



A new species of the genus *Indolipa* Emeljanov, 2001 from China (Hemiptera: Fulgoromorpha: Cixiidae: Pentastirini), with a checklist of world species

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Abstract

The cixiid planthopper genus *Indolipa* Emeljanov, 2001 is revised taxonomically. Seventeen species are recognized of which one, *Indolipa gansuensis* **sp. nov.**, is new to science. *Indolipa kureongensis* (Distant, 1911) and *I. gansuensis* represent the first record of the genus for the Palearctic Region. A list of all known species of the genus *Indolipa* is given as well as new descriptions, illustrations and an identification key to Chinese species.

Key words: planthopper, Homoptera, Auchenorrhyncha, Fulgoroidea, morphology, distribution

Introduction

The cixiid planthopper genus *Indolipa* was erected by Emeljanov (2001) to accommodate 16 species from the Oriental Region formerly assigned to the genus *Oliarus*. Emeljanov (2001) characterised the genus as follows: “Basal laterodorsal angle of apical dilation of stylus usually with tooth. Lobes of pygofer symmetrical or nearly so, without marked projection or processes.” These features separate the genus *Indolipa* from the other *Oliarus*-like genera.

The current paper provides additional characters at the generic level, supplementing the original description given in Emeljanov’s (2001) key and expanding the generic concept.

Generally, the most important diagnostic features distinguishing *Indolipa* from other Pentastirini are those of the male genitalia, especially the characteristic genital styles and uniform shape of the anal segment.

In addition, a new species is described from China, *I. gansuensis* Feng, **sp. nov.**, bringing the number of recognized species in this genus to 17 (list provided below).

Material and methods

Specimens were dissected by removing the abdomen with a pin. The abdomen was then macerated in a 1.5ml PVC centrifuge tube, containing 10% NaOH, for about 12 hours or put in a centrifuge tube in a hot water bath for 10 to 20 minutes. Prior to examination of the aedeagus, the abdomen is washed in distilled water 3 to 5 times and a drawing is made of the anal segment and pygofer (this is necessary as the pygofer might be damaged upon removal of the aedeagus). The aedeagus is carefully removed by using pins and forceps. Observations and drawings are done in glycerine under a LEICA MZ12.5 anatomy stereoscopic microscope fitted with a drawing tube and mirror, often a small amount of cotton fiber is added to keep the parts still from moving during the course of drawing. After examination the abdomen is stored in a PVC microvial containing a small amount of glycerine and reassociated with the mounted specimens.

Specimens examined during the course of this study are deposited in the Entomological Museum, Northwest A & F University (NWAUFU).

The morphological terms applied in this paper mainly follow Van Stalle (1991) apart from the nomenclature applied to the venation of the tegmen and the hind wing following Anufriev & Emeljanov (1988).

The following measurements were taken in this study:

- body length: tip of head to tip of forewing
- width of vertex: width level with tip of basal emargination
- length of vertex: apical transverse carina to most caudal limits of vertex
- width of frons: at level of frontoclypeal suture
- length of frons: apical transverse carina to frontoclypeal suture, in median line
- width of forewing: at level of apex of clavus
- length of forewing: base to tip of wing
- Chaetotaxy: $a / b = [\text{number of apical teeth on first hind tarsomere}] / [\text{number of apical teeth on second hind tarsomere}]$

Results

Genus *Indolipa* Emeljanov, 2001

Indolipa Emeljanov, 2001: 71.

Type species: *Oliarus indiensis* Van Stalle, 1991, by original designation.

Description. Body length: 5.4–8.9 mm.

Head. Vertex with angularly incised basal emargination; lateral carinae slightly elevated; subapical transverse carina various in shape, arcuate, U-shaped, angulate or almost straight, connected or not connected with apical border by two small longitudinal carinae; median longitudinal carina present, absent or only distinct at basal half of disc. Face with frons and postclypeus combined forming elongate hexagonal figure; position of maximum width of frons slightly dorsad of centre of frontoclypeal suture, the latter arched dorsally; median ocellus present but usually inconspicuous at centre of frontoclypeal suture.

Thorax. Pronotum short, with a distinct median carina and two intermediate carinae, posteriorly deeply and wide angulately emarginated in median area, curving laterally, collar-like. Mesonotum usually black with five concolorous or yellowish carinae. Tegmen without concavity at costal border, 2.7 to 3.4 times as long as broad, hyaline or translucent; granules (with or without setae) present along veins; venational pattern similar to genus *Oliarus* (Figs 1, 12), usually with 10 apical cells. Hind tibiae with 3–6 lateral spines. Chaetotaxy of hind tarsomere 6/5 or 7/5 in most species, less commonly 7–9/7. Hind tarsi without platellae.

Male genitalia. Anal segment with posterior margin forming a large retrorse, variously shaped apical lobe (Figs 3, 16). Genital styles symmetrical or nearly so, dilated apically, shaft short, excavated between base and dilated apex, with one acute or blunt tooth (Figs 10, 11, 21, 23) expanding laterally from posterior margin of excavation (basal laterodorsal angle of dilated apex of Emeljanov, 2001). Aedeagus structurally highly variable between species.

