

Tinodes species (Trichoptera: Psychomyiidae) from The People's Republic of China

Youwen J. Li and John C. Morse

Department of Entomology
Clemson University, Clemson, SC 29634-0365, USA

Abstract: Five species of the genus *Tinodes* from the People's Republic of China are described and re-described, among which four species are new to science. A key to males of all five species and a key to females of two species are given.

Keywords: Oriental biogeographic region, new species, China, male genitalia, female genitalia.

Introduction

More than 170 species of the genus *Tinodes* have been found in the world. However, only one species has been described from mainland China previously. In the present study, four new species are added from southern China, based primarily on material collected in a joint expedition by Nanjing Agricultural University, People's Republic of China (PRC), and Clemson University, USA, in 1990.

Materials and Methods

All specimens were collected by using 15-watt ultraviolet light traps and are preserved in 75% ethyl alcohol. All genitalia used for illustrations were cleared with 10% KOH and each set is now kept in glycerine in a microvial in a vial of 75% ethanol with the rest of the specimen. Type specimens are deposited in Nanjing Agricultural University (NAU), PRC, and the Clemson University Arthropod Collection (CUAC), South Carolina, United States of America.

The terminology for head warts is that of Ivanov (1990). The terminology for female genitalia is that of Schmid (1980). Terms for male genitalia and wing venation are from Botosaneanu (1992) unless otherwise indicated.

Genus *Tinodes* Curtis, 1834

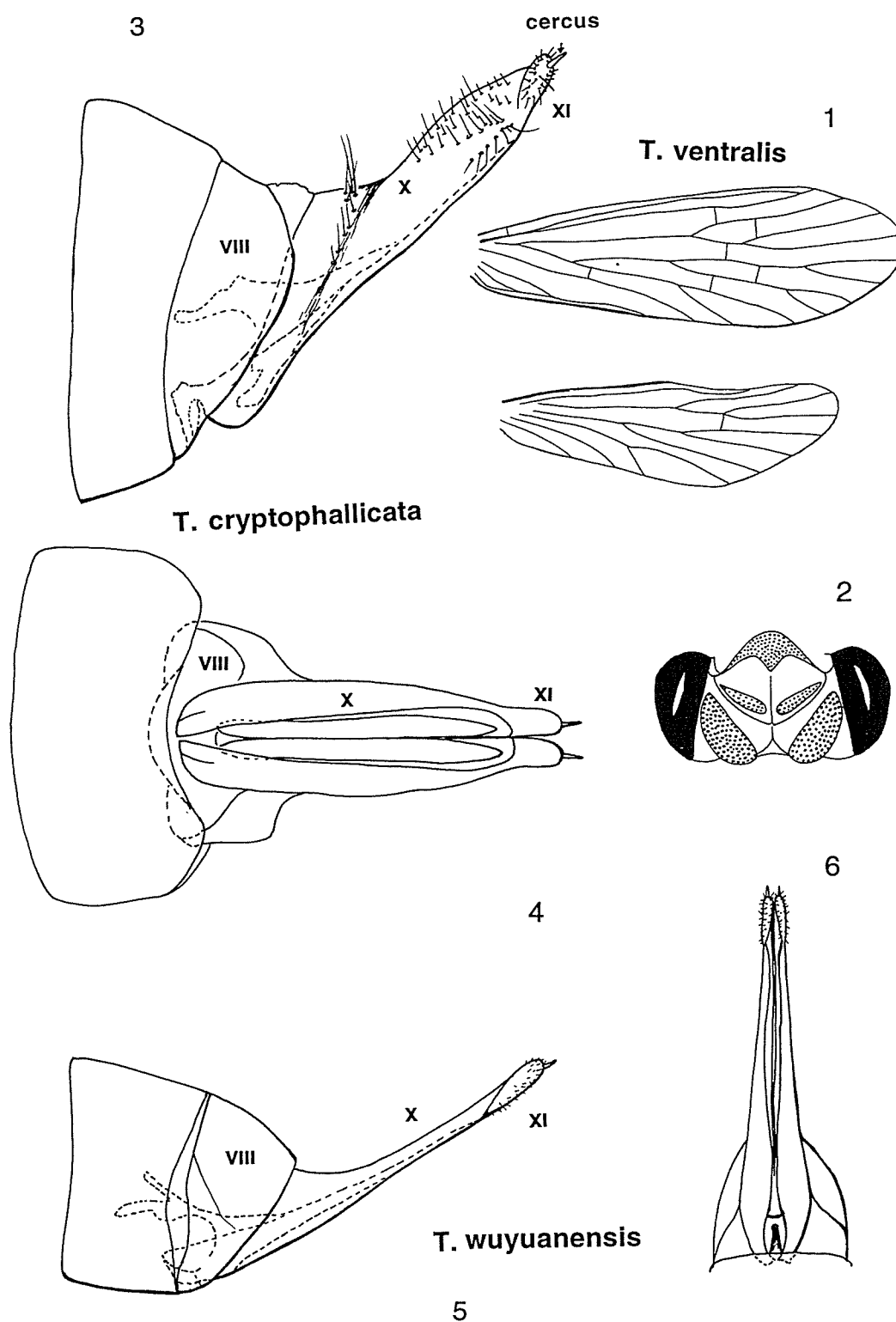
Tinodes Curtis, 1834: 216. Type species: *Tinodes lurida* Curtis (monobasic), synonym of *Phryganea waeneri* L.

