



## A taxonomic review of the Old World leafhopper genus *Changwhania* Kwon (Hemiptera: Cicadellidae: Deltocephalinae: Paralimnini)

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### Abstract

The Old World leafhopper genus *Changwhania* Kwon is reviewed and three of its four species are illustrated and male genital characters are provided. One new species from China, *Changwhania digitata* Zhang and Duan, is described. A key to species is also provided.

**Key words:** Homoptera, Auchenorrhyncha, grassland, morphology, identification, new species, China

### Introduction

The Old World grassland leafhopper genus *Changwhania* Kwon (Deltocephalinae: Paralimnini) was established by Kwon (1980) for two species from Korea, *C. terauchi* (Matsumura, 1915), the type species, and *C. changwhani* Kwon, 1980. Later, Webb & Heller (1990) transferred *C. ceylonensis* (Baker, 1925) and *C. distant* (Baker, 1925) to the genus from *Deltocephalus* and at the same time placed *C. changwhani* Kwon and *Cicadula bipunctatus* Singh-Pruthi, 1930 in synonymy with *C. ceylonensis* (Baker, 1925).

In this paper, the species of *Changwhania* are reviewed with description of a new species from China. All species of the genus are listed and a key to males is provided for the three species for which males are known. Due to the difficulty of identifying females, i.e. on external features (see Remarks under *C. ceylonensis*), the species *C. distant* (a replacement name for *Deltocephalus capitatus* Distant), known only from its female syntype (in the Natural History Museum), is regarded as a species of uncertain identity and is not dealt with further. Its locality (India) and more rounded head spots (similar to Fig. 1A) suggests that it could be a synonym of one of the two widespread species, *C. terauchi* (but see discussion on variability under *C. ceylonensis*). An externally similar genus and species to *C. terauchi*, *Mayawa capitatus* (Kirkaldy), is found in Australia (see Fletcher, 2000), where *Changwhania* has yet to be recorded.

Type specimens and other materials examined are deposited in Entomological Museum of Northwest A & F University (NWAUFU), The Natural History Museum, London, UK (BMNH) and The Bernice P. Bishop Museum, Honolulu, Hawaii (BPBM). Morphological terminology follows Oman (1949), Kuoh (1966) and Zhang (1990).

### *Changwhania* Kwon

*Changwhania* Kwon, 1980: 96–97; Webb & Heller, 1990: 452. Type species: *Aconura terauchi* Matsumura, 1915.

Yellow to sordid yellow. Head with spot or line adjacent to eye on vertex and another spot below each antenna on face.

Head wider than pronotum, vertex in mid-line about as long as or slightly longer than width between eyes and as long as or slightly shorter than pronotum, flat or slightly convex, transition to face somewhat acutely rounded in profile. Distance between ocelli and eyes approximately equal to diameter of ocellus. Frontoclypeus distinctly longer than wide. Anteclypeus slightly narrowed distally, with rounded lower margin. Rostrum shorter than anteclypeus, reaching end of fore coxae. Pronotum about twice as wide as long, its lateral side very short. Tegmina elongate, macropterous, with two anteapical cells, inner anteapical cell closed basally. Hind wings with three apical cells. Profemur with approximately 8 setae in row AV, with more anterior seta thicker; protibia dorsal setal formula: 1+4; hind femur apical setal formula: 2+2+1.

Male genitalia. Pygofer elongate, oblique anteriorly, exceeding subgenital plates, bearing numerous long macrosetae scattered over posterior half, and armed with pair of long spine-like sharp processes on inner sides of ventral margins, directed caudad. Anal tube with well developed pair of appendages on anterior ventral side, their apical margins serrate. Subgenital plate triangular with rounded to truncate apex and undulated lateral margin; with uniseriate row of macrosetae laterally. Aedeagus sharply curved at base; basal apodeme narrow; shaft very elongate, slightly twisted at midlength, asymmetrical; with pair of apical or subapical processes; gonopore subapical on ventral surface. Connective with arms convergent apically, stem very short.

Female seventh sternum more or less produced mesally on posterior margin. First valvula ramus not strongly curved, dorsal sculpturing maculose to granulose and reaching dorsal margin. Second valvula with very small obliquely triangular dorsal teeth on apical 1/2.

**Distribution.** Palaearctic region, Asia and Austro-Oriental region.

**Remarks.** This genus belongs in Paralimnini based on the arms of the connective converging apically (see Fig. 2E). The most reliable features for identifying species in this genus are the shape of the style apical process and the shape and position of the aedeagal processes. Although there is a slight difference between the two widespread species (*terauchii* and *ceylonensis*) in the shape of the head spots this may not always be reliable (see key and Remarks under these species).

### Checklist of the species of *Changwhania*

*C. ceylonensis* (Baker, 1925: 537). Replacement name for *Deltocephalus bimaculatus* Melichar.

*Deltocephalus bimaculatus* Melichar 1903: 204. Preoccupied.

*Cicadula bipunctatus*, Singh-Pruthi, 1930: 59.

*Changwhania changwhani* Kwon, 1980: 99.

*C. digitata* **n. sp.**

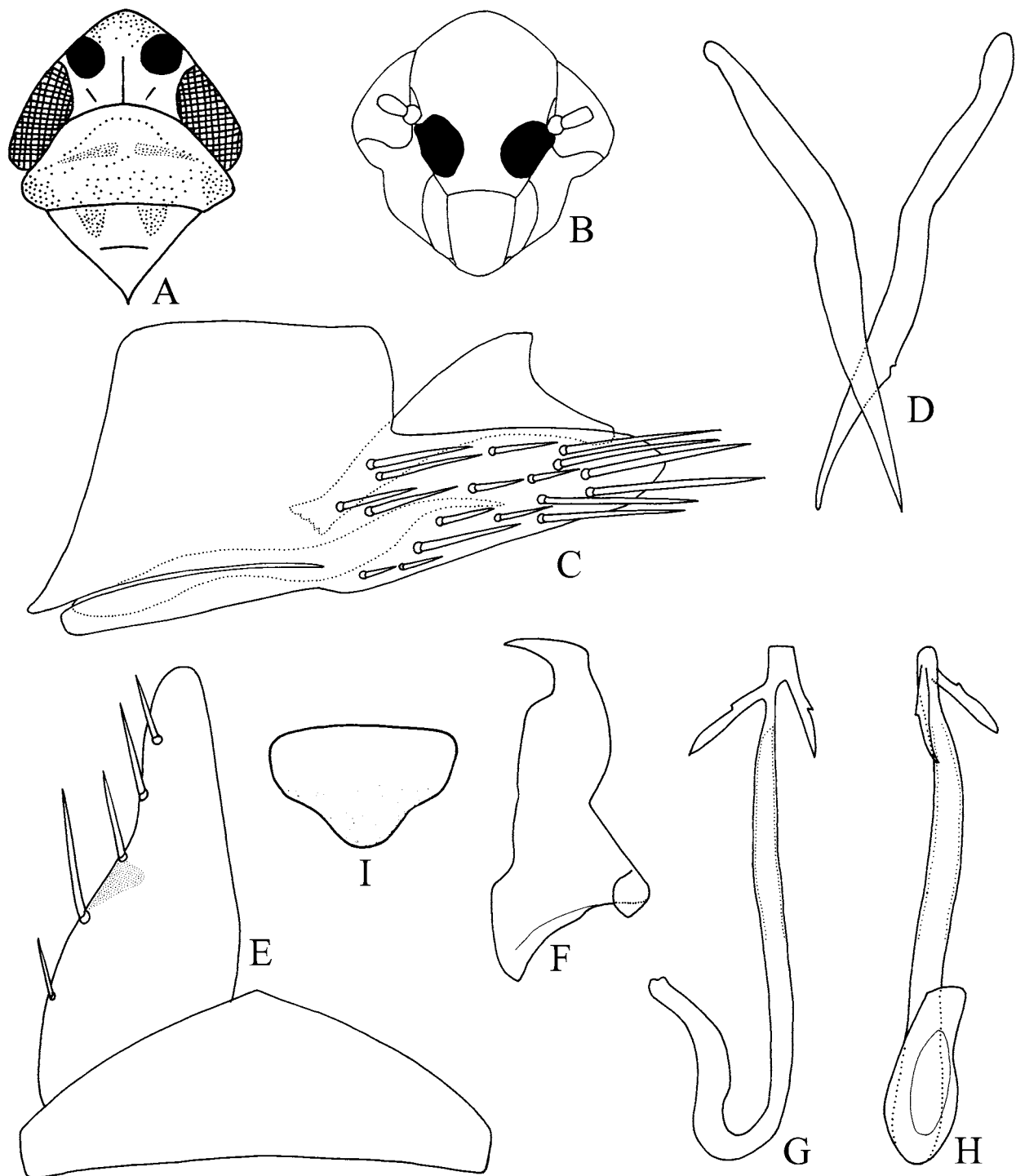
*C. distanti* (Baker, 1925: 537, *Deltocephalus*). Replacement name for *Deltocephalus capitatus* Distant.

