

ORIGINAL ARTICLE

A new species of genus *Brithura* Edwards from China, with notes on its internal reproductive system (Diptera: Tipulidae)

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Abstract One new species of the genus *Brithura* Edwards, 1916, *B. triprocessa* Men & Liu **sp. nov.** from China is described and illustrated. The morphological description of the internal reproductive system for both sexes of the new species is provided, which represents the first concern of the internal reproductive system in this genus.

Key words Tipulidae, taxonomy, hypopygium, ovipositor, morphological comparison.

1 Introduction

Brithura Edwards, 1916 is a small genus in the family Tipulidae with 16 species worldwide, mainly distributed in the Oriental and Palaearctic Regions (Oosterbroek, 2018). The genus was established by Edwards in 1916 with the type species *Brithura conifrons* Edwards, 1916 from Taiwan, China by original designation, which was subsequently treated as a junior synonym of *Brithura imperfect* (Brunetti, 1913). The genus has 12 species reported in China, mainly distributed in the southern part of the country (Oosterbroek, 2018). For Chinese fauna, Liu and Yang reported six species and provided an identification key for all species worldwide (Liu & Yang, 2009, 2010). We noticed one previously unknown species of *Brithura* while sorting and identifying crane fly specimens collected from southwest region of Anhui Province, China, which is described and illustrated here.

Internal reproductive system is poorly documented in Tipuloidea and concerns only few genera: *Baeoura* Alexander, 1924, *Cheilotrichia* Rossi, 1848, *Chionea* Dalman, 1816, *Dicranota* Zetterstedt, 1838, *Dolichopeza* Curtis, 1825, *Hexatoma* Latreille, 1809, *Holorusia* Loew, 1863, *Libnotes* Westwood, 1876, *Nephrotoma* Meigen, 1803, *Pedicia* Latreille, 1809, *Rhabdomastix* Skuse, 1890, *Tipula* Linnaeus, 1758, *Toxorhina* Loew, 1850 and *Trichoneura* Loew, 1850 (Byers, 1961, 1983; Frommer, 1963; Tjeder, 1963a, b, 1964a, b, 1967, 1972, 1979a, b, 1981; Mendl & Tjeder, 1974, 1976; Men *et al.*, 2015, 2018). In the present paper, we provide morphological descriptions of the reproductive system for both sexes of the new species, which represents the first description of the internal reproductive system in the genus *Brithura*.

2 Materials and methods

Specimens used in present study were collected from Yaoluoping National Natural Reserve, Anhui Province, China, by

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light trap from the year of 2013 to 2018, which were preserved in 95% ethyl alcohol. Type species were deposited in the Systematics and Evolution Laboratory, School of Life Sciences, Anqing Normal University (ANU), Anhui, China.

The external genitalia, including male hypopygium and female ovipositor were removed and soaked in 10% NaOH for an hour in a 70°C metal bath to clear the muscle, then immersed in glycerin jelly for drawing using a SOIF XTZ-E stereomicroscope (SOIF, Shanghai, China). The internal reproductive systems were dissected in water, and then examined and drawn using the same stereomicroscope. Dissection was made with the aid of two very fine needles, scissors and fine-tipped tweezers. The terminology and methods of description and illustration follow that of Byers (1961), Frommer (1963) and Alexander & Byers (1981). The abbreviations are used as following.

A—adminiculum;
 Ae—aedeagus;
 AG—accessory gland;
 AIA—anterior immovable apodeme;
 BC—bursa copulatrix;
 CA—compressor apodeme;
 Ce—cercus;
 Co—copulatory opening;
 CVD—common vas deferens;
 ED—ejaculatory duct;
 gc—gonocoxite
 ge br—genital bridge;
 hyp vlv—hypogynial valve;
 i ol—inner obtuse lobe;
 OG—outer gonostylus;
 o ol—outer obtuse lobe;
 PIA—posterior immovable apodeme;
 S—sternite;
 se p—semen pump;
 shp—sharp process;
 SP—spermatheca;
 SPD—spermathecal duct;
 SV—seminal vesicle;
 T—tergite;
 TS—testis;
 VD—vas deferens.

