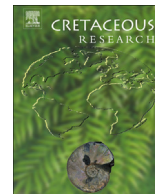




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A new genus of Scoliidae (Insecta: Hymenoptera) from the Lower Cretaceous of northeast China

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ABSTRACT

A new genus and species of Scoliidae (Hymenoptera), *Sinoproscolia yangshuwanziensis* gen. et sp. nov., is described from the Lower Cretaceous Yixian Formation in Inner Mongolia, China and attributed to the subfamily Proscoliinae. Some characteristics, including complete crossveins 1r-rs and 2r-m in the forewing, and a free section present in almost all longitudinal veins indicate a basal position of the new genus in Proscoliinae. The presence of vein 2A suggests its atavistic origin in *Sinoproscolia* gen. nov. rather than a true plesiomorphy.

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1. Introduction

Scoliidae is a small family of aculeate wasps and is subdivided into three subfamilies: Scoliinae, Proscoliinae and Archaeoscoliinae (Rasnitsyn, 1977, 1993). It is composed of about 500 extant species that occur worldwide (Brothers, 1975; Rasnitsyn, 1993) and 18 extinct species (Heer, 1865; Day et al., 1981; Osten, 1987; Zhang, 1989, 2004, 2006; Rasnitsyn, 1993; Rasnitsyn and Martínez-Delclòs, 1999, 2000; Zhang et al., 2002; Nel et al., 2013). The subfamily Proscoliinae Rasnitsyn includes just two genera: the extant genus *Proscolia* Rasnitsyn with two closely related species, *P. archaica* Rasnitsyn, 1977 and *P. spectator* Day, 1981, and the Early Cretaceous genus *Cretaproscolia* Rasnitsyn and Martínez-Delclòs with two species, *C. josai* Rasnitsyn and Martínez-Delclòs, 1999 and *C. asiatica* Zhang, 2006 (Day et al., 1981; Rasnitsyn and Martínez-Delclòs, 1999; Zhang, 2006).

In the Cretaceous of China, all scoliids are known from the Early Cretaceous Jehol Biota including 7 species in 3 genera within 2

subfamilies: *Protoscolia sinensis* Zhang et al., 2002, *P. normalis* Zhang et al., 2002, *P. imperialis* Zhang et al., 2002, *Cretoscolia formosa* Zhang, 2004, *C. laiyangica* Zhang, 2004, *C. rasnitsyni* Zhang, 2004 (Archaeoscoliinae), and *Cretaproscolia asiatica* Zhang, 2006 (Proscoliinae) (Zhang et al., 2002, 2010; Zhang, 2004, 2006).

A new genus and species is described herein from the Jehol Biota in Inner Mongolia, China and assigned to the subfamily Proscoliinae.

2. Material and methods

The new genus and species established herein is based on a specimen found near Yangshuwanzi Village in the Bisiyingzi Township, Ningcheng County, Chifeng City, Inner Mongolia (41° 25' N, 118° 57' E) (Fig. 1) and deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences. The specimen is from the lacustrine Yixian Formation and its horizon is equivalent to the lower Aptian Jianshangou Bed (Wang and Zhang, 2011).

The specimen was prepared with PaleoTools Micro-Jack 3, examined dry and immersed in ethanol under a NIKON SMZ1000 microscope with fibreoptics and photographed with a digital camera (DXM1200) connected to the microscope at the State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing. Line

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drawings were made using CorelDraw X5.0 software. The nomenclature of the wing venation follows that of Rasnitsyn (1980).

3. Systematic palaeontology

Order: Hymenoptera Linnaeus, 1758
 Suborder: Apocrita Gerstacker, 1867
 Superfamily: Vespoidea, Latreille, 1802
 Family: Scoliidae Latreille, 1802
 Subfamily: Proscoliinae Rasnitsyn, 1977

Proscoliinae: Rasnitsyn, 1977, 523

Type genus. *Proscolia* Rasnitsyn, 1977

Diagnosis. Eyes without deep excision (unlike Scoliinae). Mouth cavity and mouthparts short (unlike Scoliinae). Neither metasomal dorsum (mesoscutellum + metanotum + propodeal dorsum) nor metasomal venter (meso- + metaventer) level (i.e. not strictly in the same plane unlike Scoliinae). Wings with outer membrane regularly corrugated (unlike Archaeoscoliinae), pterostigmal base separated from C and R by distinct groove continuing posteriorly into cell 1(+2)r (unlike Scoliinae).