*Deltocephalus capitatus* Distant, 1918. Preoccupied.

*C. terauchii* (Matsumura, 1915: 163).

### Key to species (males)

1. Vertex with two round black markings near coronal margin (Figs 1A, 9A, 9F). Aedeagus with truncate apex and two processes arising subapically (Figs 1G, 2F, 2G) ..... *Changwhania terauchii*
- Vertex with two oval or transverse black markings near coronal margin (Figs 9B–E, 9G, 4A). Aedeagus with rounded apex with one or both processes arising apically (Figs 3D, 4I–N, 5F, 6F, 7E)..... 2
2. Style apical process foot-like with a variable heel (Figs 3C, 4E–H) and sometimes with a small to large triangular distal extension(Figs 5D, 5E, 6E) ..... *Changwhania ceylonensis*
- Style apical process with digitate distal extension (Fig. 7D)..... *Changwhania digitata* **n. sp.**



**FIGURE 1.** *Changwhania terauchii* (Matsumura), A and B from Kwon (1980). A: head and thorax; B, face; C, male pygofer and Xth segment, lateral view; D: pygofer processes, ventral view; E: valve and subgenital plate, ventral view; F: style, dorsal view; G, H: aedeagus, lateral and dorsal view respectively; I: female 7<sup>th</sup> sternite.

***Changwhania terauchii* (Matsumura)**

(Figs 1–2, 9A, 9F)

*Aconura terauchii* Matsumura, 1915: 163, Table 1, fig. 8; Matsumura, 1931: 1250; Esaki & Ito, 1954: 175.

*Changwhania terauchii*, Kwon, 1980: 97–99, figs 1 (1–3), 2 (1–8); Webb & Heller, 1990: 452; Cai, Sun & Jiang 2001: 93.

Length (including tegmen), male 3.0–3.3mm; female: 3.3–3.5mm.

General coloration pale yellowish orange to sordid yellow. Vertex pale yellowish orange, with two round black markings near coronal margin. Face yellowish orange to yellowish brown. Frontoclypeus with two black markings on each side just below antennal sockets. Pronotum sometimes with transverse brown marking medially. Tegmina pale yellowish, with slightly visible brownish tinge on inner margins. Female pregenital sternite with posterior medial lobe usually with black margin.

Male genitalia. Styles apically hooked. Aedeagal shaft with truncate apex, with one pair of similar length subapical process, each armed with a tooth near midlength.

Female seventh sternum produced lobe-like medially on posterior margin.

**Material examined.** INDIA, Taplejung District: 4 ♂♂, North of Sangu c. 5000', 5.i.1962, dry grass above river bank; 4 ♀♀, Dobban, c. 3,500' 21.27.i.1962, shady places on shrubby slope above River Tamur. NEPAL: 3 ♂♂, 1 ♀, Jiri, 2000m, 17.vi and 9.viii.64. CHINA: **Jiangxi Prov.**, 2 ♀♀, Mt. Jinggang, 650.670m, 2004.viii.03, coll. Wei Cong & Yang Meixia; **Zhejiang Prov.**, Wuyanling, coll. Dun Yani, 1 ♂, 6 ♀♀, 800m, 2006.vii.29, at light, 2 ♂♂, 2 ♀♀, 670m, 2006.vii.02, 1 ♂, 1 ♀, 670m, 2006.viii.02, at light. THAILAND: 10 ♂♂, 1 ♀, no further data. MALAYSIA: 1 ♂, Eenting, vii.1981; 1 ♂, Selangor, 23.ix.1963. INDONESIA: Java, 4 ♂♂, 9 ♀♀, Purwokerto, 18.iii.1981. All in BMNH except specimens from China (NWAFU).

**Distribution.** Korea, Japan, China, India, Thailand, Malaysia, Java.

**Remarks.** The identity of this species is taken from Kwon 1980 who described and figured specimens from Korea, the type locality. Kwon stated that the species could be distinguished by the larger head spots and different male genitalia, i.e. the truncate aedeagal apex with processes subapical. Kwon presumably arrived at his identification of *terauchii* based on Matsumura's description that included a figure of the female holotype showing round head spots. All specimens examined have the vertex spots more rounded than in most *ceylonensis* and facial spots larger (but see Remarks under *ceylonensis*). Both these species have similar distributions and are sympatric in Nepal (Jiri) and possibly other areas as well.

### ***Changwhania ceylonensis* (Baker, 1925)**

(Figs 3–6, 9B–D, 9G, 9H)

*Deltocephalus bimaculatus* Melichar, 1903: 204, Sri Lanka; Kuoh, 1966: 128, China.

*Deltocephalus ceylonensis* Baker, 1925: 537. Replacement name for *Deltocephalus bimaculatus* Melichar.

*Cicadula bipunctatus*, Singh-Pruthi, 1930: 59, plate V, fig. 3. India. Synonymised by Webb & Heller, 1990: 8.

*Changwhania changwhani* Kwon, 1980: 99, figs 1.8. Korea. Synonymised by Webb & Heller, 1990: 8.

*Changwhania ceylonensis* Baker, Webb & Heller, 1990: 452.

