The tube-making spittlebug genus *Machaerota* (Hemiptera: Cercopoidea: Machaerotidae) from China, with description of a new species

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Abstract: The tube-making spittlebug genus *Machaerota* Burmeister from China is reviewed and a new species, *Machaerota liangi* **sp. nov.** from Yunnan, is described. This new species is characterized by having black body, head with postclypeus broadly rounded, scutellar process slightly longer than scutellum proper, weakly arched, apically reaching level of tegminal apices, and aedeagal shaft with conspicuous extension subapically on anterior margin. A key to the species from China is provided.

Key words: Auchenorrhyncha; taxonomy; key; spittlebug

中国棘沫蝉属记要并记一新种（半翅目：沫蝉总科：巢沫蝉科）

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摘要：对中国棘沫蝉属 *Machaerota* Burmeister 作了综述，并记述采自云南的 1 新种：梁氏棘沫蝉 *Machaerota liangi* **sp. nov.**。本新种体黑色，头部额部圆弧状突出，小盾片突起长于小盾片、略弧形弯曲、端部伸达翅端部，阳茎端部前缘显著突出，可与其它种类区分。文中提供了中国种类分种检索表。

关键词：头喙亚目；分类；检索表；沫蝉

Introduction

Machaerotidae is a small and morphologically diverse family of spittlebugs with approximately 115 described species in 31 genera and has an exclusively Palaeotropical distribution (Bell *et al*. 2014). This family is unique in Cercopoidea in that their nymphs construct conical dwelling tubes on the stems of their host plants, in which they immerse themselves in a clear liquid excretion (Ratte 1884; Maa 1963).

Machaerota, first described by Burmeister in 1835, is the largest genus in Machaerotidae. The species of this genus feed and breed on woody dicotyledons from 19 genera (Marshall & Marshall 1966; Pramanik & Liang 2019). *Machaerota spangbergii* Signoret 1879 is a pest of cotton in India (Misra 1919; Prodhan *et al*. 2016). Maa (1963) in his comprehensive review of the world Machaerotidae recorded forty-two species in the genus. Six species were described from China (Lu 1982; Hayashi 1985; Nie & Liang 2008) since Maa's (1963) review. To date,

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forty-eight species in *Machaerota* have been described, all of which occur in the Old World tropics. Due to their low population densities and dull appearance, this genus is not well represented in collections and remains poorly studied.

Here we describe one new species and provide an identification key to the species from China.

Terminology is based on Maa (1963) and Dietrich (2005). The specimens examined in this study are housed in the Entomological Museum, Northwest A&F University, Yangling, China (NWAFU).

Taxonomy

Genus *Machaerota* Burmeister, 1835

Machaerota Burmeister, 1835: 128. Type species: *Machaerota ensifera* Burmeister, 1835.

Narnia Walker, 1870: 192. Type species: *Narnia rastrata* Walker. Preoccupied by *Narnia* Stål, 1862.

Pachymachaerota Schmidt, 1907: 194 Type species: *Pachymacha erotanigrifrons* Schmidt.

Conmachaerota Schmidt, 1918: 371. Type species: *Machaerotamotoceras* Schmidt; synonymized by Maa, 1949: 14.

Promaxudea Lallemand, 1927: 100. Type species: *Promaxudea humboldti* Lallemand; synonymized by Maa, 1963: 96.

Eumachaerota Schmidt, 1928: 111. Type species: *Eumachaerota siebersi* Schmidt; synonymized by Maa, 1963: 96.

Asichaerota Matsumura, 1940: 40. Type species: *Asichaerota taiheisana* Matsumura; synonymized by Maa, 1963: 96.

For the diagnosis and relationships of *Machaerota*, see Maa (1963).

