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Descriptions of two new *Vietomartyria* species (Lepidoptera, Micropterigidae) from China

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Abstract. Micropterigidae is a family of Lepidoptera characterized by plesiomorphic morphological characters. Presently, this family consists of more than 22 genera and is distributed throughout all biogeographic realms. *Vietomartyria* Hashimoto & Mey, 2000 presently consists of six species mainly from South China. Two new species of the genus, *V. wuyunjiena* sp. nov. and *V. maoershana* sp. nov., are described herein from China; adult genitalia and wing venation are illustrated. Some biological accounts of the new species are also provided. A key to all described *Vietomartyria* species is given.

Keywords. Micropterigidae, *Vietomartyria*, new species, morphology, taxonomy.

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Introduction

The family Micropterigidae Herrich-Schäffer, 1855 consists of more than 160 species in 20 extant genera worldwide (van Nieukerken *et al.* 2011; Imada & Kato 2018). The micropterigids form a sister clade to all the other families of the extant Lepidoptera (Kristensen *et al.* 2007; Regier *et al.* 2015). The adults are devoid of proboscis and instead possess well developed functional mandibles, by that they are regarded as a plesiomorphic group of moths together with the other non-glossatan moth families Agathipagidae and Heterobathmiidae (Kristensen 1984, 1999). Micropterigidae are easily distinguished from the other non-glossatans by the following combination of characters: ocelli present; spur formula of 0:0:4; Sc vein of forewing forked; and pterostigma absent (Kristensen 1984, 1999; Hashimoto 2006). Although the biology of micropterigids is underexplored, food sources of the larvae of some species are known.

Typically the micropterigid larvae feed on liverworts (Tillyard 1922; Tuskes & Smith 1984; Yasuda & Hashimoto 1989; Hashimoto 2006; Imada *et al.* 2011; Davis & Landry 2012), and less commonly, on decayed plants (Carter & Dugdale 1982), or on fresh photosynthetic angiosperm tissues (Erenler & Gillman 2010). The adults of some species of the genera *Sabatinca* Walker, 1863 and *Micropterix* Hübner, 1825 feed either on pollens of angiosperms or spores of ferns (Zeller-Lukashort 2007; Gibbs 2010, 2014; Erenler & Gillman 2010; Davis & Landry 2012).

The genus *Vietomartyria* was established by Hashimoto & Mey (2000) with *Paramartyria expeditionis* Mey, 1997 from Vietnam as the type species, based on the long basal stalk of each flagellomere and the position of the gonopore opening. Some additional distinguishing characters of *Vietomartyria* are: the large number of flagellum segments, more than 55 in males and 42 in females; foretibial epiphysis absent; primary R fork of forewing equal or more distal to the Sc fork; posterior margin of segment IX expanded ventro-posteriorly in male genitalia; and signum absent in female genitalia (Hashimoto & Mey 2000). Hirowatari *et al.* (2009) described two new species of *Vietomartyria* from South China of which females have a signum in the corpus bursae and considered that the absence of a signum in the female may be unique to *V. expeditionis*. Subsequently, Hirowatari *et al.* (2010) added one new species, *V. gladiator* Hirowatari & Huang, 2010 from South China and transferred two species of *Paramartyria* Issiki, 1931, *P. jinggangna* Yang, 1980 and *P. baishanzuna* Yang, 1995, to this genus. To date, six *Vietomartyria* species have been recorded, of which five species are distributed in South China (Guangdong, Jiangxi, Zhejiang). In this paper, two new *Vietomartyria* species are described from Hunan and Guangxi, South China.

Material and methods

Adult specimens were collected in Wuyunjie National Nature Reserve, Hunan Province and Mao'ershan National Nature Reserve, Guangxi Province, China and the wings were spread. Male and female genitalia were dissected after maceration in 10% NaOH solution heated in a waterbath, and preserved in glycerol after scales were removed. The wings were treated using the same methods. The photos of adults were taken using a Leica S8APO microscope and Leica DFC435 with LAS v4.9 software. The photos of male and female genitalia and wings were taken with a ZEISS Axio Vert.A1 inverted microscope. Terminology for adults and genitalia used in this paper follows Hashimoto & Mey (2000), Hirowatari *et al.* (2009) and Davis & Landry (2012). All studied materials are deposited in Hunan Agricultural University, China (HUNAU).

Results

Class Insecta Linnaeus, 1758
Order Lepidoptera Linnaeus, 1758
Superfamily Micropterigoidea Herrich-Schäffer, 1855
Family Micropterigidae Herrich-Schäffer, 1855
Genus *Vietomartyria* Hashimoto & Mey, 2000

Vietomartyria wuyunjiena sp. nov.

