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A Revision of the *quadratula* Group of the Genus *Terellia* Robineau-Desvoidy (Diptera: Tephritidae)

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ABSTRACT

The *quadratula* group is revised to include 8 species known predominantly from the Middle East: *T. montana* Korneyev, n. sp., *T. tarbinskiorum* Korneyev, n. sp., *T. bushi* Korneyev, n. sp. are described; *T. quadratula* (Loew), *T. vilis* (Hering), *T. deserta* Korneyev, *T. matrix* Korneyev, and *T. orheana* Korneyev are redescribed; and all the species are figured. A key to the species is given.

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INTRODUCTION

The genus *Terellia* Robineau-Desvoidy, 1830 includes about 50 species widespread in the Palaearctic Region and three species in the Nearctic Region (Norrbom et al. 1999). Korneyev (1985) reviewed the genus and recognized several species groups based on similarity of structure of the male terminalia, predominantly regarding the glans of the phallus. Two monotypic groups were proposed for two species, respectively, with quite different wing and body patterns, *T. quadratula* Loew and *T. deserta* Korneyev. They share a long apicodorsal rod and a rather long and robust acrophallus with two non-filament-like semitubular lobes and white setulose abdominal tergites. Korneyev (1988; 1990) described two additional species, *T. matrix* Korneyev and *T. orheana* Korneyev, and discussed the taxonomic position of *Galada vilis* Hering (all with similar phallus structure). Korneyev (1999) reconsidered the position of these species (as the "*quadratula–vilis* group") in the course of preliminary analysis of phylogenetic relationships among the species of the tribe. The five species mentioned above and the three new species described below form a group, which may be the most primitive in the tribe Terelliini and in the subfamily Tephritinae. Species for which host plants are known, are associated with flowerheads either of *Echinops* (Asteraceae: Cardueae: Echinopsidinae) or *Jurinea* (Cardueae: Carduinae).

MATERIAL AND METHODS

The material examined is deposited in collections of the following institutions:

BMNH — The Natural History Museum, London, formerly British Museum (Natural History).
DEI — Deutsches Entomologisches Institut, Eberswalde (before 2003) / Müncheberg, Germany
MHNG — Museum d'histoire naturelle, Genève, Switzerland
NMP — National Museum, Prague (Kunratice)
NHMW — Naturhistorisches Museum Wien
SIZK — I.I. Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine, Kiev
SMNS — Staatliches Museum für Naturkunde, Stuttgart
TAUI — Tel Aviv University
ZFIB — Zoologische Forschungsinstitut und Museum Alexander Koenig, Bonn
ZMHB — Zoologisches Museum, Humboldt-Universität zu Berlin
ZMUM — Zoological Museum, University of Moscow
ZISP — Zoological Institute, Russian Academy of Sciences, St. Petersburg

Species are listed by their relationships rather than alphabetically. The listed material, unless otherwise stated, has been examined by the author. Morphological terminology follows White *et al*. (1999).

The following morphometric characters with their abbreviations are used for each species: head ratio (HR = head length: head height: head width); frons ratio (FR = frons length: frons width); wing length (WL); aculeus length (AL); aculeus apex ratio (AAR = apex length (from ventral lobes apices to tip): aculeus apex width (at apices of ventral lobes); aculeus-costa ratio (AL/C2 = aculeus length: costal cell length). The samples are usually small, and these measurements are used as additional characters only.

