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Minucella, a new leafhopper genus from China (Hemiptera: Cicadellidae: Stegelytrinae)

CONG WEI[1, 2], YALIN ZHANG[1,3] & M. D. WEBB[2]

[1]*Key Laboratory of Plant Protection Resources and Pest Management of Ministry of Education, Entomological Museum, Northwest A & F University, Yangling, Shaanxi, 712100, P. R. China. E-mail: Yalinzh@nwsuaf.edu.cn*
[2]*Department of Entomology, The Natural History Museum, Cromwell Road, South Kensington, London SW7 5BD, UK*
[3]*Corresponding author*

Abstract

Minucella **gen. n.** and two species (*M. divaricata* **sp. n.** and *M. leucomaculata* (Li & Zhang) **comb. n.**) from southern China are described in the leafhopper subfamily Stegelytrinae. Difficulties in the delimitation of one of the included species, *M. leucomaculata* and its junior synonym *Placidus maculates* Li & Zhang, **syn. nov.**, are discussed, and the observed variation is considered to be intraspecific. 'Mud-puddling' is recorded for the new genus and discussed for the subfamily.

Key words: Homoptera, Auchenorrhyncha, morphology, intraspecific variation, mud-puddling

Introduction

Stegelytrinae Baker is a small leafhopper subfamily restricted to the Palaearctic and Oriental regions. Compared to many other subfamilies of Cicadellidae the included genera in this subfamily are remarkably diverse, and the Oriental genera were either only recently placed in the subfamily (being unassigned by Oman *et al* 1990), or described or revised more recently (see generic remarks below).

In the present paper a new genus, *Minucella* **gen. n.**, and two included species (*M. divaricata* **sp. n.** and *M. leucomaculata* (Li & Zhang) **comb. n.**) of Stegelytrinae are described from southern China. The considerable intraspecific variation encountered in the latter species is documented and an unusual behavior ('mud-puddling') is recorded for the new genus and discussed for the subfamily.

Depositories: Material examined is deposited in various institutions abbreviated in the text as follows:

BMNH	The Natural History Museum, London, UK
CAU	China Agriculture University, Beijing, China
IRSNB	Institute royal des Science naturelles de Belgique, Brussels, Belgium
IZAS	The Institute of Zoology, Chinese Academy of Sciences in Beijing, China
NKU	Nankai Univerity, Tianjin, China
NWAFU	The Entomological Museum, Northwest A & F University, Yangling, Shaanxi, China
TJNHM	Tianjin Natural History Museum, Tianjin, China
ZSU	Zhongshan University, Zhongshan, China

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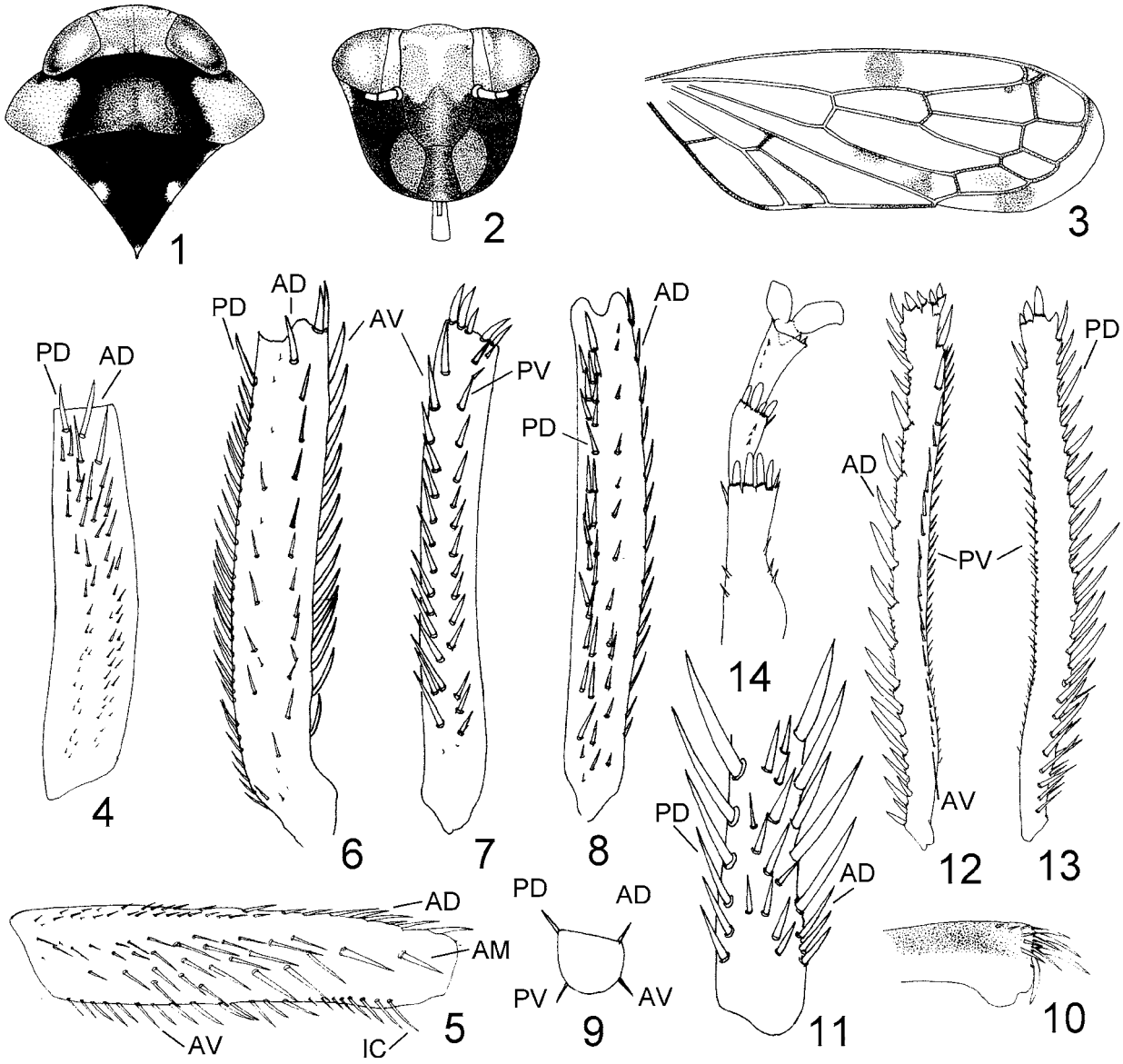
***Minucella* gen. n.**

Type Species: *Minucella divaricata* **sp. n.**

Etymology. The generic name *Minucella* is an arbitrary combination of letters. Gender is feminine.