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Figs 1A, C–F, 2A, 3A–F, 5A–C

Diagnosis

The adults of this species are very similar to *Vietomartyria nankunshana* Hirowatari & Hashimoto, 2009 and *V. nanlingana* Hirowatari & Jinbo, 2009 because of their same ground color, but are separable from these two species by the dorsal process of the valva slightly curved inwardly (but almost right-angularly

curved inwardly in *V. wuyunjiena* sp. nov.), and by tergite X slightly emarginate at the middle (but broadly emarginate in *V. nankunshana* and narrowly in *V. nanlingana*).

Etymology

The specific epithet is derived from the name of the type locality, Wuyunjie National Nature Reserve.

Type material

Holotype

CHINA • ♂; Hunan Province, Taoyuan County, Changde City, Wuyunjie National Nature Reserve; 21 Apr. 2019; C.Q. Liao, M.W. Liao and G.H. Huang leg.; HUNAU.

Paratypes

CHINA • 19 ♂♂, 9 ♀♀; same data as for holotype; HUNAU.

Description

FOREWING LENGTH. 2.9–3.5 mm (3.0 mm in holotype).

WING EXPANSE. 6.3–7.5 mm (6.6 mm in holotype).

HEAD. Vertex densely covered with long piliform scales except for exposed part between compound eye and ocellus; tufts of scales yellow brown, mixed with dark brown hairs. Maxillary palpus pale yellow. Antennal scape and pedicel with dark brown hair-like scales; flagellum 58-segmented (46 segments in female), covered with dense black hairy scales.

THORAX. Tegular tufts of piliform brown scales; mesonotum densely covered with golden broad scales, possessing metallic blue luster. Legs with dark brown scales; inner surface of fore- and mid-femur and apical band of each tarsal segment yellow; fore-tibia without epiphysis, mid-tibia without spur, hind-tibia with two pairs of spurs. Forewing ground color dark brown, basal $\frac{2}{5}$ with golden luster, apical $\frac{3}{5}$ with purple luster; metallic blue luster along costa; cilia brown, paler on posterior margin. Hindwing dark fuscous except costal margin with metallic blue luster, covered with slender scales on basal half and broad scales on apical half; cilia dark brown.

WING VENATION (Fig. 2A). Forewing with humeral vein (h) present at base; Sc deeply bifurcate; R with five branches, primary R fork equal to Sc fork, R_4 and R_5 long stalked; Sc-R crossvein near basal $\frac{1}{3}$ of Sc_2 ; M with three branches; CuA with two branches, M-CuA crossvein present; CuP separate; 1A and 2A fused at basal $\frac{3}{5}$. Hindwing venation very similar to forewing venation, except Sc and R1 fused; M-CuA crossvein absent; 1A fused with CuP basally, then independent and fused with 2A.

ABDOMEN. Pregenital abdomen dark brown to black, covered with glossy dark brown scales; venter paler. Genital segments dark yellowish to fuscous, covered with long fuscous scales.

MALE GENITALIA (Fig. 3). Ring IX and tergite X strongly sclerotized and fused (Fig. 3A–B). Dorsal part of ring IX (tegumen) short, approximately $\frac{1}{5}$ of length of ventral part (vinculum). Tergite X (uncus) short bilobed, dorsal part arched upward; paired X tergal lobes triangular with rounded apex, bearing some long setae apically. Sternum X (gnathos) well developed, strongly sclerotized, extremely extended ventrally, ventro-posterior corners hook-like, right-angularly curved laterally (Fig. 3A, C). Valva rectangular, approximately $0.9 \times$ as long as sternum IX; dorsal process slightly curved inwardly; basal inner surface with a small denticulate projection. Medial plate (juxta) oval, slightly membranous (Fig. 3B–C). Phallobase slender, approximately as long as aedeagus; phallobase with an indistinct longitudinal keel on dorsal median line at posterior $\frac{1}{3}$; aedeagus covered with a lot of serrate minute processes at basal

$\frac{1}{5}$ to apex ventro-laterally and at $\frac{4}{5}$ to apex dorsally, with very narrow sclerites extending from basal $\frac{1}{5}$ to gonopore at both sides; gonopore opening longitudinally at $\frac{2}{3}$ to $\frac{4}{5}$ of aedeagus, bordered by radial folds (Fig. 3D–F).

FEMALE GENITALIA (Fig. 5A–C). Segment IX sclerotized, short in dorsal part (approximately $\frac{2}{5}$ length of ventral part), slightly concave dorsally and laterally. Segment X and XI formed two pairs of well sclerotized lateral plates; anterior plates triangular, dorso-posterior angle slightly rounded; posterior plates irregular quadrilateral, with minute digitate projections along posterior and ventral margins.