Notes. The genus *Machaerota* belongs to the tribe Machaerotini of Machaerotidae, which is relatively long and slender with a weakly humpbacked pronotum. This tribe was placed as sister to Maxudeini based on a morphological phylogenetic analysis (Maa 1963). Except for the hind tibia lacking a lateral spine, most species of *Machaerota* show an obvious feature in external appearance: head convex, not vertically produced, and scutellar process originating from postero-superior corner of scutellum proper. Based on a comparison of *Narnia*, *Conmachaerota*, *Promaxudea*, *Eumachaerota*, *Asichaerota* and *Pachymachaerota* with their original descriptions and their originally included species, Maa (1949, 1963) proposed all above genera were synonyms of *Machaerota* and divided the species of *Machaerota* into two subgenera based on their external shapes.

Comparative study of the male genitalia of available specimens revealed certain variations in several structures that appeared to be diagnostic at the species level. The overall structure of the genital capsule was remarkably uniform, but variation occurred in the shape of the caudal margin of the pygofer. The structure of the styles and connective were relatively constant among species with only minor variation in relative proportions and in the shape of the style apophysis. The aedeagus was also conservative in structure, the main variation occurring in the shape of shaft.

Machaerota are predominantly distributed in the Oriental Region but with minor extensions into the Australian and Palaearctic Regions. Many species are endemic to the areas from which their specimens had originated (Maa 1963). Nevertheless, many regions or

countries where this genus likely occurs still have no records, or there are only scattered records from earlier published papers or data gathered during occasional collecting.

China is one of the world's most biodiverse countries, hosting more than ten percent of known species (McBeath & McBeath 2006), including a considerable number of endemic species. However, the scattered published records of species in *Machaerota* are from China. Kato (Maa 1949) described *M. formosana* and *M. esakii* from Taiwan, China. Matsumura (1940) described *M. taiheisana* from Taiwan, China. Maa described *M. fukienicola* from Fujian in 1947, transferred *Conmachaerota coronata* in Fujian and *Asichaerota taiheisana* in Taiwan to *Machaerota*, and recorded *M. coomani* Lallemand from China in 1963. Lu (1982) described four new species from China: *M. choui*, *M. jiangxiensis*, *M. shaanxiensis*, and *M. yunnanensis*. Hayashi (1985) described *M. propria* from Taiwan, China. Nie and Liang (2008) described *M. conicapita* from Yunnan, China. Our re-examination of some of the species (Figs 1–3) described by Lu (1982) revealed the need for a comprehensive review of the species of *Machaerota* from China. More detailed investigations with expanded taxonomic sampling are also needed to address species diversity and distribution.

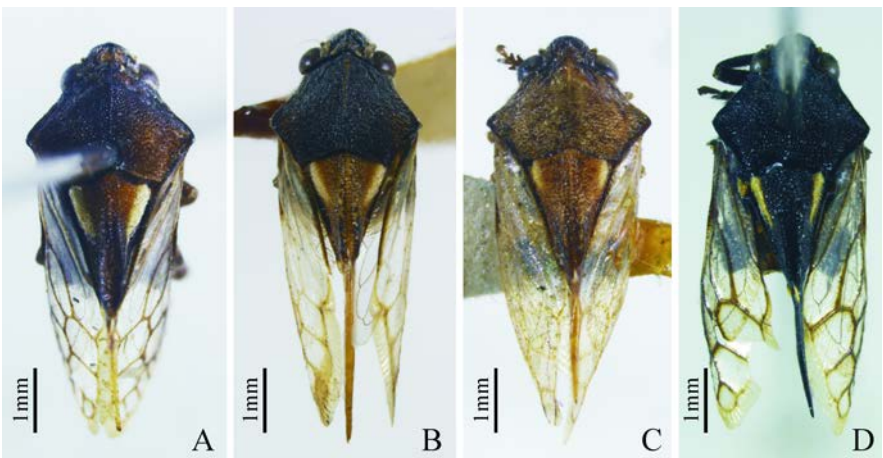

Figure 1. The habitus, dorsal views. A. *M. choui* Lu; B. *M. notoceras* Schmidt; C. *M. yunnanensis* Lu; D. *M. shaanxiensis* Lu.