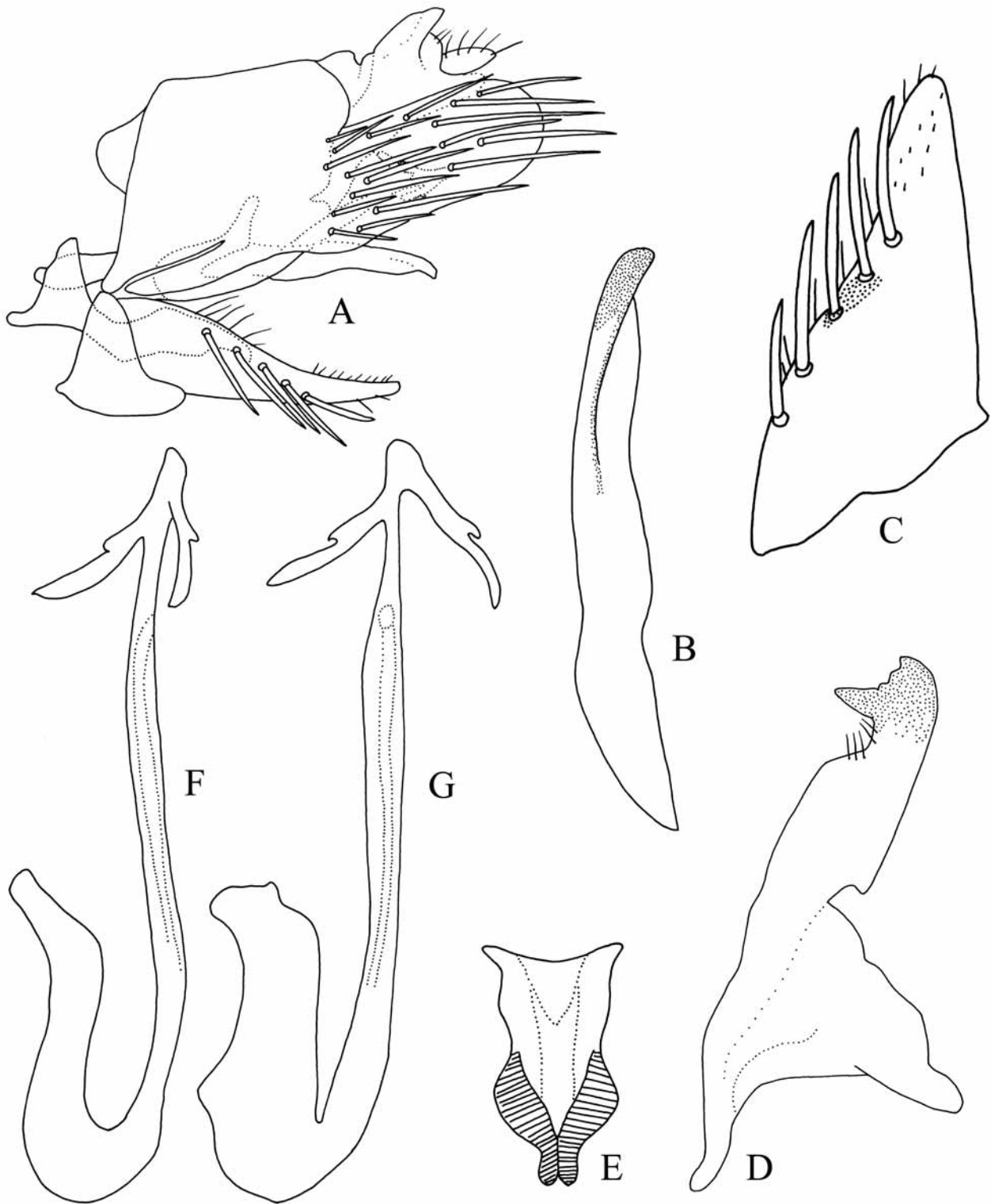
Length (including tegmen), male: 2.6–2.7mm; female: 2.9–3.2mm.

General coloration pale yellowish orange to sordid yellow. Vertex pale yellowish orange, with two transversely oblong black markings near coronal margin, rarely markings joined medially or more rounded (see Remarks). Frontoclypeus with two black oval markings on each side just beneath antennal sockets. Pronotum and scutellum pale yellow to light brownish yellow without any striking transverse brown bands. Rostrum tip blackish. Tegmina pale yellow, subhyaline, Legs and venter pale yellowish orange to light brownish yellow. Female pregenital sternite with posterior medial lobe usually with black margin.

Male genitalia. Style apical process foot-like with a variable heel, the latter sometimes with a small to large triangular extension. Aedeagal shaft with rounded apex; with one short and one long apical process, latter variable in length (see Remarks), with or without a tooth near midlength.

Female seventh sternum produced lobe-like medially on posterior margin.

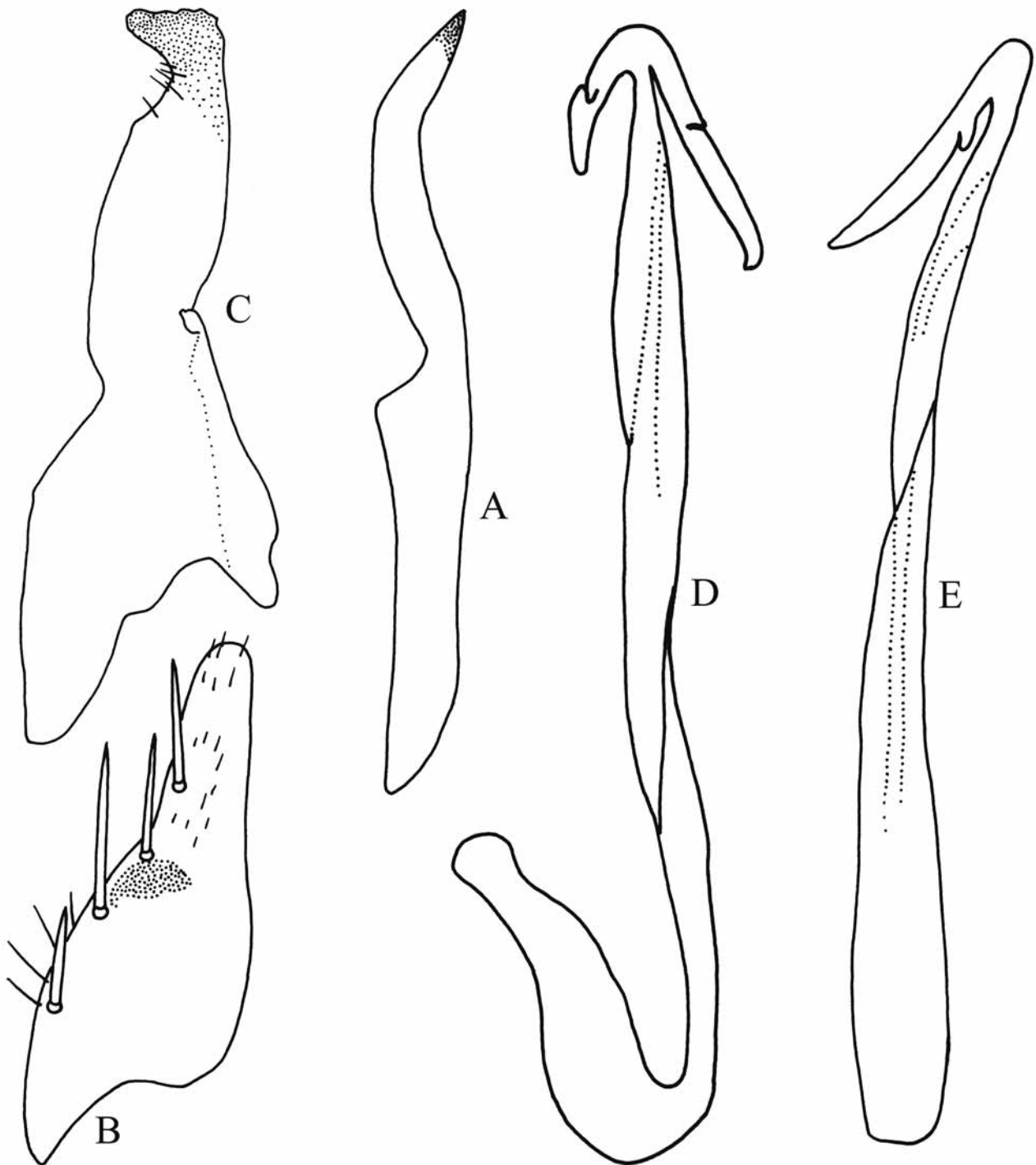
**Material examined.** JAPAN, 2 ♂♂, 2 ♀♀, Ryukyus, Yonguni Is., Higawa. M. Hayashi, 9.x.93 (BMNH). KOREA: 1 ♂, Gyeongnam Prov., Mt Gajisan, 1.x.1984, Y.J. Kwon (BMNH). INDIA: 1 ♀, Nilgiri Hills, T.V. Campbell (syntype of *Deltocephalus capitatus* Distant); 1 ♀, Arun Valley, below Tumlingar, River Sabhaya,