Description. Frontal wart fused with two antennal warts laterally. Ocellar warts long, ovoid, not expanded anteriorly. Occipital warts large and oval (Figure. 2). Maxillary palpi each five-segmented, with first segment shortest, third segment longer than second, fourth about same as third, fifth longest. Labial palpi three-segmented, last segment longest. Anterior wings round apically, each

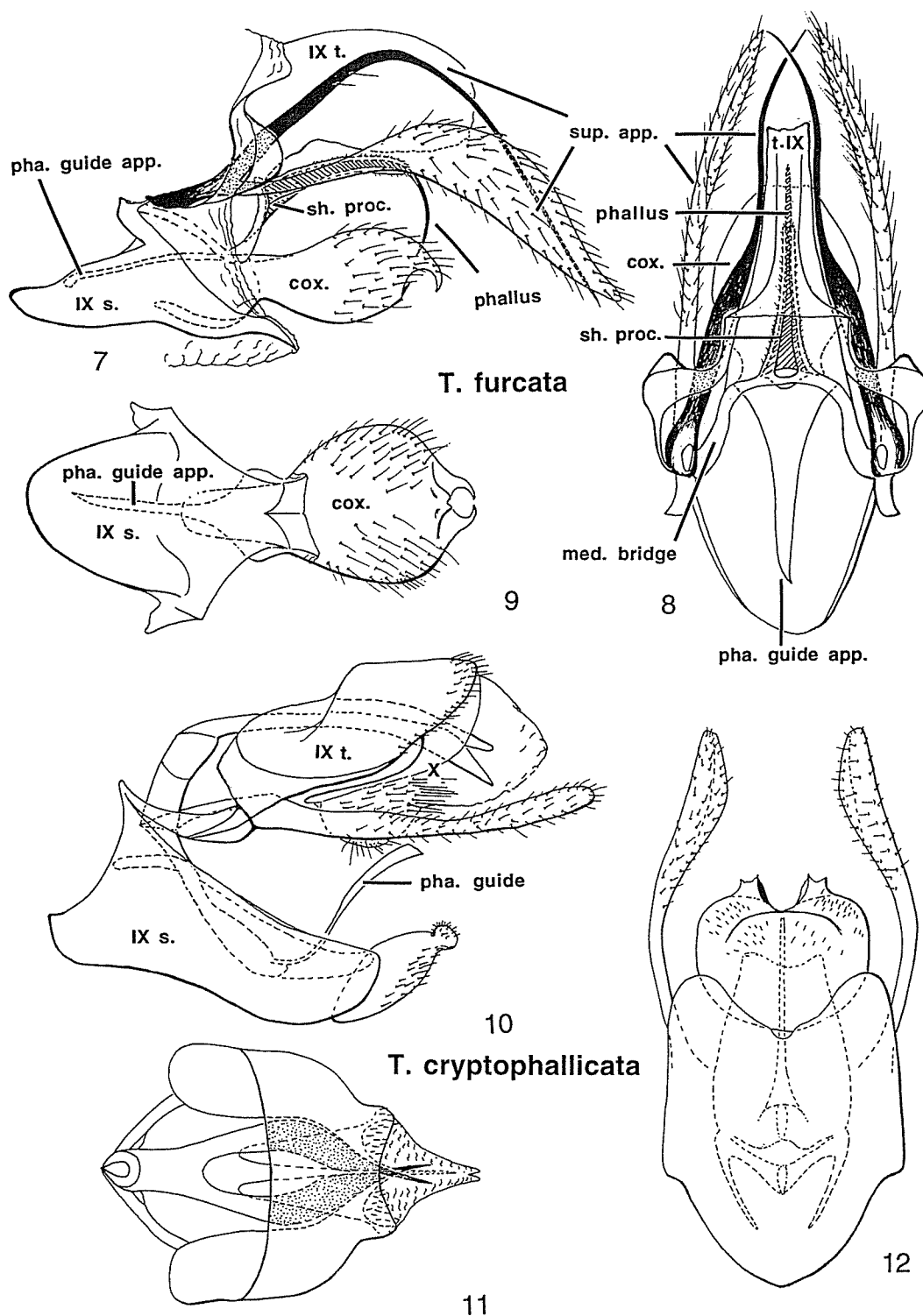
with apical forks II, III, IV, V. Posterior wings each with forks II, III, V; costal margin with rounded projection in the middle (Figure. 1). Spur formula: 2, 4, 4. Female middle tibiae not dilated.