3 Taxonomy

Brithura triprocessa Men & Liu sp. nov. (Figs 1–31)

Diagnosis. Antenna including flagellum yellow. Prescutum brown with three brownish-yellow stripes; pleura generally brown with a white stripe from the lateral region of pronotum to the base of wing. Femora yellow with broadly black tip. Tergite nine with lateral margins straight, shallowly emarginated at hind margin, a pair of horn-shaped processes inserted from the middle region.

Description. Adult length. Male body 18.4–22.6 mm (not including antenna, $n = 16$), wing 19.2–22.6 mm ($n = 16$), antenna 4.1–4.6 mm ($n = 16$); female body 28.4–30.6 mm (not including antenna, $n = 32$), wing 20.2–25.4 mm ($n = 32$), antenna 4.5–4.8 mm ($n = 32$).

Head. Head brown with rostrum brown in coloration (Figs 1–3). Nasus light brown, cone in shape, densely covered with black setae (Fig. 3). Eye black. Occiput and vertex lacking of marking, mostly dark brown, narrowly margined with yellow along the eyes (Fig. 1). Vertical tubercle cone-shaped, dark brown, black apically (Fig. 1). Antenna 13-segmented, bent backward not reaching the base of haltere; scape brown, elongated, cylindrical, expanded apically; pedicel brown, very short; flagellum entirely yellow with the first flagellomere longest, the remaining segments generally shortened and thinned, base of each flagellomere enlarged with abundant black verticils, the verticils longer than the length of corresponding



Figures 1–8. *Brithura triprocessa* Men & Liu **sp. nov.** 1. Head, dorsal view. 2. Thorax, dorsal view. 3. Thorax, lateral view. 4. Wing. 5. Abdomen, lateral view. 6. Hypopygium, lateral view. 7. Abdomen, lateral view. 8. Ovipositor, lateral view.

flagellomere; surface of flagellomere densely covered with short white setae (Fig. 1). Palpus dark brown (Fig. 3).

Thorax. Pronotum black medially, dark brown laterally (Fig. 3). Prescutum brown with three brownish-yellow stripes, median one divided by a brown vitta, lateral stripes subequal in length to half of median one, rounded apically (Fig. 2). Scutum with two yellow markings connected to each other, the upper one triangular, the lower one oval, the latter at least two times longer than the former. Scutellum brown with yellow median line (Fig. 2). Postnotum wholly dark brown (Fig. 2). Pleura generally brown with a white stripe from the lateral region of pronotum to the root of wing, laterotergite basally suffused with white (Fig. 3). Leg stout, coxa and trochanter brown, the latter suffused with black apically; femur yellow with broadly black tip; tibia yellow at basal one fifth, the rest region yellowish-brown; tarsi yellowish-brown. Haltere with stem yellow, knob black. Wing light brown, cells c and sc darker than ground color; stigma dark brown, extending to the bases of cells r₄, r₅ and discal cell; a black spot at the origin of Rs; discal cell transparent, relatively short; wing tip suffused with slightly smoky gray on cells r₃ and r₄, with five light spots along the outer margin of wing (Fig. 4). Venation: petiole of cell m₁ slightly shorter than discal cell, distinctly shorter than the length of cell m₁ (Fig. 4).

Abdomen. Abdominal tergites brown with lateral margin black, the hind margin suffused with white, extending to the hind corner (Fig. 5). Sternite generally brown with second to fifth segments narrowly suffused with black on lateral margin (Fig. 5). Hypopygium with tergite nine and sternite nine separated to each other, only fused at base (Figs 6, 9). Tergite nine with lateral margins straight, shallowly emarginated at hind margin, a pair of horn-shaped processes generated from the middle region, which divided by a narrow groove on dorsal surface, a pair of ear-shaped lobes extended from the ventral side (Figs 10–11). Gonocoxite stout, broad basally and shallowly concaved at apex, densely covered with long setae, with two horn-shaped processes black and pointed inward (Figs 9, 12). Sternite nine broad, equipped with a stout process at base, above which with paired finger-shaped processes which directed ventrally (Figs 9, 12). Outer gonostylus complicated, terminated into an obtuse lobe (o ol) and a sharp process (shp) on outer side, between them with a narrow light region, with another obtuse process (i ol) on inner side which connected to the sharp process (Figs 13–18). Inner gonostylus broad basally, squarely turned into a complicated and narrowed apex, a black finger-shaped process generated in the middle region, many long setae covered on dorsal corner (Figs 19–20). Adminiculum cylindrical, broad basally and narrowed to apex, deeply concaved apically (Figs 12, 23).