Female genitalia. Structurally variable among the included species. Posterior margin of pregenital sternite usually convex or shallowly excavated in middle, the latter bearing two small convex processes submedially. Ovipositor reduced, with first and second pair of valvulae comparatively thin, reduced in various degrees.

Distribution. China (Gansu, Tibet, Taiwan), Borneo, Burma (Rangoon), India, Malaysia, Singapore, Sri Lanka.

Remarks. This genus is recorded here for the first time from the Palaearctic Region (Gansu Province and Tibet Autonomous Region, China). Three species of *Indolipa* are so far known from China.

Key to Chinese species of *Indolipa* (based on males)

1. Right lateral sinuation of flagellum with a long rod-like apical process; basiventral process of periandrium not scoop-like 2
- Right lateral sinuation of flagellum with two long subparallel ribbon-like processes; basiventral process of periandrium scoop-like (Figs 6, 9) *Indolipa gansuensis* Feng, **sp. nov.**
2. Apical process of flagellum curving left-caudodorsally; basiventral process of periandrium spoon-like (Figs 18–20, 22) *Indolipa kurseongensis* (Distant, 1911)
- Apical process of flagellum curving caudoventrally; basiventral process of periandrium acute apically *Indolipa tappanus* (Matsumura, 1914)

Indolipa gansuensis Feng, **sp. nov.**

(Figs 1–11)

Description. Body length: ♂ 5.8 mm.

Head. Head fuscous, carinae and borders concolorous. Frons with median longitudinal carina prominent, forked near apex; frons flat but postclypeus swollen. Vertex about 1.4 times as long as broad, with obtusely angled basal emargination; subapical transverse carina deeply U-shaped, connected with apical border by two small longitudinal carinae; median longitudinal carina absent. Rostrum reaching hind coxae.

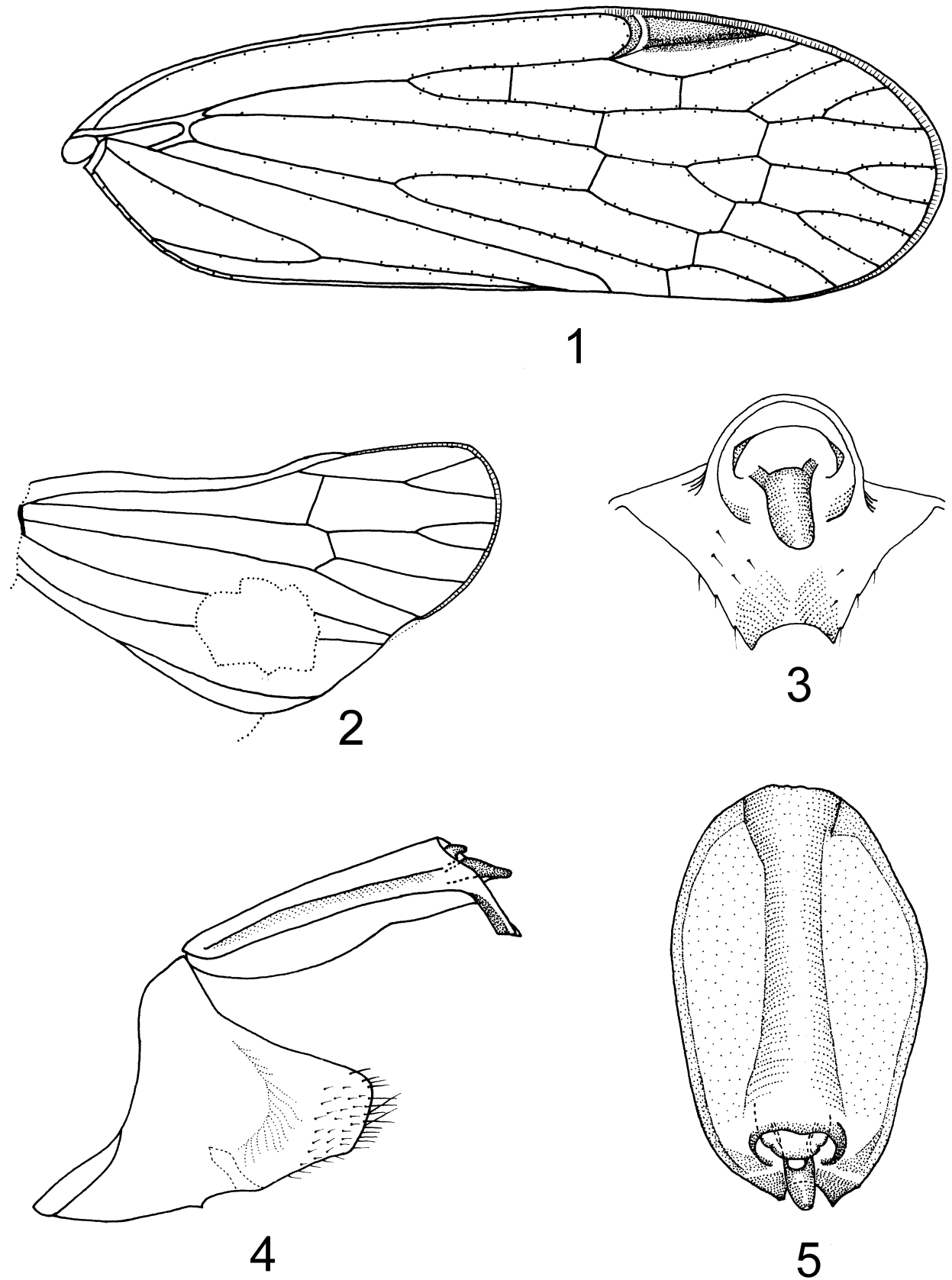
Thorax. Pronotum black, carinae and borders testaceous; hind margin obtusely angled. Mesonotum moderately flattened, black, with concolorous carinae. Tegmina whitish-hyaline, 3.0 times as long as broad; veins yellowish with dark brown granules without setae; pterostigma yellow-brown, elongate triangular; RA unbranched, RP apically trifurcated, MA apically bifurcated, MP apically bifurcated, CuA bifurcated; Sc+R forked at same level as fork CuA1+CuA2, r-m crossvein distinctly basad of fork MA+MP; apex with ten cells (Fig. 1). Claval veins Pcu and A1 united at centre of clavus (Fig. 1). Hind wing with MP and CuA1 complete terminal fusion (Fig. 2). Legs with femora brown, tibiae and tarsi yellowish; hind tibia with six apical teeth and three lateral spines. Chaetotaxy of hind tarsomere 7/5.