RESULTS

The *quadratula* group of species

Diagnosis

Apicodorsal rod of glans long and narrow (differing from other Terelliini), not fan-like dilated (differing from species of subgenus *Cerajocera* Rondani), acrophallus large, with wide, non-filament-like terminal lobes (differing from *serratulae* group), well-sclerotised ligula between phallus stipe and glans (differing from *Chaetorellia* Hendel), epandrium rather broad in caudal view (differing from *megalopyge* group), hypandrium bottom not sculptured (differing from *serratulae* group + *Chaetostomella* Hendel + *Chaetorellia* + *Craspedoxantha* Bezzi), aculeus longitudinally wrinkled (differing from other Terelliini except *Orellia* Robineau-Desvoidy). Setulae on abdominal tergites 1-5(-6) predominantly white, except those in posteromedial portion of tergite 5 of males sometimes black (differing from other Terelliini except distantly related species of *virens* and *serratulae* groups). Supra-alar setae without dark spots (differing from *Orellia* and *Chaetorellia*). Scutellum without black apical spot (differing from *Chaetostomella* and *Chaetorellia*) and without spots at bases of setae (differing from *Orellia*). Long black subvibrissal setae not developed (differing from *Chaetostomella*). Presutural dorsocentral setae absent (differing from *Chaetorellia* and *Terellia blanda* Richter).

Description

Head. as long as high or slightly higher than long, yellow, except ocellar triangle sometimes brown. Frons as long as wide, or at most 1.1 times as long as wide. Frontal vitta bare. Fronto-orbital plate with brown, yellowish or white setulae. Setae yellowish to black. Postocular setae yellowish white, 1-3 ventralmost setae sometimes brown. Subvibrissal setulae black, yellow or white, not enlarged at vibrissal edge, short, about half as long as distance between genal groove and ventral margin of gena; genal setulae anterior to genal seta short, black or, rarely, yellowish-white; occipital setulae white. Palpus not protuberant beyond subcranial cavity, yellow, with sparse black, and sometimes also white setulae.

Thorax. Scutum with black lyrate pattern, medial vittae broadly fused forming central mark reaching posteriorly to, or extending beyond, base of dorsocentral setae; lateral vitta either fused to central mark or separate from it and sometimes divided by transverse suture. White setulae dense. Black coloration of cuticle sometimes obscured by whitish microtrichia. Black shining spots at bases of postsutural dorsocentral and prescutellar acrostichal setae either present or absent. Pleuron non-striated, yellow except red to black triangular mark on katepisternum often obscured by whitish microtrichia; meron and posterior portion of anatergite often with reddish yellow to black spot; dorsal portion of anepisternum and dorsal portion of katepisternum concolorous with medial portion of anepisternum. Scutellum subshining yellow; anterolateral corner dark brown, without black spot at apex, bases of scutellar setae without dark spots; mediotergite red to black, microtrichose laterally. Legs orange yellow.

Wing. With pattern of four or three brownish yellow crossbands, sometimes reduced, or completely hyaline. Cell bcu with short posterodistal lobe not reaching level of crossvein BM-Cu.

Abdomen. General color yellow; tergites with or without black spots, covered by white setulae and brown or black marginal setae; male tergite 5 posteromedially often with black setulae and marginal setae. Female tergites 5-6 usually without black setulae.

Male terminalia. Epandrium rounded in caudal view, posterior lobe of lateral surstylus very weakly produced. Hypandrium with anterior membrane ("bottom") smooth. Phallus without spines or microtrichia; basiphallus protruding posteriorly, more or less oval, slightly truncated at anterior margin; ligula well-developed and sclerotized; glans large, with wide tubular base of acrophallus and rather wide apical semitubular lobes.

Female terminalia. Oviscape yellow (in *T. vilis*, according to original description, black), without darker spots at base, about as long as preceding 2-4 abdominal tergites. Eversible membrane with dense, uniformly blunt scales forming regular rows; 4-5 pretaenial setulae; apicomedial lobe of oviscape usually large, microtrichose; aculeus wide, with longitudinal wrinkles and apex blunt to moderately pointed; 2 shortly papillose spermathecae with broad apical portion of duct.