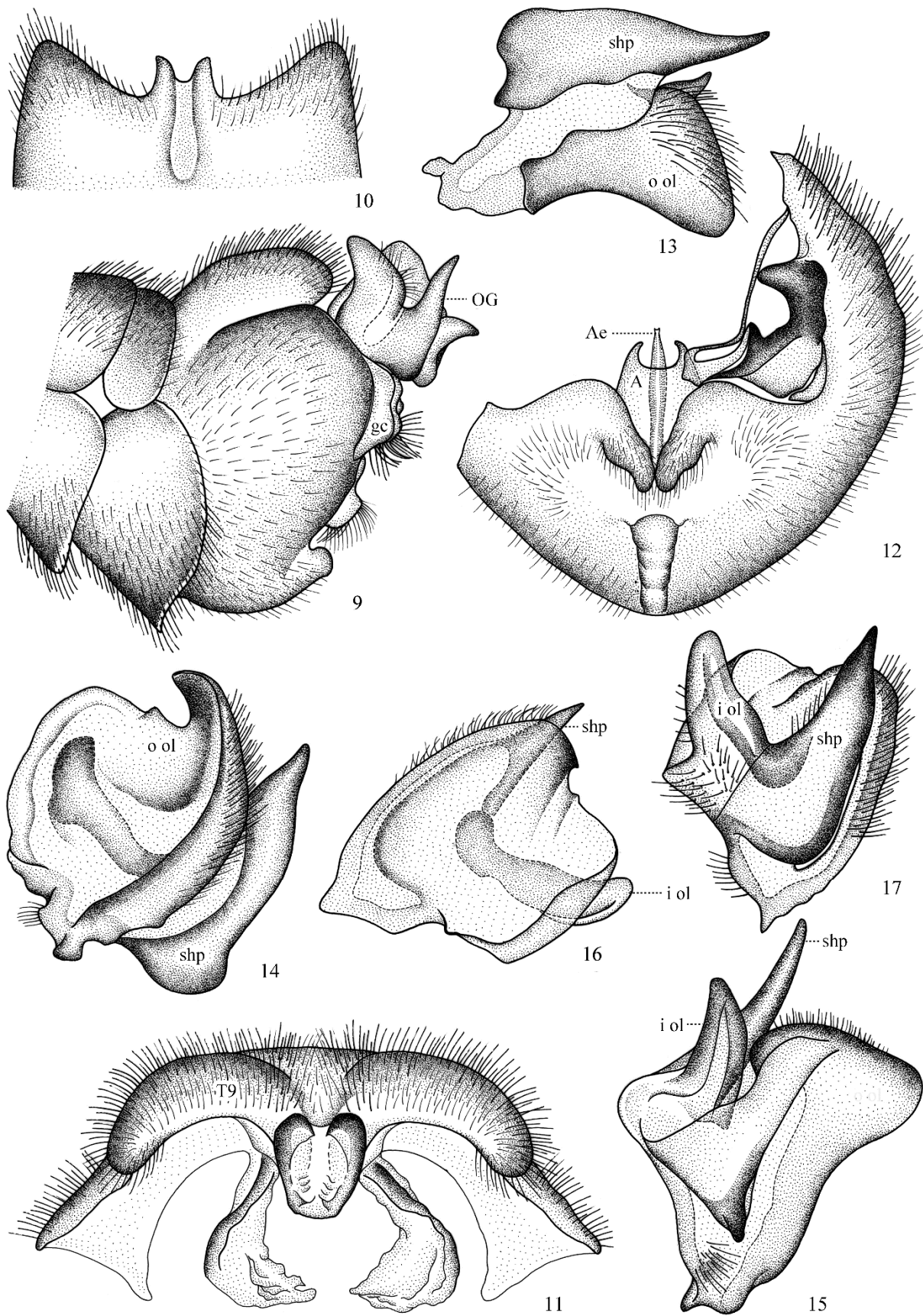
Semen pump. Semen pump with compressor apodeme fan-shaped (Fig. 21). Posterior immovable apodeme being triangular lobe, its dorsal angle sharply acute (Figs 22–23). Anterior immovable apodeme flattened and elongated, roundly expanded in dorsal view (Figs 22–23). Semen pump with a pair of wrinkled lobes which extended posteriorly forming a sheath (Figs 21–22). Aedeagus very short, tubular, narrowed basally, gradually broadened to the distal two third, and then narrowed to end again (Figs 22–23). Compressor apodeme and anterior immovable apodeme both directed ventrally (Fig. 23).