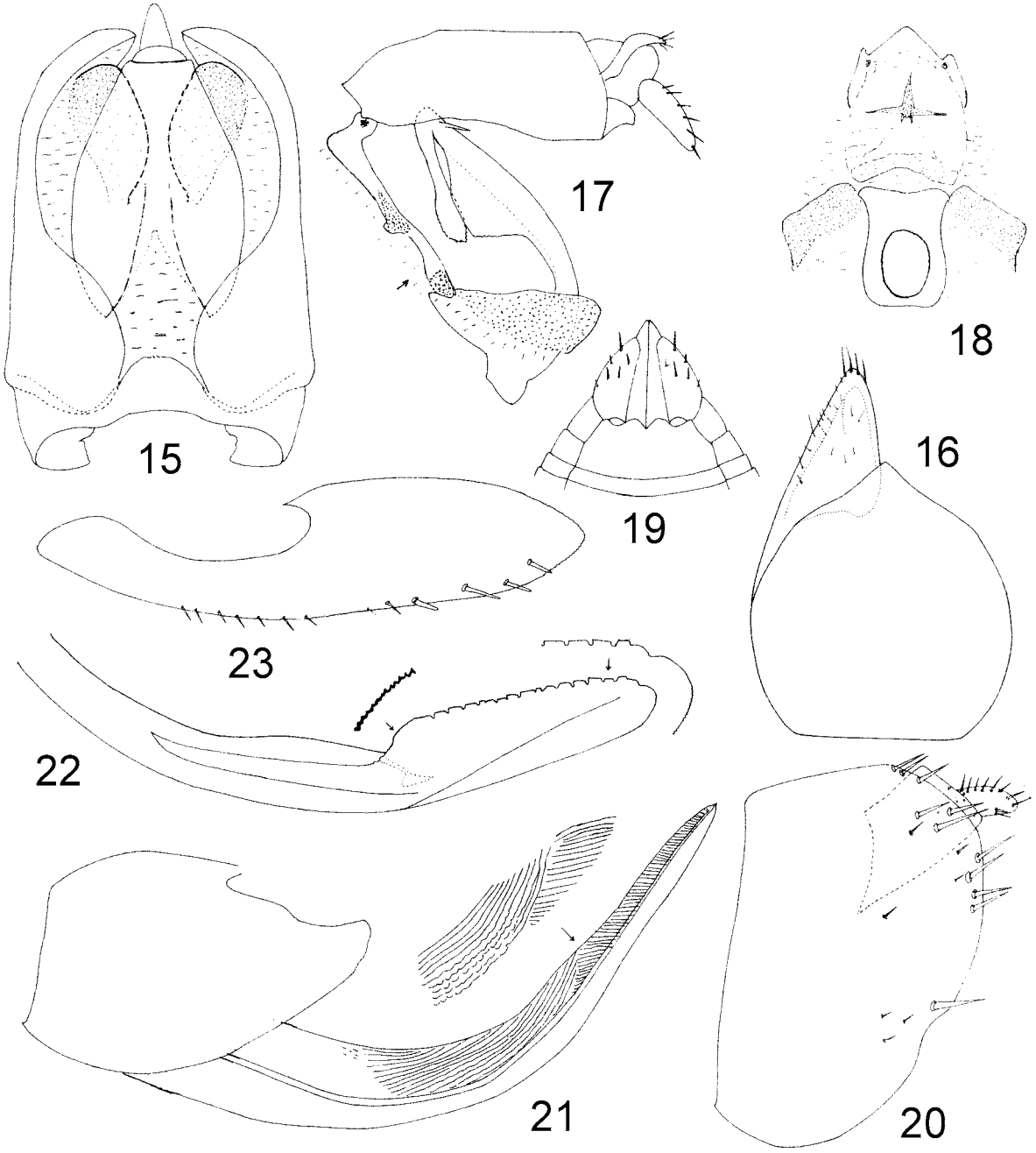
Diagnosis. This new genus is similar to other oriental stegelytrine genera, i.e. *Cyrta* Melichar 1902, *Paracyrta* Wei, Webb & Zhang 2008 and *Trunchinus* Zhang, Webb & Wei 2007, in having the laterofrontal sutures extending well onto the vertex with apices converging (Figs 1, 29). It differs from the above and other genera in the following characters: claval veins fused (Fig. 3), colour pattern consisting of symmetrical patches (Figs 2, 3), 5th apical cell of the fore wing very small (Fig. 3), inner processes of the male pygofer large and lobe-like, and aedeagus with paired apical processes or a dorsal process (Figs 17, 34).



FIGURES 1–14. *Minucella leucomaculata* 1, head and thorax, dorsal view; 2, face; 3, fore wing; 4, fore femur, dorsal view; 5, fore femur, anterior view; 6, fore tibia, anterodorsal surface; 7, fore tibia, ventral surface; 8, fore tibia, dorsal surface; 9, cross section of fore tibia; 10, apex of hind femur, lateral view; 11, base of hind tibia, ventral view.; 12, hind tibia, anterior surface; 13, hind tibia, dorsal surface; 14, hind tarsomeres and pretarsus, ventral surface.

Description. Body generally yellow-brown to black. Frontoclypeus with basal half generally pale yellow to dark brown; lower half black (Figs 2, 24, 30). Scutellum with a large white spot near lateral margin medi-

ally. Fore wing with a somewhat fuscous patch on appendix and another one adjacent to costal margin medially; 5th apical cell overlapped by a small fuscous patch (Figs 3, 31).



FIGURES 15–23. *Minucella leucomaculata* 15, male genital capsule and segment X, dorsal view; 16, valve and left subgenital plate, ventral view; 17, base of aedeagus, part of sclerotised inner process and dorsal connective, lateral view; 18, aedeagus, part of scerlerotised inner process and dorsal connective, in view of arrow in Fig. 17; 19. apex of female abdomen. 20, female genital capsule; 21, first valifer and first valvula; 22, second valvula. 23, third valvula.

