



***Condensella* and *Endogena*, two new genera of the *Alebroides* genus group (Hemiptera: Cicadellidae: Typhlocybinae) from the Oriental Region with notes on the phylogeny of Empoascini**

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Key words. Auchenorrhyncha, Cicadellidae, microleafhopper, taxonomy, *Alebroides* group, new genera, phylogeny, Oriental Region

Abstract. Two new microleafhopper genera of Empoascini within the subfamily Typhlocybinae (Hemiptera: Cicadellidae), *Condensella* Xu, Dietrich & Qin gen. n., based on the type species *C. filamenta* Xu, Dietrich & Qin sp. n., and *Endogena* Xu, Dietrich & Qin gen. n., based on the type species *E. flava* Xu, Dietrich & Qin sp. n., are described from southern China and Thailand. Male habitus photos and illustrations of male genitalia of the two new species are provided. Comparative notes on related genera are provided. Phylogenetic relationships and the status of genus groups within the tribe are also discussed.

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INTRODUCTION

Empoascini is a tribe of the microleafhopper subfamily Typhlocybinae. It comprises 89 previously described genera and more than 1000 species worldwide (Xu et al., 2017), including widespread, polyphagous agricultural pests such as the Potato Leafhopper, *Empoasca fabae* (Harris) (Chasen et al., 2014) and Cotton Leafhopper *Amrasca biguttula biguttula* (Ishida) (Saeed et al., 2015), as well as pests that appear to be monophagous on one particular crop, such as the Tea Green Leafhopper, *Empoasca onukii* Matsuda (Qin et al., 2015). Knowledge of the world fauna of Empoascini remains incomplete and new genera and species continue to be discovered at a rapid pace. Members of this tribe have been assigned to three informal generic groups (Qin et al., 2011; Xu et al., 2015, 2016), one of which, the *Alebroides* group, is characterized by the vein CuA in the hind wing branched preapically. The *Alebroides* group comprises 158 species in 27 genera so far, widely distributed in the Old World (Xu et al., 2017).

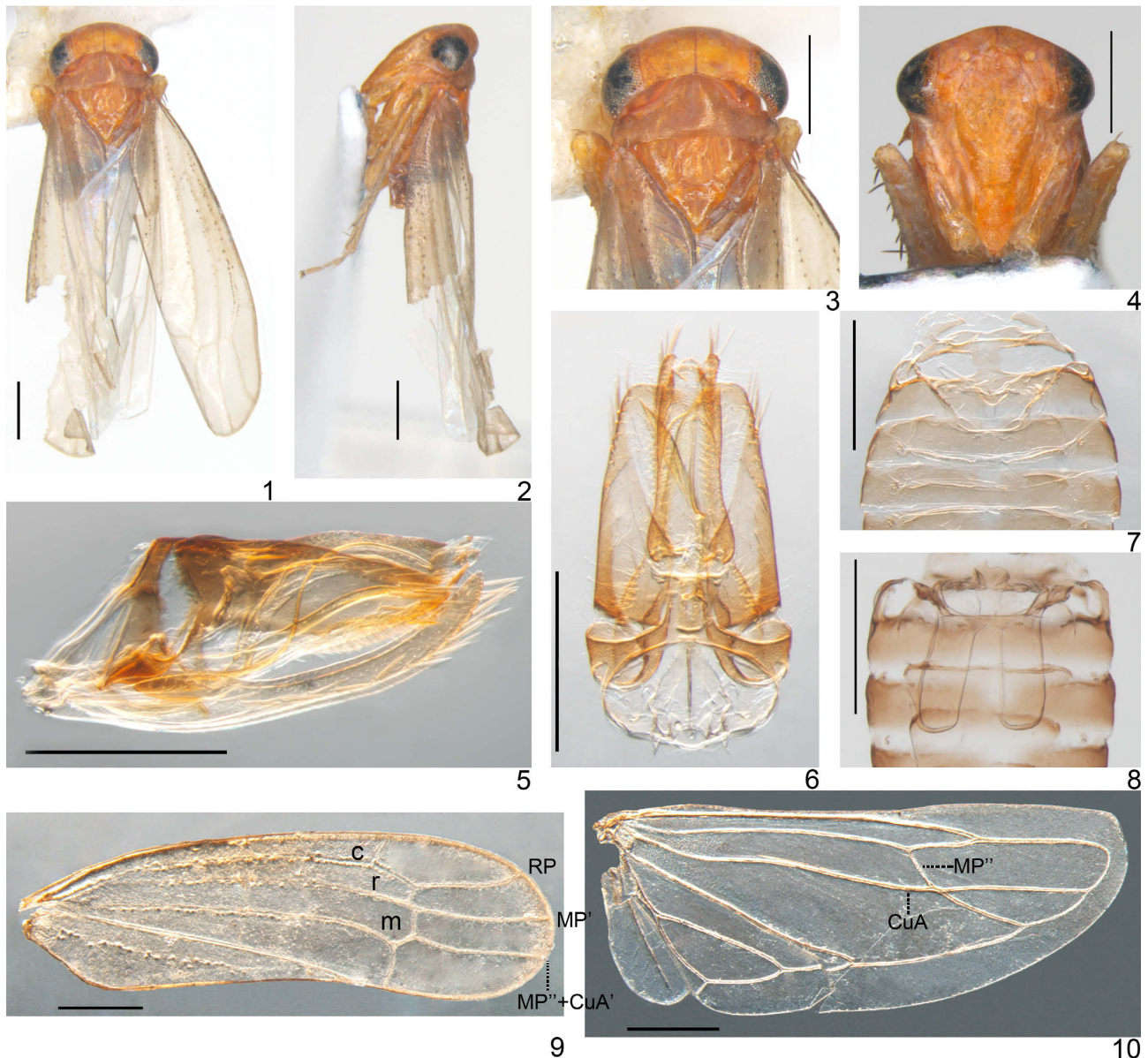
The Oriental Region harbors the richest biodiversity of the *Alebroides* group, with 23 genera reported so far, including 16 genera known in the Chinese fauna. Despite recently published papers treating the *Alebroides* genus