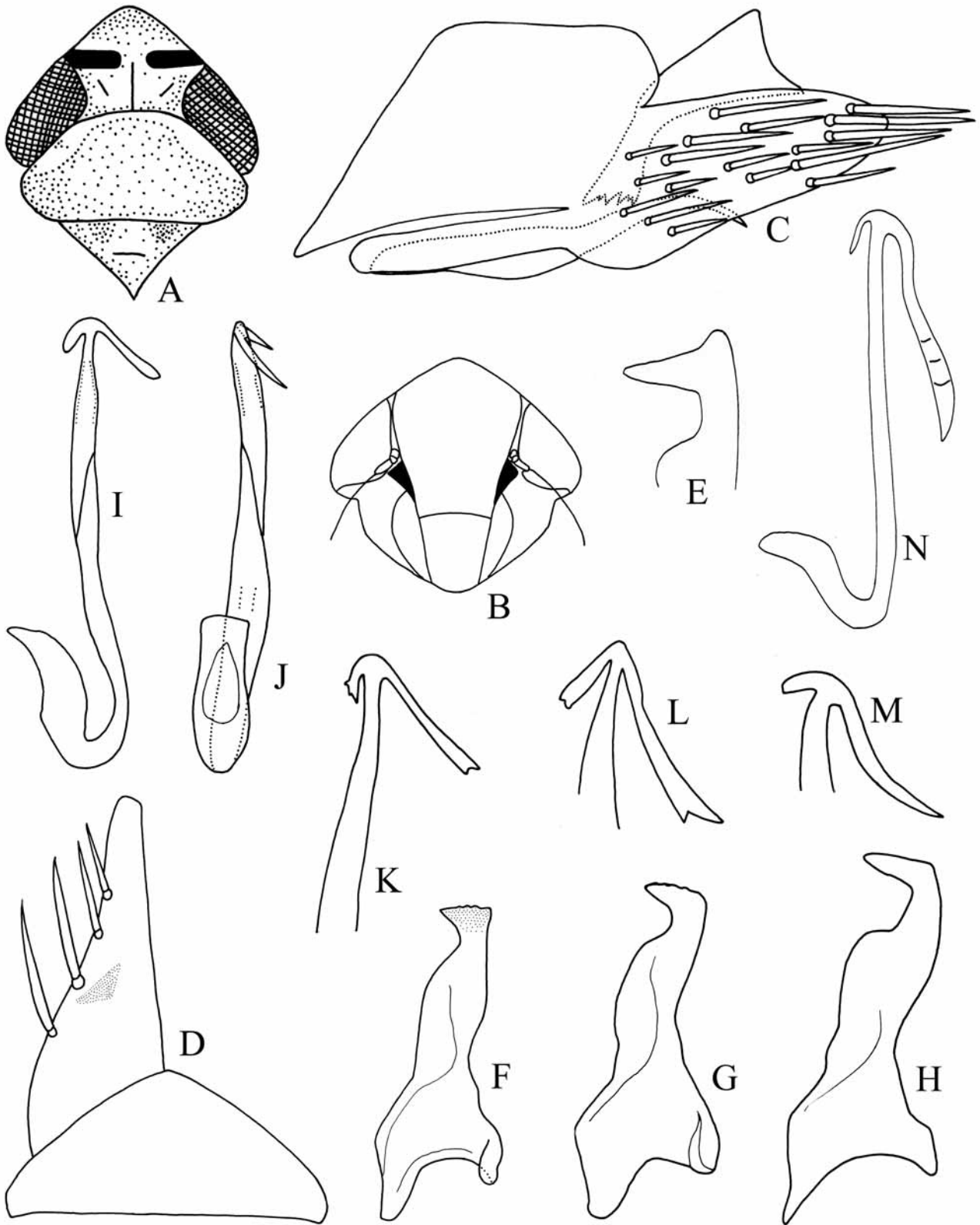
**FIGURE 2.** *Changwhania terauchii* (Matsumura) (Sri Lanka). A: male genital segment, lateral view; B: pygofer process, ventral view; C: subgenital plate, ventral view; D: style, dorsal view; E: connective, dorsal view; F, G: aedeagus, lateral view.

west shore, c.1800', 22.xii.1961, dead leaves lying in sun on sandy shore; 1♂, Arun Valley, below Tumlingar, c. 1800', 14.23.xii.1961, evergreen shrubs bordering dry stream beds (BMNH). NEPAL: 1♂, Bhandar, 2,200m., 5.viii.1964; 3 ♂♂, 1♀, Jiri, 2000m, 17.vi and 9.viii.64 (BMNH). CHINA: **Shaanxi Prov.**: 1♀, Xixiang, 1980.vii.29; 1♀, Ankang, 1980.vii.29; 2♀♀, Yangling, 1986.vii; 1♂, **Shangdong Prov.**, Laiyang,