Fig. 1. Adults and habitat of *Vietomartyria* spp. **A.** *Vietomartyria wuyunjiena* sp. nov., holotype, ♂. **B.** *Vietomartyria maoershana* sp. nov., holotype, ♂. **C.** One adult of *V. wuyunjiena* sp. nov. perching on fern. **D.** Habitat of *V. wuyunjiena* sp. nov. **E.** Specimen collection of *V. wuyunjiena* sp. nov. by sweep net. **F.** One adult of *V. wuyunjiena* sp. nov. perching on the white curtain of a light trap.

Corpus bursae membranous, elongate, apical half covered with minute wrinkles; signa with two pairs of scale-like plates with many long hairs.

Immature stages

Unknown.

Distribution

This species is known from Wuyunjie National Nature Reserve (Taoyuan, Changde, Hunan, China).

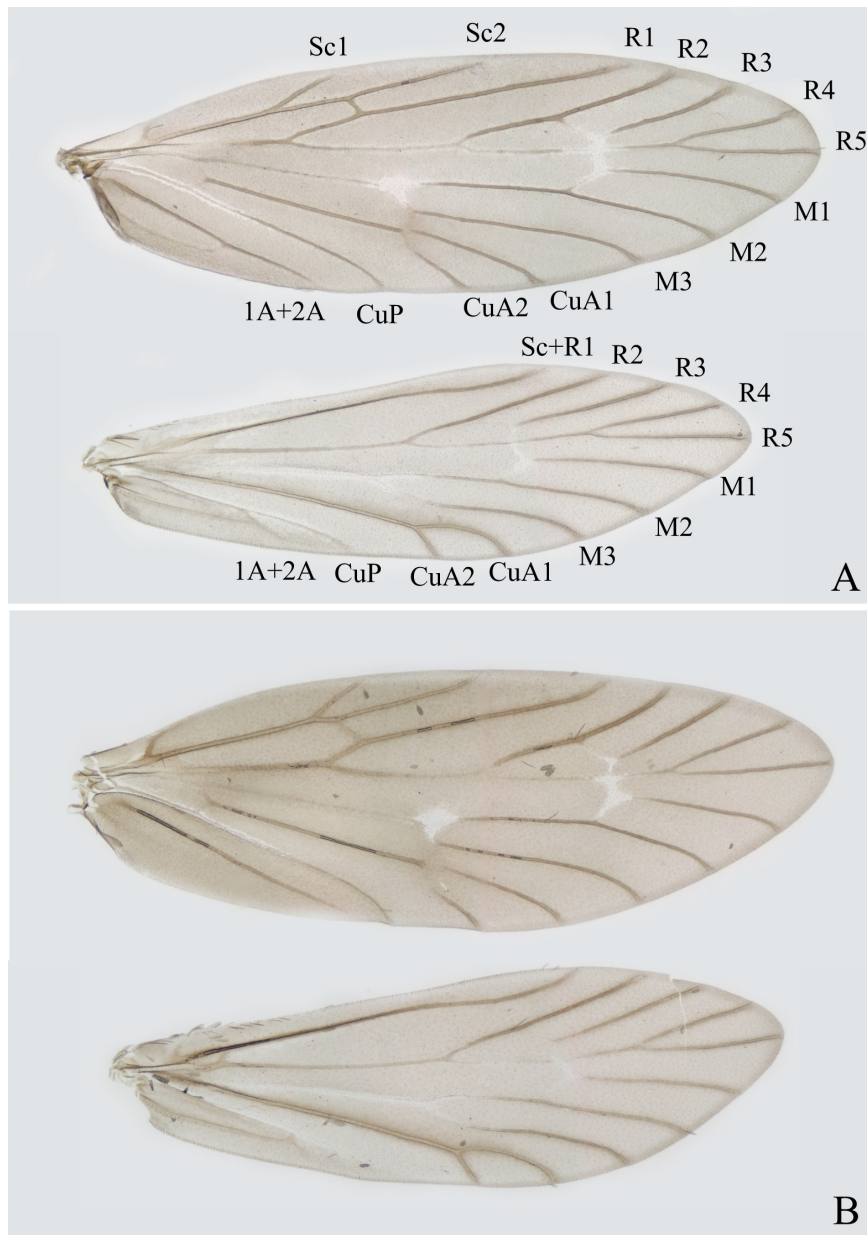


Fig. 2. Wing venation. **A.** *Vietomartyria wuyunjiena* sp. nov. ♀. **B.** *V. maoershana* sp. nov. ♂.