group of China and South Asia, recent sampling in this region suggests that the fauna remains inadequately surveyed. This paper adds two new genera and species based on specimens from South China and Thailand. Furthermore, the possible phylogenetic status and relationships of the generic group in Empoascini are also discussed. The aim of this study is to provide more information for comprehensive phylogenetic analysis of this tribe in future studies.

MATERIALS AND METHODS

The specimens examined in this study were collected by sweep net and Malaise trap, they are dry or preserved in ethanol and now deposited in the Entomological Museum, Northwest A&F University, Yangling, Shaanxi, China (NWAFU), the Insect Collections, China Agricultural University, Beijing (CAU) and the insect collection of the Illinois Natural History Survey, Champaign, Illinois (INHS) as indicated under each species. The entire male abdomens of the examined specimens were removed and macerated in 10% NaOH solution at approximately 90°C for about 2–3 min, subsequently rinsed several times with pure water and transferred into glycerin. Photographs of the specimens were made using a Leica M205A microscope with Leica DFC Camera. Images were captured and processed using Leica Applica-

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Figs 1–10. *Condensella filamenta* Xu, Dietrich & Qin sp. n. 1 – male adult (abdomen removed), dorsal view; 2 – male adult (abdomen removed), left lateral view; 3 – head and thorax, dorsal view; 4 – face; 5 – male genitalia, left lateral view; 6 – male genitalia, dorsal view; 7, 8 – abdominal apodemes; 9 – forewing; 10 – hind wing. Scale bars = 0.5 mm.

tion Suite (LAS) V3.7 and edited using Adobe Photoshop CS 8.0 (Adobe Systems). Body measurements (in mm) are from apex of vertex to tip of forewing.

Morphological terminology follows Zhang (1990) with the following exceptions: wing venation follows Dworakowska (1993), chaetotaxy of the subgenital plate follows Southern (1982), and leg chaetotaxy follows Rakitov (1998).