Male genitalia (Figs. 7-9). Tergum IX narrow, apron-like in dorsal view with "apron" extended caudad and covering remainder of genitalia and antero-lateral "strings" narrow, jointed with dorsal edges of sternum IX. Sternum IX well developed, broad in ventral view; its anterodorsal corners extended dorsally and joining each other at middle, forming "median bridge" (= sclerite of genital chamber of Botosaneanu, 1992) to support base of phallus (= phallic complex of Botosaneanu, 1992). Superior appendages each long, slender, and hairy, arising near conjunction of sternum and tergum, single or forked at base. Enormous fused coxopodites of inferior appendages as wide as sternum IX, with various projections; harpago much smaller than coxopodite, rooted subapically on mesal surface of coxopodite; phallic guides fused, forming single acute mesal projection from dorsal side of fused coxopodites, extended posteriorly and with long anterior horizontal apodeme. Pair of processes arising from "median bridge," close by phallobase (= phallus proper of Botosaneanu, 1992), fused partially or completely around phallobase forming "phallic sheath," with various number of posterior processes or no processes. Phallobase variously-shaped, simple, long tube, sclerotized or membranous, with or without spines. Phallicata (= aedeagus of Botosaneanu, 1992) absent or oval plate with central long, fine ejaculatory duct projection (not mentioned by Botosaneanu, 1992) at middle of phallobase. Parameres (not mentioned by Botosaneanu, 1992) present or absent.