Remarks

Adults of *V. wuyunjiena* sp. nov. were observed flying or perching on low shrubs and ferns along a muddy road leading to the mountain, of which the other side faces a river valley (Fig. 1C–D). It was cloudy and humid while the collections were made during 4–6 p.m. on April 21st 2019. Adults flew relatively slowly making them easy to collect with sweep nets (Fig. 1E). Unfortunately, we could not observe feeding and mating behaviors of adults, nor did we collect any specimens in immature stages. Additionally, we observed one adult attracted to a light trap at 11:30 p.m. on April 21st 2019 (Fig. 1F). The female adults of *Agrionympha capensis* Whalley, 1978 can also be attracted by lights at night (Gibbs & Kristensen 2011).

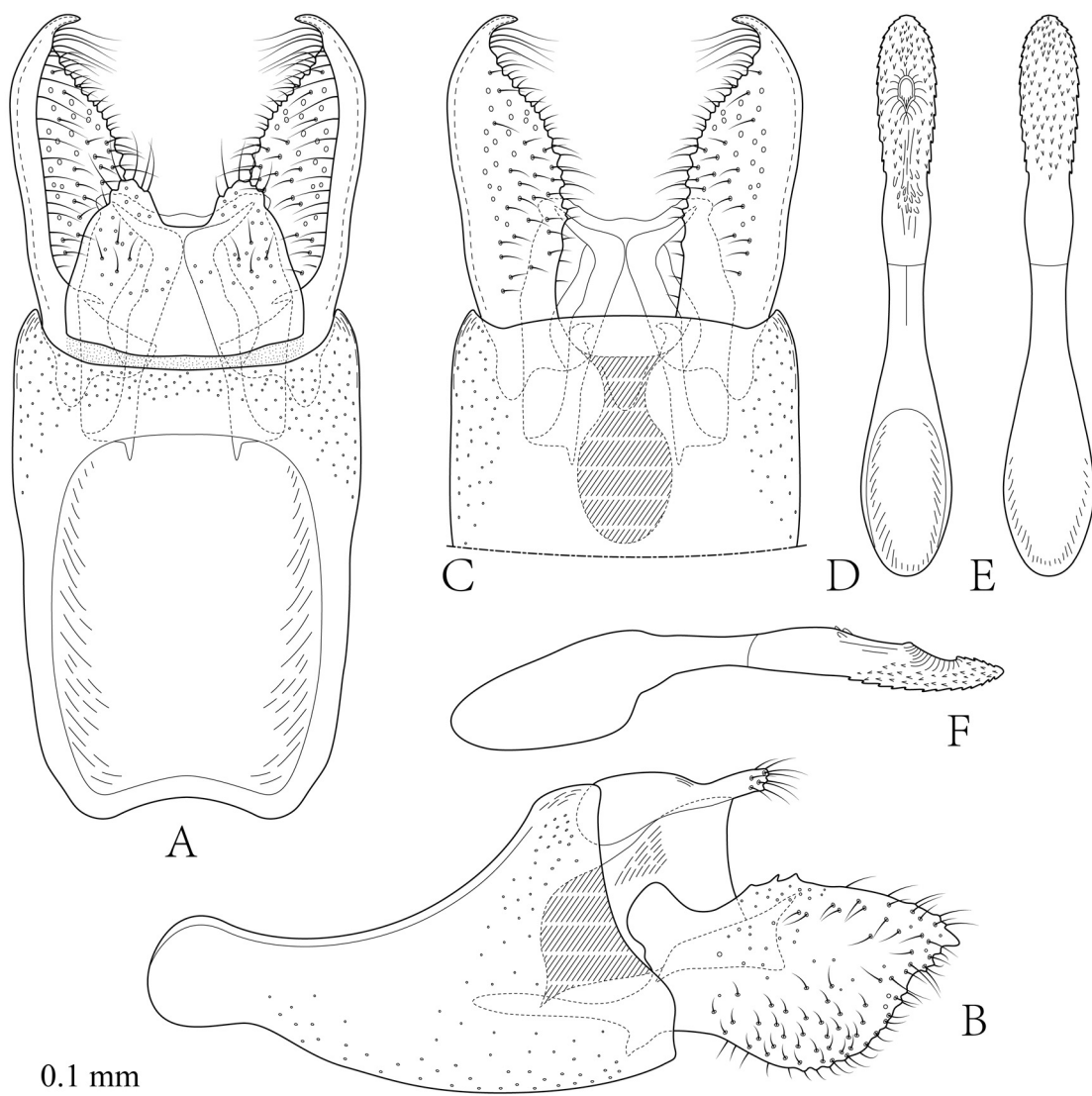


Fig. 3. Male genitalia of *Vietomartyria wuyunjiena* sp. nov. **A.** Dorsal view, with phallus removed. **B.** *Ditto*, ventral view. **C.** *Ditto*, lateral view. **D.** Phallus, dorsal view. **E.** *Ditto*, ventral view. **F.** *Ditto*, lateral view.