TAXONOMY

***Condensella* Xu, Dietrich & Qin gen. n.**

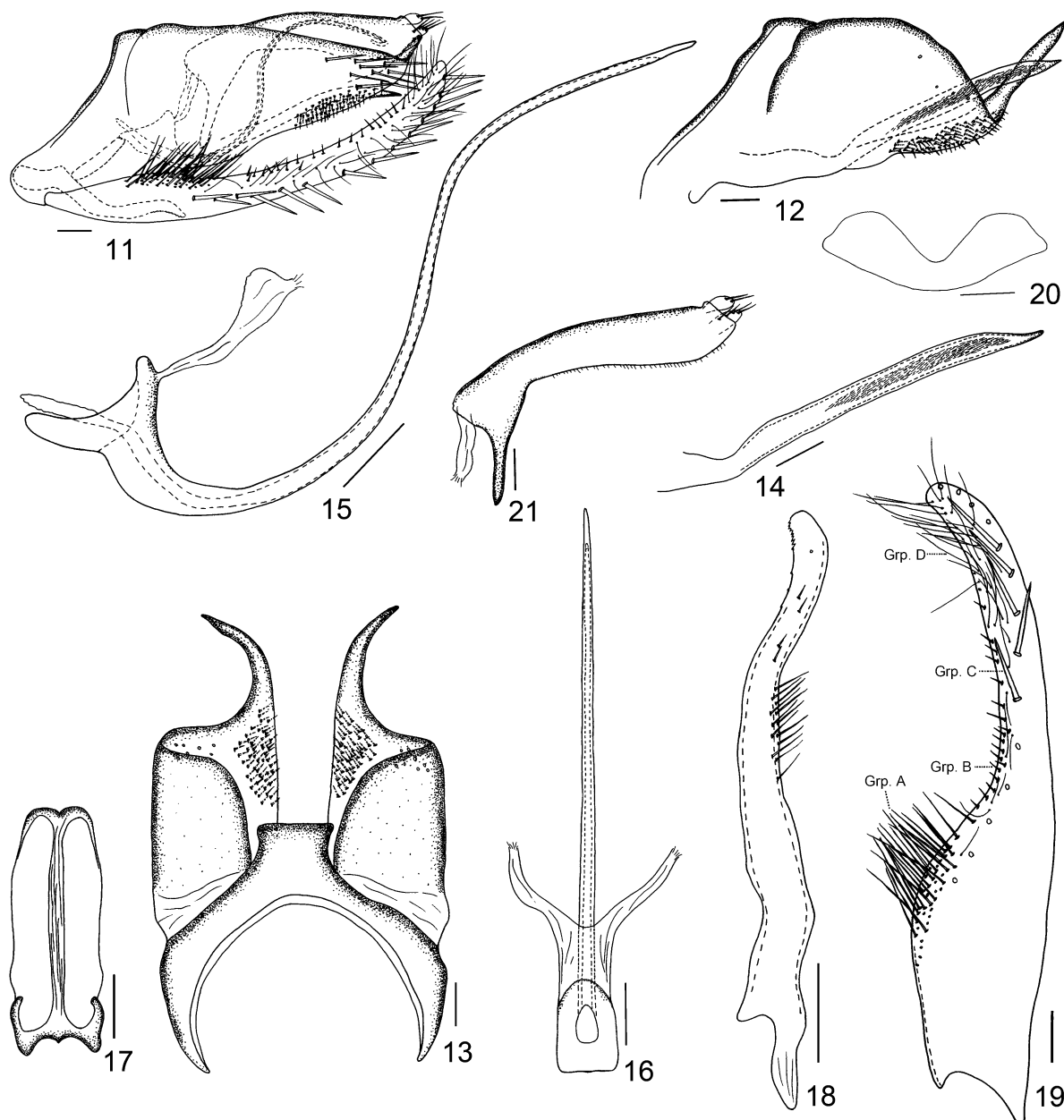
ZooBank taxon LSID:

30A49527-2FDB-43CA-A87B-EA93D9DF12BE

Type species: *C. filamenta* Xu, Dietrich & Qin sp. n. here designated.

Description. Head including eyes broader than pronotum in dorsal aspect (Figs 1, 3), in profile slightly up-turned apically, transition of crown to face rounded (Fig.

2). Crown short and broad, rounded anteriorly, anterior and posterior margins nearly parallel, middle length shorter than half width between eyes (Figs 1, 3); coronal suture long, passing to face and terminating at level of antennal bases (Figs 1, 3, 4). Ocelli distinct, on face, well separated from eyes (Fig. 4). Face broad, lateral frontal sutures extended ventromesad of ocelli, anteclypeus slightly convex, not expanded (Fig. 4). Pronotum relatively short (Figs 1, 3). Forewing narrow, rounded apically, apical cells occupying nearly one-third of total length, c and r cells nearly equal in width, both narrower than m and cua cells; vein RP arising from r cell and MP' and MP''+CuA' from m cell, MP' and MP''+CuA' almost parallel throughout their length (Fig. 9). Hind wing with CuA branched, branching point distad of coalescence of CuA with MP'' (Fig. 10). Front femur seta AM1 stout, well developed, situated near ventral margin; intercalary row with one large basal seta



Figs 11–21. *Condensella filamenta* Xu, Dietrich & Qin sp. n. 11 – male genitalia, left lateral view; 12 – pygofer side and ventral pygofer appendage, left dorso-lateral view; 13 – pygofer, dorsal view; 14 – ventral pygofer appendage, left lateral view; 15 – aedeagus, left lateral view; 16 – aedeagus, dorsal view; 17 – connective; 18 – paramere; 19 – subgenital plate; 20 – sternite IX, dorsal view; 21 – anal tube, left lateral view. Scale bars = 0.1 mm.

and six smaller setae near tip of femur. Hind femur with macrosetal formula 2+1+1. Hind-tibia row AV with ten preapical macrosetae.

Male basal abdominal sternal apodemes developed (Figs 7, 8). Male pygofer elongate, caudoventral margin folded inward and produced terminally (Figs 5, 11, 12), ventral appendage robust (Figs 12, 14); dorsal bridge short with single truncate posteromedial lobe; with a dorsolateral membranous fracture (Figs 6, 13). Subgenital plate longer than pygofer side in lateral view, all categories of setae present, A-group setae slim, densely grouped near base of plate, B-group setae rigid, not reaching apex of plate, C-group setae uniseriate, sharply pointed, reaching apex of plate (Figs 5, 11, 19). Paramere robust and sinuate, nu-

merous fine setae submedially, dentifer bearing tiny teeth (Figs 5, 18). Aedeagus slender, preatrium and dorsoatrium weakly developed, shaft slender, tubular, sinuate, gonopore subapical on ventral surface (Figs 15, 16). Connective about two times longer than wide, central lobe small, almost obsolete (Fig. 17). Anal tube elongate, basolateral process straight (Figs 5, 11, 21).

