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A NEW GENUS AND SPECIES OF VILLOESTRINI HULL
(DIPTERA: BOMBYLIIDAE) FROM THE ORIENTAL REGION
PARASITIC ON ANT LIONS (NEUROPTERA: MYRMELEONTIDAE),
WITH KEY TO GENERA IN THE TRIBE

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Cover image: *Taiwanon phormae* Evenhuis, n. sp.. dorsal and lateral habitus of male holotype.

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A new genus and species of Villoestrini Hull (Diptera: Bombyliidae) from the Oriental Region parasitic on ant lions (Neuroptera: Myrmeleontidae), with key to genera in the tribe¹

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Abstract. The new genus and species of Villoestrini, *Taiwanon phormae*, **n. gen., n. sp.** is described and illustrated and marks the first record of the tribe from the Oriental Region. The specimens were reared as parasites of a dendroleontine ant lion, which do not make pitfalls. The pupal exuvium is described and illustrated.

INTRODUCTION

The tribe Villoestrini Hull consists of 22 species in four genera found in the western U.S., Europe, the Mediterranean, Asia, and Africa (Evenhuis & Greathead 1999). They are anomalous in the normally flower-feeding family Bombyliidae in that they have reduced and non-functional or vestigial mouthparts. The current genera in the tribe are *Marleyimyia* Hesse, 1956, *Oestranthrax* Bezzi, 1921, *Oestrimyza* Hull, 1973, and *Villoestrus* Paramonov, 1931. The only other genera of Bombyliidae with reduced mouthparts are *Walkeromyia* Paramonov, 1934 (Anthracini) and *Xenoprosopa* Hesse, 1956 (Xenoprosopinae).

Examination of a number of specimens of bee fly parasites of ant lions sent for identification has revealed the new genus described below from Taiwan. It marks the second record of the tribe from the Oriental Region (one species of *Marleyimyia* Hesse is known from peninsular Malaysia). Records of the biologies of the immature stages of this tribe are few with only three records of parasitism: one species (*Oestranthrax myrmecaeluri* Miksch) was recorded as a parasite of ant lions in Greece (Miksch 1993); two other records (*Marleyimyia* spp.) are from cossid larvae (Yeates & Greathead 1997). The new genus and species described herein, *Taiwanon phormae*, **n. gen., n. sp.** has also been reared from ant lions, but from a tribe of ant lions whose immatures do not make pits. The pupal exuvium is described and information on the biology is given. A key to the genera of Villoestrini is presented.

MATERIAL AND METHODS

The material examined derives from the collections of Robert Miller and Lionel Stange. Additional material on loan to me from a number of institutions and persons as well as material in the United States National Museum (USNM) Bombyliidae Collection (currently housed at the Bishop Museum in Honolulu [BPBM]) was used to compare genera

1. Contribution 2018-002 to the Pacific Biological Survey.

and species. Photographic images were accomplished by obtaining a series of stacked images using a Leica M165C stereo dissecting scope via the Leica Microsystems LAS Multifocus software (v. 4.12.0) and using Zerene Stacker® stacked focusing software (v. 1.04) (Zerene Systems, LLC, Richmond, Washington, USA) to align and stack-focus each final image.

General adult morphological terminology follows Cumming & Wood (2017). Pupal morphology follows Evenhuis (2017).

TAXONOMY

Villoestrini Hull

Villoestrini Hull, 1973: 411. Type genus: *Villoestrus* Paramonov, 1931.

Oestrimyini Hull, 1973: 63. *Nomen nudum*. Incorrect original spelling of Oestrimyziini.

Oestrimyziini Hull, 1973: 63. *Nomen nudum*. Sabrosky 1999: 220 (corrected spelling).

Hull (1973) proposed the tribe Villoestrini for four genera, *Marleyimyia*, *Oestranthrax*, *Oestrimyza*, and *Villoestrus*, based primarily on only two character states: the lack of macrochaetae (on the notopleural and postalar areas of the thorax) and reduced mouthparts. Examination of specimens in this tribe during this study has found additional characters listed in the diagnosis below. The new genus described herein possesses the absence of macrochaetae in the notopleural, supraalar, and postalar areas, the lack of specialized pollen collecting hairs, and has a tumid face between and below the antennae.