Genera included. *Proscolia* Rasnitsyn, 1977, *Cretaproscolia* Rasnitsyn et Martnez-Delcls, 1999 and *Sinoproscolia* gen. nov.

Remarks. The position of *Cretaproscolia asiatica* Zhang, 2006 in that genus and in Proscoliinae in general is questionable because the regular corrugation is described as invisible in the outer wing membrane but is present in the type species, *C. josai* Rasnitsyn et Martnez-Delcls, of *Cretaproscolia* (Rasnitsyn and Martnez-Delcls, 1999). Absence of corrugation is not characteristic of Proscoliinae but of Archaeoscoliinae and would suggest a transfer of *C. asiatica* to the subfamily Archaeoscoliinae. The combined cell 2+3rm present in *C. asiatica*, however, is characteristic of Proscoliinae rather than Archaeoscoliinae. Therefore we refrain from making the transfer until restudying the type material.

The systematics of *C. asiatica* might suggest synonymising Proscoliinae and Archaeoscoliinae, particularly if the membrane corrugation, their only discriminating character still available, is found to vary in its distinctness. More data are necessary to resolve the issue.

Genus *Sinoproscolia* gen. nov.

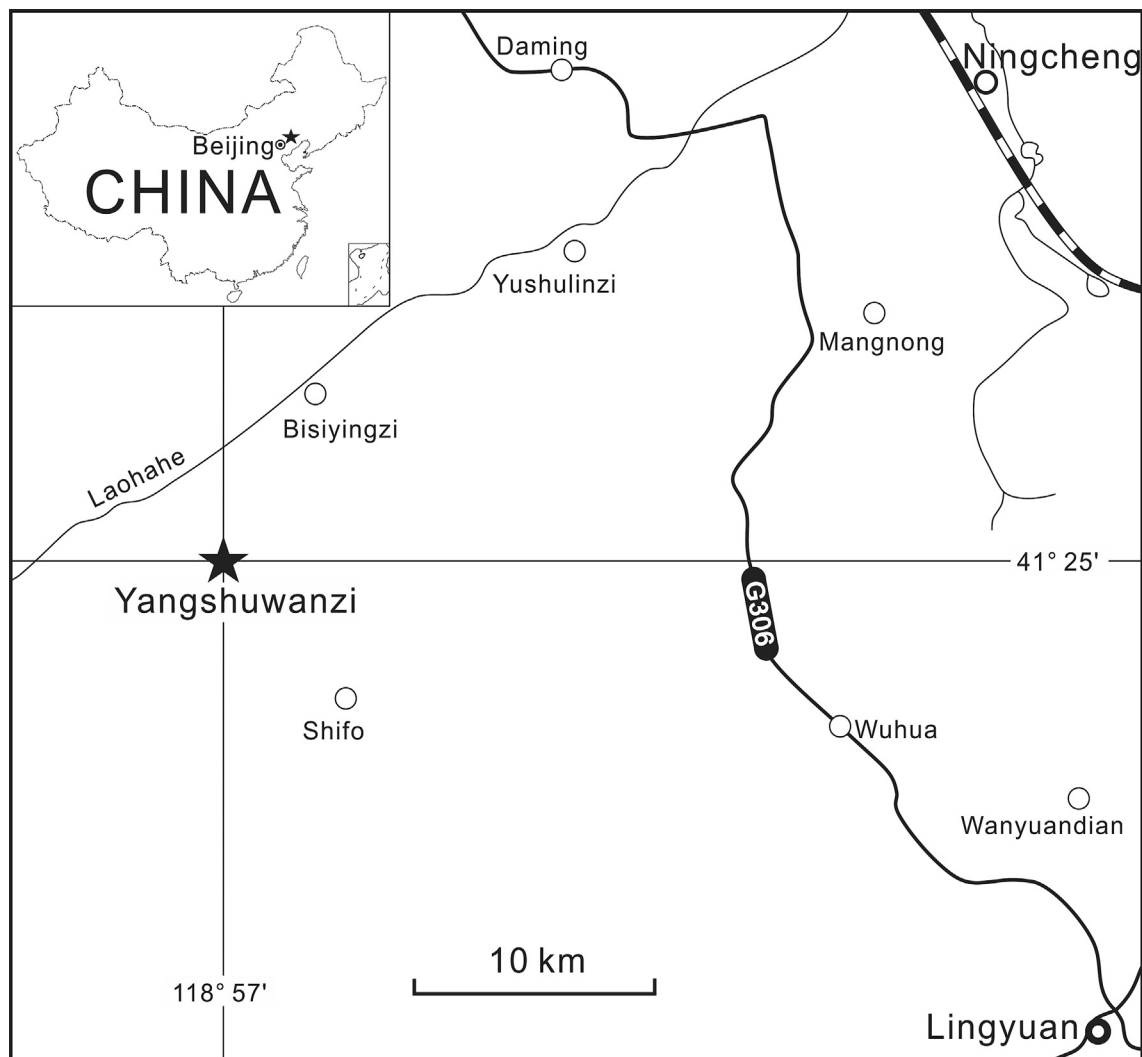


Fig. 1. Geographic map showing the location of the type locality near Yangshuwanzi Village.

Type species. *Sinoproscolia yangshuwanziensis* gen. et sp. nov.

Etymology. From Latin *sino-*, China, and genus *Proscolia*.

Material. Type species only.

Diagnosis. Body rather slim. Mesonotum with notauli and adlateral lines well developed and medial line absent. Metasternal plate rather small, middle coxae separated by at most half their width. Propodeum very short (structure unknown in detail). Forewing with