Genital bridge. W-shaped basally. Terminated into two narrowed lobes, the dorsal one longer than the ventral one (Fig. 24).

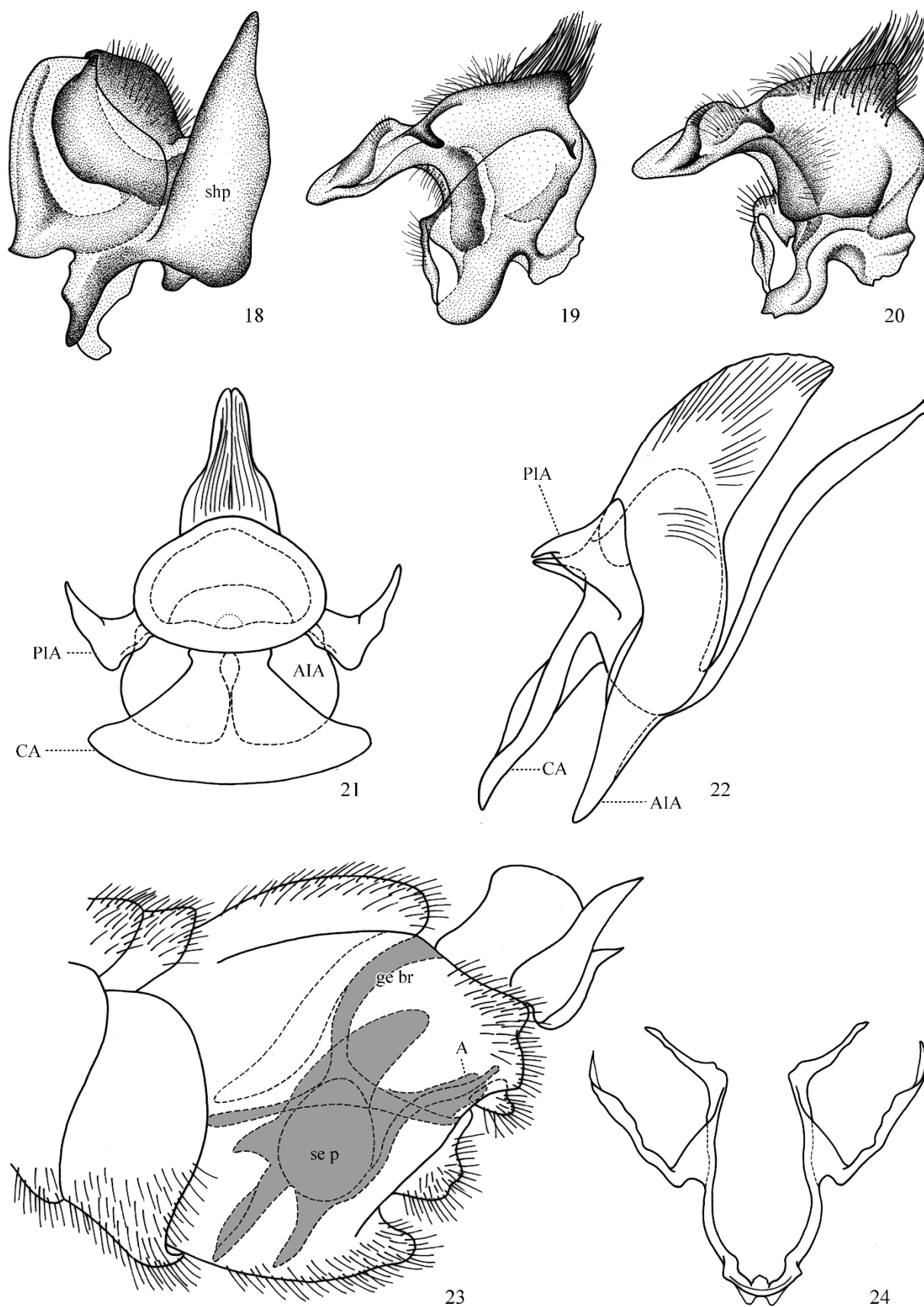
Ovipositor. Elongated. Tergite nine very short, dark brown (Figs 25–26). Sternite nine broad basally, narrowed to the median region, and then gradually broadened forming a fusiform part, finally terminated into an acute apex in dorsal view (Figs 7–8, 27–28). Tergite ten yellow. Sternite eight brown, longer than tergite ten (Figs 25–26). Cercus elongated, acinacifoliate, obtuse apically (Fig. 25). Hypogynial valve broad at base, narrowed to apex, distinctly shorter than cercus (Figs 7–8, 25–26). Vaginal apodeme broad basally, narrowed to apex (Fig. 29).