Key to species of *Machaerota* from China

1. Head with postclypeus protruding forward and upward …… 2
-. Head with postclypeus not protruding forward and upward …… 4
2. Head subangularly produced; antero- and posterolateral margins of pronotum subequal in length …… *M. esakii* Kato
-. Head produced both forward and upward into a distinct subconic process; anterolateral margin of pronotum longer than posterolateral margin …… 3
3. Anterolateral margin of pronotum about 2.0× as long as posterolateral margin …… *M. propria* Hayashi
-. Anterolateral margin of pronotum about 1.5× as long as posterolateral margin …. *M. conicapita* Nie & Liang
4. Body black, with greyish or brownish pubescence …… 5
-. Body yellow to brownish black …… 8
5. Anterior margin of head carinate, with tylus concave …… 6
-. Anterior margin of head round …… 7

6. Scutellar process without pale marking at base ····· *M. formosana* Maa
-. Scutellar process with a pale marking at base ····· *M. shaanxiensis* Lu
7. Scutellar process hardly longer than scutellum proper; legs with hind tibia black ····· *M. fukienicola* Maa
-. Scutellar process slender, slightly longer than scutellum proper; legs with hind tibia yellowish white; aedeagus with shaft elongate, slender, dorsoposteriorly curved, anterodorsally directed, with conspicuous extension subapically on anterior margin ····· *M. liangi* **sp. nov.**
8. Pronotum black, discally with 2 large brown markings extending nearly to posterior margin; postclypeus keeled ····· *M. taiheisana* (Matsumura)
-. Pronotum not colored as above; postclypeus not distinctly keeled ····· 9
9. Veins of forewing with fine punctures ····· 10
-. Veins of forewing without punctures ····· 12
10. Median carina of pronotum complete; punctures on veins of forewing without setae ····· ····· *M. coomani* Lallemand
-. Median carina of pronotum poorly defined at posterior 1/3; punctures on veins of forewing setigerous ····· 11
11. Tylus convex; discoidal and apical cells of forewing wrinkled ····· *M. notoceras* Schmidt
-. Tylus flattened; discoidal and apical cells of forewing smooth ····· *M. jiangxiensis* Lu
12. Scutellum proper posteriorly strongly convex in lateral view; dorsal sulcus narrowed basally and apically, rather wide in middle ····· *M. choui* Lu
-. Scutellum proper gently raised in lateral view, dorsally slightly concave in middle; dorsal sulcus gradually narrowed caudad ····· *M. shaanxiensis* Lu
13. Oblique ental carina of pronotum absent; lateral stripe of scutellum not definable ····· *M. coronata* (Maa)
-. Oblique ental carina of pronotum short and weak; lateral stripe of scutellum definable ····· *M. yunnanensis* Lu

