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A new genus of the tribe Parahiraciini from China, with notes on the tribe (Hemiptera: Fulgoroidea: Issidae)

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Abstract

The new issid taxon, *Folifemurum duplicatum* **gen. *et* sp. nov.** from China is described and illustrated. This description includes external morphology of the adult, and structures of the male and female genitalia. The genus is placed in the tribe Parahiraciini. A diagnosis of *Folifemurum* **gen.nov**. is given and is compared to the related genus *Neodurium* Fennah. In addition, a key to all genera of the tribe is provided.

Key words: Fulgoromorpha, issid, planthopper, *Neodurium*

Introduction

The tribe Parahiraciini is distinguished by the following characters: tegmen convex (beetle-like), plus long fore and middle legs (Gnezdilov & Wilson 2007). Currently the tribe comprises 11 genera with 39 species found in eastern and southeastern Asia (Gnezdilov 2011; Wang & Wang 2011). The tribe is also characterized by having well-developed two- or three-lobed (anal lobe more or less reduced) hind wings with a deep notch between the remigium and vannus, and a net of transverse veins in the distal part, which were regarded as plesiomorphies by Gnezdilov and Wilson (2007). Although the variability in the head and fore wings between genera is well documented, little information is available on varieties of the hind wings. Compared with the well-developed three- or two-lobed species, hind wings of *Neodurium duplicadigitu* Zhang & Chen (Zhang *et* Chen 2008: Figs 12–13) are distinctly reduced and differ as follows; hind wings with simple veins only 0.4 times as long as forewings, and slightly incised on the margin into two lobes. In addition to hind wings, almost all of the species within this tribe have a deep and complete claval suture on the tegmen, with the exception of *Neodurium* Fennah, which is either present but obscure apically (Wang & Wang 2011: Figs 5, 12) or absent. Most of the genera excluding *Flavina*, *Paratetricodes*, *Fusiisus*, *Neodurium*, and *Tetricodes* are characterized by a well developed metopial proboscis (Gnezdilov & Wilson 2007; Zhang *et* Chen 2008, 2009, 2010; Wang & Wang 2011; Ran *et al*. 2005; Ran *et* Liang 2006; Zhang *et al*. 2010), which is treated as an essential character to differentiate groups within Parahiraciini.

In the present paper, *Folifemurum duplicatum* **gen.** *et* **sp. nov.** from China, without developed metopial proboscis, claval suture and developed hind wings, is described and illustrated, and placed into the tribe Parahiraciini.

Material and methods

The terminology of the head and body follows Chan & Yang (1994) and Emeljanov (1995), and the terminology of female and male genitalia follows Bourgoin (1993) and Gnezdilov (2003), respectively. Spinal formula of hind leg indicates number of spines at apex of hind tibia and tarsomeres I and II. The genital segments of the examined

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specimens were macerated in 10% KOH and observed in glycerin jelly using a Leica MZ125 stereomicroscope. Photographs of the specimens were made using a Leica M205A microscope with Leica DFC Camera. Images were produced using the software version LAS (Leica Application Suite) V3.7. All the specimens studied are deposited in the Entomological Museum of Northwest Agriculture and Forestry University (NWAFU).

Taxonomy

Key to genera of the tribe Parahiraciini

(modified from Genzdilov & Wilson (2007) and Zhang & Chen (2010))