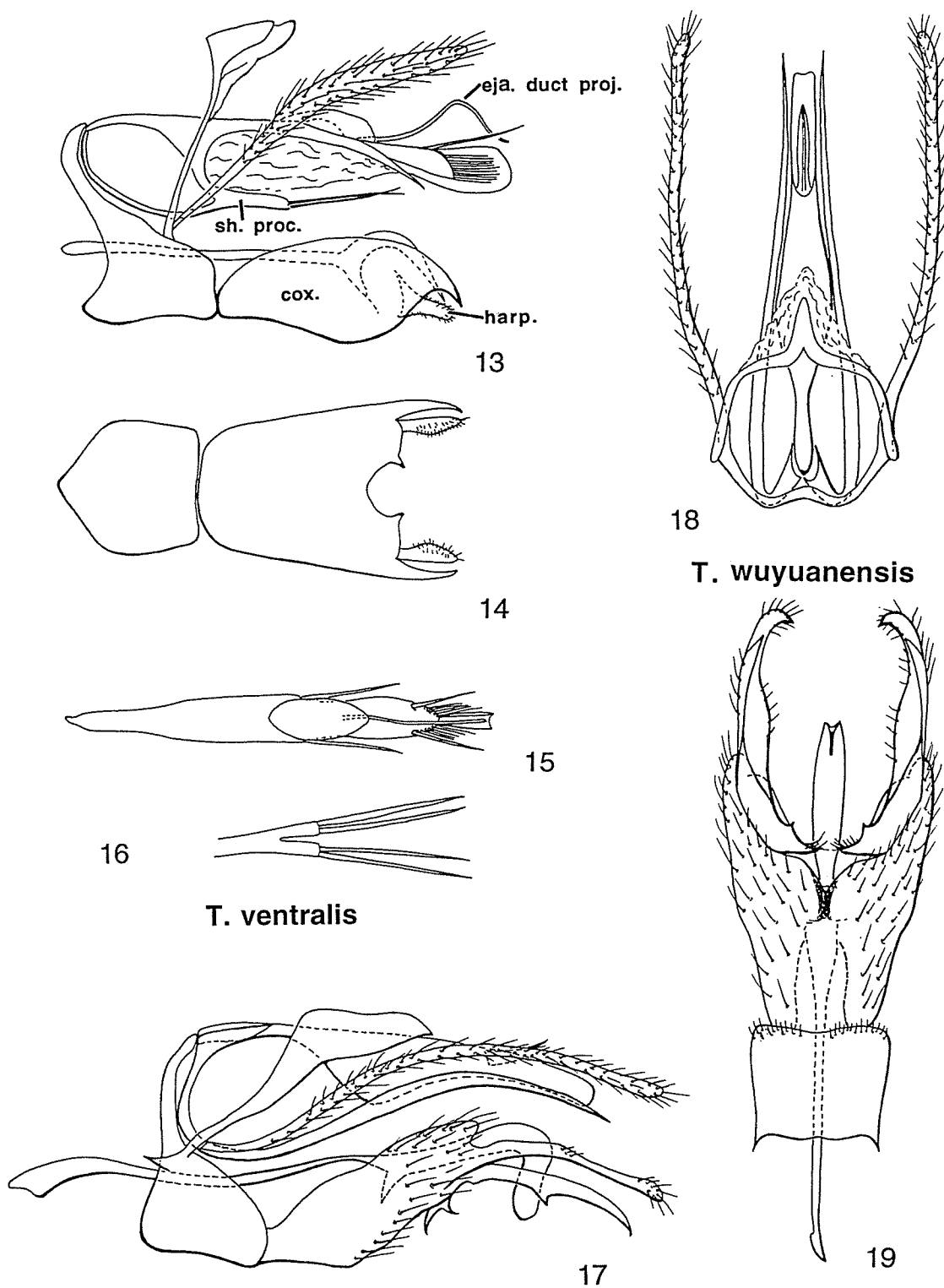
Female genitalia (Figs. 3-4). Female genitalia involve segment VIII - XI. Segment VIII normally long. Segment IX reduced, inconspicuous. Segment X at least twice longer than segment VIII, tapering toward apex, with or without transverse



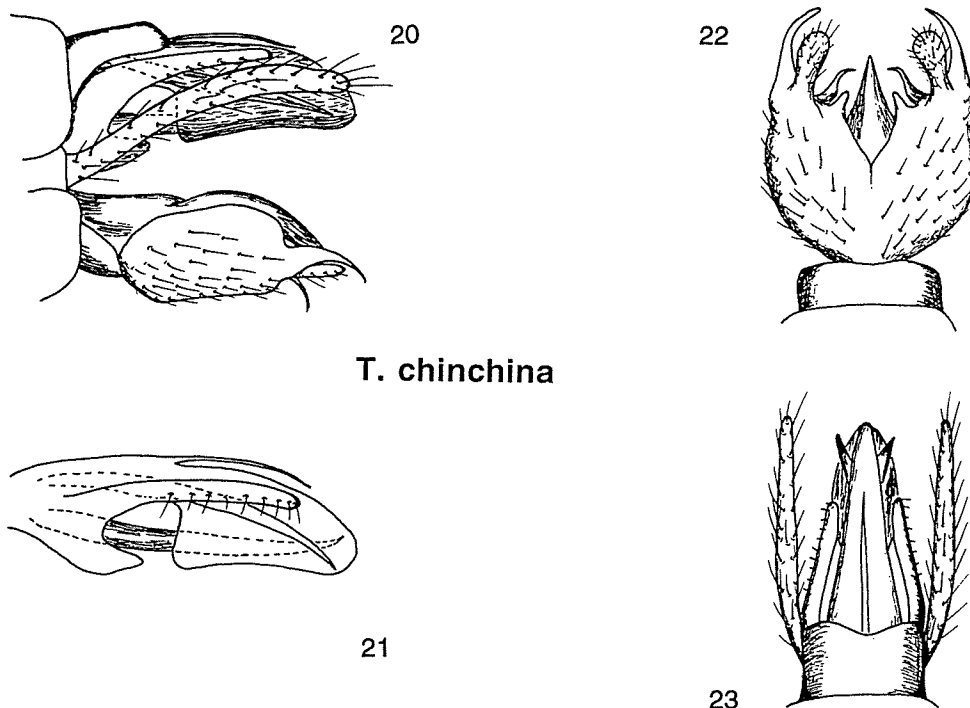
Figs. 1-6. Adults of *Tinodes* spp. 1. Vertex of *Tinodes ventralis*, sp. n. 2. Right fore and hind wing of *Tinodes wuyuanensis*, sp. n. 3. Female genitalia of *Tinodes cryptophallicata*, sp. n. 3, lateral. 4. same as 3, ventral. 5. Female genitalia of *Tinodes wuyuanensis*, sp. n. left lateral; 6., same as 5, ventral.