Male genitalia. Anal segment in dorsal view longer than wide, asymmetrical, right lateral margin more swollen than left lateral margin, apical lobe with ventral margin moderately excavated in middle, and with two convex projections laterally (Figs 3–5, 8). Pygofer with two small lateral protuberances; without ventromedian process (Fig. 7); lateral lobes of pygofer subtriangular, asymmetrical, with several setae along apical margin; outer borders of pygofer with semicircular, furrow-like sulcus near middle (Figs 4, 8). Genital styles greatly dilated apically, thumb-shaped in lateral view; caudal border subtruncate; margin and outer surface setose; shaft short; a deep excavation present between shaft and dilated apex; excavation large, its proximal margin smoothly rounded and bearing short, stout setae, its apical margin (i. e. basal laterodorsal angle of dilated apex (Emeljanov 2001)) with a tusk-like tooth (Figs 6, 9–11). Aedeagus wound helix-like. Flagellum convoluted with two sinuations, a right lateral one (Fig. 9) and a left lateral one (Fig. 6). Right lateral sinuation of flagellum with dorsal margin sclerotized, foliaceously elevated and terete or cylindric at base (Figs 6, 9). Aedeagus in total with 6 sclerotized processes. Flagellum with two long subparallel ribbon-like processes on right lateral sinuation, upper one long (broken off apically in the holotype), with apical portion (apical process) curving left-caudodorsally, lower one comparatively short, with apex acute, curving right-laterally, and with basal portion curving left-caudally, slightly dilated and round apically; a somewhat undulate process arising from midway of left lateral sinuation of flagellum; midway of dorsal side of left lateral sinuation of flagellum with a stout, bifurcated process, the upper ramus of bifurcation long and thin, the lower one short and stout. Apex of aedeagus with a big S-shaped process, tongue-like apically, two-thirds of ventral margin of process serrate (Fig. 6). Basiventral process of periandrium scoop-like, directed caudad (Figs 6, 9).