Diagnosis. Maxillary palpi absent or reduced; labellum absent, lobes fused and/or without pseudotracheae; proboscis much shorter than oral cavity; thorax without strong macrochaetae; face large, often bulging, convex, much longer from antennae to oral cavity than length of oral cavity; fore tarsi of females without specialized pollen hairs (Fig. 8); legs often thick and slightly bowed; male genitalia with gonocoxa in ventral view (Fig. 9) long, narrow on apical one-third, expanding basally to twice apical width.

KEY TO WORLD GENERA OF VILLOESTRINI

1. Mouthparts well developed, functional, labellum bilobed and pseudotracheae, maxillary palpi well developed, the last usually one-third to one-half length of proboscis; thoracic macrochaetae present on supraalar and postalar areas, thick bristles or hairs along posterior edge of scutellum; face not conspicuously enlarged and convex, either receding or conical; pollen collecting hairs of fore tarsi present in females; legs generally long, thin VILLINI
- Mouthparts reduced or absent, labellum, if present, reduced to nubs or fused and shovel-shaped, often without pseudotracheae; face large, bulging, convex, distance from antennal base to oral cavity often much larger than length of oral cavity; pollen collecting hairs of fore tarsi absent in females; thorax without macrochaetae (thick hairs [but not true macrochaetae] present in notopleural and/or postalar areas in *Oestrimyza* and some species of *Oestranthrax*), posterior margin of scutellum without bristles; legs generally shorter, thicker; fore tibia with thick or thin black spicules or bristles (spicules orange in *Oestranthrax farinosa* Johnson & Maughan) VILLOESTRINI ... 2

2. Oral cavity reduced to thin groove and small opening; palpi not evident or reduced to small nubs; other mouthparts absent or extremely reduced; palpi absent; wing with medial infuscation; eye margin distinctly indented posterolaterally; occiput well developed posteriorly (Palearctic) *Villoestrus* Paramonov
- . Oral cavity present, large or small, but not a small slit or groove; mouthparts present but all or some parts reduced to various degrees and non-functional; palpi absent or reduced 3
3. Wing completely infuscated brown with clear areas surrounding crossveins; face without scales; halter knob without minute hairs on ventral surface (Neotropical).....
..... *Oestrimyza* Hull
- . Wing hyaline or infuscated to varying degrees, if infuscated, not with hyaline areas surrounding crossveins; face with or without scales; halter knob with minute hairs on ventral surface (absent in *Oestranthrax farinosus*) 4
4. Mouthparts only slightly reduced; labellum present, bilobed, shovel-shaped or fused and narrow 5
- . Mouthparts extremely reduced; labellum absent or reduced to point; wing almost entirely infuscated (either darkly or pale smoky brown); wing veins brown to black; thoracic pile generally shaggy and dense *Marleyimyia* Hesse
5. Wing with vein R_{4+5} curved downward, ending in costa at wing apex (Figs. 5, 6); anal cell closed at wing margin; epiphallus of male genitalia without ventral keel (Fig. 12)
..... *Taiwanon* Evenhuis, n. gen.
- . Wing with vein R_{4+5} curved upward, ending in costa distinctly before apex; anal cell open in wing margin; epiphallus with ventral keel *Oestranthrax* Bezzi

Genus *Taiwanon* Evenhuis, new genus

Type species: *Taiwanon phormae* Evenhuis, n. sp., by present designation.

Diagnosis (can serve as diagnosis for species as well). Appears closest to *Oestranthrax obesus* (Loew) due to the generally black body color and presence of abdominal tomentose banding (most others do not have this banding and have some reddish ground color) but can be separated from it (and all other Anthracinae) by the wing venation: vein R_{4+5} does not curve 90° upward to end in the costa before the wing apex but is instead slightly curved and ends in the costa at the apex of the wing (Figs. 5, 6). Only one other bombyliid, *Thevenetimyia* Bigot, has species with this type of venation. It can also be separated from all other Villoestrini by the epiphallus without a ventral keel (Fig. 12) (this keel present in all other Villoestrine genera and most other villine genera. *Taiwanon* also has the general appearance of a *Villa* Lioy and, in addition to the R_{4+5} venation character noted above, it can be separated from species in *Villa* by the lack of macrochaetae on the notopleural area and postalar calli, the absence of maxillary palpi, and the tumid and long face below the antennae without dense scales.