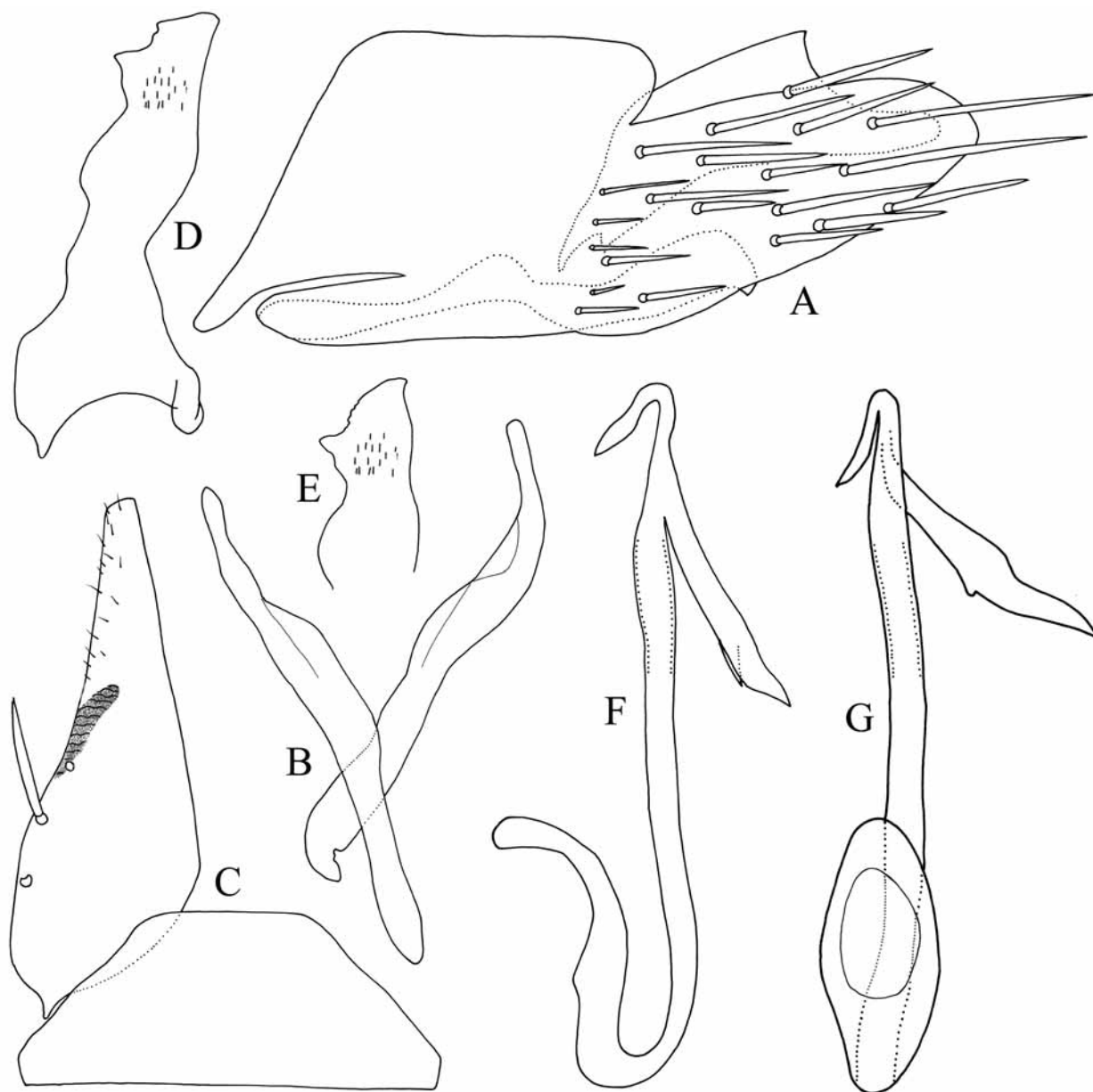
500–800m, 2001.vii.22, coll.; 1♂, 4♀♀, **Hubei Prov.**, County Fangxian, Town Jundian, 2001.vii.30, coll. He Zhiqiang; 1♀, **Sichuan Prov.**, Huanglong, 1980.vii.02; **Hunan Prov.**, Chenzhou: 1♂, 4♀♀, 1985.vii.23; 1♂, 1985.viii.03, **Jiangxi Prov.**: Pingxiangfanglou: 1♂, 2002.viii.05; 3♀♀, 2002.viii.05; Shangrao, Mt. Qianshan: 2♀♀, 2002.viii.13; 1♂, 8♀♀, 80m, 2006.viii.31; 1♀, **Fujian Prov.**, County Shanghang, 2003.viii.16; **Guangxi Autonomous Region**: 1♀, Park Shiwandashan, 2001.xi.30, coll.; 5♀♀, Xinzhai, 900m, 2006.viii.18, ; **Guangdong Prov.**: Dianbai: 1♀, 1983.iv.08; 1♂, 2♀♀, 1983.iv.10; 1♂, 4♀♀, 1983.iv.11; 2♀♀, 1983.iv.12; 1♂, 4♀♀, 1983.iv.13; 2♀♀, Shenzhen, 1983.iv.18; 1♀, Mt. Dinghu, 1983.vii.17; **Sichuan Prov.**, 3♂♂, 1♀, Batang, Zhubalong, 2450m, 2001.vii.12, coll. Sun Qiang; 1♂, 1♀, Mianning, 1650m,



**FIGURE 3.** *Changwhania ceylonensis* (Baker) (Sri Lanka, figure by C. Viraktamath). A: male pygofer process, ventral view; B: subgenital plate, ventral view; C: style, dorsal view; D, E: aedeagus, lateral and ventral view respectively.



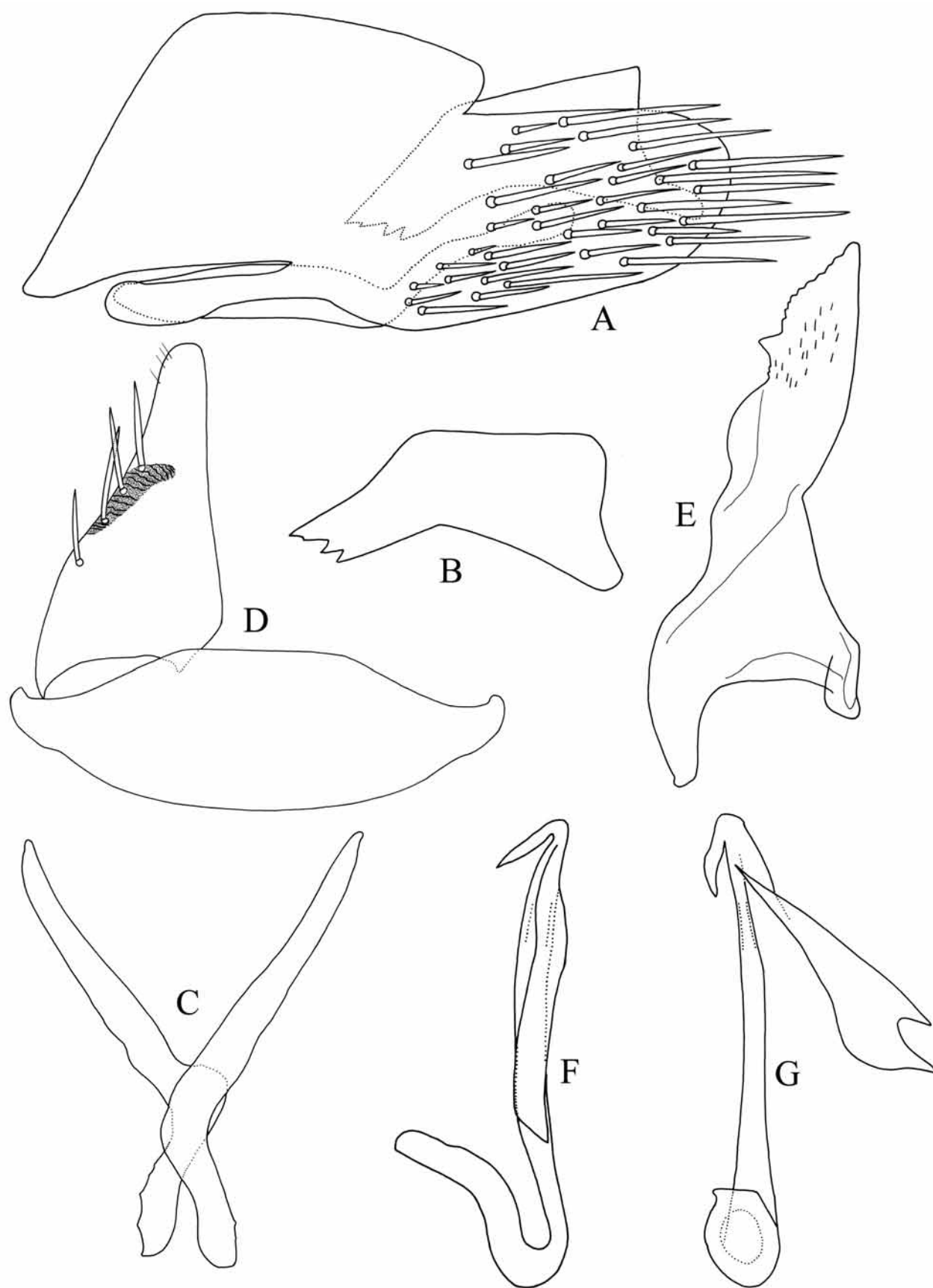
**FIGURE 4.** *Changwhania ceylonensis* (Baker), A, B, from Kwon (1980). A: head and thorax (dorsal view); B: face; C: male pygofer and Xth segment, lateral view; D: valve and subgenital plate, ventral view; E: apex of style; F–H: style, dorsal view; I, J: aedeagus, lateral and dorsal view respectively; K–M: apex of aedeagus, lateral view; N: aedeagus, lateral view.