Head small, distinctly narrower than pronotum, fore margin rounded; eyes encroaching onto pronotum laterally. Vertex slightly shorter than width between eyes, sloping to front; coronal suture distinct, nearly extended to fore margin. Face approximately as long as wide; ocelli on anterior margin of vertex, situated approximately 3X their own diameter from corresponding eye; lateral frontal suture extending well beyond lateral margin of corresponding ocellus; transclypeal suture distinct. Anteclypeus broadening apically, apical

margin slightly convex; gena flat; lora broad. Antenna slightly shorter than body length, arising adjacent to lower corner of eye; antennal ledge absent (Figs 1–2 and 29–30). Pronotum about 3X broader than median length; posterior margin slightly concave; lateral margin long with carina present, sharply curved to eye anteriorly. Scutellum slightly longer than pronotum; basal width subequal to width of head (Figs 1, 29). Fore wing with five apical cells; 5th apical cell very small; middle and outer subapical cells closed, inner subapical cell open; claval veins fused medially and a cross-vein present between inner claval vein and claval suture; appendix broad with margin rounded, extended to fourth apical cell; claval margin strongly elevated and crimped at apex (Figs 3, 31). Legs densely setose. Fore femur setae short to long: anterior surface with intercalary (IC) setae comb-like and anteromedial (AM) setae irregular; dorsal surface with anterodorsal (AD) and posterodorsal (PD) setae arranged into two rows on basal half and irregular on apical half (Figs 4, 5). Fore tibia with dorsal surface flattened, sloped (Fig. 9); setae of posterodorsal (PD), anterodorsal (AD), anteroventral (AV) and posteroventral (PV) setal rows of similar length, a row of setae (intercalary) between PD and AD rows (Figs 6, 8). Hind femur broadened distally and slightly bowed, with several distal setae elevated on strong bases and several short setae subbasally (Fig. 10). Hind tibia flattened and slightly bowed; several supernumeral setae present between anterodorsal and anteroventral rows (Fig. 11), with posterodorsal row setae very long; anterodorsal row with somewhat thin setae between very thick macrosetae (Figs 12, 13).

Male pygofer side longer than broad, strongly attached to lateral basal margin of valve thereafter with or without an excision, or excision indistinct; with macrosetae near posterodorsal margin and smaller setae near distal margin (Figs 15, 25, 32); posterior interconnecting membrane with relatively weakly developed sclerotised areas comprising star-shaped medial area (dorsal connective) between dorsal apodeme of aedeagus and 10th segment and a lobe-like lateral inner process between pygofer and basal apodeme of aedeagus (Figs 17, 18). Valve large, posterior margin angularly produced medially in ventral view (Figs 16, 33). Subgenital plate moderately long, subtriangular, with a few long fine setae distally (Figs 16, 33). Connective somewhat T-shaped; stem broad; arms short with weakly fused apical extensions (Figs 26, 35). Style with inner basal arm short, outer basal arm elongate; preapical lobe prominent with several setae adjacent apical process; apical process elongate, tapered to acute apex distally, crenulate ventrally (Figs 26, 35). Aedeagus flat and broad, with lateral margin irregularly dentate in dorsal view; curved anterodorsally in lateral view; with pair of dorsal and ventral processes apically (Figs 27, 28) or with well developed ventral process subbasally (Fig. 34); gonopore apical; basal apodeme moderately long (Figs. 28, 30). 10th segment large (Figs 17, 25, 32).

Female 7th sternite with posterior margin with a very distinct V-shaped incision medially and a rounded incision laterally. First valvifer very long, visible in undissected specimen (Fig. 19). Female pygofer with ventroposterior margin incurved (Fig. 20). First valvulae sculpture comprising striations and scale like rows, arranged longitudinally basally and oblique to transverse more distally (Fig. 21). Second valvulae with blade-like area extending over distal half, relatively broad in lateral view with teeth robust and truncate, dorsal sclerotised and hyaline areas absent (Fig. 22). Third valvulae with ventral margin slightly incurved at midlength, expanded distal region extending over distal one half (Fig. 23).

Distribution. China (Fujian, Yunnan, Zhejiang, Sichuan, Hainan and Shaanxi Prov.).

Key to species of *Minucella* gen. n.

- Aedeagus with well developed ventral process subbasally ..... *divaricata* **sp. n.**
- Aedeagus with pair of long dorsal processes and pair of ventral processes at apex..... ..... *leucomaculata* (Li & Zhang)