Figs. 7-12. Male genitalia of *Tinodes furcata*, sp. n., and *T. cryptophallicata*, sp. n. 7. *T. furcata*, left lateral; 8, same as 7, dorsal; 9, same as 7, ventral; 10. *T. cryptophallicata*, sp. n. left lateral; 11, same as 10, ventral; 12, same as 10, dorsal. eja. duct proj. = ejaculatory duct projection; IX s. = sternum IX; IX t. = tergum IX; med. bridge = median bridge; pha. guide = phallic guide; pha. guide app. = phallic guide apodeme; sh. proc. = phallic sheath process; sup. app. = superior appendage.



Figs. 13-19. Male genitalia of *Tinodes ventralis* sp. n., *T. wuyuanensis* sp. n. 13, *T. ventralis* sp. n., left lateral; 14, same as 13, ventral; 15, same as 13, phallus, dorsal; 16, same as 13, 17. *T. wuyuanensis* sp. n., left lateral; 18, same as 17, dorsal; 19, same as 17, ventral. eja. duct proj. = ejaculatory duct projection.



T. chinchina

Figs. 20-23. Male genitalia of *Tinodes chinchina* Mosely (from Mosely 1942): 20, left lateral; 22, ventral; 23, dorsal.

ring of setae in middle, and with median ventral cleft. Segment XI short with pair of cerci not accompanied by papillae.

Distribution. Up to now, 177 species of the genus have been described from throughout the world. Most species (72%) are known from the Western Palearctic (84 spp.) and the Oriental (62 spp.) Biogeographic Regions. Others are reported from the Nearctic (14 spp.), Afrotropical (10 spp.), East Palearctic (6 spp.), Neotropical (3 spp.), and Australasian (2 spp.) Biogeographic Regions.

The *Tinodes* species now known from the People's Republic of China and the provinces from which they have been reported (all in the Oriental Biogeographic Region) include the following: *Tinodes chinchina* Mosely, 1942, from Fu-zhou ("Fochow"); *Tinodes cryptophallicata*, sp. n., from Jiang-xi; *Tinodes furcata*, sp. n., from Hu-bei, Jiang-xi, and Si-chuan; *Tinodes ventralis*, sp. n., from Si-chuan; and *Tinodes wuyuanensis*, sp. n., from Jiang-xi.

Key to males of *Tinodes* species from The People's Republic of China

1. Superior appendages forked at base (Figs. 7, 8), phallic sheath processes hairy and membranous

(Figs. 7, 8); inferior appendages without phallic guide (Fig. 7) *Tinodes furcata*, sp. n.

- 1'. Superior appendages each single, without fork (Figs. 10, 12); phallic sheath processes sclerotized, bare (Figs. 10, 11); inferior appendages with phallic guide (Fig. 10) 2

- 2(1'). Phallic sheath processes not fused with phallobase, directed ventrad at base, then caudad (Fig. 13); ejaculatory duct projection long and slender (Fig. 13) 3

- 2'. Phallic sheath processes fused with phallobase basally, directed dorsad, then caudad (Figs. 10, 11); phallus inconspicuous and ejaculatory duct projection absent (Fig. 11) *Tinodes cryptophallicata*, sp. n.

- 3(2). Inferior appendages each with four apical processes (Fig. 22) *Tinodes chinchina* Mosely.

- 3'. Inferior appendages each with two or three apical processes (Fig. 14) 4

- 4(3). Phallic sheath processes fused at base and fused again with phallus about 1/3 distance from base (Fig. 13); phallobase projecting well beyond phallicata and with pair of paramere spines and row of subapical bristles (Figs. 13, 15) *Tinodes ventralis*, sp. n.