Male internal reproductive system. Consisting of a pair of accessory glands generating from the distal end of seminal vesicle which extended posteriorly into ejaculatory duct, a pair of vasa deferentia linking to paired testes anteriorly and converged into a common vas deferens which receiving to seminal vesicle posteriorly (Fig. 30). Ejaculatory duct relatively elongated, longer than the common vas deferens, flexible and spiral (Fig. 30). Seminal vesicle ball-shaped, leading to the proximal end of common vas deferens, running posterior to the apex of ejaculatory duct (Fig. 30). Accessory glands being a pair of elongated tubes, simple and sinuous, arising from base of seminal vesicle, very elongated (Fig. 30). Vas deferens short and stout, slightly shorter than common vas deferens, very smooth (Fig. 30). Testis, an elliptical structure (Fig. 30).

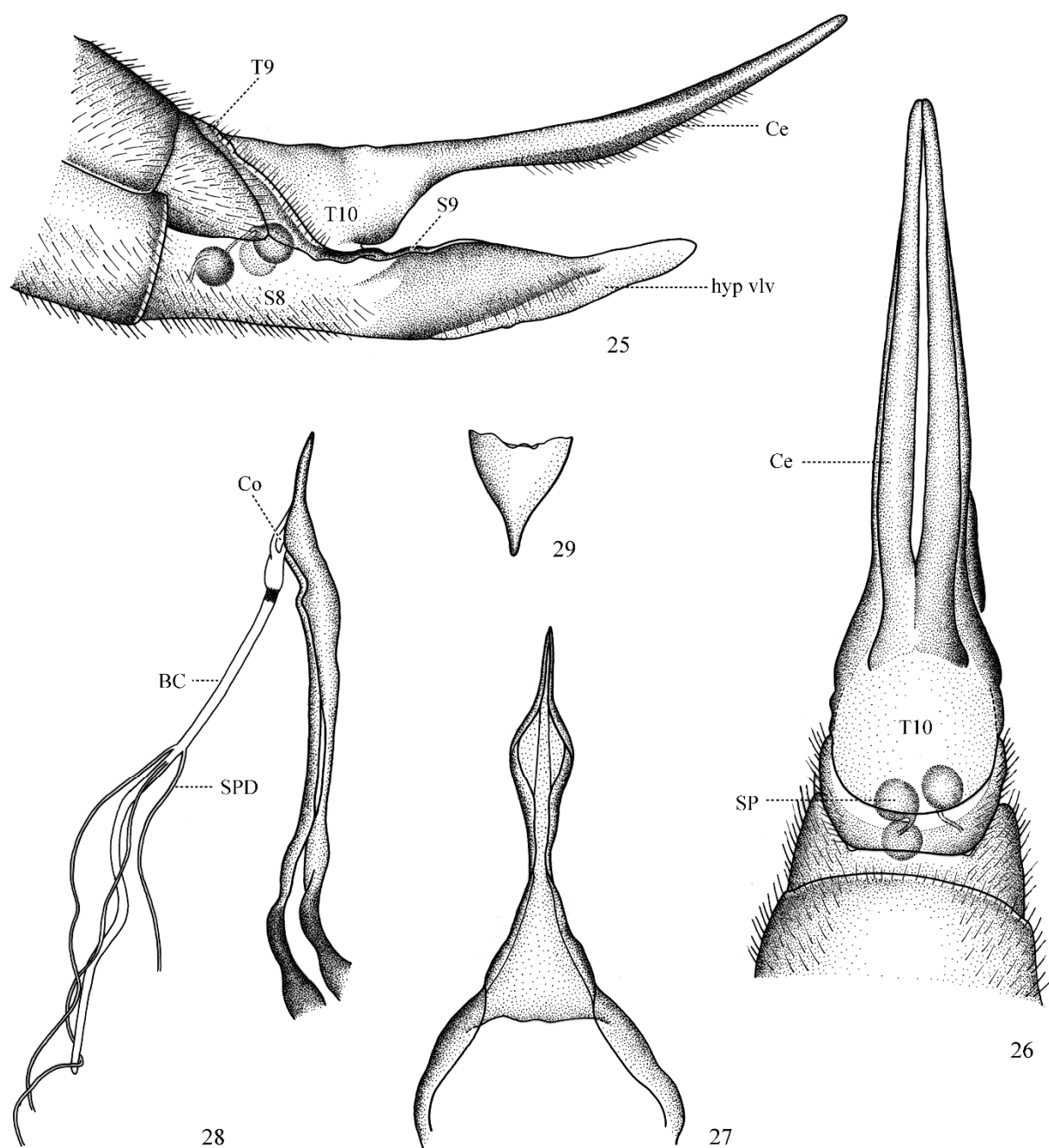
Female internal reproductive system. Consisting of a pair of accessory glands connected to bursa copulatrix by a short stem respectively, three spermathecae with responding spermatheca duct (Fig. 31). Bursa copulatrix relatively short and tough, generated from the ventral side of sternite nine, with a strongly sclerotized region near the copulatory opening (Fig. 31). Accessory gland arising from the base of bursa copulatrix, narrowed basally and terminated into an oval and swollen ball, densely covered with small dots (Fig. 31). Spermatheca three, spherical and black, bigger than the expanded end of accessory gland (Fig. 31). Spermathecal duct slender, half the thickness of bursa copulatrix, flexible, arising from the middle of bursa copulatrix and leading to the spermatheca by black internal tube which broadened and strongly sclerotized; the connection points of three spermathecal ducts with bursa copulatrix not at same level (Fig. 28).



Figures 9–17. *Brithura triprocessa* Men & Liu **sp. nov.** 9. Hypopygium, lateral view. 10. Tergite nine, dorsal view. 11. Tergite nine, caudal view. 12. Sternite nine, caudal view. 13–17. Outer gonostylus, rotate clockwise.



Figures 18–24. *Brithura triprocessa* Men & Liu **sp. nov.** 18. Outer gonostylus, rotate clockwise. 19. Inner gonostylus, inner view. 20. Inner gonostylus, outer view. 21. Semen pump, dorsal view. 22. Semen pump, lateral view. 23. Perspective of hypopygium, gray regions show the position of semen pump, genital bridge and adminiculum. 24. Genital bridge, dorsal view.