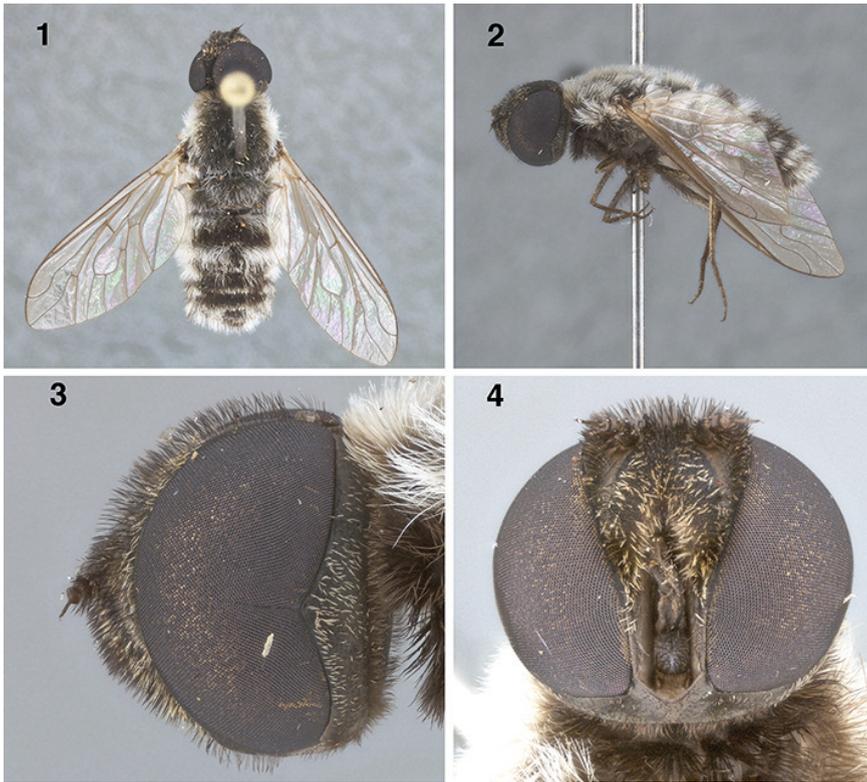


Fig. 1–4. *Taiwanon phormae* Evenhuis, n. sp., holotype male. 1. Habitus, dorsal view. 2. Habitus, lateral view. 3. Head, lateral view. 4. Head, ventral view, showing shriveled labellum.

Etymology. The generic name derives from the type locality in Taiwan with the addition of the “-on” suffix mimicking the ending of so many Myrmeleontidae. The generic name is treated as feminine.

***Taiwanon phormae* Evenhuis, new species**
(Figs. 1–6, 8–17)

Anthrax Scopoli. Stange *et al.* 2003: 10, 73 (misidentification).

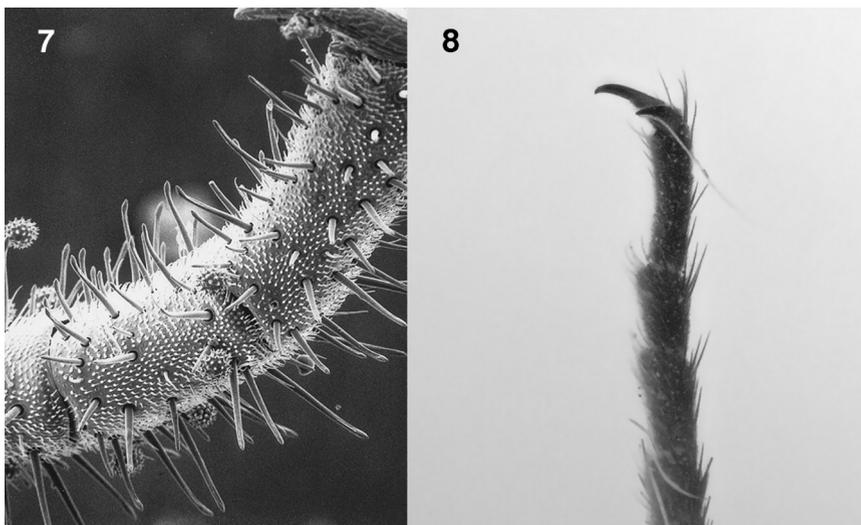
Types. *Holotype* male (USNMENT1353690) and *paratype* female from: **TAIWAN:** Taoyuan County: Yunghua, 3 May 1998, R. Miller, L. Stange, H. Wang. *Other paratypes:* 1 male, 1 female from: **TAIWAN:** Taipei county: Shintau, 10 km NE San Min (site #1), 24°49'54"N, 121°19'53"E, Jun 1998, R. Miller, L. Stange, H. Wang, ex *Dendroleon esbenpeterseni*. Holotype in USNM; paratypes in BPBM and the Florida State Collection of Arthropods (FSCA)