outer membrane narrow but distinctly and regularly wrinkled; pterostigma very narrow- and parallel-sided; venation complete with cell 3r comparatively long, acuminate at anterior wing margin near wing apex; 1r-rs complete, bent, and very weak near pterostigmal base; 2r-m and 3r-m curved and subparallel; cell 2rm longer than 3rm both on RS and M with base at level of pterostigmal apex; 1m-cu and 2m-cu reach cells 2rm and 3rm respectively well before their midlengths; M and Cu with free section reaching wing margin or nearly so; cu-a interstitial; cell 2cu with posterior distal corner narrowly rounded. Hindwing with r-m much shorter than basal section of Rs; M originating basal of Rs origin and bent basally; cu-a postfurcal; apices of Rs, M, Cu and 1A present as free sections; 2A vestigial near wing base.

Comparison. The genus is unique within the family Scoliidae in having cell 2rm roughly quadrangular rather than triangular and with a modest overlap with 1mcu, as well as in having a complete and bent 1r-rs. Additionally, it differs from other Proscoliinae in having cell 3r extremely long, from *Proscolia* and *Cretaproscolia* in having 2r-m present, and from *Proscolia* in having 3r acuminate at its anterior margin.

Sinoproscolia yangshuwanziensis gen. et sp. nov.

Figs. 2, 3

Etymology. From Yangshuwangzi Village, where the holotype was collected.

Type locality and horizon. Near Yangshuwanzi Village (41° 25' N, 118° 57' E) (Fig. 1), Bisiyingzi Township, Ningcheng County, Chifeng City, Inner Mongolia, China; lower Aptian Jianshangou Bed, Yixian Formation.

Material. Holotype NIGP159636 (female), part and counterpart. Head, legs and metasoma incomplete; wings slightly damaged.