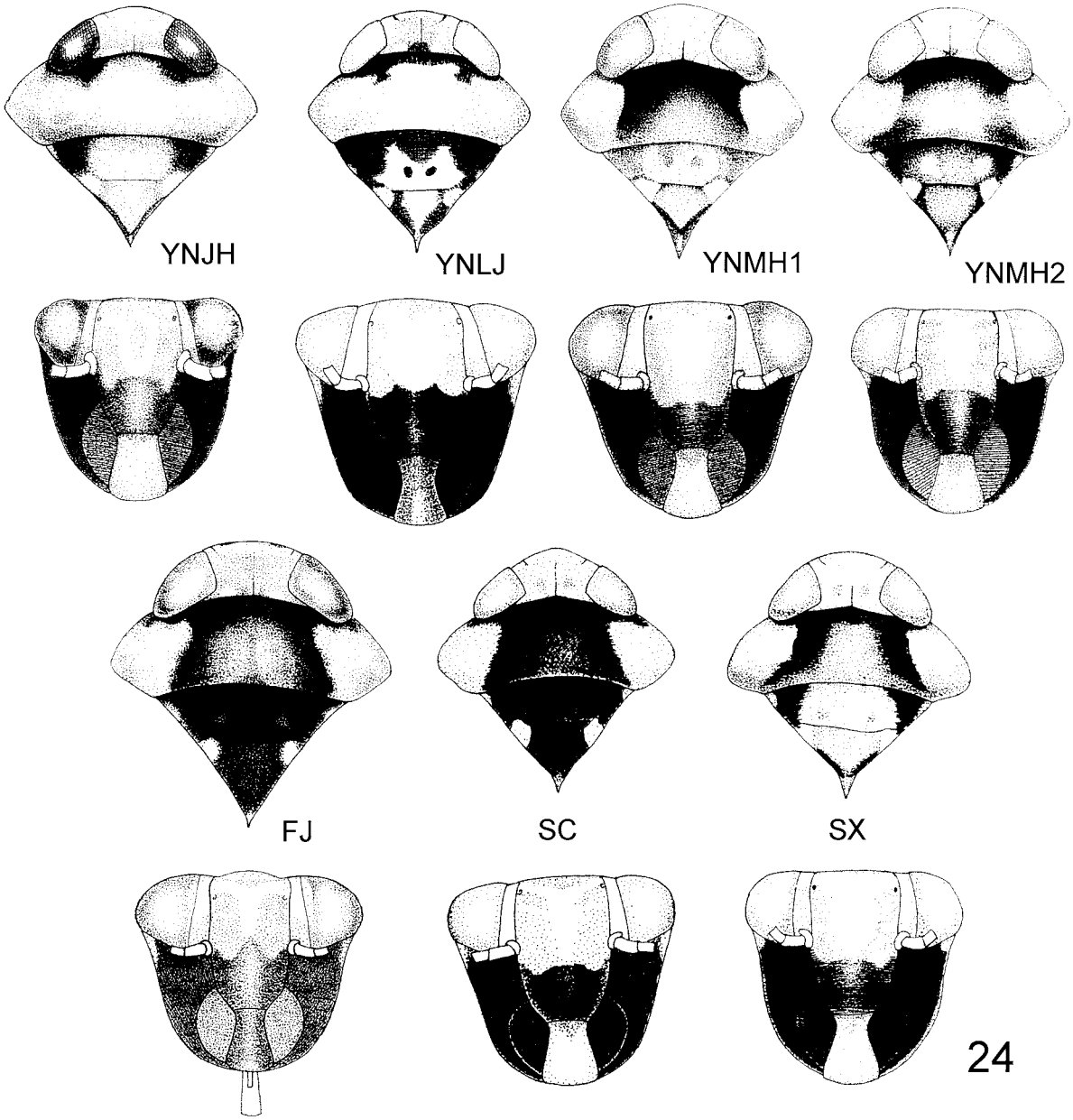


FIGURE 24. *Minucella leucomaculata* Colour pattern variations of face, head and thorax. YNJH (YUNNAN PROV.: Jing-Hong Co.); YNLJ (YUNNAN PROV.: Li-Jiang Co.); YNMH1(YUNNAN PROV.: Meng-Hai Co.; coll. Ji-Kun YANG); YNMH2 (YUNNAN PROV.: Meng-Hai Co.; coll. Huan-Guang ZOU); SC (SICHUAN PROV.: Omei Shan); FJ (Fujian PROV.); SX (SHAANXI PROV.: Zi-Yang Co.).

***Minucella leucomaculata* (Li & Zhang) comb. n.**
(Figs 1–28)

Placidus leucomaculatus Li & Zhang 2006: 156, Figs 10–17.
Placidus maculates Li & Zhang 2007: 149, Fig. 5 (in Li *et al* 2007), **syn. nov.**

Description. Body length (incl. fore wings), male: 5.3–6.8 mm; female: 5.6–6.9mm. Body generally yellow-brown, with variable black to dark brown markings on thorax (see Fig. 24). Fore wing with 5th apical cell very

small, sometimes indistinct when R_{1a} and R_{1b} almost fused; some specimens with crossvein between R and costal margin.

Aedeagal shaft broadly compressed dorsoventrally, with pair of dorsal processes and ventral processes apically (Figs 17, 27, 28).

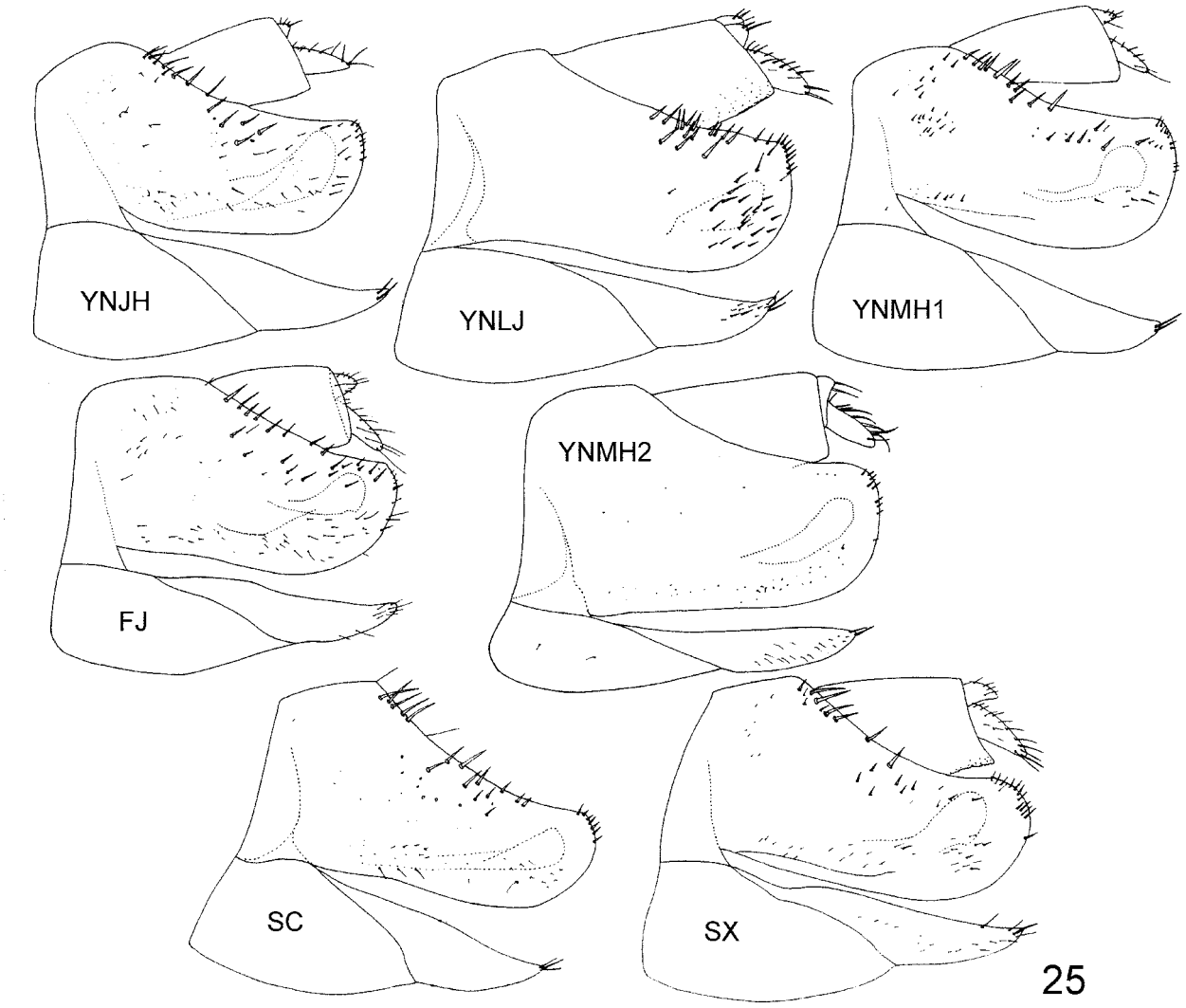


FIGURE 25. *Minucella leucomaculata* Variations of male pygofer, lateral view.