Figs. 5–6. *Taiwanon phormae* Evenhuis, n. sp., wings. 5. Female paratype. 6. Male holotype.

Description.

Adult Male and Female. Measurements. Body: 9.0–9.2 mm. Wing: 8.8–9.0 mm. *Head.* Black; occiput with sparse but evenly distributed scales; occipital fringe surrounding occipital foramen with short dark brown hairs. Mentum very narrow (Fig. 4), inner eye margin contiguous with oral cavity ventrally. Eyes separated at vertex by 1.25 x width of ocellar tubercle; ocellar tubercle hemispherical, not triangular, median ocellus slightly larger than lateral ocelli. Front and face convex, bulging, short erect black pilose, admixed with sparse yellowish brown tomentum; face rounded and receding in profile, not conical, bare immediately below antenna. Antenna black, scape subcylindrical, three times length of pedicel, with tufts of black hairs laterally and mesally; pedicel subspherical, with ring of black hairs, densest ventrally; flagellomere subequal in length to scape and pedicel combined; base subconical, tapering to long, thin, styliform apical three-fourths, style small, terminal. Proboscis short, black, not projecting beyond oral margin. Palpi absent; labellum varying from shriveled in some specimens (cf. Fig. 4) to well developed; theca broad, length subequal to width, with black hairs.



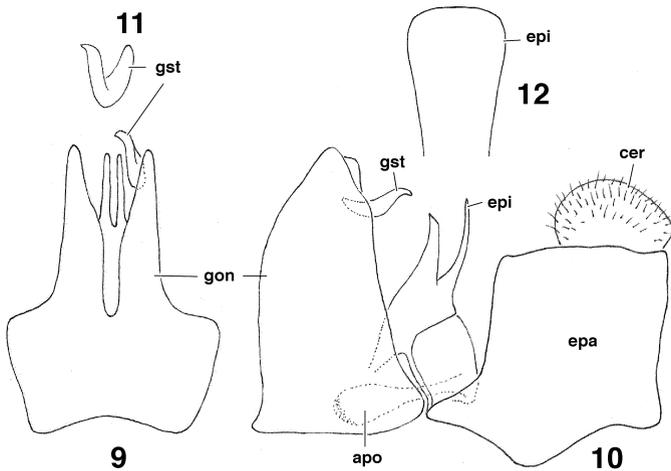
Figs. 7–8. Fore tarsi of anthracine genera. **7.** *Exoprosopa eremita* Osten Sacken, showing specialized erect pollen collecting hairs (from Neff *et al.* 2003). **8.** *Taiwanon phormae* Evenhuis, n. sp., showing lack of pollen collecting hairs.

Thorax (Fig. 1). Mesonotum and scutellum matte black, macrochaetae absent, with anterior and lateral margins dense white pilose; dorsum of mesonotum and scutellum uniformly covered with dense fine, white hairs, these hairs thicker and denser anteriorly and dorsolaterally, tomentum and scales absent. Pleura black except katepimeron and meron grayish brown pruinose, white haired above, blacked haired below; laterotergite with tuft of white hairs, posterior portion of anepimeron with admixture of dense white and a few black hairs; small tuft of short white hairs below posterior spiracle. Halter stem yellow, knob yellowish brown, knob with minute hairs ventrally.