1 Metope not extended to form a proboscis 2
- Metope strongly extended to form a proboscis 7
2 Metope with a hemispherical protuberance 3
- Metope without hemispherical protuberance 4
3 Coryphe in dorsal view with anterior margin roundly concave. Metope with a hemispherical protuberance distally. Femora and tibiae of forelegs strongly flattened. Aedeagus with long lateral hooks . . . . . *Paratetricodes*
- Coryphe in dorsal view with anterior margin angularly convex medially. Metope with a hemispherical protuberance in basal half. Femora and tibiae of forelegs not flattened. Aedeagus without lateral hooks . . . . . *Tetricodes*
4 Metope with apical margin broadly concave, 1.5 times longer in mid line than widest part. Hind tibia with 3–5 lateral teeth. . . . . *Flavina*
- Metope with apical margin strongly concave medially, 1.2–1.4 times longer in middle line than widest part. Hind tibia with 2–3 lateral teeth 5
5 Coryphe with median carina, disc slightly depressed, anterior margin acutely angulately produced. Metope without median and sublateral carina. . . . . *Fusiissus*
- Coryphe without median carina, disc strongly depressed, anterior margin obtusely angulately produced. Metope with median and sublateral carinae 6
6 Hind wing large with developed remigium and rudimentary anal lobe. Pronotum with median and lateral carinae present. Spinal formula of hind leg 8-(11–19)-2 . . . . . *Neodurium*
- Hind wing small with vannus and anal lobe rudimentary. Pronotum with only median carina present. Spinal formula of hind leg 8-8-2 . . . . . ***Folifemurum* gen.nov**.
7 Metope with median and sublateral carinae. Fore femora and tibiae weakly flattened 8
- Metope without median and sublateral carinae. Fore femora and tibiae strongly flattened 9
8 Forewing with wide hypocostal plate. CuP of forewing well marked throughout its length. Metopial proboscis relatively long. Lateral metopial keels not joining at apex of proboscis. Gonoplacs bearing two pairs of projections. . . . . *Fortunia*
- Forewing without hypocostal plate. CuP of forewing well marked only proximally. Metopial proboscis relatively short. Lateral metopial keels almost joining at apex of proboscis. Gonoplacs without projections . . . . . *Mincopius*
9 Metopial proboscis cylindrical. Lateral keels of metope are not reaching apex of proboscis. Aedeagus without ventral hooks. . . . . *Pinocchias*
- Metopial proboscis more or less flattened dorso-ventrally and laterally. Lateral keels of metope are reaching apex of proboscis. Aedeagus with a pair of ventral hooks 10
10 Metopial lateral keels not run to the apex of proboscis but to postclypeus. Hind wing with wide anal lobe. . . . . *Scantinius*
- Metopial lateral keels run to the apex of proboscis. Hind wing with narrow anal lobe 11
11 Metopial proboscis with glossy swelling apically. . . . . *Bardunia*
- Metopial proboscis without glossy swelling apically . . . . . *Narinosus*

Folifemurum gen. nov.

Type species: *Folifemurum duplicatum* **sp. nov.**

Description. Head with eyes distinctly narrower than pronotum (Fig. 1). Metope and genae not extended to form a proboscis (Fig. 2). Coryphe more or less quadrilateral, rough with fine granules, disc depressed; length in midline almost equal to width at two posterior angles (Fig. 1). Ocelli present. Metope with disc finely granulose and distinctly elevated, median carina present (Fig. 3). Metopoclypeal suture slightly arched. Postclypeus smooth, on same plane as metope, apical part curved downward (Fig. 3). Rostrum relatively long, exceeding mid-trochanter. Pronotum with anterior margin distinctly convex and posterior margin nearly truncate; disc finely granulose with median carina and two pits. Mesonotum nearly triangular, with pit on lateral margin; disc slightly elevated with fine granules, median carina present. Forewings coleopterous, nearly rectangular and rounded apically, costal

margin nearly parallel to inner margin; claval suture absent, longitudinal veins present and distinct, irregular cross veins distinct (Figs. 4, 23). Hind wings reduced with vannus and anal lobe rudimentary, shorter than half length of forewings; veins indistinct (Fig. 5). Legs relatively long, fore and middle femora slightly foliate (Figs 6–7); lateral margin of hind tibia with 3 teeth (Fig. 8). Spinal formula of hind leg 8–8–2 (Fig. 9).

Male genitalia. Symmetrical; anal tube mushroom-shaped. Posterior margin of pygofer not produced and without spines; penis tubular, U-shaped, symmetrical with two spiniform processes near mid-length.

Female genitalia. Anal tube cuplike, longer than widest part. Anterior connective lamina of gonapophyse VIII with teeth. Gonoplacs nearly triangular in lateral view.

Diagnosis. In view of its elliptical body, the forewing without claval suture, its small hind wings (with vannus and anal lobe rudimentary and shorter than half of fore wings) and foliately dilated fore and middle femora, we treat this genus as a member of the tribe Parahiraciini. This genus resembles *Neodurium* Fennah according to the lack of a claval suture in the forewing and the lateral margin of hind tibia bearing 3 teeth, but can be distinguished by the following characteristics: 1) hind wing with vannus and anal lobe rudimentary (anal lobe only rudimentary in *Neodurium*); 2) pronotum with median carina only present (median and lateral carinae present in *Neodurium*); 3) spinal formula of hind leg 8–8–2 (in *Neodurium*: 8–(11–19)–2).

Etymology. The name "Folifemurum" is compiled from the Latin prefix "foli-" meaning leaf-shaped, and the Latin noun "femur", together indicating the fore femur of this genus is slightly foliately dilated. This name is neutral in gender.

Distribution. China (Sichuan, Yunnan Province).

Folifemurum duplicatum sp. nov.

Figs. 1–27

Description. Length, male (including fore wing) (N=6): 4.0–4.2 mm, length of fore wing: 3.5–3.6 mm; female (including fore wing) (N=4): 4.1–4.3 mm, length of forewing: 3.6–3.8 mm.