Key to the species of the *quadratula* group

1. Wing with conspicuous yellow-brown pattern either of crossbands or dark stripe along anterior margin **2**
- Wing hyaline, without pattern **7**
2. Cell dm at base and middle completely hyaline, without dark areas (Figs. 13, 14); wing with dark stripe along anterior margin; discal and subapical crossbands not developed (Tadjikistan, Afghanistan) ..... ***vilis* Hering**
- Cell dm at base and middle with brownish yellow areas. Wing with 3 or 4 more or less complete crossbands **3**
3. Brownish yellow areas in cells r_{4+5} and br shifted towards apex; wing pattern appears as chessboard (Fig. 1) (In *Echinops* flowerheads. Armenia, Azerbaijan, Turkey, Iran, Lebanon, Israel, Jordan) ..... ***quadratula* Loew**
- Brownish yellow areas in r_{4+5} and br cells aligned with those in cells r_{2+3} and dm forming straight crossbands, not as chessboard **4**
4. Mesonotum with 3 pairs of large shining black spots: at transverse suture, around bases of dorsocentral and presutural acrostichal setae (Figs. 19, 20) (Associated with *Echinops*) .. **5**
- Transverse suture without any dark spots; dorsocentral and presutural acrostichal seta at most with small brownish spot at base (Figs. 30, 40) (Associated with *Jurinea*) **6**
5. Aculeus tip bluntly pointed: AAR ≤ 1.5 (Figs. 24, 25) (Kyrghyzstan; Kazakhstan) .... ***tarbinskiorum* Korneyev, n. sp.**
- Aculeus tip acutely pointed: AAR = 2.0 (Fig. 29) (Kyrghyzstan) .. ***bushi* Korneyev, n. sp.**
6. Subvibrissal setulae whitish yellow (Fig. 31); male tergite 5 with 2-4 small brown spots at anterior margin (Fig. 30) (Turkmenistan: Kara-Kum Desert) ..... ***deserta* Korneyev**
- Subvibrissal setulae brown (Fig. 41); male tergite 5 with 6 large black spots (Fig. 40) (Kyrghyzstan: Western Tien Shan and Kazakhstan: Kara-Tau Mountains) .... ***montana* Korneyev, n. sp.**
7. Eye at most 2.5 times as high as gena (Fig. 17) (Tadjikistan) ..... ***matrix* Korneyev**
- Eye more than 3 times as high as gena (Fig. 52) (Moldova, Ukraine) .. ***orheana* Korneyev**

***Terellia quadratula* (Loew)**
(Figs. 1-12)

Loew, 1869: 13; Becker, 1905: 121 (*Trypeta*); Hendel, 1927: 134; Zaitzev, 1947: 8; Richter, 1960: 394; 1970: 154; Foote, 1984: 106; Kugler and Freidberg, 1975: 63; Freidberg and Kugler, 1989: 164 (*Orellia*); Korneyev, 1985: 630; Norrbom *et al*., 1999: 223; Korneyev and Dirlbek, 2000: 465 (*Terellia*).

Diagnosis

Wing with brownish yellow pattern of chessboard or spotted appearance (Fig. 1). Thorax without shining black spots at bases of setae. Abdomen without dark spots.

Redescription

Head (Figs. 1, 2). HR= 1:1.1:1.4; FR = 1. Major setae brownish yellow to black. Fronto-orbital plate with brown setulae. Postocular setae yellowish white, 1-3 ventralmost setae often brown. Subvibrissal setulae black, genal setulae anterior to genal seta short, black; occipital setulae white. Palpus yellow, with sparse black setae.