Etymology. The generic name is derived from the Latin word “*condensus*” (dense), referring to the densely grouped setal group A of the subgenital plate. Gender: feminine.

Remarks. Among previously described genera of the *Alebroides* group, this new genus is most similar to *Apheliona* Kirkaldy, 1907 and *Znana* Dworakowska, 1994a. It differs from both in having vein MP’ in the forewing aris-

ing from the m cell (Fig. 9), in having a caudoventral process on the pygofer in addition to a ventral appendage (Figs 5, 11, 12) and having a small central lobe of the connective (Fig. 17). This new genus is also similar to *Schizandrasca* Anufriev, 1972 in the slender and sinuate aedeagus, but differs from the latter in having a long coronal suture (Figs 3, 4), the dorsal habitus of head rounded anteriorly, the crown broader than the pronotum (Figs 1, 3), a ventral pygofer appendage (Figs 5, 11) and setal group C of the subgenital plate uniseriate near the base (Figs 11, 19).

Apart from the new genus, seven more genera in *Empoascini* (*Apheliona* Kirkaldy, 1907, *Znana* Dworakowska, 1994a, *Smyga* Dworakowska, 1995, *Ficiana* Ghauri, 1963, *Dialecticopteryx* Kirkaldy, 1907, *Lankasca* Ghauri, 1963 and *Dapitana* Mahmood, 1967) have similar crown proportions (short and rounded anteriorly, anterior and posterior margins nearly parallel, middle length distinctly shorter than width between eyes), wide heads (broader than maximum width of pronotum), and a long coronal suture (extended onto the face, reaching near or surpassing the antennal bases). However, five of these genera (*Smyga*, *Ficiana*, *Dialecticopteryx*, *Lankasca* and *Dapitana*) belong to the *Empoasca*-complex, based on hind wing venation. More study is needed to explore the phylogenetic relationships among these genera.

Distribution. China (Guangxi, Yunnan), Thailand (Kanchanaburi).

***Condensella filamenta* Xu, Dietrich & Qin sp. n.**

(Figs 1–21)

ZooBank taxon LSID:

723122C0-5B0A-4FC4-A68C-306391D5AC90

Type materials. **Holotype.** ♂, China, Guangxi, Pingxiang City, Xiashi Town, 22.viii.2014, coll. Ye Xu & Yinfeng Meng (NWFU). **Paratypes.** 1♂, China, Yunnan, Puer City, 6.iv.81, coll. Jikun Yang (CAU); 1♂, Thailand, Kanchanaburi, Khuean Srinagarindra NP, Behind tourist center, 14°38.155'N, 98°59.85'E, 210 m, Malaise trap, 28.vii.–4.ix.2008, Chatchawan & Boonkam leg., T3422 (INHS).

Description. Body length: male 3.8–3.9 mm.

General color orange red (Figs 1–4). Ocelli surrounded by whitish creamy patches (Fig. 4). Coronal suture reddish brown (Figs 1, 3, 4). Eyes black (Figs 1–4). Face orange, frontoclypeal area with irregular beige patches near base, anteclypeus ochreous (Fig. 4). Pronotum with pale brownish, sinuate transverse depression anterolaterally, remaining area brown (Figs 1, 3). Fore- and hind wing subhyaline (Figs 1, 2, 9, 10). Legs beige (Figs 1–4).

Basal sternal abdominal apodemes not extending to end of segment III (based on one male from China, another male with dissected abdomen damaged) (Fig. 7), or extending to membrane between segment IV and V (based on one male from Thailand) (Fig. 8). Male pygofer strongly narrowing in caudal 2/5, terminally bearing 6–8 long and more than 30 small rigid setae, caudo-ventral extension curved upwards and outwards (Figs 5, 11, 12, 13); dorsal bridge less than one-fourth length of lobe (Figs 6, 11, 13); ventral appendage robust, margins parallel through most length but

narrowed terminally with pointed apex, with submarginal band of microtrichia from near middle to subapex (Figs 5, 6, 11, 12, 14). Subgenital plate broad near base, thence strongly narrowed, and parallel-sided in apical half, apex rounded, A-group setae (more than 20) densely grouped in 1–4 irregular rows, B-group setae (22–25) in 1–2 rows, C-group setae (14) arising near base, D-group setae (45–50) arranged in 2–4 irregular rows apically (Figs 5, 11, 19). Paramere bearing 9–10 tiny teeth apically and 12–14 fine setae submedially (Figs 5, 11, 18). Aedeagus broad at base, thence strongly narrowed distad, apical 3/5 with nearly same width in lateral aspect, gonopore subapical on ventral side (Figs 5, 11, 15, 16). Connective nearly rectangular, anterior margin slightly emarginate in middle, lateral margin nearly membranous (Fig. 17). Anal tube sclerotized, ventrobasal appendage long, acuminate, almost two-thirds height of pygofer (Figs 5, 11, 21). Ninth sternite wider than long, with a pair of lateral lobes, caudal margin strongly sunken in middle (Fig. 20).