Description. Female, male unknown. Head length, as preserved, 1.1 mm, mesosoma 5.3 mm, metasoma 17.9 mm; forewing length 14.4 mm, width 4.8 mm; hindwing, as preserved, length 10.4 mm, width 3 mm.

Body yellowish-brown; mesosoma dorsally and first metasomal segment basally infuscated; mesoscutum in rear half and mesoscutellum both medially with an ovate light spot; legs with pale femora and tibiae; metasomal terga with transversely ovate pale spots sublaterally; sterna with similar but smaller spots visible on sterna 3 and 4 only. Mesosoma long and densely pubescent below.

Head poorly preserved, medium-sized. Antenna thin with 9 segments preserved; flagellomeres gradually decreasing in length and thickness apically. Mesosoma suboval; mesonotum with notauli and adlateral lines long, percurrent; scutellum large; metanotum short; propodeum 1.2 times as long as scutellum. Coxae of legs medium-size; fore- and midlegs with femora and tibiae thin; hind femur comparatively thick and swollen midway.

Forewing with pterostigma long and narrow, light brown; costal vein interrupted before pterostigma; R very thick near

pterostigma, but sharply narrowed (like a narrow cleft) at pterostigmal base; concave fold present from pterostigmal base to near 2rm base; basal section of Rs (1Rs) 1/3rd as long as that of M (1M); 1r-rs present at angle of Rs, curved up in its basal 1/3rd and connected with R at base of pterostigma, 1r-rs with distal 2/3rds thick and basal 1/3rd very weak (just distinguishable); section of Rs between 1r-rs and M perpendicular to Rs+M; 2r-rs short and twice as long as pterostigmal width; cell 3r about 5 times as long as wide, acuminate at anterior margin at shorter distance to wing apex than to 3r-m, Rs abruptly bent apically to end perpendicular to wing margin; cell 3r about 1.3 times as long as cells 1r+2r together; 2r-m separated from 3r-m by slightly less than its own length; 2r-m, 3r-m and section of Rs between them bent; apex of 3rm distinctly basal to end of cell 3r; 2rm about 1.5 times as long as 3rm; 1m-cu undulate, meeting 2rm in basal 2/5ths of its posterior margin; 2m-cu bent, meeting 3rm in basal 1/3rd of its posterior margin; cu-a interstitial; free apices of M and Cu long and reaching wing margin. Hindwing with first section of Rs about 3.5 times as long as r-m; r-m short, slightly oblique towards wing base, and slightly bent; M originating well basal of origin of Rs and strongly bent basally; Cu present as a free vein; cu-a distal of M+Cu fork, slightly undulate and nearly twice as long as r-m; Rs, M and 1A with free apical sections distinct, 2A vestigial near wing base. Fore- and hindwings both with regularly, longitudinally wrinkled apical membranes.

Metasoma almost twice as long as mesosoma with 6 segments. Sting short and slightly protruding out of metasomal apex; sheaths incompletely preserved.

Remarks. The longitudinally wrinkled structures are widely present in the apical parts of the fore and hindwings in extant Scoliidae and are also known from some extinct representatives, such as *Cretaproscolia josai* Rasnitsyn et Martínez-Delclòs, 1999 and *Araripescolia magnifica* Nel, Escuillie et Garrouste, 2013 (Rasnitsyn and Martínez-Delclòs, 1999; Nel et al., 2013). In this new species, this kind of structure is distinct in the apical parts without veins. It is notable that similar wrinkles are also observed in cells 3r and 3rm of both forewings (Fig. 2A–D,G).