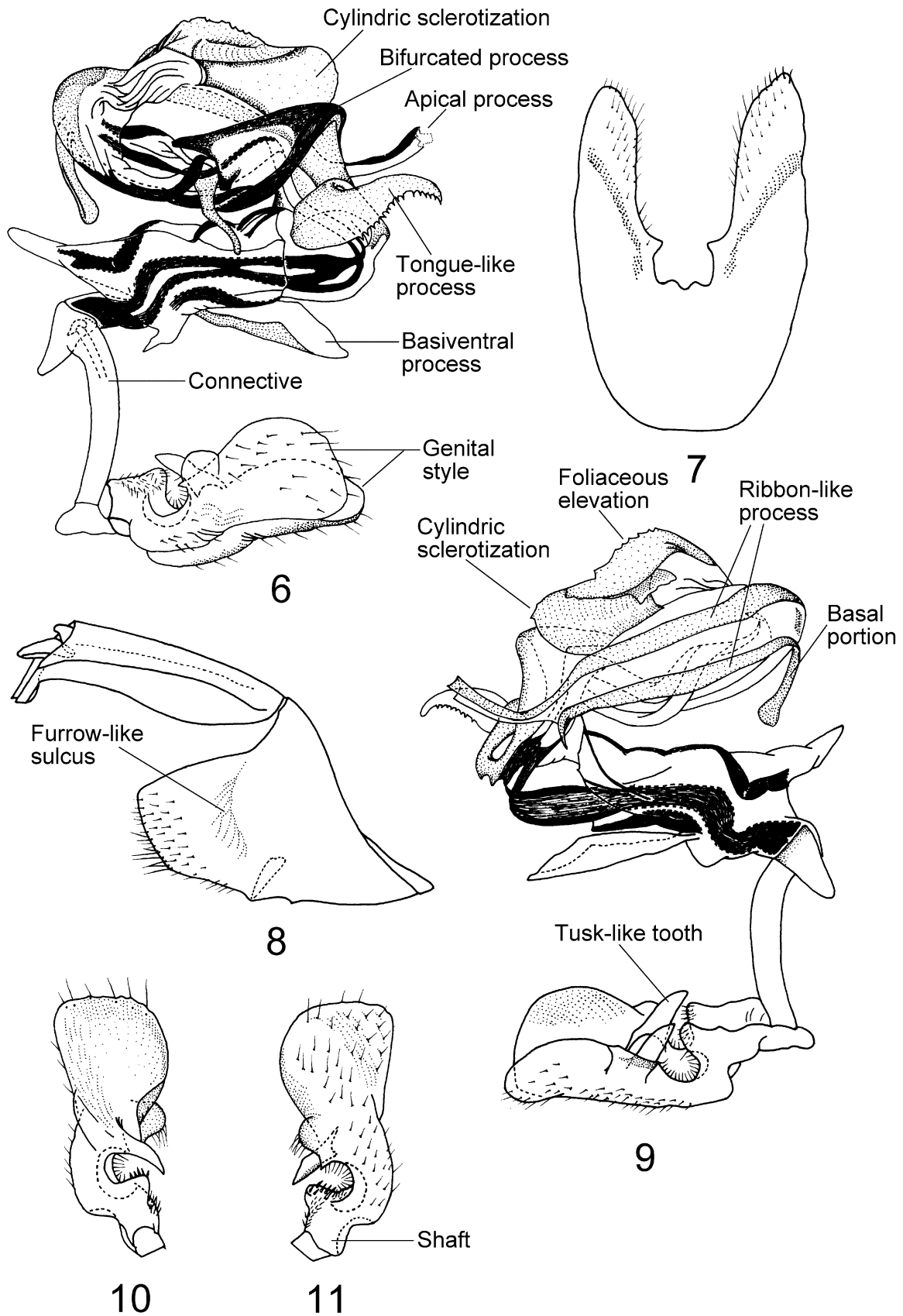
Female genitalia. Unknown.

Material examined. Holotype ♂, **CHINA:** Gansu Province, Kangxian County, Jincaifeng, 30-VII-1980 (Chun-Hua Yang) (NWAUFU).

Etymology. Named after Gansu, the type locality.



FIGURES 1–5. *Indolipa gansuensis* Feng, **sp. nov.** 1. right tegmen; 2. right hind wing (damaged); 3. anal segment, caudal view; 4. pygofer and anal segment, left lateral view; 5. anal segment, dorsal view.



FIGURES 6–11. *Indolipa gansuensis* Feng, sp. nov. 6. aedeagus, connective and genital styles, left lateral view (dotted line indicates where apical process of flagellum is broken off); 7. pygofer, ventral view; 8. pygofer and anal segment, right lateral view; 9. aedeagus, connective and genital styles, right lateral view; 10. left genital style, inner maximum view; 11. left genital style, outer maximum view.

Distribution. China (Gansu).

Remarks. *Indolipa gansuensis* is similar to *I. kurseongensis* and *I. tappanus* in external appearance and male genitalic configuration — the helix-shaped aedeagus; the apex of the aedeagus with a large S-shaped, apically tongue-like process; the uniform shape of the genital styles and the anal segment; and the pygofer without a ventromedian process. *I. gansuensis* differs from both by the following characters: 1) the processes of right lateral sinuation of the flagellum (*I. gansuensis* has two long subparallel ribbon-like processes, *I. kurseongensis* and *I. tappanus* have one produced rod-like process); 2) the processes of left lateral sinuation of the flagellum (*I. gansuensis* has a somewhat undulate process arising from midway, *I. kurseongensis* has a Y-shaped process arising from the basidorsal area, *I. tappanus* has no process); 3) the basiventral process of the periandrium (scoop-like in *I. gansuensis*, spoon-like in *I. kurseongensis*, but more acute in *I. tappanus*); 4) the processes in the basiventral area of the right lateral sinuation of the flagellum (*I. gansuensis* without process, *I. kurseongensis* giving rise to a sclerotized, basally sheet-like process which is divided into three processes and *I. tappanus* with two spine-like processes).

This new species here represents the first record of the genus *Indolipa* for the Palaearctic Region (China's Gansu Province).

***Indolipa kurseongensis* (Distant, 1911)**

(Figs 12–25)

Oliarus kurseongensis Distant, 1911: 737; Fennah, 1956: 451; Van Stalle, 1991:51.

Indolipa kurseongensis (Distant), Emeljanov, 2001: 72.