Material examined. P. R. CHINA, **Shaanxi Prov.**: 1♂ (NWAFU), Zi-Yang Co. (E108.55°, N32.56°), 11-VIII-1973, Jin-Sheng LU. **Sichuan Prov.**: 1♂ (ZSU), Omei Shan: Shin-Kai-Zao (E103.29°, N29.36°), 1500m, 15-VIII-1940, L. Gressitt. **Fujian Prov.**, De-Hua Co. (E118.24°, N25.5°): 1♂ (CAU), 13/VI/1974, Ji-Kun YANG; 1♂ (CAU), 11/VI/1974, Ji-Kun YANG; 1 ♀ (IZAS), Chong-An Co. (E118.02°, N27.76°), 720~800m, 10-VIII-1960, Shen-Qiao JIANG; 1 ♀ (IZAS), Jian-Yang Co. (E118.07°, N27.21°), 300~320m, 29-III-1960, Fu-Ji PU. **Yunnan Prov.**: 1♂ (IZAS), Jing-Hong Co. (E100.48°, N22.01°), Xiao-Meng-Yang, 26-III-1957, Ling-Chao ZANG; 1♂ (CAU), Meng-Hai Co. (E100.5°, N21.95°), 1160m, 18-IV-1981, Ji-Kun YANG; 1♂, 1♀ (NKU), Meng-Hai Co., 6-X-1979, Huan-Guang ZOU; 1♀ (IZAS), 1200m, 28-V-1958, Xu-Wu MENG; 1♀ (IZAS), Meng-Hai Co., 1200~1400m, 2-V-1958, Xu-Wu MENG; 1♂ (IZAS), Meng-Lian Co. (E99.55°, N22.32°), 1050~1080m, 17-X-1958, Zhi-Zi CHEN; 1♀ (CAU), Si-Mao Co. (E101.00°, N22.79°), 1320m, 7-IV-1981, Ji-Kun YANG; 1♀ (CAU), Long-Chuan Co. (E97.96°, N24.33°), 1430m, 28-IV-1981, Ji-Kun YANG; 2♂♂ (IRSNB), Jing-Hong Co. (E100.48°, N22.01°), Mengyang, 05, 11-III-1999, River Bed, P. Groo-

taert;1♂ (TJNHM), Li-Jiang Co. (E116.26°, N29.42°), 5-VIII-1979, Sheng-Li LIU; 1♀ (TJNHM), Li-Jiang Co., 5-VIII-1979, Sheng-Li LIU; 1♀ (NKU), Li-Jiang Co., Xiang Shan, 2-VIII-1979, Huan-Guang ZOU; 1♀ (NKU), Li-Jiang Co., Xiang-Shan, 5-VIII-1979, Huan-Guang ZOU.