4. Discussion

Fossil Scoliidae, usually in an imperfect state of preservation as compared with living taxa, are insufficiently known to provide a reliable cladistic classification. However, their available morphology is sufficient to provide an informal cladistic analysis of Hennig's own "pen and paper" style. The new genus is assigned to the subfamily Proscoliinae due to the following forewing characteristics defined by Rasnitsyn and Martínez-Delclòs (1999): vein C is interrupted before the pterostigma; vein R is very narrow at the pterostigmal base; and the concave fold of the membrane runs distinctly from the pterostigmal base to near the base of cell 2rm. These characters rule out attribution of the genus to extant Scoliinae. The regularly corrugated outer wing membrane is considered an apomorphy based on its absence from the wings of almost all basal Hymenoptera, except for a few specialized taxa with a particularly large body size. In the Mesozoic, the character is only known from Myrmiciidae amongst Symphyta and Proscoliinae in Apocrita. This putative synapomorphy with Proscoliinae prevents the new genus from being assigned to the subfamily Archaeoscoliinae and leaves as the only choice subfamily Proscoliinae. Unlike the other proscoliine genera (*Cretaproscolia* and *Proscolia*), the new one has a complete forewing venation with crossvein 1r-rs complete, cell 3r quite long and ending at the anterior wing margin close to the wing apex, cell 2rm nearly quadrangular and only slightly overlapping with 1mcu and the