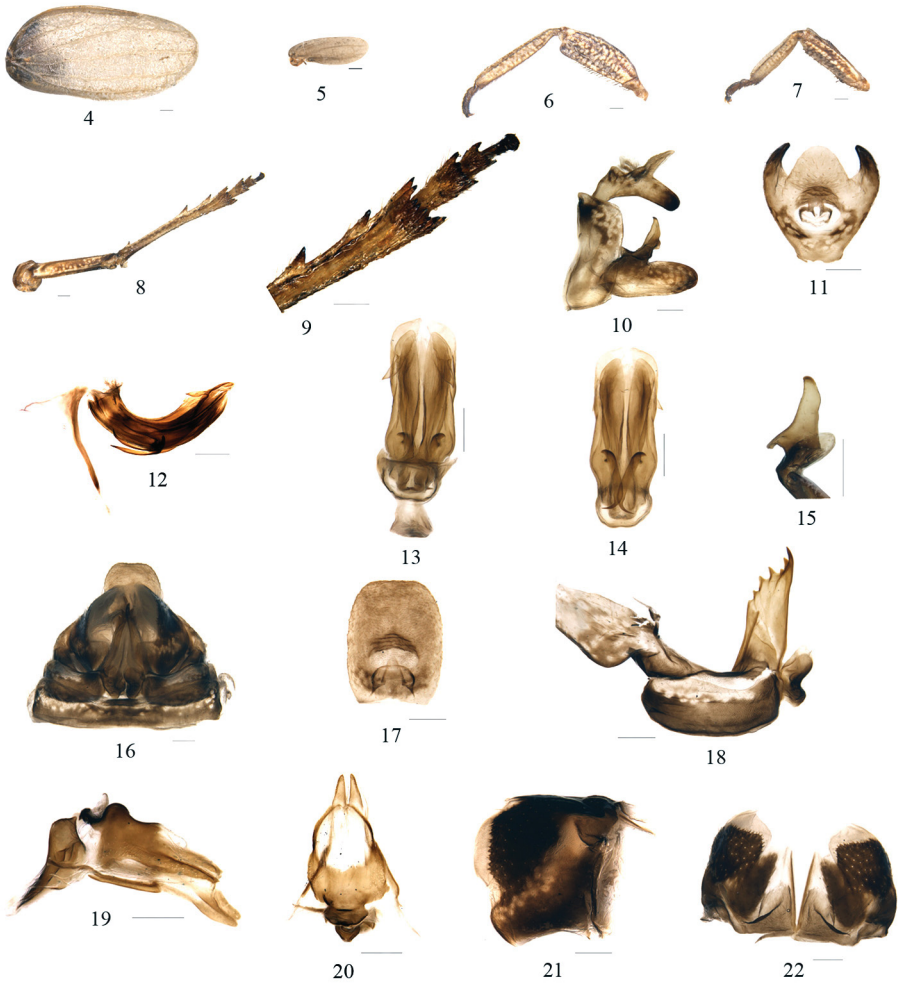
Colouration. Body, pronotum and mesonotum brown with pale yellow tubercles (Fig. 1). Coryphe brown with disc dark brown. Eyes black. Metope blackish brown suffused with pale yellow tubercles; postclypeus blackish brown (Fig. 3). Genae brown with blackish brown fascia (Fig. 2). Rostrum brown, apex blackish brown. Forewings brown, hind wings dark brown (Figs 4–5). Legs brown, fore and middle femora blackish brown with pale yellow tubercles (Figs 6–7). Venter and dorsum of abdomen dark brown, apex somewhat brown.

Head and Thorax. Coryphe (Fig. 1) approximately pentagonal with disc depressed, apical margin slightly convex and basal margin suddenly concave, posterior angles acuminate, 1.8× wider at posterior angles than long at midline. Metope (Fig. 3) granulose with disc slightly elevated, suffused with tubercles, median carina present, 1.8× longer at mid-length than widest part, 1.1× wider at widest part than at base. Genae (Fig. 2) with fascia directed towards corresponding eye near antenna. Metopoclypeal suture slightly arched. Postclypeus smooth, without carina. Pronotum (Fig. 1) with anterior margin distinctly convex and posterior margin nearly truncate; disc a little depressed with median carina two pits and scattered small tubercles. Mesonotum (Fig. 1) granulose with tubercles, short and stout, with pit on lateral margin; disc slightly elevated with median carina, 2.2× wider at the widest part than medial length. Forewings nearly elliptical, 2.3× longer than widest part; Sc+R vein forking near base, M and CuA veins simple; lots of indistinct and irregular transverse veinlets scattered on the forewing; CuP absent, claval vein Pcu and A_1 fused distinctly before half of length (Figs. 4, 23). Hind wings small, shorter than half of forewings, 0.3 times length of forewing, veins indistinct (Fig. 5). Fore and middle femora slightly foliate (Figs 6–7). Spinal formula of hind leg 8-8-2 (Fig. 9).