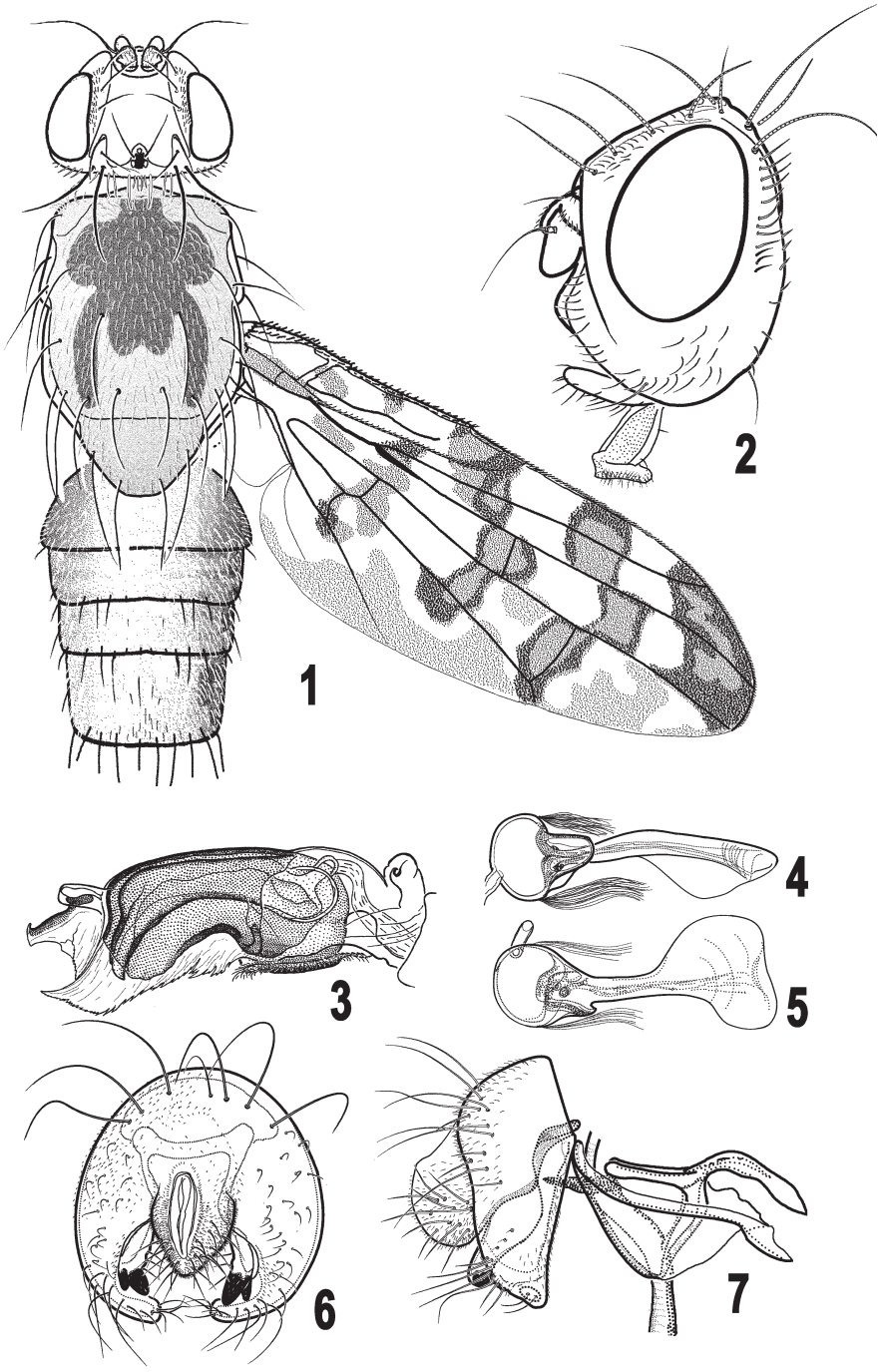
Thorax (Fig. 1). Scutum with black lyrate pattern, vittae broadly fused; central mark extending posteriorly beyond base of dorsocentral seta; white setulae very dense; black coloration of cuticle often obscured by 4 wide stripes of whitish microtrichia; black shining spots at bases of postsutural dorsocentral and prescutellar acrostichal setae absent, at most base of acrostichal seta surrounded by brown. Pleuron yellow except red or brown triangular mark on katepisternum obscured by whitish microtrichia; meron and posterior portion of anatergite often with brown to black spot; dorsal portion of anepisternum and katepisternum concolorous with medial portion of anepisternum; Scutellum subshining yellow; anterolateral corner dark brown, without black spot at apex; mediotergite black, microtrichose laterally.