***Vietomartyria maoershana* sp. nov.**

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Figs 1B, 2B, 4A–F, 5D–F

Diagnosis

This species is very similar to *V. wuyunjiena* sp. nov. and *V. expeditionis*, but can easily be distinguished by the following characters: paired X tergal lobes slender and digitate (slightly emarginate in *V. wuyunjiena* sp. nov. and broadly emarginate at the middle in *V. expeditionis*); basal process of valva long and pointed (absent in *V. wuyunjiena* sp. nov. and short obtuse in *V. expeditionis*); slightly curved dorsal process of gonopod (strongly curved in *V. expeditionis*).

Etymology

This specific epithet is derived from the name of the type locality, Mao'ershan National Nature Reserve.

Type material

Holotype

CHINA • ♂; Guangxi Province, Xin'an County, Guilin City, Mao'ershan National Nature Reserve; 1500 m a.s.l.; 25–26 May 2010; T. Hirowatari and G.H. Huang leg.; HUNAU.

Paratypes

CHINA • 15 ♂♂; 4 ♀♀; same data as for holotype; HUNAU.

Description

FOREWING LENGTH. 3.0–3.3 mm (3.1 mm in holotype).

WING EXPANSE. 6.6–7.1 mm (6.7 mm in holotype).

HEAD. Vertex densely covered with long piliform scales except for an exposed part between compound eye and ocellus; tufts of scales yellow to brown, mixed with dark brown hairs. Maxillary palpus pale yellow. Antennal scape and pedicel with pale brown hair-like scales; flagellum 58-segmented (46 segments in female), covered with dense black hairy scales, some basal segments with somewhat metallic blue luster.

THORAX. Tegular tufts of piliform brown scales; mesonotum with dense golden scales which possess metallic blue luster. Legs with black scales; inner surface of fore- and mid-femur yellow; fore-tibia without epiphysis, mid-tibia without spur, hind-tibia with two pairs of spurs. Forewing ground color yellow, basal $\frac{2}{5}$ with golden luster, apical $\frac{3}{5}$ with blue and purple luster; cilia dark brown, paler on posterior margin. Hindwing pale fuscous, covered with slender scales on basal half and broad golden scales on apical half; cilia dark brown.

WING VENATION (Fig. 2B). Very similar to *V. wuyunjiena* sp. nov., but Sc-R crossvein near Sc fork, about $\frac{1}{9}$ of Sc₂, R₄ and R₅ relatively short stalked, and 2A almost absent in forewing.

ABDOMEN. Pregenital abdomen fuscous, covered with dark fuscous scales; venter paler. Genital segments dark gray to fuscous, covered with long fuscous scales.

MALE GENITALIA (Fig. 4). Ring IX and tergite X strongly sclerotized and fused (Fig. 4A). Dorsal part of ring IX (tegumen) short, approximately $\frac{1}{8}$ of length of ventral part (vinculum). Tergite X (uncus) deeply bilobed, dorsal part slightly arched upward; paired X tergal lobes slender digitate, bearing some long setae apically. Sternum X (gnathos) well developed, strongly sclerotized, extremely extended ventrally (Fig. 4C–D). Valva sclerotized, approximately $0.8 \times$ as long as sternum IX; dorsal process slightly

curved inwardly; basal inner surface expanding dorsally, with a long pointed arcuate projection near dorsal part (Fig. 4B). Medial plate (juxta) extended, with an oblong apex, slightly sclerotized (Fig. 4A). Phallobase slender, approximately as long as aedeagus; aedeagus covered with a lot of serrate minute processes at basal $\frac{1}{4}$ to apex ventro-laterally and at $\frac{1}{3}$ to apex dorsally, with very narrow sclerites extending from base to gonopore at both sides; gonopore opening longitudinally at dorsal $\frac{1}{2}$ to $\frac{3}{4}$ of aedeagus, bordered by radial folds (Fig. 4E–F).