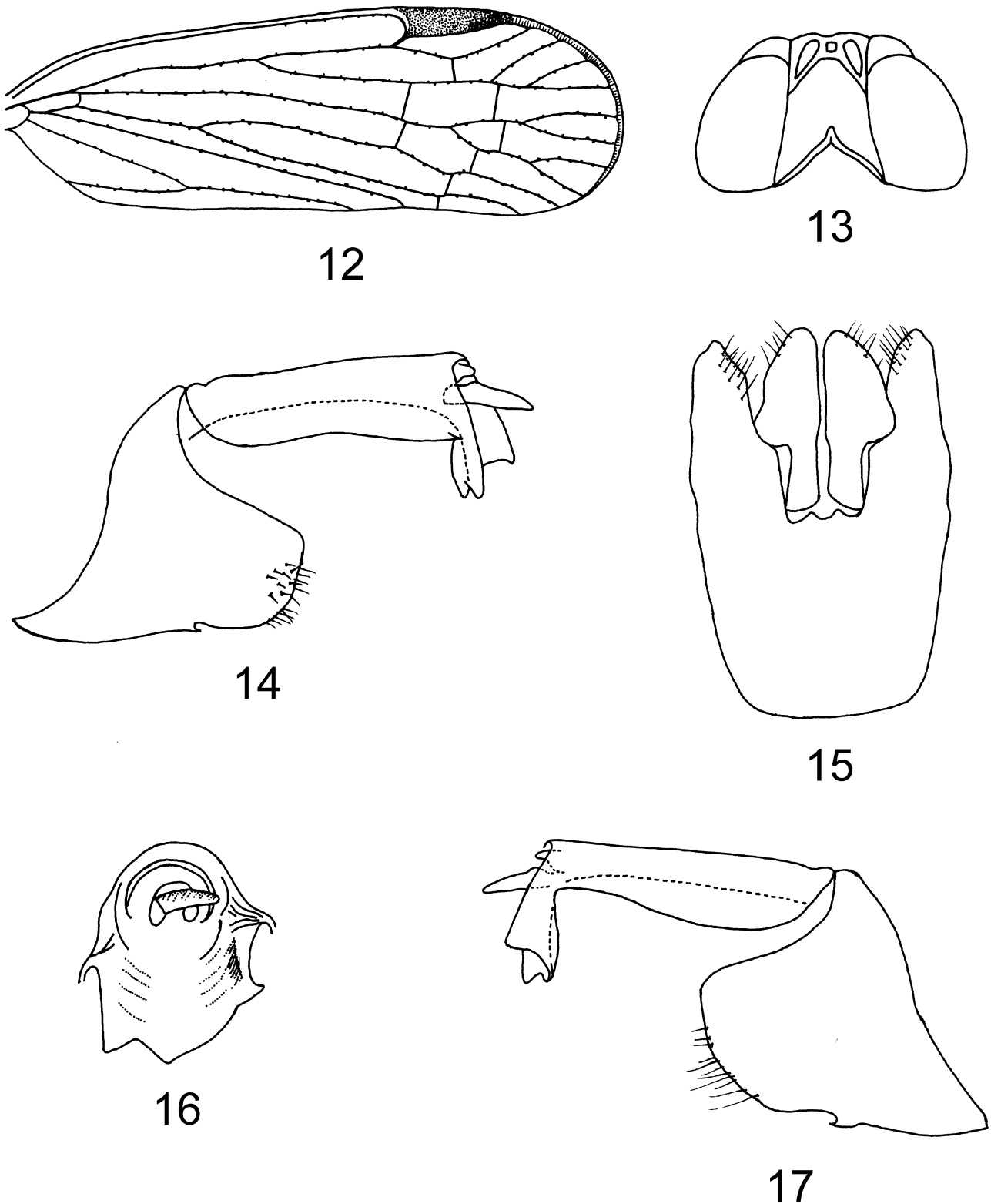
Description. Body length: ♂ 6.5–7.0 mm, ♀ 7.0–8.0 mm.

Head. Face piceous with carinae yellowish, median longitudinal carina prominent; median carina of frons forked at apex; frons flat but postclypeus swollen. Vertex about 1.8 times as long as broad, with obtusely angled basal emargination; subapical transverse carina V-shaped, connected with apical border by two small longitudinal carinae; median longitudinal carina absent (Fig. 13). Rostrum reaching hind coxae.