Legs. With a generally shaggy haired appearance on the bases of femora. Coxae black with dense admixture of fine white and black hairs; mid and hind femora black with long shaggy yellowish white hairs ventrally, fore femur sparser haired ventrally, all femora with decumbent long, whitish yellow scales; fore and mid tibiae yellowish, covered with black scales and decumbent black hairs; hind tibia black, covered with thick yellow scales; fore tibia with row of short erect black setae anteriorly; mid and hind tibiae with erect setae laterally and mesally; all tarsi yellow with black decumbent hairs (cf. Fig. 8); claws of equal size.

Wing (Figs. 5, 6) Hyaline; some specimens with small stump veins in R_{4+5} and vein closing cell dm (cf. Fig. 5); anal cell closed in wing margin. Tegula a thick yellow hook; patagium not enlarged, with sparse yellow scales and short black setae. Alula and squama opaque yellow white, fringed with yellowish long white scales. Wing Interference Pattern with a greenish band along posterior margin from cell m1 to anal lobe, magenta medially.

Abdomen (Fig. 1). Black. Tergite I with long fine white hair; tergite II dense long white pilose anteriorly and laterally, black hairs and tomentum on medial three-fourths of



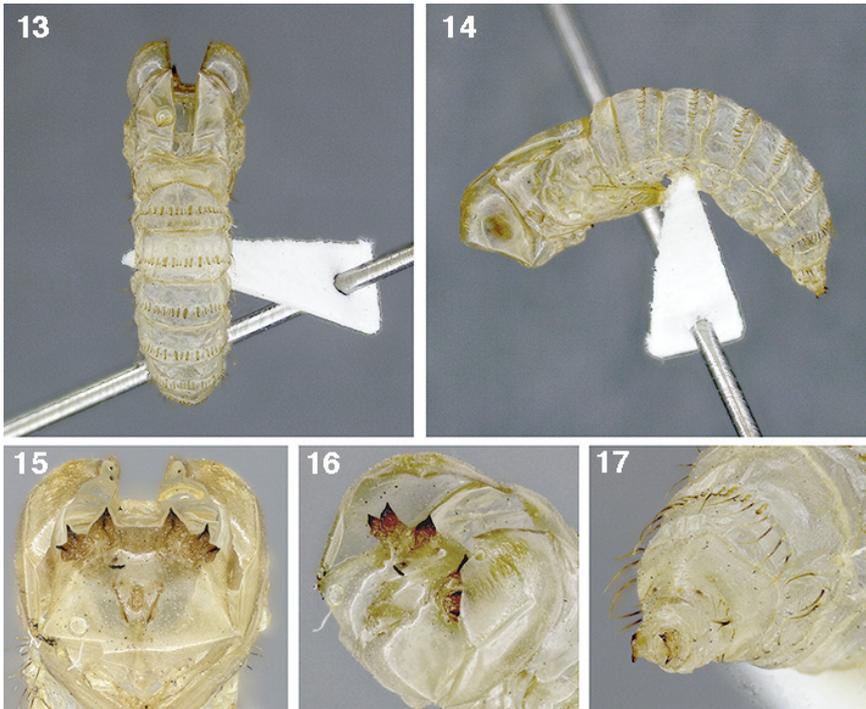
Figs. 9–12. *Taiwanon phormae*, Evenhuis, n. sp., male genitalia. **9.** Ventral view. **10.** Lateral view. **11.** Detail of gonostylus, caudal view. **12.** Detail of epiphallus, ventral view. Abbreviations: apo = aedeagal apodeme; cer = cercus; epa = epandrium; epi = epiphallus; gon = gonocoxa; gst = gonostylus.

tergite; tergite III appearing as a transverse white band, vestiture consisting of dense white hairs laterally, sparser medially, predominantly white tomentose medially, small patch of dark brown scales posteromedially; tergites IV–V with admixed white and black hairs medially, white pilose laterally, otherwise predominantly black tomentose, with small band of white tomentum posterodorsally; tergite VI with admixed white and black hairs laterally and dorsolaterally, black hairs and tomentum medially; tergite VII with admixed white and black hairs, sparse white tomentose. Sternites black with long fine black hair and dense black tomentum.