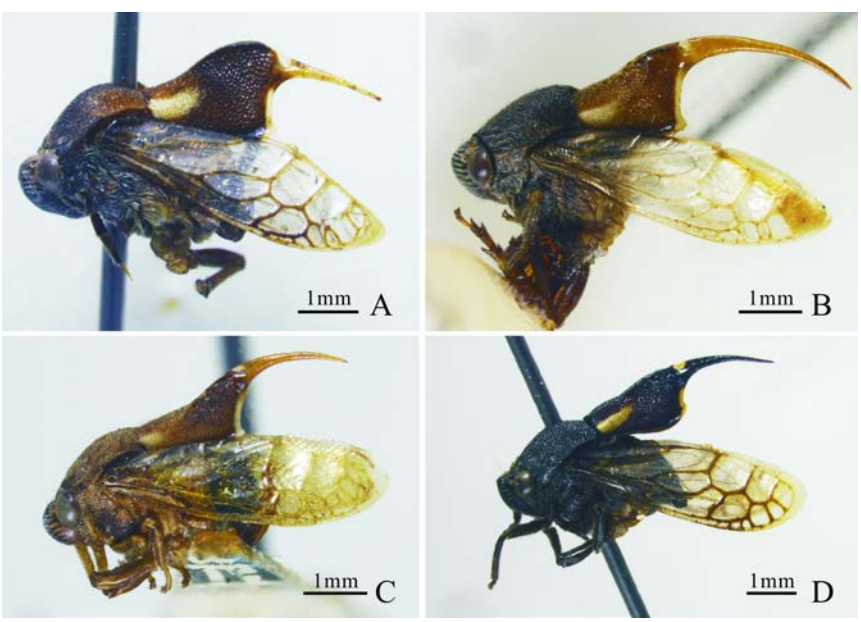

Figure 2. The habitus, lateral views. A. *M. choui* Lu; B. *M. notoceras* Schmidt; C. *M. yunnanensis* Lu; D. *M. shaanxiensis* Lu.

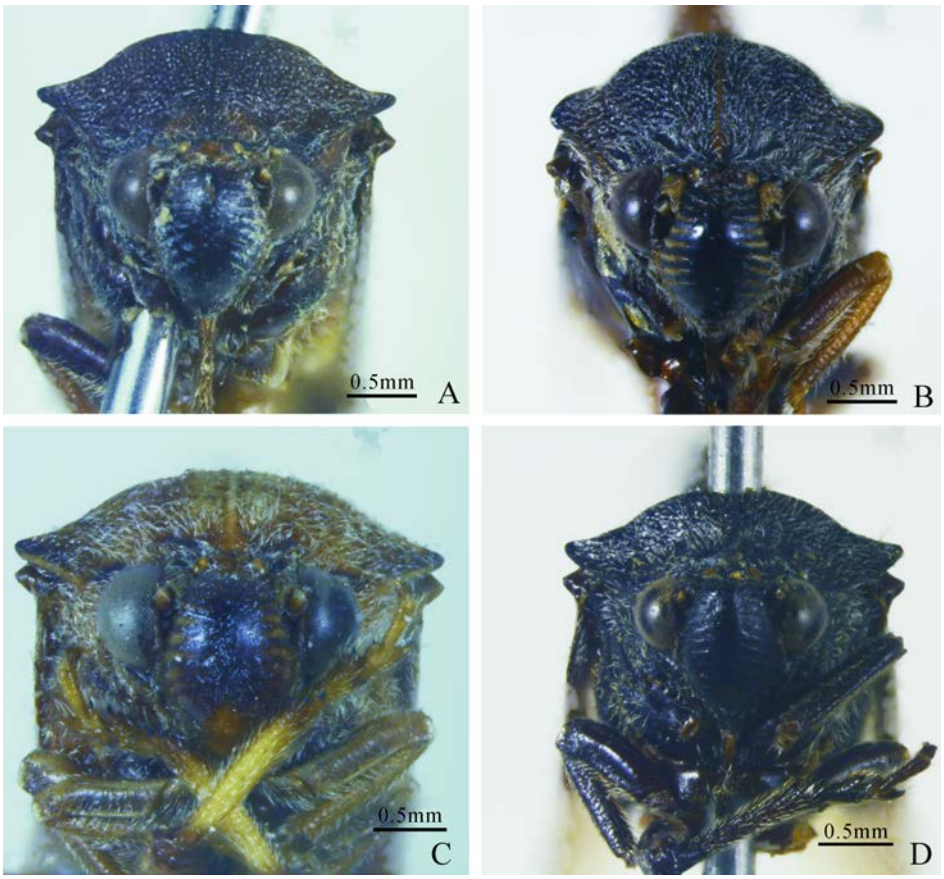

Figure 3. Faces. A. *M. choui* Lu; B. *M. notoceras* Schmidt; C. *M. yunnanensis* Lu; D. *M. shaanxiensis* Lu.

***Machaerota liangi* sp. nov.** (Figs 4, 5)

Male. Length (from tip of head to tip of forewing), 6–7 mm.