Etymology. The specific epithet is derived from Latin adjective “*filamentus*” (filaments), which refers to the shape of the aedeagus.

Distribution. China (Guangxi, Yunnan); Thailand (Kanchanaburi).

***Endogena* Xu, Dietrich & Qin gen. n.**

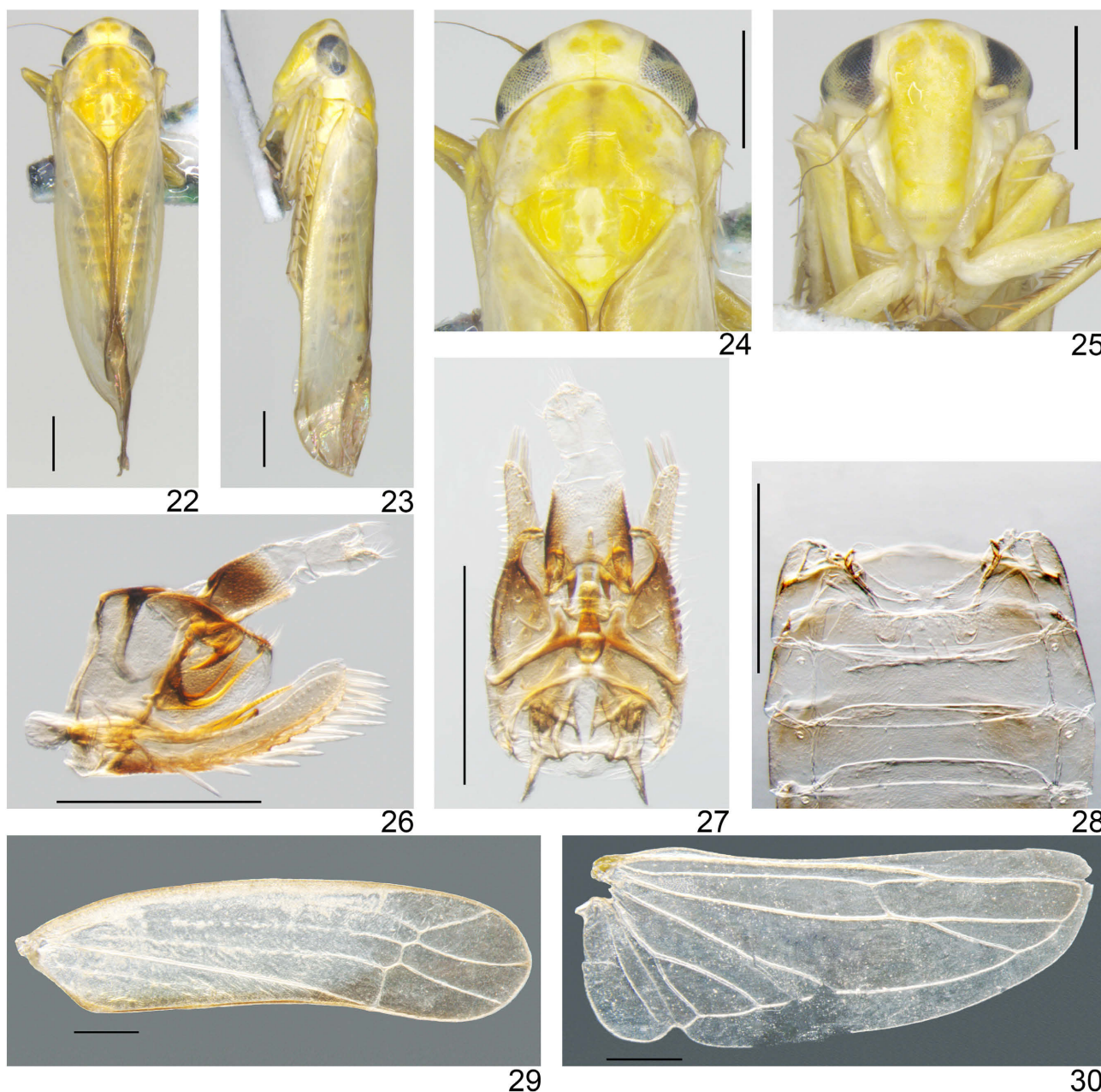
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Type species: *E. flava* Xu, Dietrich & Qin sp. n. here designated.