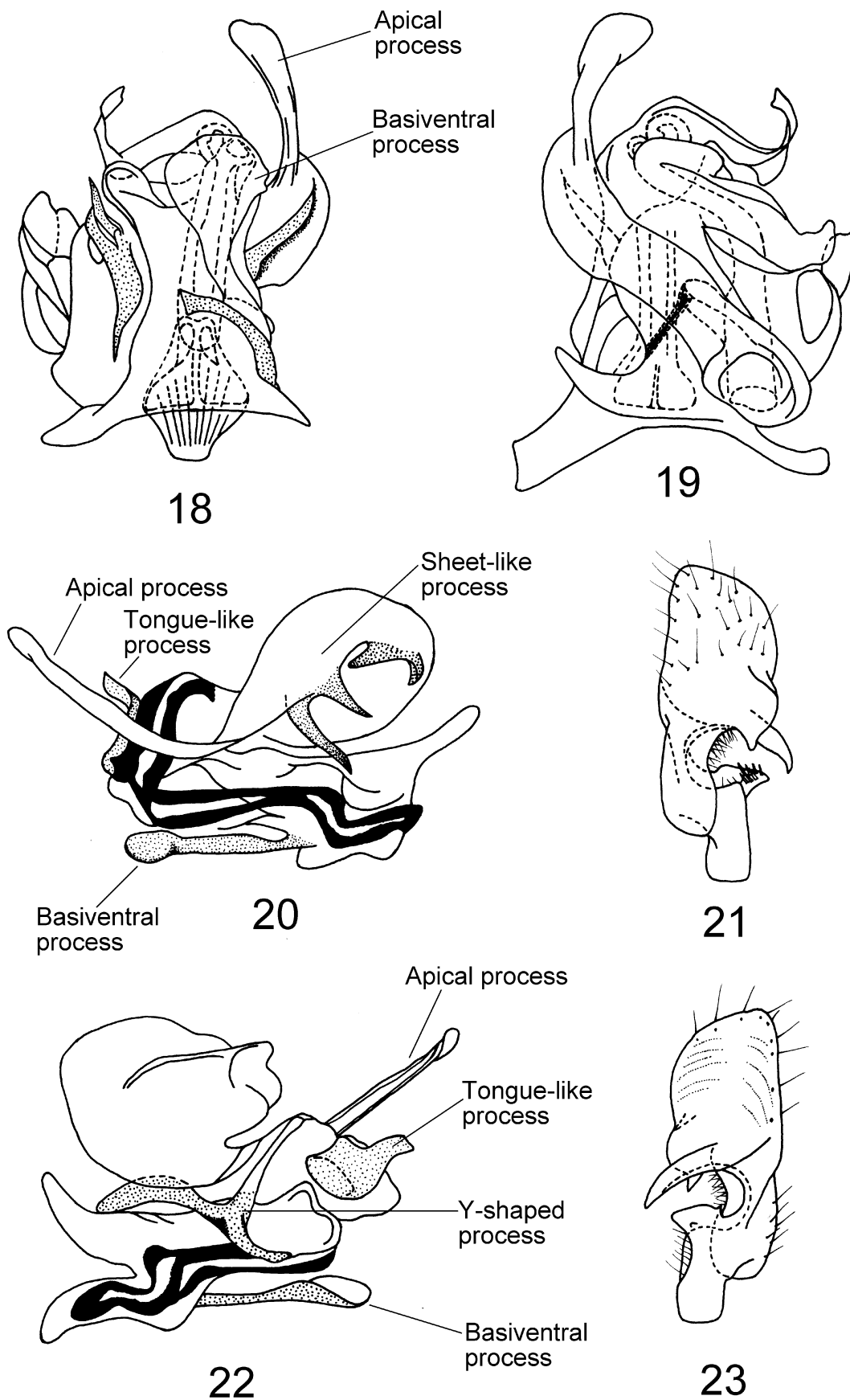
Thorax. Pronotum black, carinae and borders pale yellow; hind margin obtusely angled. Mesonotum moderately flat, black, with concolorous carinae. Tegmina whitish, semihyaline, 2.8 times as long as broad; veins brownish with dark brown setiferous granules; pterostigma brown, elongate triangular in shape; RA unbranched, RP apically trifurcated, MA apically bifurcated, MP apically bifurcated, CuA bifurcated; Sc+R forked distad of fork CuA1+CuA2, r-m crossvein distinctly basad of fork MA+MP; apex with ten cells (Fig. 12). Claval veins Pcu and A1 united centre of clavus. Hind wing with MP and CuA1 complete terminal fusion. Legs with femora brown, tibiae and tarsi yellowish; hind tibia with six apical teeth and three lateral spines. Chaetotaxy of hind tarsomere 6/5.

Male genitalia. Anal segment in lateral view longer than broad, asymmetrical, slender, apical lobe with ventral margin convex medially and with two excisions submedially (Figs 14, 16, 17). Pygofer without ventromedian process, replaced by two small protuberances (Fig. 15); lateral lobes of pygofer subtriangular, nearly symmetrical, with several setae along apical margin (Figs 14, 17); outer borders of pygofer with semicircular furrow-like sulcus near middle. Genital styles greatly enlarged apically, thumb-shaped in lateral view, margin and outer surface setose; shaft short, a deep excavation present between shaft and dilated apex, excavation large, its proximal margin smoothly rounded and bearing short, stout setae, its apical margin (i.e. basal laterodorsal angle of dilated apex (Emeljanov 2001)) with a tusk-like tooth (Figs 21, 23). Aedeagus wound helix-like. Flagellum convoluted with two sinuations, a right one (Fig. 20) and a left one (Fig. 22). Aedeagus in total with 7 sclerotized processes. Apex of flagellum with a long rod-like apical process, curving and directed left-dorsocaudad, its apex slightly roundly expanded. Basiventral area of right lateral sinuation of flagellum giving rise to a sclerotized, basally sheet-like process which is divided into three processes, inner one of these the longest, tusk-like, directed ventrad primarily; middle one shorter, tusk-like, curving cephaloventrally; outer one curly (Fig. 20). Basidorsal area of left lateral sinuation of flagellum giving rise to a oblique Y-shaped process, with basal shaft long, slender, straight, then unequally forked apically into two

prominent rami; inner ramus broader, falciform, its basal portion directed to inner side, then curving cephaloventrally, rounded apically; outer ramus small, tapering and curving initially caudoventrally in basal half then caudally in apical half (Fig. 22). Apex of aedeagus with large S-shaped, apically tongue-like process (Figs 20, 22). Basiventral process of periandrium spoon-like, directed caudad (Figs 18, 20, 22).