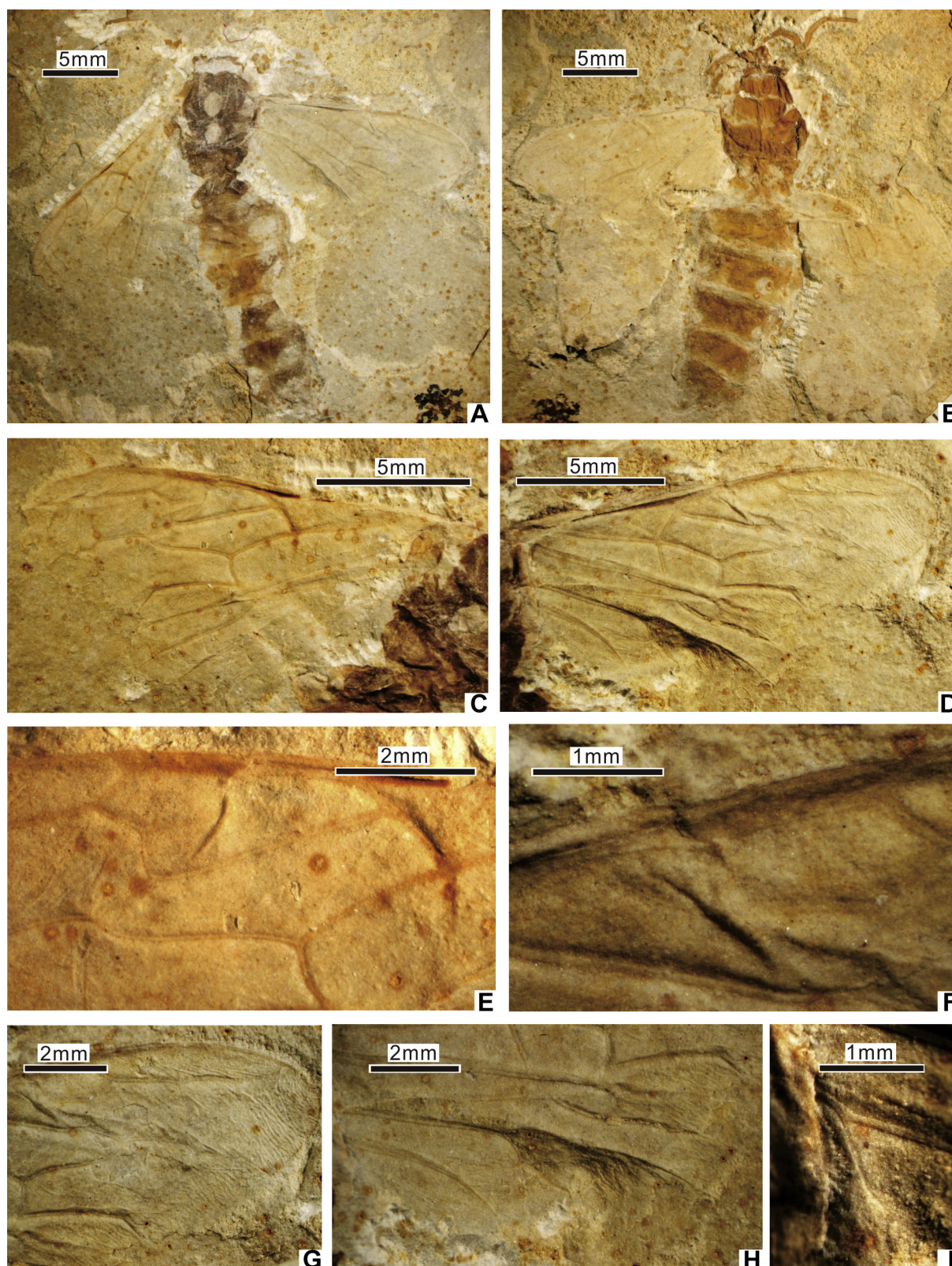


Fig. 2. *Sinoproscolia yangshuwanziensis* gen. et sp. nov., holotype NIGP159636; Yangshuwanzi, early Aptian; photographs. A, part, dorsal view; B, counterpart, ventral view; C, part, left forewing and hindwing; D, part, right forewing and hindwing; E, part, pterostigma and crossvein 1r-rs in left forewing; F, part, pterostigma and crossvein 1r-rs in right forewing; G, part, distal part of right forewing; H, part, distal part of right hindwing; I, part, vestigial vein 2A in right hindwing.