Description. Head including eyes almost as wide as pronotum in dorsal aspect (Figs 22, 24). Crown short and narrow, rounded anteriorly, anterior and posterior margins nearly parallel, middle length shorter than width between eyes, coronal suture distinct (Figs 22, 24); posteromedial corner of eye separated from posterior margin of head (Fig. 24). Head in profile only slightly upturned relative to pronotum, transition of crown to face rounded (Fig. 23). Ocelli distinct (Figs 22, 24, 25), on crown margin well separated from eyes. Face broad and distinctly convex in profile, lateral frontal suture extended ventromesad of ocelli, anteclypeus strongly inflated in male (Fig. 25). Pronotum large (Figs 22, 24). Forewing narrow, rounded apically, apical cells occupying more than one-fourth total length, c, r and m cells nearly equal in width, all narrower than cua cell; veins RP and MP' arising from r cell and MP''+CuA' from m cell (Fig. 29). Hind wing with CuA branched, branching point distad of coalescence of CuA with MP'' (Fig. 30). Front femur seta AM1 stout, situated near ventral margin; intercalary row with one large basal seta and seven to eight smaller setae near tip of femur. Hind femur with macrosetal formula 2+1+1. Hind-tibia row AV with ~13 preapical macrosetae.

Male basal abdominal sternal apodemes weakly developed (Fig. 28). Male pygofer short, with few rigid microsetae on each side of lobe, a mesoapical spine present near caudo-dorsal angle of the lobe, directed dorsad (Figs 26, 31, 32), ventral appendage present (Figs 26, 31, 32, 34), dorsal bridge short, weakly bilobed (Figs 27, 33). Subgeni-

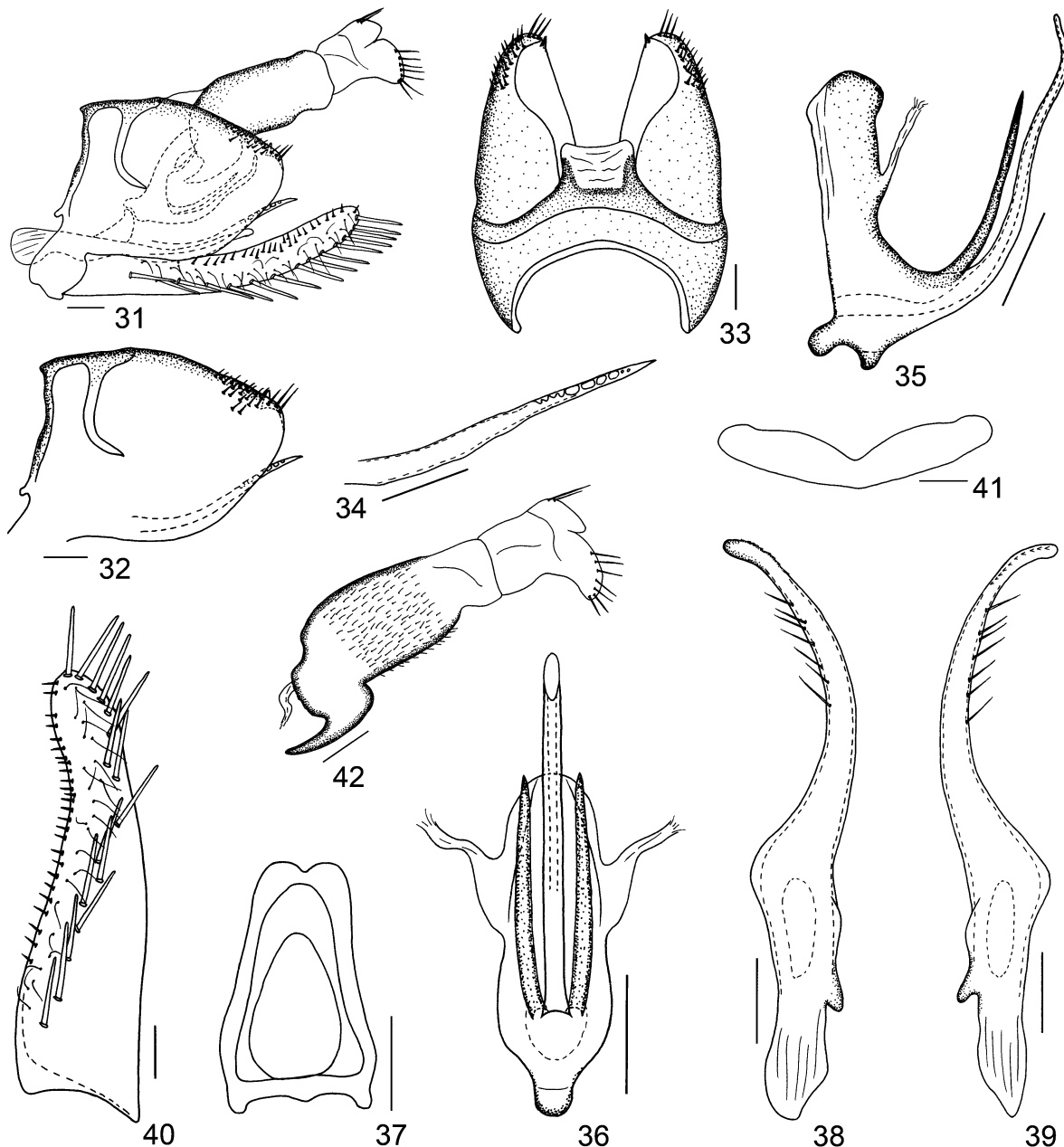


Figs 22–30. *Endogena flava* Xu, Dietrich & Qin sp. n. 22 – male adult, dorsal view; 23 – male adult, left lateral view; 24 – head and thorax, dorsal view; 25 – face; 26 – male genitalia, left lateral view; 27 – male genitalia, dorsal view; 28 – abdominal apodemes; 29 – forewing; 30 – hind wing. Scale bars = 0.5 mm.