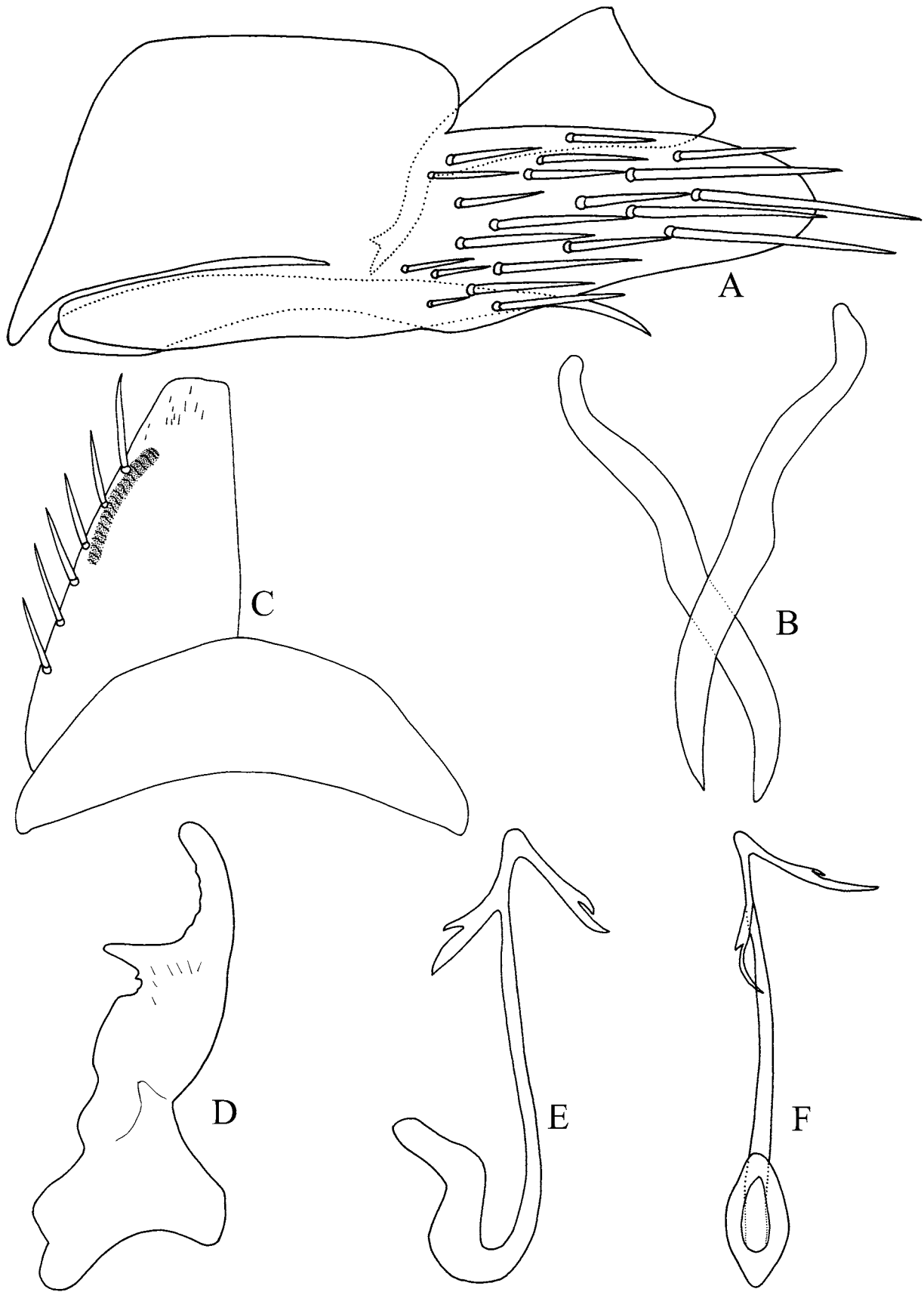
**FIGURE 5.** *Changwhania ceylonensis* (Baker) (China, Mianning). A: male pygophore, lateral view; B: pygofer processes, ventral view; C: valve and subgenital plate, ventral view; D: style, dorsal view; E: apex of style, dorsal view; F, G: aedeagus, lateral and dorsal view respectively.

1999.viii, coll. I. Dworakowska; **Hainan Prov.:** 1♀, Xinglong, 1983.iv.27; 1♀, Changjiang, 1983.vi.22; Bawangling: 1♂, 1983.vi.24, ; 2♀♀, 1983.vi.26; Liangyuan: 2♂♂, 1983.vi.29; 1♀, 1983.vi.31; 1♂, 4♀♀, 1983.vi.01; 1♀, 1983.vi.02, ; 1♂, 1983.vi.07; Qiongzong: 3♀♀, 1983.vi.04; 1♀, 1983.vi.05; 1♀, Tongshen, 1983.vi.07. Various collectors (Zhang Yalin, Yang Meixia, Ma Ning, Chai Yonghui, Qin Daozheng, Liu Zhenjiang, Sun Qinxia, Yuan Zhonglin, Duan Yani, Wang Zongqing), at light or without further information (NWFU). **THAILAND:** 3♂♂, 5♀♀, Chiangmai, upland rice, v.1982; 2♂, 1♀, Lopburi, vi.1974; 1♂ (BMNH). **PHILIPPINES:** 1♂, Malangol, Kalinga, 8.iv.1972, A.D. Pawar; 1♂, Luzon, Albay Prov., Guinobatan, 2.3.viii.1978 (BMNH); 3♂♂, 1♀, Mountain Prov., Abatan, Buguias, 1800–2000m., iv, v.1964, H.M. Torrevillas; 2♀♀, Luzon, La Trinidad, 4–5.iv.1968, D.E. Hardy; 1♀, Tifalmin, 1400m., 21.viii.1963, R. Straatman, light trap (BPBM). **PAPUA NEW GUINEA:** 1♂, W. Sepik, 19.xi.1985, J.W. Ismay, on taro (BMNH). **NEW CALEDONIA:** 3♂♂, hills behind Noumea, 17.vii.1940, F.X. Williams (BPBM).