FEMALE GENITALIA (Fig. 5C–D). Segment IX sclerotized, short in dorsal part (approximately $\frac{1}{3}$ length of ventral part), slightly concave laterally. Segment X with a pair of triangular, well sclerotized lateral plates with broad digitate projections along apical half margin, and densely covered with minute spines on basal half ventrally. Corpus bursae membranous, oval, apical half covered with minute wrinkles; signa with two pairs of rhombus-shaped plates with many long hairs.

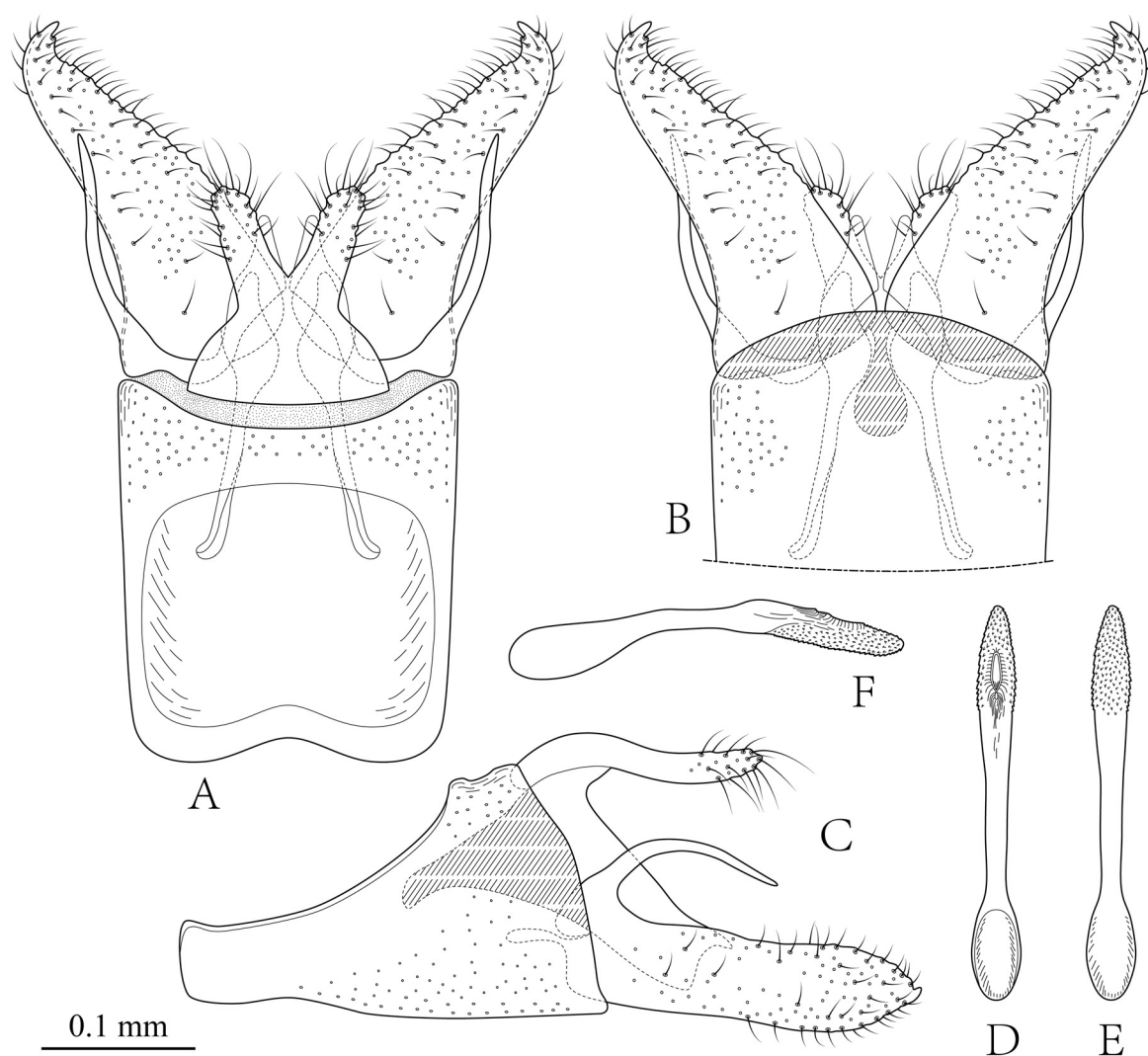


Fig. 4. Male genitalia of *Vietomartyria maoershana* sp. nov. **A.** Dorsal view, with phallus removed. **B.** *Ditto*, ventral view. **C.** *Ditto*, lateral view. **D.** Phallus, dorsal view. **E.** *Ditto*, ventral view. **F.** *Ditto*, lateral view.