tal plate far exceeding pygofer lobe, A-group setae absent, B-group setae rigid, almost continuous in apical 2/3 on dorsal margin, C-group bluntly terminated, arranged in irregular single row, reaching apex of plate (Figs 26, 27, 31, 40). Paramere robust, sinuate, base broadened, distal part evenly curved laterad, several fine setae present near apical half, dentifer adorned with small evenly spaced teeth (Figs 26, 31, 38, 39). Aedeagus shaft tubular, preatrium short, dorsoatrium well developed, gonopore apical on ventral surface (Figs 35, 36). Connective nearly trapezoidal (Fig. 37). Anal tube process developed, tapered apically (Figs 26, 31, 42).

Etymology. The generic name is derived from the Latin word “*endogenus*” (internal), referring to the small mesoapical spine near caudo-dorsal angle of the pygofer lobe. Gender: feminine.

Remarks. The new genus is superficially similar to *Inflatopina* Lu, Dietrich & Qin, 2017 (in Xu et al., 2017), *Alafrasca* Lu & Qin, 2014 and *Flaviata* Lu & Qin, 2014 (in Qin et al., 2014) in having the male anteclypeus strongly inflated and vein MP’ in the forewing arising from the r cell. However, the new genus differs from *Inflatopina* and *Alafrasca* in having the aedeagus with a well-developed dorsoatrium (Fig. 35) and the subgenital plate lacking A-group setae (Figs 31, 40). It differs from *Alafrasca* and *Flaviata* in having the C-group setae bluntly terminated



Figs 31–42. *Endogena flava* Xu, Dietrich & Qin sp. n. 31 – male genitalia, left lateral view; 32 – pygofer side and ventral pygofer appendage, left lateral view; 33 – pygofer, dorsal view; 34 – ventral pygofer appendage, left lateral view; 35 – aedeagus, left lateral view; 36 – aedeagus, ventral view; 37 – connective; 38, 39 – paramere; 40 – subgenital plate; 41 – sternite IX, dorsal view; 42 – anal tube, left lateral view. Scale bars = 0.1 mm.

(Fig. 40). It also differs from *Flaviata* in having a ventral pygofer appendage (Figs 26, 31, 32, 34), the paramere not curved and tapered apically (Figs 38, 39) and the branching point of CuA in the hind wing distad of the coalescence of CuA with MP” (Fig. 30). It differs from *Alafrasca* in having the preatrium of the aedeagus not trough-like (Figs 35, 36) and the paramere without prominent teeth apically (Figs 38, 39). It differs from *Inflatopina* in having the paramere not strongly arcuate apically (Figs 38, 39) and setal group C uniseriate near the base (Fig. 40). The new genus differs from all these other genera in having a mesal spine near the caudo-dorsal angle of the pygofer lobe (Figs 26, 31–33).

Distribution. China (Sichuan).

***Endogena flava* Xu, Dietrich & Qin sp. n.**

(Figs 22–42)

ZooBank taxon LSID:

9AC0D2EA-1BEC-43A7-881F-962F3DB3B6A7

Type materials. **Holotype.** ♂, China, Sichuan, Xichang City, Zhaojue Country, 6.vi.2015, coll. Ye Xu & Huanrong Luo (NWAUFU). **Paratype.** 5♂, 2♀, same data as holotype (NWAUFU).

Description. Body length: male 4.0–4.5 mm, female 4.1–4.2 mm.

General color of body yellow (Figs 22–25). Crown with three round spots, two situated submedially on each side of coronal suture and one medially at crown-face transition

(Figs 22, 24, 25). Ocelli surrounded with irregular creamy patches (Figs 24, 25). Eyes grey (Figs 22–25). Pronotum with irregular pale patches sub-laterally and a brownish median stripe anteriorly (Figs 22, 24). Mesonotum centrally with longitudinal creamy patch and semi-circular patch behind scutoscuteellar sulcus (Figs 22, 24). Forewing with brown stripe along inner margin, hind wing subhyaline (Figs 22, 23, 29, 30).

