of RP and fork of MA. Differences between the two fossils are few, i.e., longer branches of MP, absence of branches of RP (Kevan and Wighton 1981).

The tegmina venation of *Renphasma* is very similar to those of the Mesozoic “phasmopteran” *Chresmoda*, *Orephasma*, and

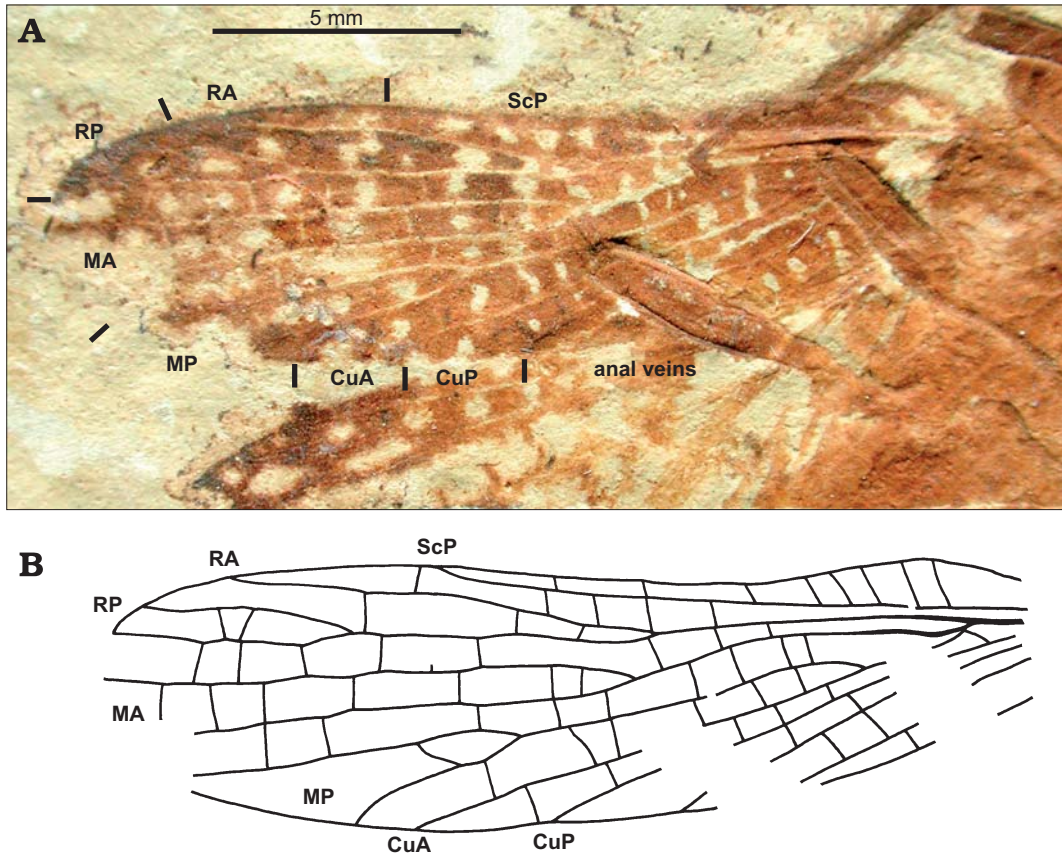


Fig. 2. Susumaniid stick insect *Renphasma sinica* gen. et sp. nov., holotype A31857, Beipiao City, China, Lower Cretaceous, Yixian Formation. Photograph (A) and drawing (B) of tegmina. Abbreviations: CuA, cubitus anterior, CuP, cubitus posterior; MA, media anterior, MP, median posterior; RA, radius anterior; RP, radius posterior; ScP, subcosta posterior.

*Aeroplana* (Delclòs et al. 2008), but also to the Earliest Eocene *Gallophasma* Nel, Delfosse, Robillard, and Petrulėvičius, 2010, which belongs to the modern group Euphasmatodea (Nel et al. 2010). All these fossils share a pattern of tegmina median and cubital veins proper to the Archaeorthoptera, viz. basal fusion of CuA with R+M and presence of an anterior branch of concave CuP reaching CuA; plus a specialised structure proper to these stick insects, viz. “a separation of M+CuA into a forked convex branch MA and a more neutral but convex posterior branch MP+CuA; a concave CuP divided into branches, one of them (CuPa) reaching the posterior branch of M+CuA; convex CuA (+CuPa) separating from weakly concave MP some distance from wing base” (Nel et al. 2010: 344). The fact that *Renphasma* has the same apomorphies in wing venation present in some other Mesozoic “Phasmatodea” and in a genuine Cainozoic taxon representative of the modern phasmid clade Euphasmatodea supports the hypothesis of Gorochov (2000) who attributed the Susumaniinae to the Phasmatodea. Furthermore our specimen of *Renphasma* shows a strongly sclerotised hook-like structure at the apex of abdomen that is exactly in the situation of the vomer of the modern male phasmids (compare Fig. 1 to Bradler 2009: fig. 18). The vomer is an apomorphy of the modern Phasmatodea; thus it confirms that these Mesozoic “Phasmoptera” belong to the same order as the modern stick insects (Bradler 1999).

The pattern of dark and hyaline spots on the wings of *Renphasma* is probably related to mimicry with plants. There is no modern Phasmatodea with a comparable pattern of wing colouration on both tegmina and hindwing.

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André Nel [anel@mnhn.fr] and Emmanuel Delfosse [delfosse@mnhn.fr], CNRS UMR 7205, Entomologie, Muséum national d'histoire naturelle, CP 50, 45, rue Buffon, 75005 Paris, France.

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