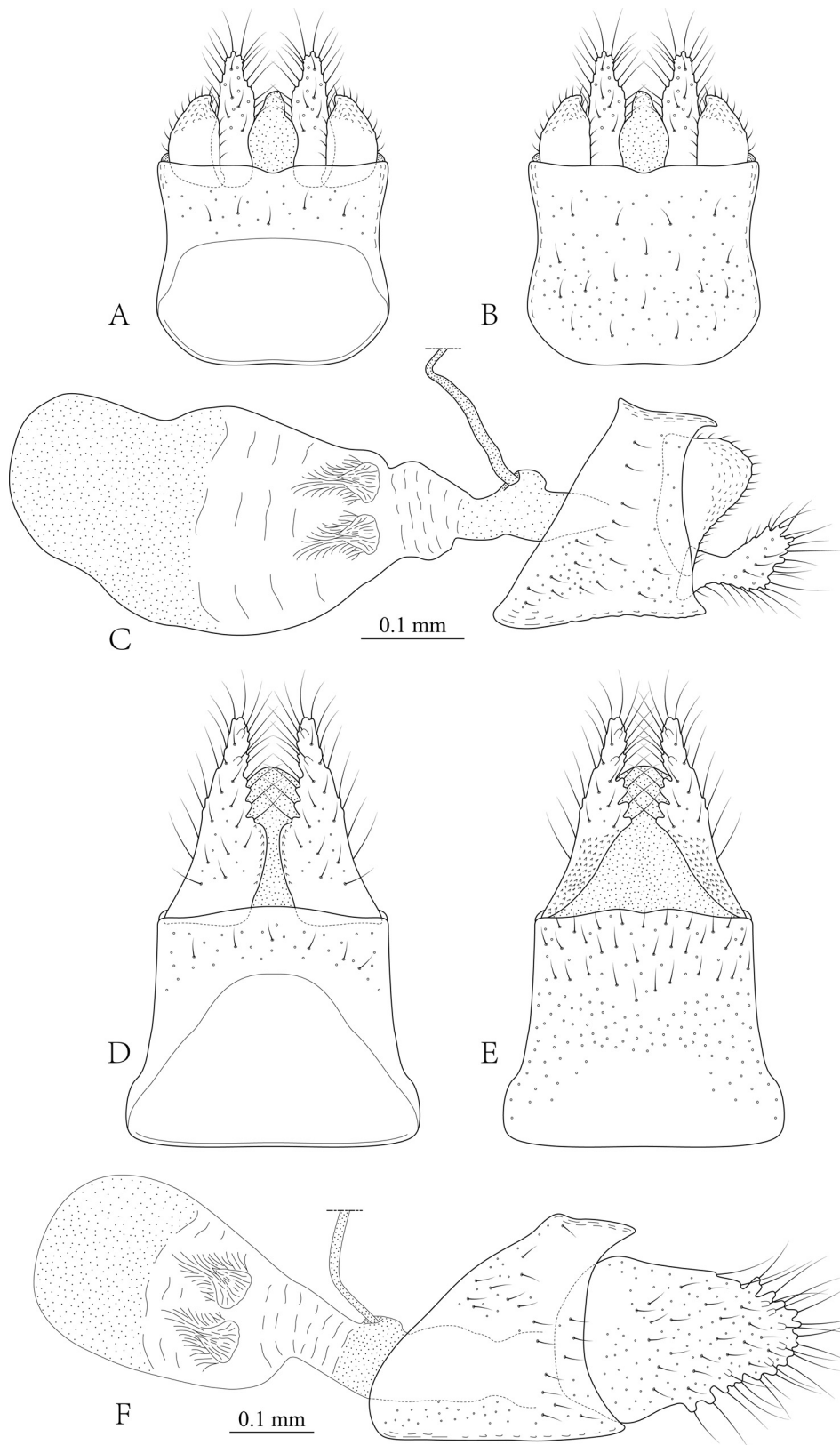


Fig. 5. Female genitalia of *Vietomartyria* spp. **A–C.** *Vietomartyria wuyunjiena* sp. nov. **D–F.** *V. maoershana* sp. nov. **A, D.** Terminalia, dorsal view. **B, E.** *Ditto*, ventral view. **C, F.** Terminalia and bursa copulatrix, lateral view.

Immature stages

Unknown.

Distribution

This species is known from Mao'ershan National Nature Reserve (Xin'an, Guilin, China).

Remarks

Adults of *V. maoershana* sp. nov. were collected along a paved road at 1500 m a.s.l., half way up Mt Mao'ershan. Similar to *V. wuyunjiena* sp. nov., the adults were observed flying or perching on low shrubs and ferns in cloudy conditions and even in weak rainfall.