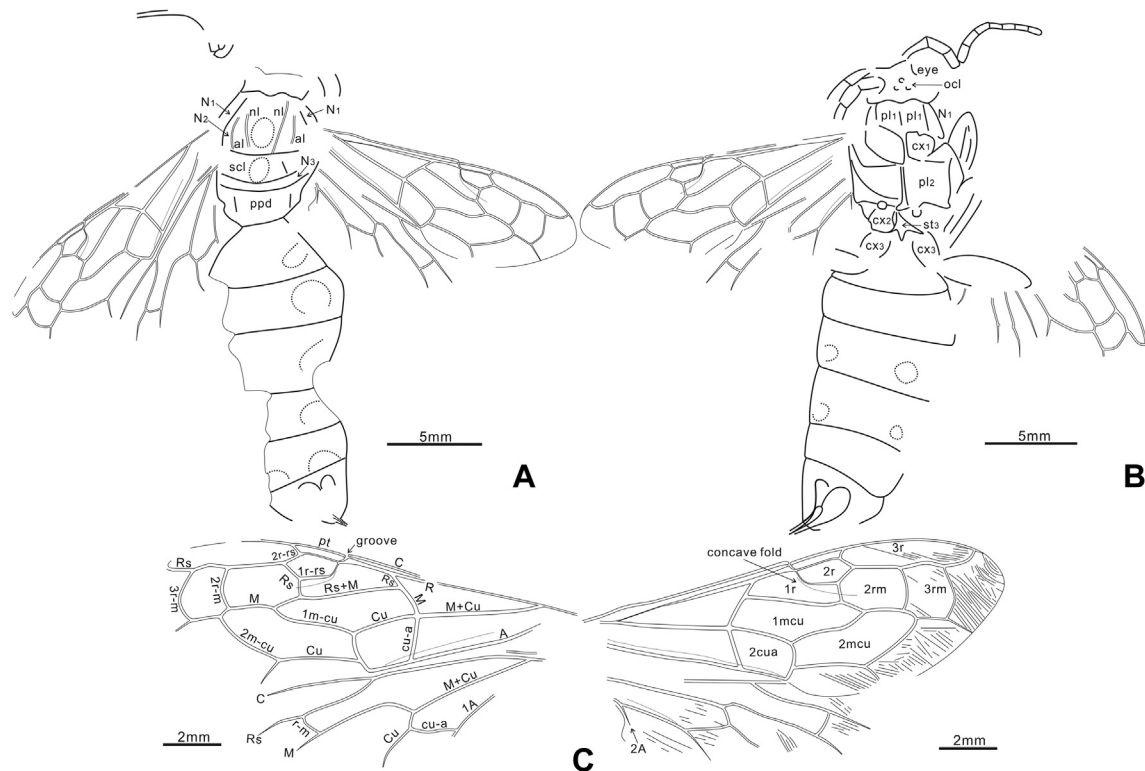


Fig. 3. *Sinoproscolia yangshuwanzienensis* gen. et sp. nov., holotype NIGP159636, line drawings, abbreviations: al, adlateral line; cx1, cx2, cx3, fore, middle and hind coxa; N1, N2, N3, pro-, meso- and metanotum; nl, notaulus; ocl, ocellus; pl1, pl2, pro- and mesopleuron; ppd, propodeum; scl, mesoscutellum; st3, metasternum; C, R, Rs, M, Cu, A, longitudinal veins; 1r-rs, 2r-rs, 2r-m, 3r-m, 1m-cu, 2m-cu, cu-a, crossveins; 1r, 2r, 3r, 2rm, 3rm, 1m-cu, 2m-cu, cells; pt, pterostigma. A, part, habitus in dorsal view; B, counterpart, habitus in ventral view; C, part, wings.

free sections of M and Cu reaching the wing margin. It further differs from *Proscolia* and *Cretaproscolia* in having 2r-m complete, and from *Proscolia* in having forewing cell 3r acuminate at the anterior wing margin, the mesonotum with the notauli well developed, the outer wing membrane narrow, the hindwing with crossvein r-m far beyond the origin of Rs, and the free apical sections of Rs, M, Cu and 1A distinct.

A long 1r-rs bending upwards and connecting to R in the new genus is unique in the subfamily Proscoliinae; 1r-rs is present but vestigial in *Protoscolia* (Archaeoscoliinae), *Araripescolia* and *Proscolia* (Day et al., 1981; Rasnitsyn, 1977; Rasnitsyn and Martínez-Delclòs, 1999; Zhang et al., 2002; Zhang, 2006; Nel et al., 2013). The presence of 1r-rs is considered plesiomorphic because this condition is present in Symphyta and many basal Apocrita (Zhang et al., 2002). The forewing crossvein 2r-m is present in Archaeoscoliinae (Zhang et al., 2002; Zhang, 2004), in *Araripescolia* and in the new genus. This crossvein is common in Hymenoptera including the majority of Symphyta, suggesting that its presence in the new genus is a plesiomorphy. Free sections of longitudinal veins both in forewings and hindwings are long in *Sinoproscolia* but short or completely absent in remaining Scoliidae (Brothers, 1975; Rasnitsyn, 1993; Rasnitsyn and Martínez-Delclòs, 1999, 2000; Zhang et al., 2002; Zhang, 2004, 2006; Nel et al., 2013). Long free sections of longitudinal veins are almost universal in Hymenoptera and therefore their presence in *Sinoproscolia* is a plesiomorphy. This collection of plesiomorphies indicates a basal position of the new genus in Proscoliinae. The presence of vein 2A in the hindwing is characteristic of Symphyta but extremely rare in Apocrita (cf. Brothers, 1975, pp. 517–518). This suggests its atavistic origin in *Sinoproscolia* gen. nov. rather than a true plesiomorphy.

5. Conclusions

The subfamily Proscoliinae Rasnitsyn, 1977 includes 3 genera: *Proscolia* Rasnitsyn, 1977, *Cretaproscolia* Rasnitsyn et Martínez-Delclòs, 1999, and *Sinoproscolia* gen. nov. The systematics of *C. asiatica* might suggest synonymising Proscoliinae and Archaeoscoliinae and more data are necessary to resolve the issue. Some plesiomorphies preserved in *Sinoproscolia* gen. nov. include complete crossveins 1r-rs and 2r-m in the forewing, and a free section present in almost all longitudinal veins, which indicates a basal position of the new genus in Proscoliinae. The presence of vein 2A in the hindwing of *Sinoproscolia* is considered atavistic rather than plesiomorphic.

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