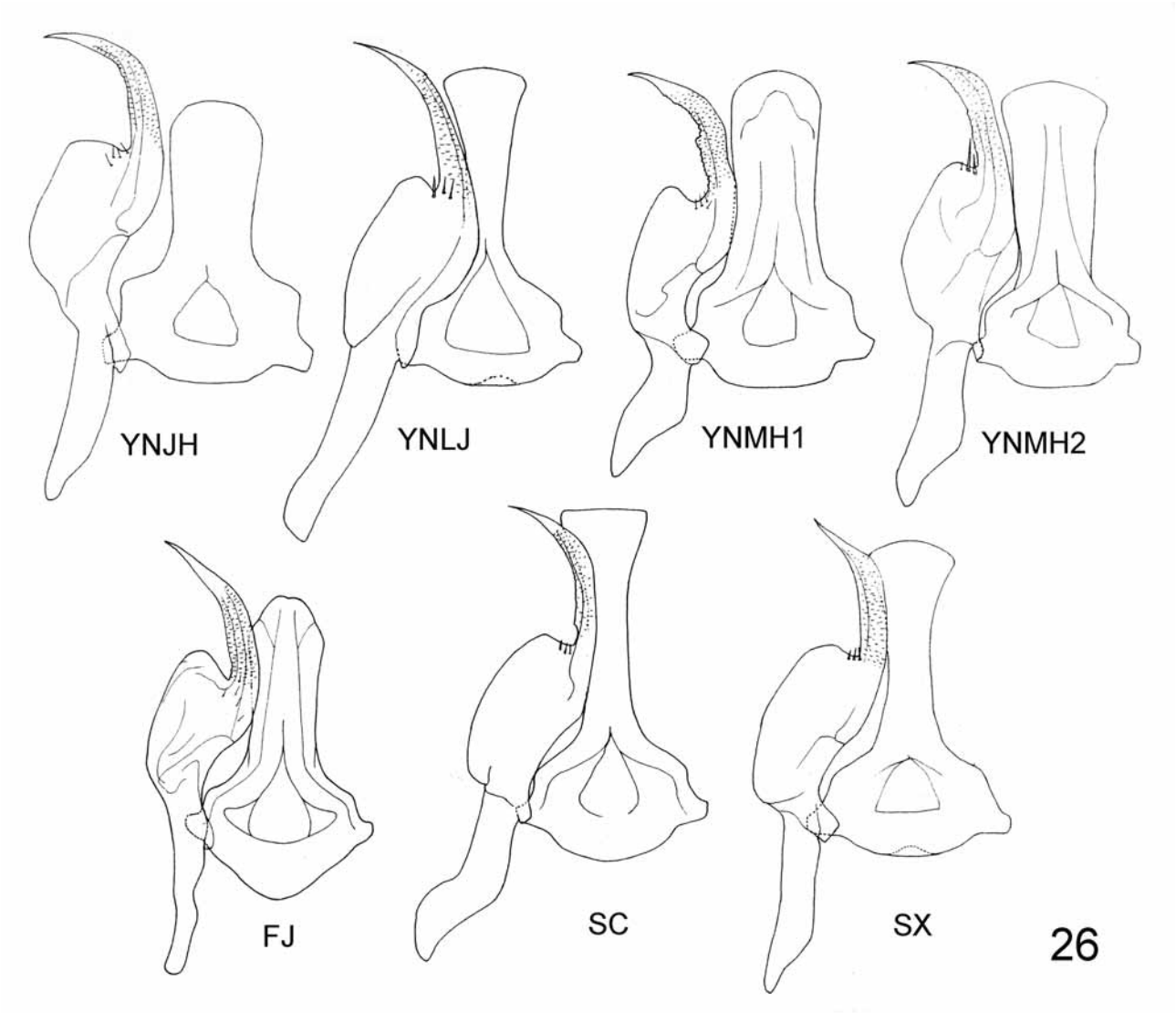
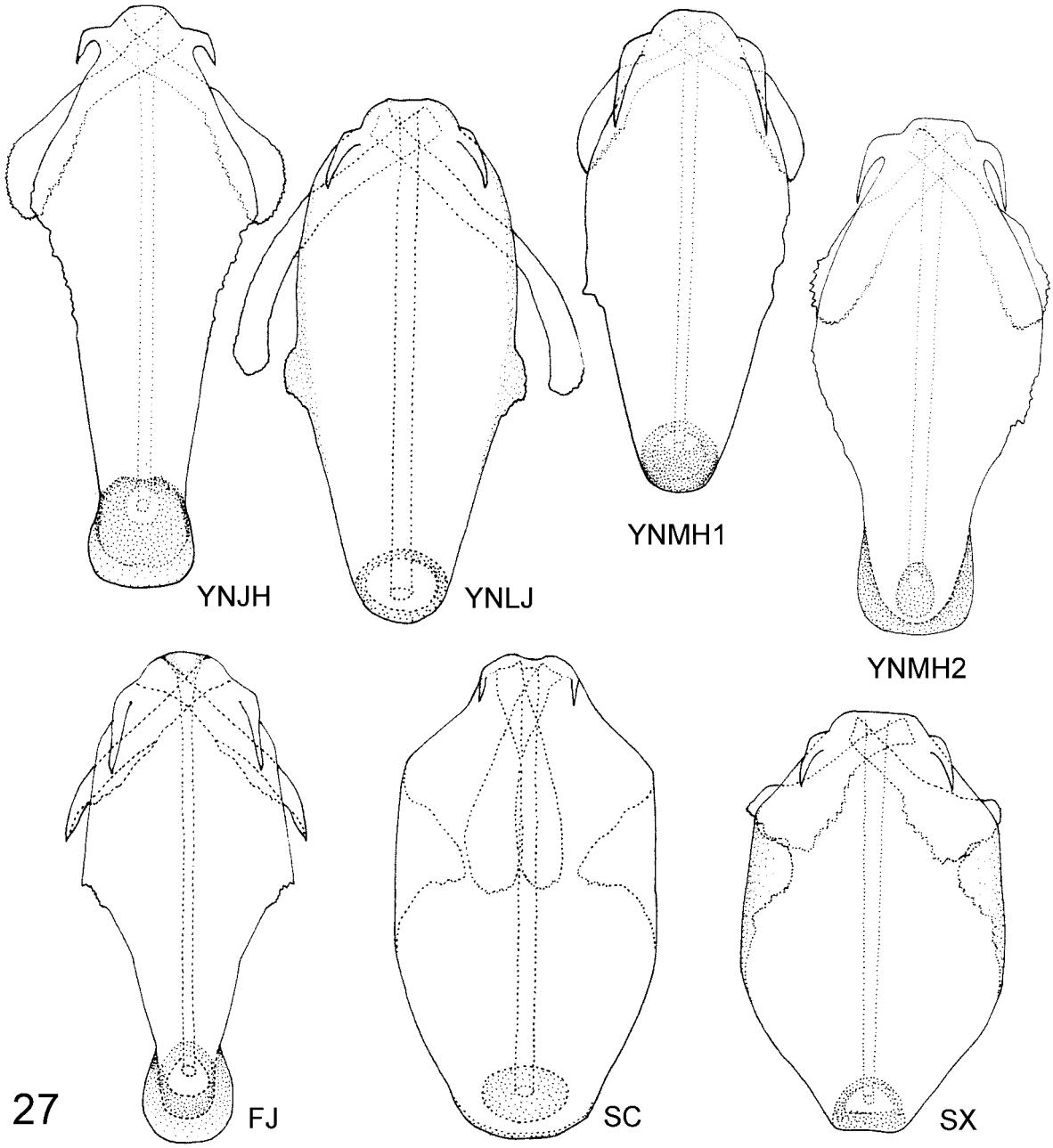


Fig. 26. *Minucella leucomaculata* Variations of styles and connectives, dorsal view.

Remarks. This species was previously misplaced in *Placidus* Distant (= *Cyrta* Melichar) (see Wei *et al*, 2008) by Li & Zhang (2006). In the present paper we place it in *Minucella* based on its similarity to the type species of *Minucella* (*M. divaricata* **sp. n.**) described below. We tentatively identify the above listed examined material as *leucomaculata* despite the considerable variation in male genitalia and discrepancies between the specimens examined and the original descriptions of *Placidus leucomaculata* and its new junior synonym *P. maculates.* These differences include the length of the aedeagal processes, which are longer in the original figures of *leucomaculata* than in our specimens, and the fact that the processes are bifurcate in the original figures, but are separate processes in our specimens. However, the latter difference may be due to incorrect interpretation by Li & Zhang (2006), resulting from the dissected genitalia being drawn from a slide, as is the usual practice of these authors. This would also explain why the shaft appears twisted in their figure of the posterior view of the aedeagus. In addition, the body length of the holotype was given as 8.5mm, which may be incorrect based on the shorter length of the specimens in our sample.



FIGURES 27. *Minucella leucomaculata* Variations of aedeagus, dorsal view.

In the following account the material examined and illustrated from various localities and collectors is abbreviated in the text, figures and figure legends as follows: **Yunnan Prov.**: Jing-Hong Co. (YNJH); Li-Jiang Co. (YNLJ); Meng-Hai Co., coll. Ji-Kun YANG (YNMH1); Meng-Hai Co., coll. Huan-Guang ZOU (YNMH2); **Sichuan Prov.**: Omei Shan (SC); **Fujian Prov.**: De-Hua Co. (FJ); Shaanxi Prov.: Zi-Yang Co. (SX).