Body shining black, with silvery hairs. Postclypeus shining black, with 7 transverse impressed yellowish white lines, anteclypeus black to brownish black. Tentorial pit and gena black. Pronotum black. Scutellum black, scutellar process brownish black, with lateral stripes, lateral ventral margin and posterior inner margin yellowish white, rim of sulcus edge white-blackish; edge of postero-inferior margin yellowish white. Forewing hyaline, veins white brown, without dark punctures; corium apically tinted with brown. Legs brownish black, with hind tibia yellowish white, with base and apex brownish black. Abdomen black, with a yellowish white longitudinal stripe in middle of tergite.

Crown moderately long, anteriorly broadly rounded, with thick hair, tylus longer than wide, gently evenly convex. Ocellar area descending forward and laterad; interocellar distance slightly greater than ocello-ocular distance. Tentorial pit deep, suture-like, curving and extending to frontal suture. Postclypeus evenly convex, not keeled.

Pronotum convex, width to length about 7 : 5; strongly punctate except at ante-callus area; median carina strong at anterior 1/2, posterior 1/2 indistinct; anterior margin of pronotum curved forward in middle; lateral angle broadly rounded, slightly surpassing level of basal sclerites of closed tegmen, posterolateral angle broadly rounded, anterolateral margin

anteriorly very slightly incurved and almost rounded-off, posterolateral margin slightly concavely curved; posterior margin angularly incised in middle.