- 4'. Phallic sheath processes never fused at base (Fig. 18); phallus simple, without paramere spines or

row of subapical bristles (Fig. 17)
 *Tinodes wuyuanensis*, sp. n.

**Key to known females of *Tinodes* species
 from The People's Republic of China**

1. Segment X 7.5 times as long as broad in middle in lateral view (Fig. 3); with transverse row of setae dorsally at middle (Fig. 3); pair of strips in median ventral cleft (Fig. 4)
 *Tinodes cryptophallicata*, sp. n.
- 1'. Segment X 18 times as long as broad in middle in lateral view (Fig. 5); without transverse row of setae at middle (Fig. 5); without pair of strips in median ventral cleft (Fig. 6)
 *Tinodes wuyuanensis*, sp. n.

***Tinodes furcata*, sp. n.**
 (Figures 7-9)

Body brown. Body length with folded wings: 5.0 mm.

Male genitalia. Mesal part of tergum IX long narrow rectangular in dorsal view, length about three times breadth, about two times breadth in lateral view. Sternum IX convex and round on anterior margin; posterior margin narrower, as wide as 1/3 at middle, v-shaped concave. Superior appendages forked, each with dorsal branch slender acute, curved ventrad; ventral branch hairy, basal 1/3 slender, expanded and compressed subapically, tapering to apex. Coxopodites round and fused almost completely in ventral view, inserted into segment IX deeply; posterior processes short, close to each other, curved ventrad, acute at apex in lateral view, curved mesad in ventral view; ventral processes very short, fused mesally. Harpagones not evident. Phallic guide absent. Phallic guide apodeme depressed, broad at base, tapering to anterior apex. Phallus simple spine-like, curved ventrad at middle, acute at apex; phallic sheath processes membranous hairy narrow bands, straight, about 2/3 length of phallus.

Holotype male. Zheng-shui-he, 15 KM N. E. of Ma-cheng, Ma-cheng-xian, Hu-bei, 250 m elevation, 13 July 1990, collected by, J. C. Morse (deposited in NAU). Paratypes: 1 male, Bai-sha-he, 6 KM W. of Guan-xian, Du-jiang-yan, Si-chuan, 780 m elevation, 19 June 1990, collected by L. YANG and X. CHEN (deposited in NAU); 1 male, Gan-xi, Shang-rao, Jiang-xi, July 1993, collected by L. LU (deposited in CUAC).

Distribution: The species is distributed in Hu-bei, Jiang-xi and Si-chuan Provinces of China, Oriental Biogeographic Region.

The species is peculiar for the forked superior appendages and the absence of a phallic guide. The coxopodites of the male are fused, somewhat similar those in *Tinodes cryptophallicata*, sp. n..

***Tinodes cryptophallicata*, sp. n.**
 (Figures 3-4, 10-12)

Body brown. Body length with folded wings: male 6.2 mm; female 5.8 mm.

Male genitalia (Figures 10-12). Tergum IX broad, concave on anterior margin, with narrower posterior portion in dorsal view. Anterolateral arms narrower suddenly from middle to apices. Sternum IX broad, anterior margin convex, posterior margin concave. Tergum X pair of compressed hairy plates under tergum IX. Superior appendages straight in lateral view, slightly expanded mesad before apex in dorsal view, blunt at apex. Coxopodites almost completely fused, forming flat plate, with two short truncated processes on posterior margin; harpagones inconspicuous. Phallic sheath processes fused with phallobase basally, acute apically. Phallus very slender, inconspicuous; basal plate of phallus very broad, slightly narrower than fused coxopodites; phallic guide slender, directed dorso-caudad, arising from sternum XI, not coxopodite, from middle of basal plate; finger-shaped lobe arising from each side of basal plate directed anterad; pair of basal strips connecting base of basal plate to median bridge; phallic guide apodeme absent.

Female (Figures 3-4). Sternum VIII membranous. Segment X with transverse row of setae and somewhat more slender at middle in lateral view, 7.5 times as long as broad at that point. Segment X with pair of slender longitudinal sclerites inside of ventromesal cleft.

Holotype male. 80 km S. of Yu-shan, San-ting-shan, Xuan-xi-he, Yu-shan-xian, Jiang-xi, 27-28 May, 1990, 470 m elevation, collected by J. C. Morse and Sun C (deposited in NAU). Paratypes: 5 males 2 females, 57 N. of Wu-yuan, Qin-huan-he, Wu-yuan-xian, Jiang-xi, collected by J. C. Morse and L. Yang (deposited in CUAC).