FIGURES 12–17. *Indolipa kurseongensis* (Distant). 12. right tegmen; 13. head, dorsal view; 14. pygofer and anal segment, left lateral view; 15. pygofer and genital styles, ventral view; 16. anal segment, caudal view; 17. pygofer and anal segment, right lateral view. (Note: The helix of the aedeagus is comparatively extended and not so tightly wound as in other dissected specimen).



FIGURES 18–23. *Indolipa kurseongensis* (Distant). 18. aedeagus, ventral view; 19. aedeagus, dorsal view; 20. aedeagus, right lateral view; 21. right genital style, outer maximum view; 22. aedeagus, left lateral view; 23. right genital style, inner maximum view.

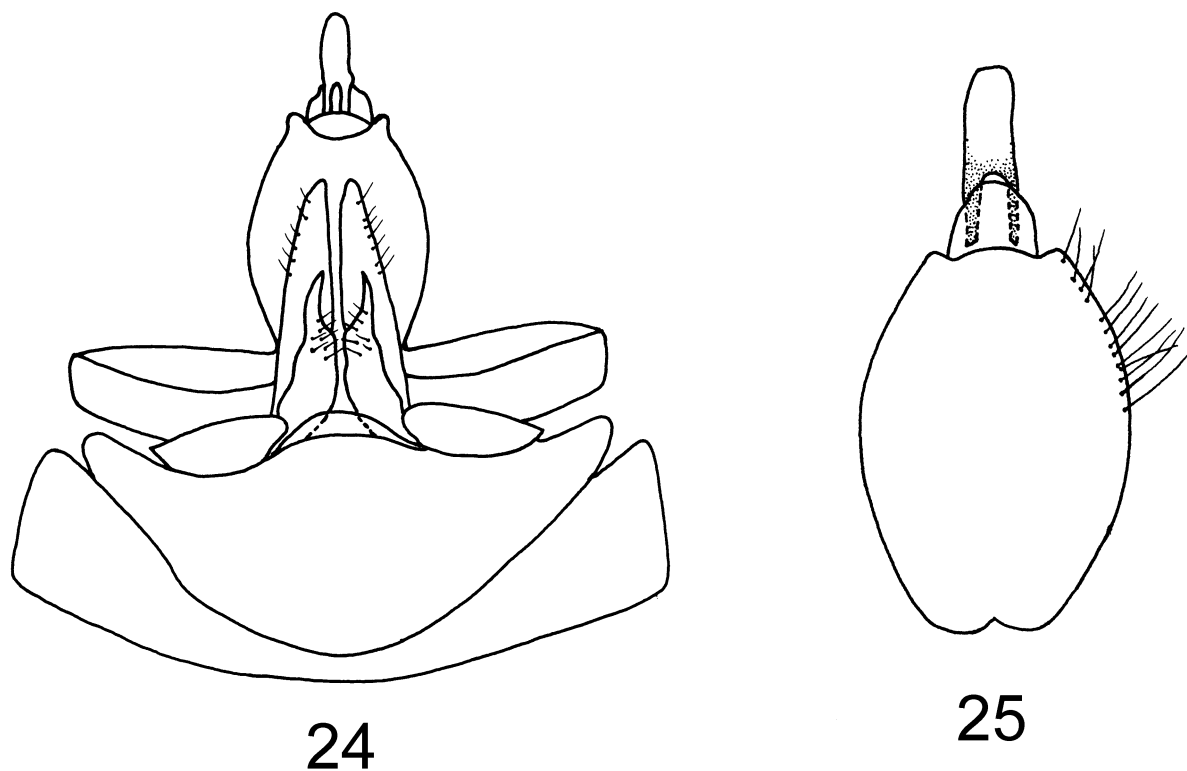
Female genitalia. Pregenital sternite with caudal border convex in middle. Ovipositor with first pair of valvulae relatively short, broad basally, then abruptly constricted near apices and acuminate to end, which is slightly curving inward and caliper-like; second pair rudimentary; third pair well developed, broader and longer than first pair; first and third pairs of valvulae with fine setae (Fig. 24). Anal segment ovate, somewhat narrower than half width of pygofer (Figs 24, 25). Pygofer with a large elliptic wax plate between anal segment and ovipositor (Fig. 24).

Material examined. CHINA: 2 ♂, 1 ♀, Tibet Autonomous Region, Chayu County, Dongjiong, 1570 m, 24-VI-1978 (Fa-Sheng Li) (NWAUFU); 1 ♀, same data, but 25-VI-1978 (Fa-Sheng Li) (NWAUFU); 2 ♂, same data, but Shajiong Township, 1700 m, 29-VI-1978 (Fa-Sheng Li) (NWAUFU); 1 ♂, 2 ♀, Tibet Autonomous Region, Motuo County, Beibeng Township, 850 m, 19-VI-1983 (Yin-Heng Han) (NWAUFU).