Wing (Fig. 1). Hyaline with well-developed pattern of four crossbands, with medial portions of discal and subapical crossbands shifted towards apex; ultimate section of vein M 1.7-2.2 times as long as penultimate section.

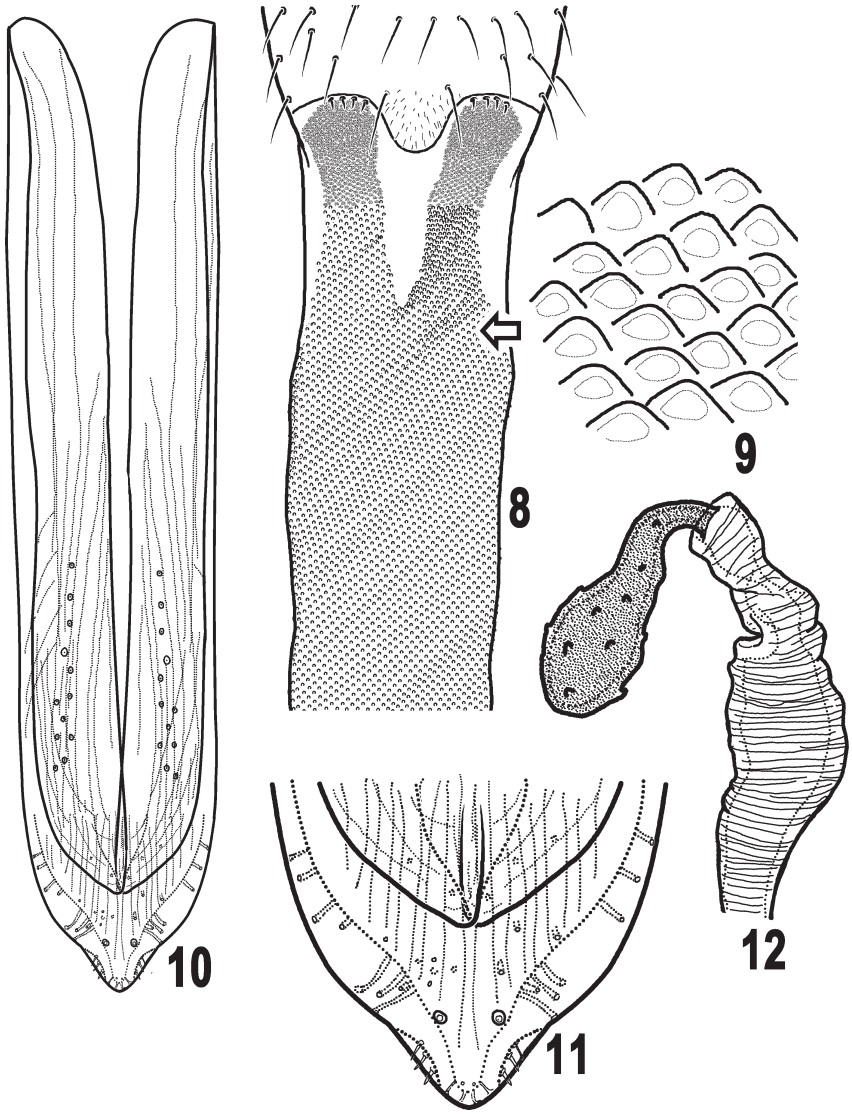
Abdomen. General color yellow; tergites without black spots, covered by white setulae and brown or black marginal setae; male tergite five 0.3-0.4 times as long as abdomen, posteromedially with black setulae and rather long and numerous marginal setae. Female tergites 5-6 usually without black setulae.