The species is distributed in Jiang-xi Province of China, Oriental Biogeographic Region.

The species is unusual in the structure of the male genitalia, with very big, flat phallic basal plate, and with a vestigial phallus and no phallic guide apodeme.

Tinodes ventralis, sp. n.

(Figures 1, 13 - 16)

Body brown. Body length with folded: male 3.8 mm.

Male genitalia. Tergum IX small, triangular, with posterior angle blunt, lateral arms slender. Sternum IX with anterior margin angled at middle, posterior margin straight. Superior appendages each slender basally, slightly thickening to middle, tapering to apex. Coxopodites fused mesally, with semicircular mesal excavation between them on posterior margin; in lateral view, each tapering to acute ventrad apex; in ventral view, ventral process short and broad, with small mesal teeth; harpago finger-shaped, arising from inner subapical margin of coxopodite; phallic guide acute at apex, curved ventrad; phallic guide apodeme straight and slender, extending anterad beyond anterior margin of sternum IX. Phallic sheath processes curved ventrad under phallobase, fused mesally to each other for most of their length, each forked only at apex, with two apical spines on each fork; reunited with ventral side of phallobase in middle; phallobase very large and complicated; apex compressed, transparent, each side with row of subapical spines; middle with pair of acute lateral processes (parameres ?) at each side of phallobase beneath phallicata; phallicata above middle of phallobase composed of oval plate with slender ejaculatory duct projection arising from middle.

Female unknown.

Holotype male. Fei-long River, Si-mian-shan, Jiang-jin-xian, Si-chuan, 7 July 1990, 800 m elevation, collected by L. Yang (deposited in NAU).

The species has been found only at the type locality in Si-chuan Province of China, Oriental Biogeographic Region.

The species is probably closely related to *Tinodes reuso* Malicky, 1993, as suggested by the very similar inferior appendages with the short and broad ventral process of the fused coxopodites and the finger-like harpagones. However, *T. reuso* has four phallic sheath processes which are not refused with the ventral side of the phallus and does not have rows of subapical spines on the phallus nor lateral spines of the phallobase.

Tinodes wuyuanensis, sp. n.

(Figures 2, 5-6, 17-19)

Body brown. Body length with folded wings: male 4.4 mm; female 4.6 mm.

Male genitalia. Tergum IX as narrow as phallus in dorsal view; lateral strip narrow, forming

small acute anterior spine after joining sternum IX. Sternum IX square in ventral view. Each superior appendage airy, long, slender, blunt at apex. Coxopodites fused mesally for two-thirds their length; in lateral view, each coxopodite directed obliquely dorsocaudad with slender posterior lobe as long as basal part. Harpagones sickle-shaped, each arising subapically from inner-posterior margin of its coxopodite and nearly as long as posterior lobe of coxopodite; phallic guide apodeme slender, as long as phallus, slightly expanded at anterior apex; phallic guide single, curved ventrad at middle, with dorsal groove at basal half, apical half compressed, rounded at apex in lateral view. Phallus long, fully sclerotized, expanded ventrad at middle; ejaculatory duct projection short, arising from dorsal socket at one-third length from base of phallus; median bridge arched; phallic sheath processes directed ventrad basally then arched caudad, long and slender, straight and acute at apex, extending beyond apex of phallus.

Female genitalia. Sternum VIII separated as two triangular sclerites. Segment X slender, 18 times as long as broad in middle in lateral view, tapering evenly to segment XI in dorsal or ventral view, without transverse row of setae dorsally and without pair of longitudinal sclerites ventrally.

Holotype male. Qin-hua-he, 57 KM, N. of Wu-yuan, Wu-yuan-xian, Jiang-xi, 25 May 1990, 250 m elevation, collected by J. C. Morse, L. Yang and C. Sun (deposited in NAU). Paratypes: 4 males, same locality as holotype (3 deposited in NAU, 1 in CUAC).

The species is similar to *Tinodes lebeli* Malicky, 1993, in the male genitalia with separated phallic sheath processes directed ventrad basally. However, the differences are obvious: the sheath processes are much longer, extending beyond the apex of the phallus in the new species; the sheath processes are slender, without any spines (broader at base and with several long setae in *T. lebeli*); and the harpagones are sickle-shaped and arise subapically (each forming a short, straight club in *T. lebeli*).