Distribution. China (Tibet), India.

Remarks. *I. kurseongensis* is similar to *I. gansuensis* and *I. tappanus* in external appearance and male genitalic configuration. Diagnosis of the three species is noted in the remarks of *I. gansuensis*.

This species is recorded here for the first time from the Palaearctic Region (China's Tibet Autonomous Region).



FIGURES 24, 25. *Indolipa kurseongensis* (Distant). 24. female genitalia, ventral view; 25. female anal segment, dorsal view.

Indolipa tappanus (Matsumura, 1914)

Oliarus tappanus Matsumura, 1914: 424; Tsaur, Hsu & Van Stalle, 1988: 46; Van Stalle, 1991: 51.

Indolipa tappanus (Matsumura), Emeljanov, 2001: 72.

Distribution. China (Taiwan).

Remarks. This species was described and figured by Tsaur, Hsu & Van Stalle (1988) and Van Stalle (1991). Based on their descriptions, this species is similar to *I. gansuensis* and *I. kurseongensis* in external appearance and male genitalic configuration. Diagnosis of the three species is dealt with under the discussion of *I. gansuensis*.

Checklist of known species of the genus *Indolipa* Emeljanov, 2001

- I. bidiensis* (Van Stalle, 1991); Borneo.
I. binghami (Distant, 1911); Burma (Rangoon).
I. brunneifrons (Muir, 1924); Singapore.
I. fusconebulosus (Distant, 1906); Burma.
I. gansuensis Feng, **sp. nov.**; China (Gansu).
I. greeni (Distant, 1911); Sri Lanka.
I. indiensis (Van Stalle, 1991); India.
I. kurseongensis (Distant, 1911); China (Tibet), India.
I. lawitensis (Van Stalle, 1991); Malaysia.
I. madrasensis (Van Stalle, 1991); India.
I. malayensis (Van Stalle, 1991); Malaysia.
I. nilgiriensis (Van Stalle, 1991); India.
I. pahangensis (Van Stalle, 1991); Malaysia.
I. sabahensis (Van Stalle, 1991); Borneo.
I. tamangensis (Van Stalle, 1991); Malaysia
I. tapanus (Matsumura, 1914); China (Taiwan).
I. thekkadiensis (Van Stalle, 1991); India.

Remarks. According to the original descriptions, two Nearctic species of the genus *Oliarus* (*O. caldwelli* Mead & Kramer, 1982 and *O. lobatus* Caldwell, 1938) share the diagnostic features of *Indolipa*, i.e., the characteristic tooth and dilated apex on the genital style and uniform shape of the anal segment, as well as lateral lobes of pygofer without marked projection or processes (Mead & Kramer, 1982, Figs 402–407 & Figs 411–417). We don't propose new combination for these two species here because material is not currently available to us. The status of both species needs to be investigated further.

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References

- Anufriev, G.A. & Emeljanov, A.F. (1988) Suborder Cicadinea (Auchenorrhyncha). In: Lehr, P.A. (Ed.), *Keys to the insects of the Far East of the USSR. Volume 2. Homoptera and Heteroptera*. Nauka Publishing House, Leningrad, pp. 441–465.
- Caldwell, J.S. (1938) New Texan Fulgoridae (Homoptera). *The Ohio Journal of Science*, 38, 304–306.
- Distant, W.L. (1906) Rhynchota. Heteroptera-Homoptera. *The Fauna of British India, including Ceylon and Burma, Volume 3*. Taylor & Francis, London, England, pp. 1–503.
- Distant, W.L. (1911) Descriptions of new genera and species of Oriental Homoptera. *Annals and Magazine of Natural History*, (8) 8, 735–747.

- Emeljanov, A.F. (2001) The genus *Oliarus* s. str. and related genera from the Oriental Region (Homoptera: Cixiidae). *Zoosystematica Rossica*, 10, 71–72.
- Fennah, R.G. (1956) Fulgoroidea from Southern China. *Proceedings of the California Academy of Science. Fourth Series*, 28, 441–527.
- Matsumura, S. (1914) Die Cixiinen Japans. *Annotationes Zoologicae Japonensis*, 8, 405–434.
- Mead, F.W. & Kramer, J.P. (1982) Taxonomic study of the planthopper genus *Oliarus* in the United States (Homoptera: Fulgoroidea: Cixiidae). *Transactions of the American entomological Society*, 107, 381–569.
- Muir, F. (1924) New Malayan species of *Oliarus* Stål (Cixiidae Homoptera). *The Philippine Journal of Science*, 24, 509–529.
- Tsaur, S.-C., Hsu, T.-C. & Van Stalle, J. (1988) Cixiidae of Taiwan, Part I. Pentastirini. *Journal of Taiwan Museum*, 41, 35–74.
- Van Stalle, J. (1991) Taxonomy of Indo-Malayan Pentastirini (Homoptera, Cixiidae). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Entomologie*, 61, 5–101.