Key to species of the genus *Vietomartyria*

1. Forewing with broad golden stria at basal $\frac{1}{3}$; tergite X (uncus) semicircular with an emarginate spine at middle posteriorly *V. gladiator* Hirowatari & Huang, 2010
– Forewing with golden luster at basal half and purple luster apically; tergite X bilobed, formed paired X tergal lobes 2
2. Dorsal process of valva right-angularly curved inwardly, with a long pointed apex 3
– Dorsal process of valva more or less curved inwardly, but not right-angular, with an obtuse or small apex 6
3. Tergite X horizontal dorsally, paired X tergal lobes slender digitate
..... *V. nanlingana* Hirowatari & Jinbo, 2009
– Tergite X curved ventrally, paired X tergal lobes broad, triangular 4
4. Basal inner surface of valva expanding dorsally, with a long hooked projection near dorsal part
..... *V. nankunshana* Hirowatari & Hashimoto, 2009
– Basal inner surface of valva not expanding dorsally, without a hooked projection near dorsal part
..... 5
5. Basal half of valva longer than width *V. jinggangana* (Yang, 1980)
– Basal half of valva distinctly wider than long *V. baishanzuna* (Yang, 1995)
6. Dorsal process of valva broad, overtly curved inwardly *V. expeditionis* (Mey, 1997)
– Dorsal process of valva small, slightly curved inwardly 7
7. Tergite X deeply bilobed, paired X tergal lobes digitate; basal inner surface of valva with a long pointed arcuate projection near dorsal part *V. maoershana* sp. nov.
– Tergite X shallowly bilobed, paired X tergal lobes triangular; basal inner surface of valva without a long pointed projection near dorsal part *V. wuyunjiena* sp. nov.

Discussion

In this study, we add two new species of *Vietomartyria* from China based on the distinguishing characters defined by Hashimoto & Mey (2000) and Hirowatari *et al.* (2009): i) each flagellomere with long basal stalk; ii) aedeagus with many minute serrate projections near gonopore; iii) gonopore situated dorsally near apex. Additionally, we provide a distribution map (Fig. 6) of all known species of *Vietomartyria*.

Among eight species of *Vietomartyria*, *V. gladiator* is unique in that it lacks the dorsal projection of the gonopod (valva) (Hirowatari *et al.* 2010). Furthermore, several other autapomorphic characters of

V. gladiator make it possible to distinguish this species from other species, such as non-bilobed tergite X (while bilobed in other species), prominent sword-like process of anal cone sclerite (extending latero-ventrally but not distinct beyond tergite X), and type and position of the gonopore. The female genitalia are similar to *V. expeditionis* in the absence of signa, but it seems to be a homoplastic condition (i.e., secondary loss). In the present study, we also found a characteristic feature of *V. wuyunji* sp. nov., whereby segments X+XI of the female are not fused into a pair of lateral plates as in other species, but form two pairs. In addition, *V. gladiator* apparently differs in habitat compared to other species: this species lives in moist habitats along a stream in a valley in Mt Nankunshan, Guangdong (Hirowatari *et al.* 2010), whereas the other species (e.g., *V. nankunshana*, *V. nanlingana*, *V. wuyunji* sp. nov. and *V. maoershana* sp. nov.) live in comparatively drier habitats such as exposed lower shrubs, weeds and ferns along mountain road-sides. The differences of habitats between these two groups may reflect differences in their host-plant uses. This study contributes to filling a knowledge gap in the diversity of micropterigids in China. To clarify the phylogenetic position of the genus, specimens of *Vietomartyria* should be examined based on morphological and molecular data and compared to some closely related genera (e.g., *Paramartyria*). Kristensen (1997) hypothesized that liverwort-feeding is a plesiomorphic feeding habit of Lepidoptera. As it is shown that most species of micropterigids in Japan feed on a single liverwort species (Imada *et al.* 2011), species of *Vietomartyria* may also be associated with some specific groups of liverworts. Elucidating the immature stages, particularly identifying their host plants, will give us insights into the evolution of host-plant use.



Fig. 6. Distribution of *Vietomartyria* spp. 1 = *V. expeditionis* (Mey, 1997); 2 = *V. nanlingana* Hirowatari & Jinbo, 2009; 3 = *V. jinggangana* (Yang, 1980); 4 = *V. baishanzuna* (Yang, 1995); 5 = *V. nankunshana* Hirowatari & Hashimoto, 2009; 6 = *V. gladiator* Hirowatari & Huang, 2010; 7 = *V. maoershana* sp. nov.; 8 = *V. wuyunji* sp. nov.

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