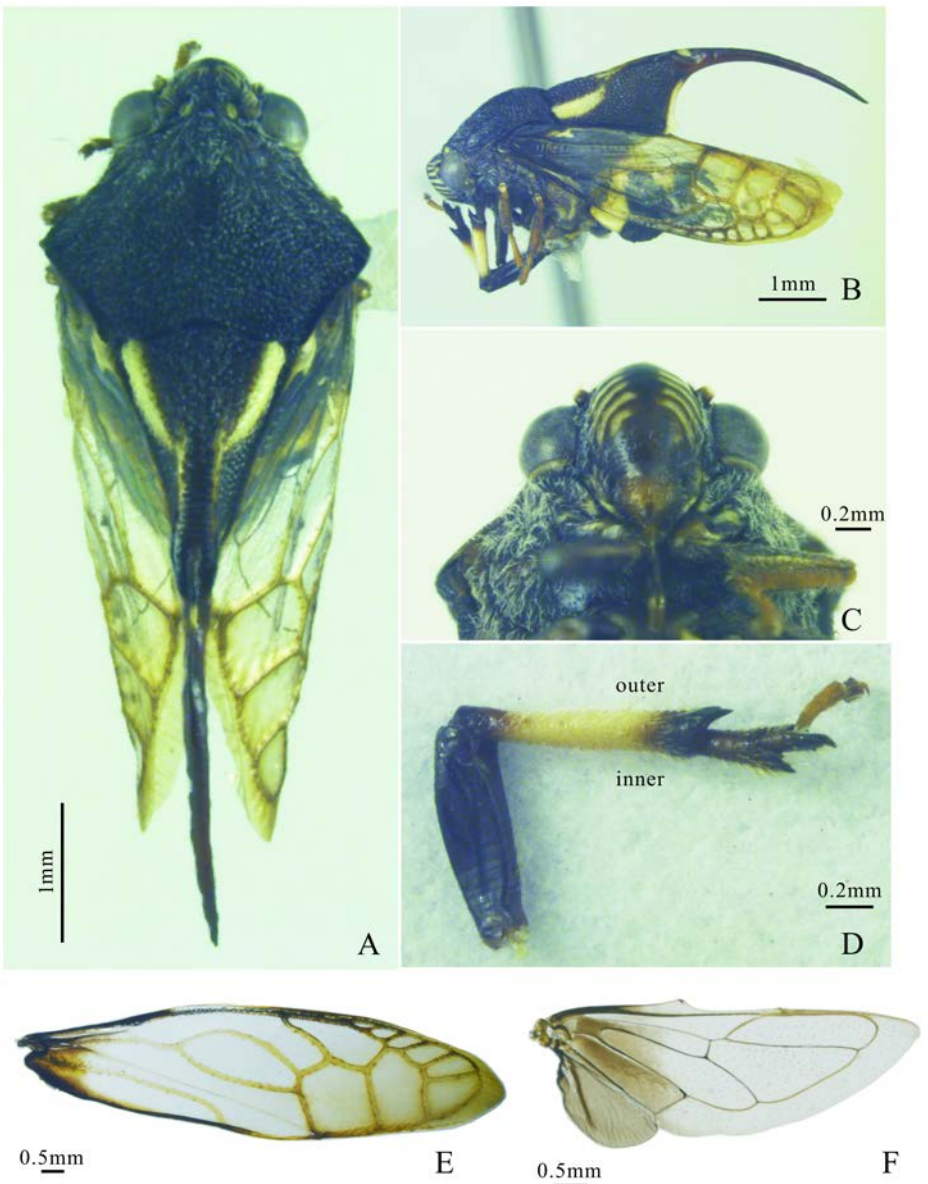

Figure 4. *Machaerota liangi* **sp. nov.** A. Habitus, dorsal view; B. Habitus, lateral view; C. Face; D. Hind leg; E. Forewing; F. Hindwing.

Scutellum similarly sculptured as pronotum, slightly longer than high in profile; superior margin in profile almost straight; scutellar process slender, originating from upper end of postero-inferior margin, basally compressed, slightly longer than scutellum proper, weakly arched, apically reaching level of tegminal apices; lateral stripe of scutellum 3/5 as long as lateral, apically slightly curved, almost reaching rim of sulcus, about 1/2 as long as scutellum;

rim of sulcus edge sharp, almost 2/3 as long as scutellum proper; sulcus evenly narrow, about 2/3 as long as scutellum, broader than interocellar distance; basilateral depression as wide as long.