Male terminalia (Figs. 3-7). Epandrium as in Figs. 6-7; setae at posterior margin of surstylus dense and long, almost as long as its length in lateral view. Hypandrium as in other terelliines, its bottom non-sculptured (Fig. 7). Basiphallus more or less oval, slightly truncated at anterior margin; glans with wide tubular base of acrophallus and rather long and wide apical semitubular lobes, wall of preputium widely sclerotised almost to its margins (Fig. 3). Ejaculatory apodeme as in Figs. 4-5.

Female terminalia (Figs. 8-12). Oviscape yellow, without darker spots at base, about as long as preceding 3 abdominal tergites. Eversible membrane as in Figs. 8-9; aculeus as in Figs. 10-11, with very short and blunt apex; 2 spermathecae as in Fig. 12.



Figs. 1-7. *Terellia quadratula* (Loew), ♂ (Israel). 1. Habitus, dorsal view (left wing omitted). 2. Head, lateral view. 3. Glans, lateral view. 4. Ejaculatory apodeme and sperm pump, dorsal view. 5. Same, lateral view. 6. Epandrium, caudal view. 7. Epandrium and hypandrium, lateral view (phallus removed).



Figs. 8-12. *Terellia quadratula* (Loew), ♀ (Armenia). 8. Apex of oviscape and eversible membrane, ventral. 9. Scales of eversible membrane, enlarged. 10. Aculeus, ventral view. 11. Apex of aculeus, enlarged. 12. Spermatheca (1 of 2).

Measurements. WL♂ = 4.25-5.45 mm (average 4.8); WL♀ = 5.45-6.20 mm (average 5.75); AL =1.40-1.73 mm.

Material examined

Syntypes 1♂, 1♀ (on one pin), [?TURKEY, ?ARMENIA or ?AZERBAIJAN:] "Russland", "coll. H. Loew", with red label "Type" (head of male missing) (ZMHB).

Other material examined: TURKEY: "Russ. Kurdistan, Kasikoporan [= Kazkoporan], E. König (1♂; DEI) (Hendel det.); "TR — Van — Achtamar, Festland", 1720 m, 17.vii.1988,

Schmid-Egger (1♀; SMNS); ?TURKEY: "Kurdistan, coll. Lichtwardt" (1♂, 1♀; NHMW); ARMENIA: "Tajtsharuch [=Taycharukh], d. Novo-Bajazet, g. Erivan", 7.viii.1924, Paramonov (3♂, 1♀; SIZK); "Gokcha [=Sevana Lich (=Lake)], mountains at Ardanysh Gulf", 2.vii.1902, Yelagich, Klemant (1♀; ZISP); AZERBAIJAN: "Paleton, Talysh, 1200'", 18.vii.1932, Znoyko (2♀; ZISP); "Amurat, Lenkoran' [=Länkäran]", 7-13.vii.1909, Kiritshenko (1♂; ZISP); LEBANON: "N.-Libanon", 1-4.vi, 21-28.vi.1931, Zerny (1♂, 1♀; NHMW); JORDAN: Aljun El Mafraq, 20.v.1958 (1♀; NMP). IRAN: N, Behsahr, vii.1970, (1♀; NMP); ISRAEL: Mt. Hermon, 21.v.1971, Kugler (5♂, 5♀; NHMW); Majdal Shams, 9.vi.1992, A. Freidberg (3♂, 3♀; SIZK), about 100 additional specimens from various localities on Mt. Hermon (TAUI).

Host plants

Echinops viscosus (Freidberg and Kugler, 1989).

Distribution

Armenia, Azerbaijan, Turkey, Iran, Lebanon, Jordan, Israel.

***Terellia vilis* (Hering)**

(Figs. 13-15)

Hering, 1961: 325; Richter, 1965: 137; Foote, 1984: 89 (*Galada*); Korneyev, 1988: 871; Norrbom et al., 1999: 222; 223 (*Terellia*).

Diagnosis

Wing with brownish-yellow pattern consisting of costal band interrupted by 4 hyaline spots and more or less distinct infuscations around crossveins (Figs. 13-14). Thorax without black spots at bases of setae. Abdomen without dark spots.