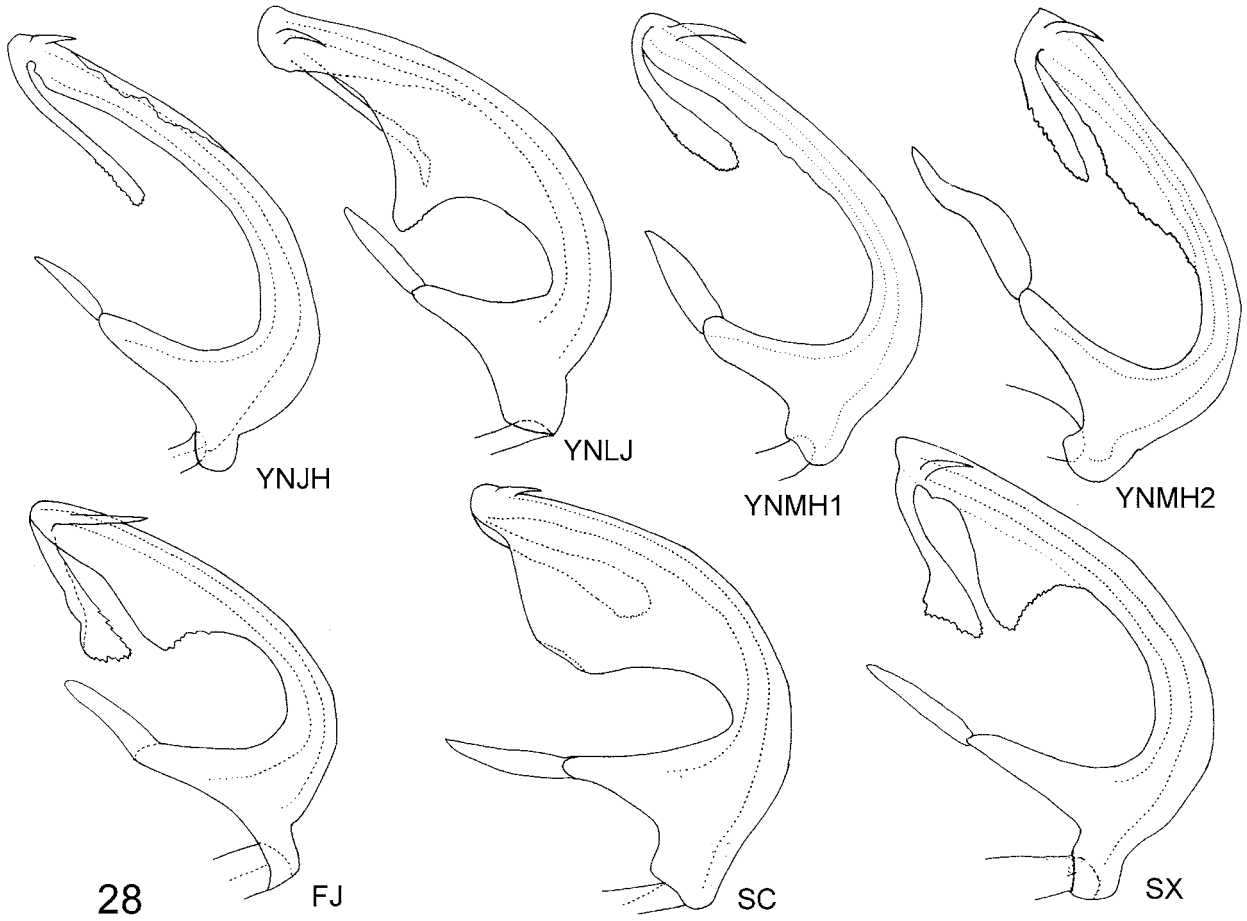


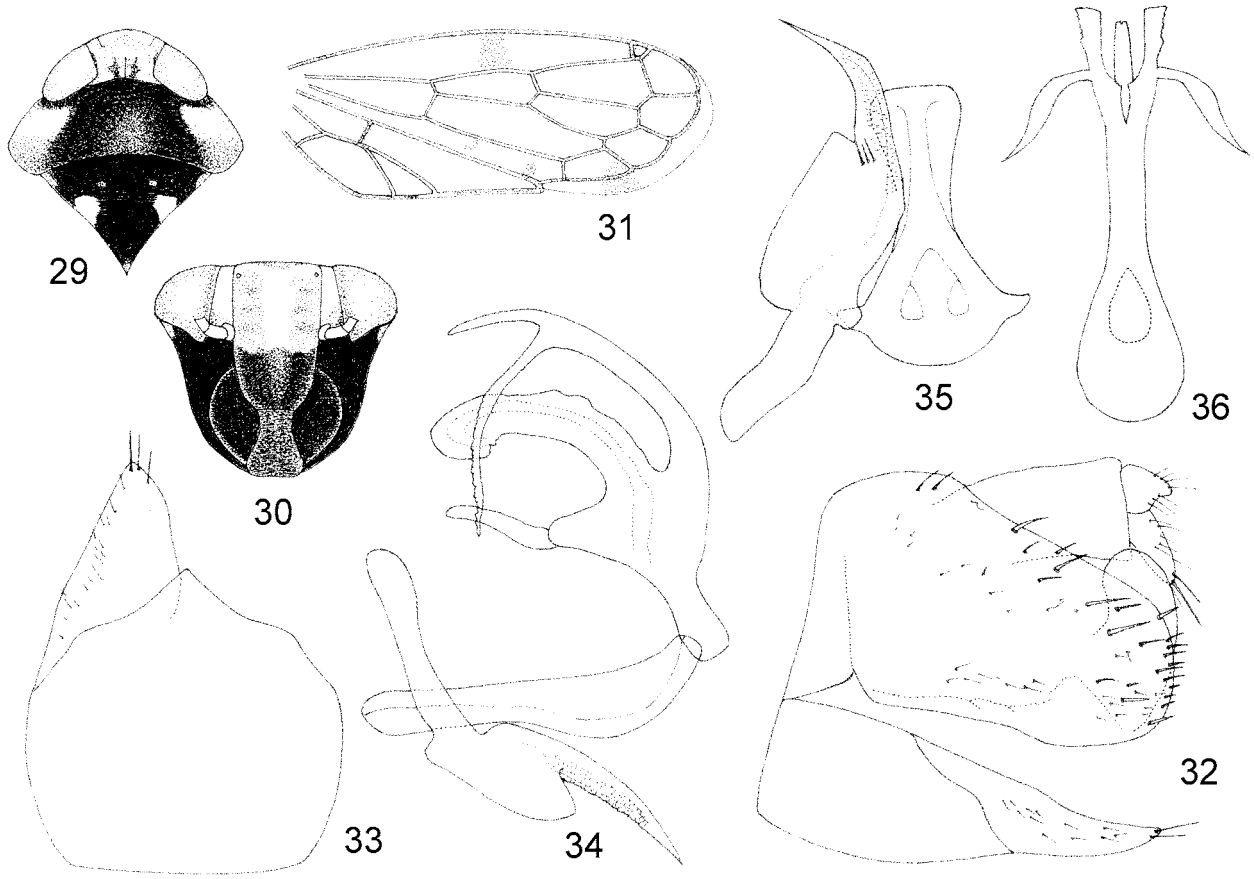
FIGURE 28. *Minucella leucomaculata* Variations of aedeagus, lateral view.