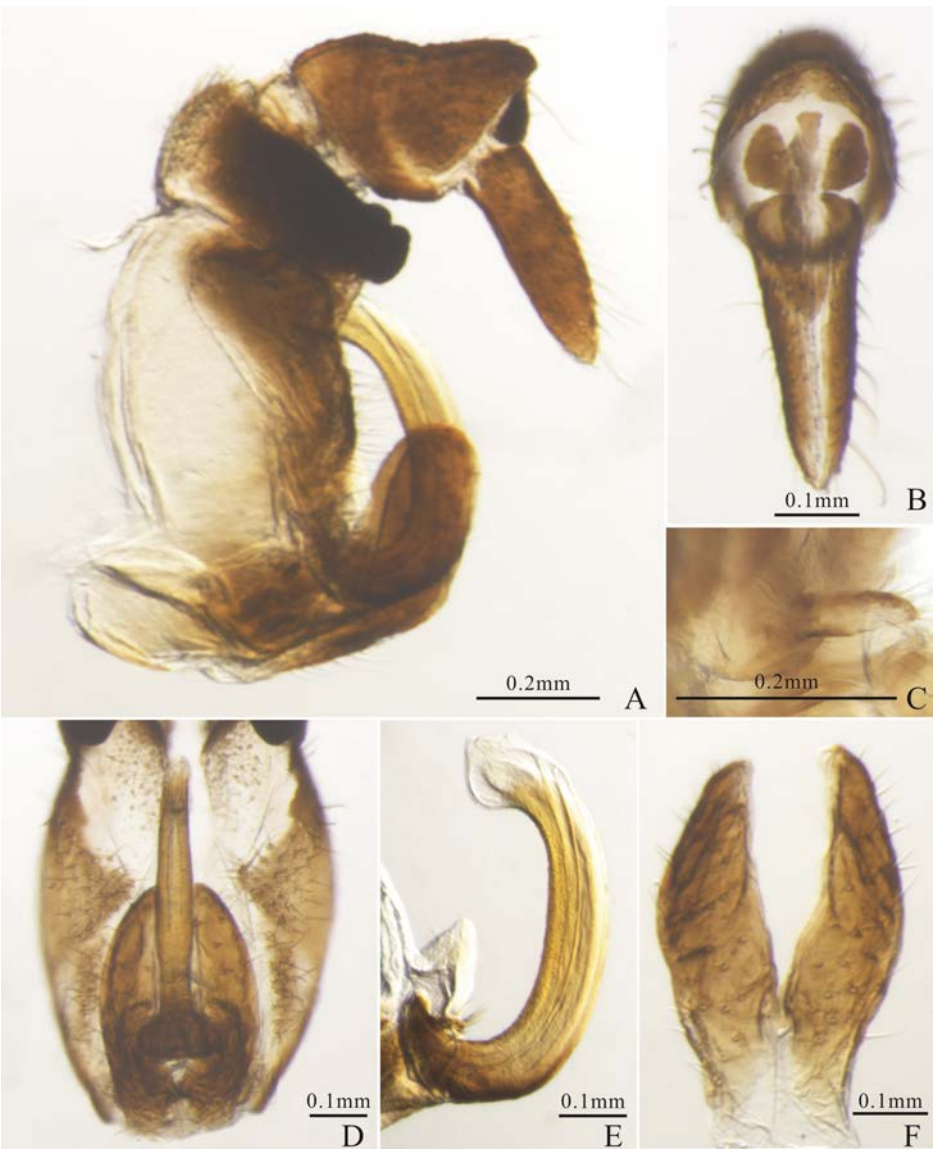

Figure 5. *Machaerota liangi* **sp. nov.,** male genitalia. A. Pygofer, lateral view; B. Anus, posterior view; C. Style, lateral view; D. Pygofer, posterior view; E. Aedeagus, lateral view; F. Subgenital plates.

Forewings about 3× longer than broad with reduced venation; apical margin conspicuously oblique; discoidal cell 2.5× longer than broad; veins M and Cu basally joined; claval vein unbranched. Hindwings subtriangular, wider than medial cell; mediocubital crossvein (m-cu) very short; apical cell 2× wider than discal cell; cubital cell 2× wider than medial cell.

Male genitalia having a pygofer at upper end, end of first section protruding slightly. Phallus slender in front view, with a membranous collar at the end, collar rectangular in side view; base of parameres wide, gradually narrowed, and the end blunt and hairy, about 1/4 of length of phallus; genital plates connecting by membrane at 1/3 base and upper 2/3 separated and hairy.

Male genitalia with apical lobe of pygofer divided into two parts, upper part broadly rounded, lower part angulate, slightly elongated both downward and hindward; scabrous area of apical lobe black, sculpture finely roundish; membrane part of pygofer with a hairy roundish area in hind view, this area protruding as a hemisphere in lateral view. Style wide at base, gradually narrowing, apex blunt and hairy. Subgenital plates elongate, lateral margin convex roundly, connected at basal 1/3, separated at apical 2/3. Aedeagus with shaft elongate, slender, dorsoposteriorly curved, anterodorsally directed, with conspicuous extension subapically on anterior margin; gonophore apically.

Female. There is no difference in appearance characteristics from males.

Holotype. ♂, **China**, Yunnan, Hekou, 1200 m, 13-IX-2018, Jing LI (NWAFU). **Paratypes**. 1♂2♀, same data as holotype.

Etymology. This new species epithet honors Dr. Aiping LIANG, in recognition of his contributions to spittlebug studies.

Remarks. This new species is externally similar to *M. formosana* Kato, 1928 from Taiwan, *M. fukienicola* Maa from Fujian, and *M. takeuchii* Kato, 1931 from Japan (see Maa 1963), but can be separated from the latter three by the following characters: legs with hind tibia yellowish white and aedeagus with shaft elongate, slender, dorsoposteriorly curved, anterodorsally directed, with conspicuous extension subapically on anterior margin. This new species is also similar to *M. discreta* (Schmidt) from Thailand in male genitalia, but differs from the latter by body black, and scutellar process strongly arched, discoidal cell 2.5× longer than broad.

References

Bell AJ, Svenson GJ & Cryan JR. 2014. The phylogeny and revised classification of Machaerotidae, the tube-making spittlebugs (Hemiptera: Auchenorrhyncha: Cercopoidea). *Systematic Entomology*, 39(3): 474–485.