Basal sternal abdominal apodemes reaching end of segment III (Fig. 28). Male pygofer bearing 3–4 relatively long and 14–19 small rigid setae, near caudodorsal angle, margin infolded distally near caudodorsal spine (Figs 26, 31, 32); dorsal bridge occupying almost one-third length of lobe (Figs 27, 33); ventral pygofer appendage sinuate, slightly surpassing end of lobe, areolate near apex (Figs 31, 32, 34). Subgenital plate broad at base, narrowed apically, apical 1/4 slightly curved caudo-dorsad, B-group setae (23–26) in 1–2 rows, C-group setae (15–16) arising near base and reaching apex of plate, D-group setae (32–38) roughly arranged in 1–3 irregular rows (Figs 31, 40). Paramere rounded apically, with 9–10 tiny teeth and 7–8 fine setae in a single row (Figs 38, 39). Aedeagus with shaft broad at base, strongly narrowed and slightly sinuate apically; pair of slender, tapered processes arising near base of shaft and extended along shaft in both lateral and ventral views; preatrium short, dorsoatrium pillar-like, gonopore subapical on ventral side of shaft (Figs 35, 36). Connective nearly twice as long as wide, caudal margin notched medially (Fig. 37). Anal tube sclerotized, ventrobasal appendage evenly tapered apically, hooked anterad, almost reaching 1/3 height of pygofer (Figs 26, 31, 42). Ninth sternite obviously wider than long, with a pair of lateral lobes, caudal margin sunken in middle (Fig. 41).

Etymology. The specific epithet is derived from the Latin adjective “*flavus*” (yellow), which refers to the body color of the new species.

Distribution. China (Sichuan).

DISCUSSION

Although Empoascini is now widely accepted as a valid tribe of subfamily Typhlocybinae, its phylogenetic position has still not been adequately elucidated. The relationship between Empoascini and other tribes was first discussed by Mahmood & Ahmed (1968), who proposed splitting Typhlocybini (sensu Young 1952) into two tribes (Empoascini and Typhlocybini) but suggested that Empoascini is “closely related to Typhlocybini.” Later, Zhang (1990) suggested that Empoascini has a closer relationship with Dikraneurini based on the presence of a well-developed submarginal vein in the hind wing of both groups.

Like other typhlocybinae tribes, Empoascini has traditionally been characterized by the wing venation. Species of this tribe lack an appendix on the forewing, and have the hind wing submarginal vein present apically between the jugal lobe and MP' or RP+MP' but not extended around the wing apex along the costal margin. Other diagnostic traits include the presence of well developed ocelli, the

characteristically curved distal segment of forewing vein MP'+CuA', presence of a longitudinal row or band of numerous macrosetae on the male subgenital plate, and absence of a well-developed preapical lobe on the paramere. These latter four features are shared with Alebrini and are presumably symplesiomorphic. The presence of well-developed paired processes at the base of the anal tube is possibly a synapomorphy of the tribe, although it is present in a few genera in other tribes [e.g., *Aphanalebra* McAtee, 1926 (Alebrini), *Tautoneura* Anufriev, 1969 (Erythroneurini)]. The venation of the hind wing may also be synapomorphic, although a similar pattern was recently reported in two Oriental genera of Dikraneurini (Dietrich, 2013), providing additional support for Zhang's (1990) hypothesis of a relationship between Dikraneurini and Empoascini.

Three informal generic groups have been explicitly recognized within Empoascini. One of them is the *Alebroides* group characterized by a branched vein CuA in the hind wing and including 27 genera, widely distributed in the Oriental, Palaearctic, Afrotropical and Australian Regions but absent in the New World (Xu et al., 2017). The second is the *Ficiiana* group comprising seven genera (*Ficiiana* Ghauri, 1963; *Ishiharella* Dworakowska, 1970b; *Dialecticopteryx* Kirkaldy, 1907; *Mahmoodia* Dworakowska, 1970a; *Nimabanana* Dworakowska, 1994b; *Kotwaria* Dworakowska, 1984 and *Daluana* Ramakrishnan, 1982) defined by having hind wing vein CuA unbranched, the male subgenital plates fused, the ventral pygofer appendage lacking and three apical veins in the fore wing arising from cell m (Xu et al., 2015). Species in the *Ficiiana* group are confined to the Oriental, Palaearctic and Australian Regions. In addition to these two groups, our recent work suggests that a third genus group (the *Usharia* group) is also recognizable and includes another seven genera in the *Empoasca*-complex (hind wing CuA unbranched): *Baguoidea* Mahmood, 1967; *Dayus* Mahmood, 1967; *Goifa* Dworakowska, 1977; *Homa* Distant, 1908; *Ifugoa* Dworakowska & Pawar, 1974; *Treufalka* Qin & Zhang, 2008 and *Usharia* Dworakowska, 1977. Species in the *Usharia* group all have the connective fused with the aedeagus and are distributed in the Oriental and Australian Regions. Among the genus groups mentioned above, it seems reasonable to hypothesize that the *Ficiiana* and *Usharia* groups are monophyletic, given the unique features of their male genitalia. The *Alebroides* group lacks such features and its monophyly is therefore doubtful. The remaining genera of Empoascini, including the type genus *Empoasca* Walsh, have hind wing vein CuA unbranched, which is presumably a derived trait within the tribe, but it is doubtful that these genera form a monophyletic group because they are apparently united only by the absence of the diagnostic traits present in other generic groups. A formal phylogenetic analysis will be needed to elucidate the status and relationships of all groups currently recognized within Empoascini and the relationship of this tribe to other Typhlocybinae.

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