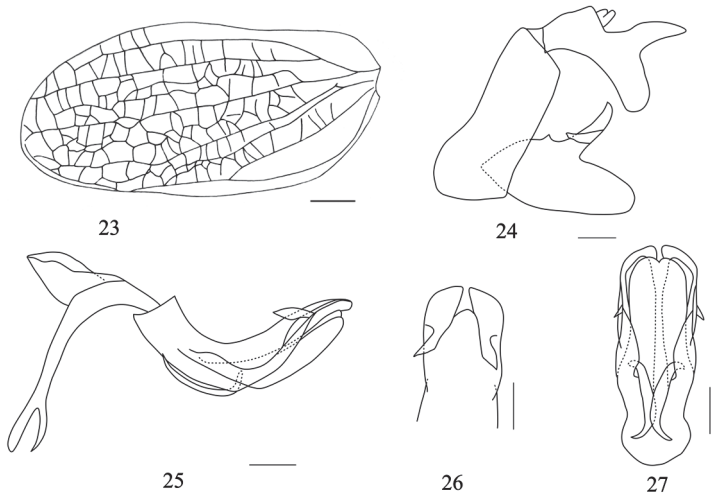
Male genitalia. Anal tube (Fig. 11) in dorsal view mushroom-like and moderately large; latero-apical angle bearing a curved finger-shaped process directed ventrad; apical margin strongly convex in middle forming a big protrusion; in lateral view anal tube relatively wide, latero-apical angles long cylindrical and recurved. Anal column short, located at the middle of anal tube (Fig. 11). Genital styles (Figs 10, 24) moderately long, nearly triangular, almost same width near base as at apex; basal margin rounded, dorso-lateral margin producing a large tapering inward lobe, near middle hind margin exceedingly concave medially, caudoventral angle obtusely convex. Capitulum of style (Fig. 15) narrow and long with a large lateral tooth. Aedeagus deeply curved medially in lateral view (Fig. 12). Phallus (Figs 12–14, 25–27) with a pair of spiniform processes ventrally directed cephalad near

middle; dorsolateral lobe of phallobase with a short tapering laminar process, with apex directed cephalad in dorsal view; ventral phallobase lobe with apical margin slightly concave medially, shorter than dorsolateral phallobase lobes. Pygofer with laterodorsal angles prominent; anterior margin slightly concave medially, longer than posterior margin, which is almost straight (Fig. 10).

FIGURES 1–3. *Folifemurum duplicatum* **sp. nov.** 1. holotype, dorsal view; 2. holotype, lateral view; 3. holotype, frontal view. Scale bars = 0.5 mm.



FIGURES 4–22. *Folifemurum duplicatum* **sp. nov.** 4. forewing; 5. hind wing; 6. fore leg; 7. middle leg; 8. hind leg; 9. apex of hind leg; 10. male genitalia, lateral view; 11. anal tube, dorsal view; 12. penis, lateral view; 13. penis, dorsal view; 14. penis, ventral view; 15. capitulum of style, dorsal view; 16. female genitalia, ventral view; 17. anal tube, dorsal view; 18. gonocoxa VIII and gonapophyse VIII, lateral view; 19. gonapophyses IX, lateral view; 20. gonapophyses IX, dorsal view; 21. gonoplac, lateral view; 22. gonoplac, dorsal view. Scale bars =0.2 mm.



FIGURES 23–27. *Folifemurum duplicatum* **sp. nov.** 23. forewing; 24. male genitalia, lateral view; 25. penis and connective, lateral view; 26. apex of penis, dorsal view; 27. penis, ventral view. Scale bars = 0.5 mm.

Female genitalia. Anal tube in dorsal view nearly rectangular, apical margin nearly straight with angles obtuse and rounded; anal foramen in basal half (Fig. 17). Gonoplac nearly rectangular in lateral view, median area slightly elevated, third gonoplac lobes fused at base (Figs 21, 22). Lateral fields of posterior connective laminae of gonapophyses IX narrow and not projecting, lateral margins slightly obtusely convex in dorsal view; median field with shallow notch in apical part, lateral margins arched and slightly sclerised and pigmented, median portion membranous (Figs 19, 20). Gonospiculum bridge large, flattened laterally, spade-shaped (Fig. 19). Anterior connective lamina of gonapophysis VIII with three teeth in apical group and four short keeled teeth in lateral group, distal parts of posterior connective laminae angularly bent, median part weakly convex with apical margin slightly concave (Figs 19, 20). Gonocoxa VIII approximately rectangular (Fig. 18). Sternum VII with posterior margin nearly straight medially (Fig. 16).