Burmeister HCC. 1835. Schnabelkerfe. Rhynchota. *Handbuch der Entomologie*, 2(1): 1–396.

Dietrich CH. 2005. Keys to the families of Cicadomorpha and subfamilies and tribes of Cicadellidae (Hemiptera: Auchenorrhyncha). *Florida Entomologist*, 88(4): 502–517.

Hayashi M. 1985. A new species of Machaerotidae (Hemiptera: Cercopoidea) from Taiwan. *Kontyu*, 53(2): 366–369.

Lallemand V. 1927. Descriptions de cercopides nouveaux provenant de la collection du British Muséum. *Transactions of the Entomological Society of London*, 1927: 99–118.

Lu Z. 1982. One new genus and five new species of Machaerotidae from China (Homoptera: Cercopoidea). *Entomotaxonomia*, 4(4): 273–278.

Maa TC. 1947. A critical review of the Chinese Machaerotidae (Insecta: Homoptera: Cercopoidea). *Technical Bulletin Taiwan Agricultural Research Institute*, 1(1): 1–28.

Maa TC. 1949. On some Machaerotinae from South-eastern Asia (Homoptera). *Treubia*, 20: 11–24.

Maa TC. 1963. A review of the Machaerotidae (Hemiptera: Cercopoidea). *Pacific Insects Monograph*, 5: 1–166.

Marshall AT & Marshall PM. 1966. The life history of a tube-dwelling Cercopoid: *Machaerota coronata* Maa (Homoptera: Machaerotidae). *Proceedings of the Royal Entomological Society of London, Series A, General Entomology*, 41: 17–20.

Matsumura S. 1940. New species and genera of Cercopidae in Japan, Korea and Formosa, with a list of the known species. *Journal of the Faculty of Agriculture, Hokkaido Imperial University*, 45(2): 35–82.

McBeath J & McBeath JH. 2006. Biodiversity conservation in China: Policies and practice. *Journal of International Wildlife Law and Policy*, 9: 293–317.

Misra CS. 1919. Some pests of cotton in North Bihar. *Report of the Proceedings of the Third Entomological Meeting held at Pusa, Calcutta, India*, 2: 547–561.

Nie J & Liang AP. 2008. A new species of *Machaerota* Burmeister (Hemiptera: Cercopoidea: Machaerotidae) from China and Laos. *Zootaxa*, 1727(1): 63–68.

Pramanik MEA & Liang AP. 2019. Description of the immature and adult stages of the jujube tube spittlebug, *Machaerota planitiae* Distant (Hemiptera: Cercopoidea: Machaerotidae) in Bangladesh. *Zootaxa*, 4624(1): 71–86.

Prodhan MZH, Noman MS, Hasan MT & Maleque MA. 2016. Evaluation and economic analysis of some integrated pest management packages for suppressing tube spittle bug (*Machaerota planitiae* Distant) infesting jujube (*Zizyphus mauritiana* Lamk), in North-Western Bangladesh. *The Agriculturists*, 14(1): 54–62.

Ratte F. 1884. On the larvae and larval cases of some Australian Aphrophoridae. *Proceedings of the Linnean Society of New South Wales*, 9: 11–64.

Schmidt E. 1907. Monographie Der Subfamilie Machaerotinae. *Stettiner Entomologische Zeitung*, 68: 165–200.

Schmidt E. 1918. Neue Gattungen und Arten der Subfamilie Machaerotinae Stal, eine Beitragzur Kenntnis der Cercopiden (Rhynchota Homoptera). *Deutsche Entomologische Zeitschrift*, 79: 366–373

Schmidt E. 1928. Die Zikaden des Buitenzorger Museums (Hemipt. -Homopt.). *Treubia*, 10(1): 107–144.

Walker F. 1870. Catalogue of the homopterous insects collected in the Indian Archipelago by Mr. A. R. Wallace, with descriptions of new species. *Zoological Journal of the Linnean Society*, 10: 82–193.