Male Genitalia (Figs. 9–12). Epandrium subquadrate in lateral view, cercus large, rounded, well exerted; gonocoxa obconical in lateral view, in ventral view narrow on apical two-thirds, basal one-third twice width of apical portion, deeply cleft medially in ventral view; gonostylus thin, sinuous in lateral view with slightly hooked apex; aedeagal complex typical of villine genera with acute aedeagal apex and thin epiphallus in lateral view; epiphallus in ventral view lacking a ventral medial keel; aedeagal apodeme, relatively small, thin with clubbed apex, sclerotized along apical margin.

Female Genitalia. Not dissected; acanthophorite spines 6–8 pairs.

Pupa. Measurements. Overall length: 7.5–8.0 mm ($n = 4$). Body (Figs. 13–17) generally without hairs dorsally and sparse hairs laterally. Head with cephalic armature (Figs. 15, 16) consisting of paired, apically sclerotized antennal sheaths on each side, each sheath short, pointed medially, other cephalic sheaths typically present in other bombyliids absent, labral sheath reduced to bump (cf. Fig. 16). Thorax generally bare. Abdomen (Fig. 13) with tergite I without medial spines, with a patch of a few short black hairs at dorso-



Figs. 13–17. Pupal exuvium of female paratype, front of head capsule collapsed. **13.** Habitus, dorsal view. **14.** Habitus, lateral view. **15.** Head capsule, frontal view showing cephalic armature. **16.** Head capsule, oblique frontal view showing cephalic armature. **17.** Oblique caudal view of terminal abdominal segments showing caudal armature.

lateral angle another small patch of short hairs laterally; tergites II–VII patch of 3–4 hairs laterally on distinct bulla; tergites II–VII with short stiff hairs interspersed between barbed spines, hairs becoming longer and more numerous on successive tergites; each segment with apically barbed and sclerotized thorn-like spines medially as follows: tergite II (20 short); tergite III (26 slightly thicker); tergite IV (20); tergite V (16); tergite VI (16); tergite VII (6 thick and long). Tergite VIII without dorsal spines or vestiture, two thick short hairs laterally. Tip of abdomen (Fig. 17) with caudal armature consisting of short paired bifid spines each side, each darkly sclerotized apically.

Etymology. The species name derives from the Greek, “*phormos*” = rug; referring to the dorsal abdominal pattern of hair and tomentum. The name is treated as a noun in apposition. The genus and species names said together honor the 2013 poem by Michael Wolf “Tie one on for me”.

Remarks. The specimens were reared from the ant lion *Dendroleon esbenpeterseni* Miller & Stange, 2000, which are restricted in habitat to rain-protected dry patches of stony rubble and fine particles beneath rocky outcroppings in cliffs or the mouths of caves. Details of the collection of the ant lion cocoons, larvae, and resulting rearing of this bee fly are given in Stange *et al.* (2003). The larvae of this bee fly were not externally visible on the host larvae and emerged about thirty days after cocoon construction. The ant lion larvae do not form pitfalls but cover themselves in fine dust with only their mandibles exposed, anchor themselves to a rock or solid substrate, and await prey to pass by. The restricted habitat may be why the bee flies have not been reported before as they are no doubt rarely found outside the habitat and do not have functional mouthparts for feeding so most likely exist only to mate and find oviposition sites.

The presence of minute hairs on the halter knob appears to be correlated with Old World taxa on Villoestrini; New World taxa do not have these hairs. The western U.S. *Oestranthrax farinosus* lacks these hairs and has other characters not typical of *Oestranthrax sensu stricto* and with further study may warrant status as a new genus.

Two male genitalic characters are different from most anthracine genera: the gonostylus is thin and sinuous with a slightly hooked apex (this structure is much more broad basally with a subapical hook in other anthracine genera); and the epiphallus lacks a ventral medial keel, the presence of which is typical of other villoestrine genera and many villine genera.

The barbed abdominal spines on the pupa are roughly one-half the length of those spines in *Chrysanthrax* (cf. Evenhuis 2017).

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