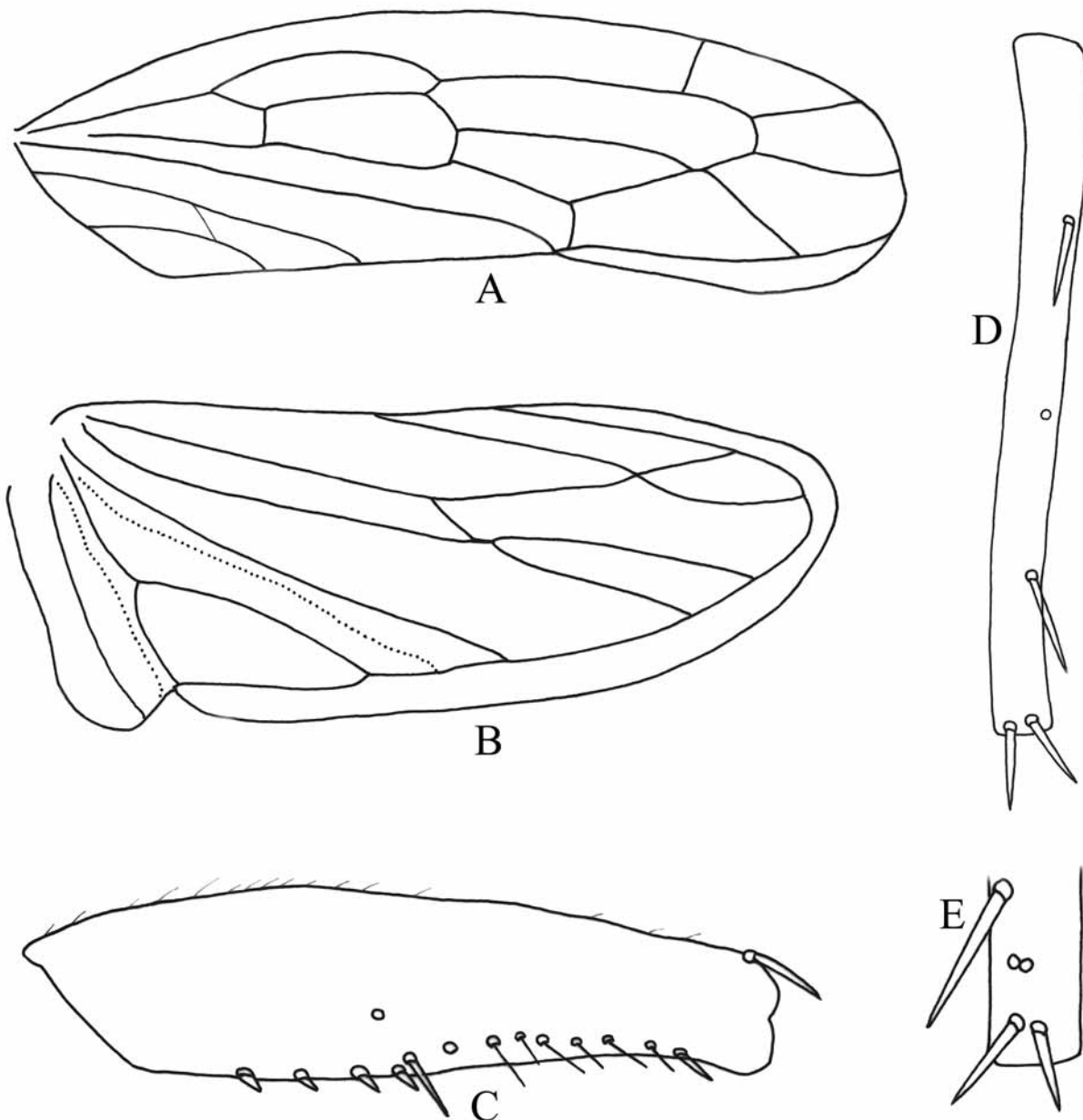




**FIGURE 6.** *Changwhania ceylonensis* (Baker) (China, Batang). A: male pygophore, lateral view; B: appendage of anal tube, lateral view; C: pygofer processes, ventral view; D: valve and subgenital plate, ventral view; E: style, dorsal view; F, G: aedeagus, lateral and dorsal view respectively.



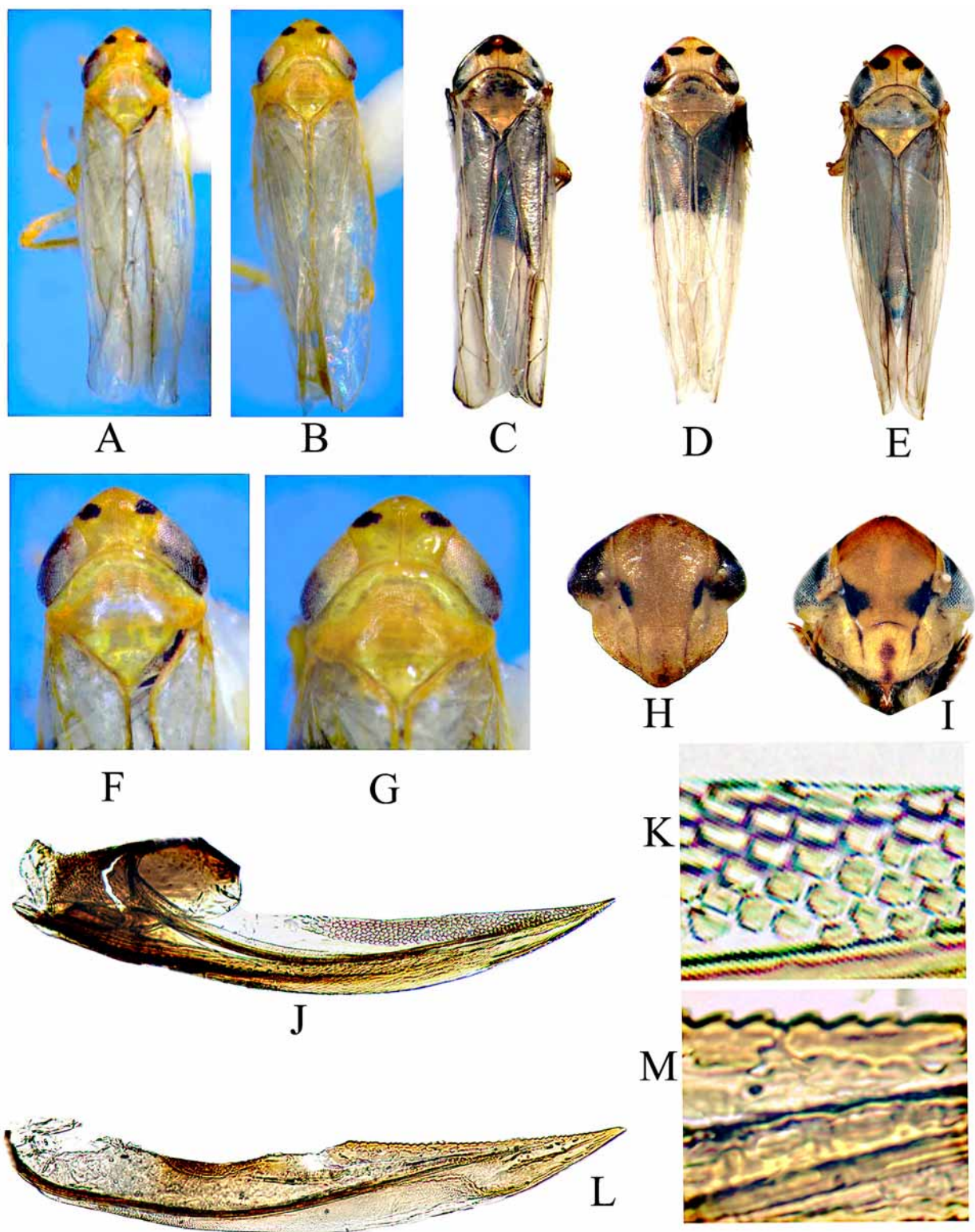
**FIGURE 7.** *Changwhania digitata* Zhang and Duan. A: male pygofer and Xth segment, lateral view; B: pygofer processes, ventral view; C: valve and subgenital plate, ventral view; D: style, dorsal view; E, F: aedeagus, lateral and dorsal view respectively.