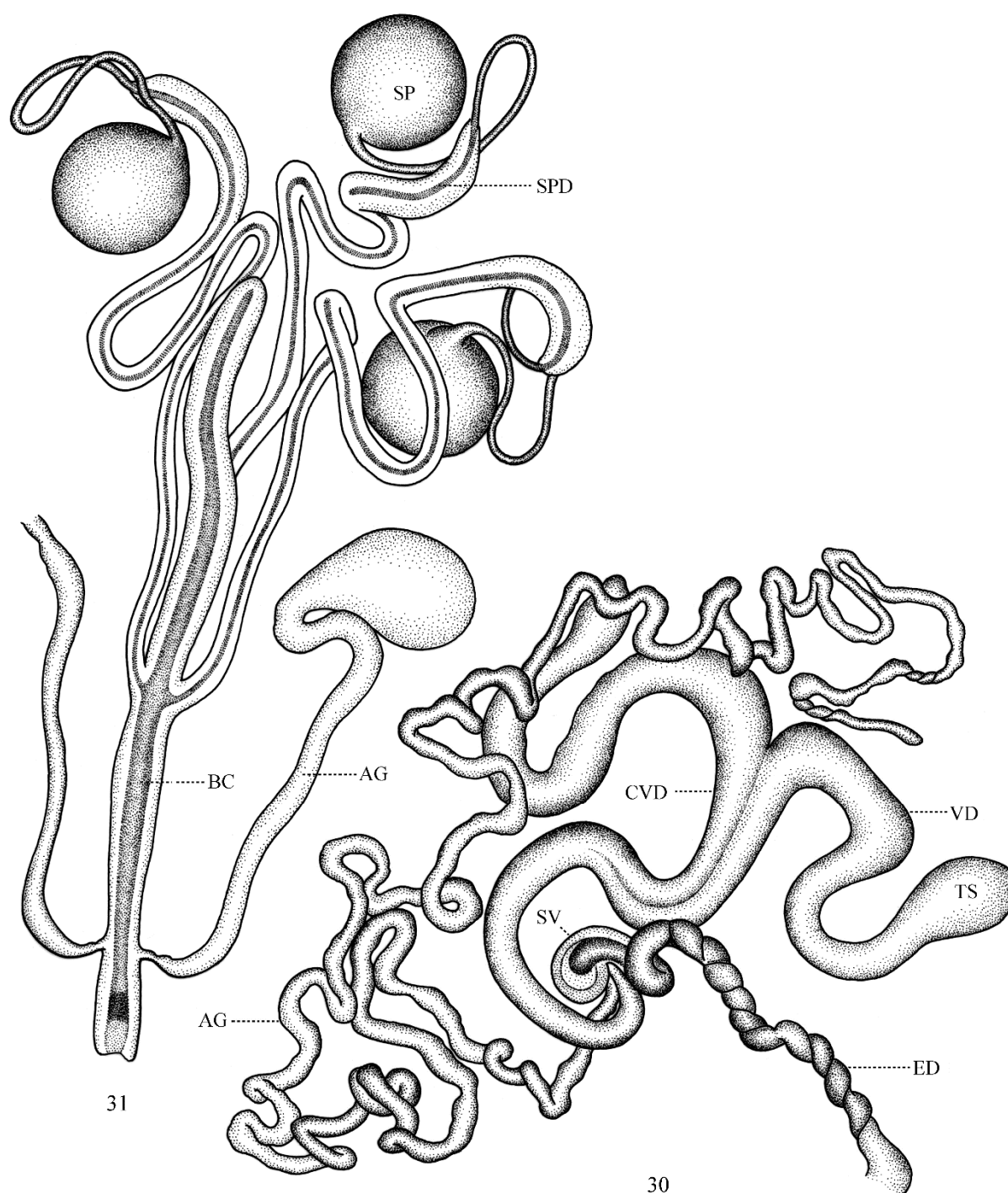
Figures 25–29. *Brithura triprocessa* Men & Liu **sp. nov.** 25. Ovipositor, lateral view. 26. Ovipositor, dorsal view. 27. Sternite nine, dorsal view. 28. Sternite nine and inner tube of female internal reproductive system, lateral view. 29. Vaginal apodeme, dorsal view.

Material examined. Holotype male, China, Anhui Province, Yuexi, Yaoluoping National Nature Reserve, 12 August 2013, leg. Qiulei Men. Paratypes. 4 females, same data as holotype; 9 males, 8 females, 22 August 2016, others same data as holotype; 6 males, 20 females, 12 August 2018, leg. Qiulei Men, Lei Yang, Weiguang Liu, others same data as holotype. All deposited in ANU.

Distribution. China (Anhui).

Remarks. The new species is most similar to another Chinese species *B. stigmosa* Liu & Yang, 2010 in body color, vein pattern and shape of outer gonostylus. It can be separated from the latter by the 9th tergite with two horn-shaped processes (absent in the latter), by the inner gonostylus terminating into a narrowed apex (not changing to a narrowed end in the latter).

Etymology. The specific epithet is a noun ‘*processa*’ with Latin prefix ‘*tri*’, referring to the outer gonostylus having three processes.



Figures 30–31. *Brithura triprocessa* Men & Liu **sp. nov.** 30. Male internal reproductive system. 31. Female internal reproductive system.

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