Distribution. The species is only found in the type location in Jiang-xi Province of China, Oriental Biogeographic Region.

Tinodes chinchina Mosely, 1942

(Figures 20-23)

Tinodes chinchina Mosely, 1942, p. 356.

Forewing length 3 mm.

Male genitalia. Tergum IX broadly rectangular with shallow, broad mesal excision on posterior

margin. Superior appendages long, slender and blunt apically. Phallic sheath processes fused at base, forming stem under phallus. Coxopodites mostly fused, with four apical processes; outer processes longer than others, acute; next inner processes (probably harpagones) hairy, round apically; next innermost ones sinuous, acute, arising from bases of next inner processes; ventral processes shortest, acute. Phallic guide broad at base, acute at apex. Phallus compressed, expanded apically; ejaculatory duct projection slender, one-third as long as phallus; pair of paramere spines beside phallus, reaching apex of phallus.

The following description was provided by Mosely (1942):

"Insect very small and yellow. Genitalia M. - Dorsal plate short, nearly square, with the apical margin excised; beneath it, attached to the upper penis-over, is a long slender, transparent spine; superior appendages long and rather stout, completely denuded of fringe on the upper surface in the example under description; penis and upper penis-cover obscure, as long as the superior appendages, wide from the side, with the upper margin curving over slightly to make a broad beak; a pair of fine, spine-like penis sheaths; inferior appendages branched; there is a very broad base from which the outer branch, a stout, curved spine, arises at the apex; the second and inner branch is slightly shorter than the outer and broad, with as obtuse apex; the third forms a short, very fine, curved spine, arching downward from the base of the second; the fourth arises from the inner margin of the appendage, below the other three as seen from beneath; inside the bases of the inferior appendages, and uniting them, is a single process, broad at the base with an acute, produced apex, curving downward, as seen from the side.

Length of the anterior wing M and F 3 mm."

This species is closely related to *Tinodes anibrita* Schmid, 1972, and *Tinodes higashiyama* Tsuda, 1942, as suggested by the compressed phallus, curved as a beak in lateral view. We have not yet studied the male genitalia of *Tinodes anibrita* and *Tinodes higashiyama*. However, from available information, it appears that the dorsal process of each inferior appendage is blunter from lateral

view and the ejaculatory duct projection arises closer to the apex of the phallus in *Tinodes anibrita* than in *Tinodes chinchina*. We are unable to distinguish *Tinodes chinchina* from *Tinodes higashiyama*; although we suspect that they are synonyms, we prefer to await making such a decision until we have seen variation in additional specimens.

The species is recorded only from the type locality in Fu-zhou, Fu-jian Province, China, Oriental Biogeographic Region.

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References

- Botosaneanu, L. 1992. Fauna Palaestina Insecta VI: Trichoptera of the Levant, Imagines. The Israel Academy of Sciences and Humanities. Jerusalem, 291 pp.
- Curtis, J. 1834. Description of some hitherto non-descript British species of mayflies of anglers. London and Edinburgh Philosophical Magazine and Journal of Science 4:120-125, 212-218.
- Ivanov, V. D. 1990. Structure and evolution of setose warts of caddisflies. Latvijas Entomologs 33:96 - 110.
- Malicky, H. 1993. Neue Trichopteren aus Thailand. Teil 1. Rhyacophilidae, Hydrobiosidae, Philopotamidae, Polycentropodidae, Ecnomidae, Psychomyiidae, Arctopsychidae, Hydropsychidae (Arbeiten über thailändische Köcherfliegen Nr. 12). Linzer Biol. Beitr. 25 (1):433-487.
- Mosely, M. E. 1942. Chinese Trichoptera: a collection made by Mr. M. S. Yang in Foochow. The Transactions of the Royal Entomological Society of London, 92 (2):343-362.
- Tsuda, M. 1942. Japanische Trichopteren I. Systematik. Memoirs of the College of Science, Kyoto Imperial University, Series B, 17 (1):239 - 339.
- Schmid, F. 1972. Sur quelques nouvelles Psychomyiines tropicales (Trichoptera: Psychomyiidae). Le Naturaliste Canadien, 99 (3):143 - 172.
- Schmid, F. 1980. Les insectes et arachnides du Canada partie 7: Genera des Trichoptères du Canada et des États adjacents. Agriculture Canada, publication 1692. Quebec, Canada. 296 pp.