Material examined. Holotype ♂ (NWAFU) China, Sichuan Prov., Xiangcheng, 2900–3500 m, 28 June 1982, coll. Wang Shuyong.

Paratypes: 3♂♂1♀ (NWAFU), same data as holotype; 2♂♂1♀ (NWAFU), Sichuan Prov., Xiangcheng, 2900 m, 18 June 1982, coll. Wang Shuyong; 1♀ (NWAFU), Sichuan Prov., Xiangcheng, 2900 m, 28 June 1982, coll. Zhang Xuezhong; 1♀ (NWAFU), Yunnan Prov., Deqin, Benzilan, 2180 m, 23 August 1981, coll. Wang Shuyong.

Diagnosis. This species resembles *Neodurium hamatum* Wang & Wang (both without claval suture), but can be distinguished by the following characteristics: 1) coryphe with carina absent (both median and lateral carinae present in *N. hamatum*); 2) mesonotum with only median carina present (median and 5 lateral carinae present in *N. hamatum*); 3) metope, pronotum and mesonotum densely scattered with pale yellow tubercles (only pronotum sparsely scattered with tubercles in *N. hamatum*); 4) phallus with a pair of spiniform processes ventrally directed cephalad near middle (2 hook-like processes at mid directed laterad in *N. hamatum*).

Etymology. The Latin term “duplicatus” means double and refers to the fore and middle femur being slightly foliately dilated.

Discussion

Considering the structure of the forewings, metope and legs, Gnezdilov and Wilson (2007) stated that *Flavina* (metope without proboscis, weakly flattened legs, reduced anal lobe of hind wing and reduced ventral hooks of aedeagus) appeared to be a sister group of the remaining Parahiraciini (i.e., *Fortunia*, *Mincopius*, *Pinocchias*, *Scantinius*, *Bardunia*, *Narinosus*), and might be the most primitive. From the perspective of the evolution of wings in Issidae, there has been a tendency of coleopterous forewings and reduced, even rudimentary, hind wings. Issini is supposedly the most primitive group of this family, with hind wings generally divided into 3 or 2 lobes. In Parahiraciini, the vast majority of species are characterized by having well-developed three- or two-lobed (anal

lobe more or less reduced) hind wings with a deep notch between the remigium and vannus, and a net of transversal veins in the distal part. The hind wings of *Folifemurum duplicatum* sp. nov., to the contrary, are strongly reduced with the vannus and anal lobe rudimentary. *Neodurium duplicadigitu* Zhang & Chen also displays such reduced hind wings.

Fennah (1967) proposed that brachypterism displayed by South African Fulgoroidea might be related to the vegetation structure and habitat, and the conservation of moisture within the insect. The new species was collected from short and thick bushes by sweep nets. The degradation of hind wings of the two species listed above is probably also related to their habitat (*Folifemurum duplicatum* **sp. nov.**: Xiangcheng County (2900–3500m), Sichuan Province and Deqin County (2800m), Yunnan Province, China; *Neodurium duplicadigitu* Zhang & Chen: Dali County (2000–4000m), Yunnan Province, China), which are all located at the junction of the Palaearctic and Oriental regions and associated with high altitudes, low temperatures and a generally dry climate.

Rather than head processes, elongate antennae, body pits and foliaceous front legs, Hamilton (2011) regarded ovipositor, adult thorax and abdomen as the stable characters in Fulgoroidea classification. He also mentioned that wings are the most variable characters. Therefore, the degradation of hind wings cannot be a single criterion that can distinguish species or genus. Independent reduction of the hind wings, associated with coleopterisation of the forewings can be found in different taxa of Issidae in all zoogeographic regions (Gnezdilov & Fletcher 2010).

Fennah (1967) stated that there has been a strong tendency in the evolution of Fulgoroid genera to develop a squat, shortly ovate or subglobose body form, a coriaceous derm, thick brachypterous or coleopterous forewings, and for the wings to become reduced or to disappear. The different types of metope, forewings and hind wings exhibited by Parahiraciini genera show them to be a classic example of this speculation.

Thus *Folifemurum* **gen. nov.** is assigned into the tribe Parahiraciini, and further investigation will be required to search more stable characteristics to support this placement.

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