**FIGURE 8.** *Changwhania digitata* Zhang and Duan. A: tegmen; B: hind wing; C: front femur, anterior view; D: front tibia, dorsal view; E: apex of hind femur, dorsal view.

**Distribution.** Korea, Japan, Nepal, India, Sri Lanka, China, Thailand, Philippines, Papua New Guinea, New Caledonia.

**Remarks.** This species can be distinguished externally by the oblong black spots on the vertex and narrow black patch below each antennal base (Figs 9B–D, 9G, 9H, 4A, 4B), and in the male genitalia by the typically foot-like apical process of the style (Figs 3C, 4E–H) or with a triangular distal extension (Figs 5D, 5E, 6E) and apical position of one or both of the aedeagal process (Figs 3D, 4I–N, 5F, 5G, 6F, 6G). This identity, which resulted in the above synonymy by Webb & Heller (1990), is based on associating males to the female types of *ceylonensis* with similar shaped head spots. However, based on the material examined in this study, in some specimens the spots in *ceylonensis* approach those of *terauchii*, i.e. are more rounded. Adding to this difficulty of separating the two species on external appearance is the fact that two species have similar distributions and females of all species of the genus have an identical medial lobed pregenital sternite. Also, in specimens from New Caledonia the vertex spots are distinctly rounded and relatively large, and in one specimen from India



**FIGURE 9.** *Changwhania* species. A–E, habitus, A: *C. terauchii* (Matsumura) (Sri Lanka); B–D: *C. ceylonensis* (Baker) (B: Sri Lanka; C: China, Mianning; D: China, Batang); E: *C. digitata* Zhang and Duan; F: head and thorax, *C. terauchii* (Matsumura) (Sri Lanka); G–H: *C. ceylonensis* (Baker), G, head and thorax (Sri Lanka); H: face (China, Batang); I–M: *C. digitata* Zhang and Duan; I: face, J: first valvula; K: detail of first valvula sculpturing; L: second valvula; M: detail of second valvula teeth.

(Arun Valley) the head spots coalesce to form a transverse band as described by Distant (1918) for part of the syntype series of *C. distanti* (Baker) i.e. that from Kodaicanal, India (specimen(s) not found). In addition, the material from Thailand, Nepal, Philippines (Abatan) and China (Sichuan Province) show more extreme variation of the male genitalia than in some other specimens, i.e. the apex of the style is extended either into a triangular lobe (China, Figs 5E, 6E) or is foot-like with a well developed heel (remainder, Fig. 4E), one aedeagal process is much longer (Figs 4N, 5F, 5G, 6F, 6G), the pygofer processes is truncate (Philippines) and the anal tube process is acute (Thailand) or bifurcate (Nepal). In contrast, some specimens on the south eastern fringes of the distribution i.e. from New Guinea and New Caledonia (see Material examined) have more typical male genitalia as in fig. 3.

### ***Changwhania digitata* Zhang and Duan, n. sp.**

(Figs 7–8, 9E, 9I–M)

Length (including tegmen), male: 2.8–3.1mm; female: 3.0–3.2mm.

Coloration as in *ceylonensis* but two transverse black markings near coronal margin on vertex usually wider and female seventh sternite with medial lobelike posterior margin usually entirely black.

Head with eyes wider than pronotum, about as long as or slightly longer than width between eyes.

Male genitalia. Subgenital plate with truncate apex. Style apical process spine-like, with adjacent pronounced digitate apical lobe, slightly curved laterally. Aedeagal shaft somewhat twisted near middle, asymmetrical, with shorter subapical process and slightly longer process near apex, each process armed with a tooth.

Female seventh sternum produced lobelike medially on posterior margin.

**Type.** Holotype: ♂, China, **Yunnan Prov.**, Country Tengchong, Dahaoping, 2000m, 1999.xi.26, coll. I. Dworakowska. Paratypes: China, **Yunnan Prov.**: 1♂, 2♀♀, data as holotype; 1♀, Menglun, 1100m, 1999.xi.02, coll. I. Dworakowska; 1♂, 14♀♀, Country Tengchong, 1660m, 1999.xi.20, coll. Qin Daozheng; 1♀, Country Tengchong, 1660m, 1999.xi.20, coll. Qin Daozheng (BMNH); 3♂♂, 6♀♀, Country Tengchong, 1660m, 1999.xi.22, coll. Qin Daozheng; 1♂, Country Tengchong, 1660m, 1999.xi.22, coll. Qin Daozheng (BMNH); 2♂♂, 3♀♀, Country Tengchong, 2000m, 1999.xi.26, coll. Qin Daozheng; 1♀, Country Tengchong, 2000m, 1999.xi.26, coll. Qin Daozheng (BMNH); 1♂, Country Tengchong, 1660m, 1999.xi.20, coll. Qin Daozheng; 4♂♂, 3♀♀, Country Tengchong, 1700m, 2006.viii.16, coll. Li Meng; 2♂♂, 1♀♀, Country Tengchong, 1700m, 2006.viii.16, coll. Li Meng (BMNH).

**Remarks.** This species can be distinguished by the digitate inner apical process of the style.

**Etymology.** The name of this species is based on the finger-like inner apical process of the style.

### **Acknowledgements**

We would like to thank C. Viraktamath in Department of Entomology, University of agricultural Sciences, Bangalore, India for supplying the figures of *terauchii* and *ceylonensis* from Sri Lanka and for his helpful comments. The project was supported by the National Science Foundation of China (30499341, 30771742) and “Northwest A & F University grant for Outstanding Faculty Members”.

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