The following differences are found in the specimens from the above localities: ventral margin of male pygofer side with excision very weak or absent (YNLJ, YNMH2 and SC); basal margin of connective strongly convex (FJ); aedeagal shaft weakly developed lateroventrally (relatively southern YNJH, YNMH1, YNMH2 and FJ excepting YNLJ); aedeagal shaft strongly developed laterally and lateral lobe-like expansion partially concealed in dorsal view (YNLJ and relatively northern SC and SX). As all these genital characteristics show a gradual change from different localities and overlap to a certain extent. We concludetherefore, that they represent variation within the same species (see also discussion below).

***Minucella divaricata* sp. n.**
(Figs 29–36)

Description. **Male**. Body length (incl. fore wing) 5.5–5.8 mm. body yellow-brown with pale yellow or white spots on head and thorax as in Figs 29–31. Scutellum with or without pair of small yellow-brown spots before transverse depression.

Male pygofer side with blunt excision on ventral margin basally, with long inner ridge near ventral margin and a very broad apical lobe-like process extending well beyond posterodorsal margin (Fig. 32). Aedeagal shaft robust, cylindrical, with posterior margin sinuate in lateral view; with well-developed ventral process subbasally, bifurcate with each branch divided into short apical truncate process and elongate secondary process, the latter with dorsal margin serrate in lateral view (Figs 34, 36).



FIGURES 29–36. *Minucella divaricata* **sp. n.** 29, head and thorax, dorsal view; 30, face. 31, fore wing. 32, male genital capsule and segment X, lateral view; 33, valve and subgenital plate, ventral view; 34, style, connective and aedeagus, lateral view; 35, connective and style, dorsal view; 36, aedeagus, dorsal view.

Female. Unknown.

Type material. **HOLOTYPE**: ♂ (CAU), P. R. CHINA, Zhejiang Prov.: Hang-Zhou (E120.10°, N30.16°), Ling-yin, 13-X-1974, Ji-Kun YANG. PARATYPES: 2♂♂ (CAU, BMNH), same data as holotype.

Etymology. Named for the bifurcate dorsal process of the aedeagus.

Remarks. This new species can be easily distinguished from *M. leucomaculata* by its unique shaped aedeagus.

Discussion

Male genitalia variation. The lock-and-key hypothesis predicts that species differ in their genitalia so that no structural overlap is present, because genitalia form a mechanical isolation system between species or a backup system when the primary isolation mechanism fails (Eberhard, 1985; Mikkola, 1992). Although presently this hypothesis is not favored by evolutionary biologists, morphology-based taxonomy is still largely based on this idea and on the assumption that genitalia show only minor intraspecific variation (Mutanen, 2006). In practice most taxonomists follow a rather typological concept of species, consciously or unconsciously, and apply the principles of the lock-and-key hypothesis, so genital characteristics are often considered superior to many other features, and often useful in taxonomy, particularly in species delimitation. Although intraspecific genital variation is familiar to most taxonomists, many pay little attention to it; and

probably such variation is greater than the literature suggests. The same situation certainly exists in leafhopper taxonomy although in some cases this is due to limited material.

This study shows that male genital variation in *M. leucomaculata* is quite extensive and overlaps between populations. Efforts to associate colour pattern or distribution with genitalic variation failed to divide the populations in any meaningful way. For this reason, we conclude that in this case the variation observed relates to a single species, but this conclusion needs to be validated because *M. leucomaculata* might be a complex of closely related cryptic species if host plant data or more materials are available in the future.

If our conclusion is correct, then it shows that leafhopper genital characteristics can vary considerably, and presuming otherwise may lead to unsound taxonomic conclusions, particularly if these conclusions are reached based on a relatively small sample.

Mud-puddling behavior. Previous host plant information for Stegelytrinae includes: *Stegelytra* and *Wadkufia* on oaks (*Quercus*, Fagaceae); *Placidus* on *Fagus* (Fagaceae), and *Pachymetopius decoratus* Matsumura on *Litsea acuminata* (Lauraceae) and shoots of bamboo (Poaceae) (Wei *et al*, 2006a). Unlike these taxa, the biology and host plants of *Minucella* species are unknown, but two male specimens of *M. leucomaculata* comb. n. described here, together with some other males of stegelytrine species, *Stenolora abbreviata* Zhang *et al* (2006) and *Daochia bicornis* Wei *et al* (2006a), were collected on exposed river banks. This habitat, connected to mineral uptake during feeding ('mud-puddling'), is well known in male Lepidoptera (Boggs & Dau, 2004) but less well known in Cicadellidae. In the later group, some less common cicadellid groups, like Stegelytrinae, are involved, e.g., Arrugadinae, Phereurhinini, Nioniinae and Neobalinae (see review by Rakitov *et al*, 2005). Previous observations showed that the leafhopper aggregations at moist ground happen sporadically, apparently being correlated with weather and consist almost exclusively of males (Rakitov *et al*, 2005). But unlike Lepidoptera, leafhoppers are apparently attracted to chemicals different from those found in the sweat, urine, excrement, or carrion to which Lepidoptera are attracted (Adler, 1982). However, the chemicals may play role in enhancing reproductive success of the males (as in Lepidoptera) via nuptial gifts from spermatophores containing male-derived chemicals that are incorporated into the developing eggs (Hayashi & Kamimura, 2002). This probably explains why a greater number of males have been collected in damp locations, with some species known only from males. This information should be valuable for the collection and study of Stegelytrinae in the future.

Acknowledgments

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