Redescription

Head (Fig. 13). HR = 1:1.1:1.4; FR = 1.1. Fronto-orbital plate with setulae yellowish to brown.

Thorax. Scutum with black lyrate pattern, subshining, very sparsely microtrichose; vittae not fused in male from Tadjikistan; central mark reaching posteriorly mid-distance between dorsocentral and prescutellar seta levels; black shining spots at bases of dorsocentral and prescutellar acrostichal setae absent; triangular mark on katepisternum black, slightly microtrichose; smaller spots on meron and anatergite black; anterolateral corner of scutellum dark brown.

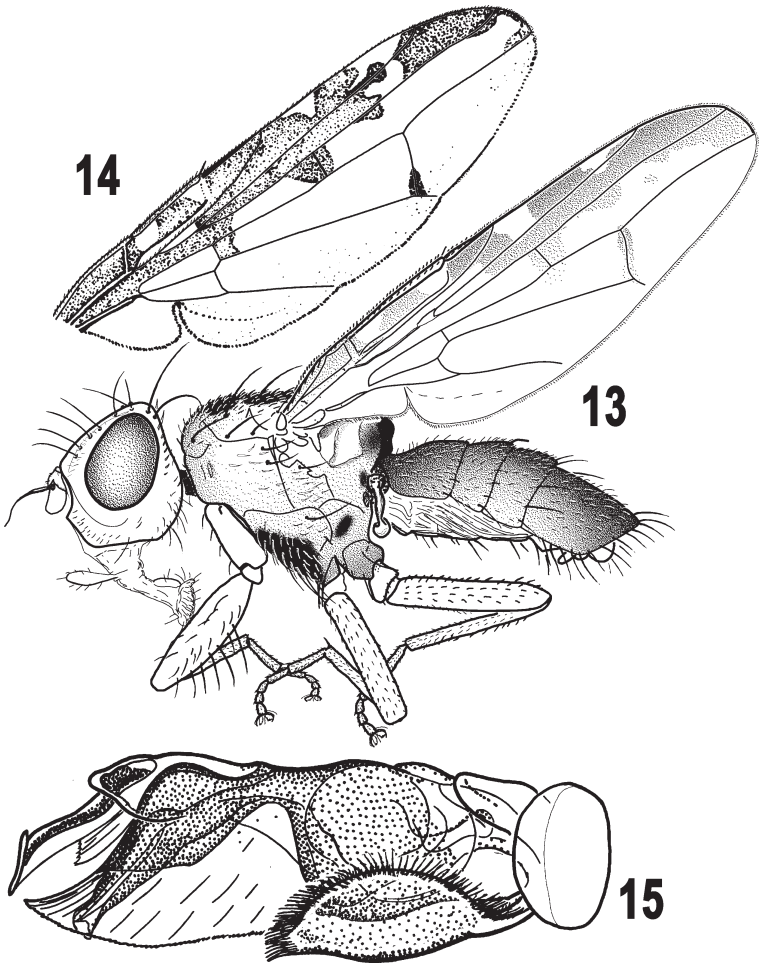
Wing. Hyaline with well-developed pattern (Figs. 13-14); ultimate section of vein M 1.8-2.2 times as long as penultimate.

Abdomen. General color dark yellow, tergites without black spots; tergal setulae predominantly white; male tergite 5 0.36 times as long as abdomen.

Male terminalia. Glans as in Fig. 15, large, with wide tubular base of acrophallus and long apical semitubular lobes, wall of preputium sclerotized only dorsally. Epandrium and hypandrium not dissected.

Female terminalia (not dissected). Oviscape, according to Hering (1961), black, about as long as preceding 4 abdominal tergites.

Measurements. WL♂ = 4.4 mm; WL♀ = 4.15 mm.



Figs. 13-15. *Terellia vilis* (Hering). 13. ♂ (Tadjikistan), habitus, lateral view. 14. ♀ (Afghanistan), wing (from Hering 1961). 15. Glans, lateral view.

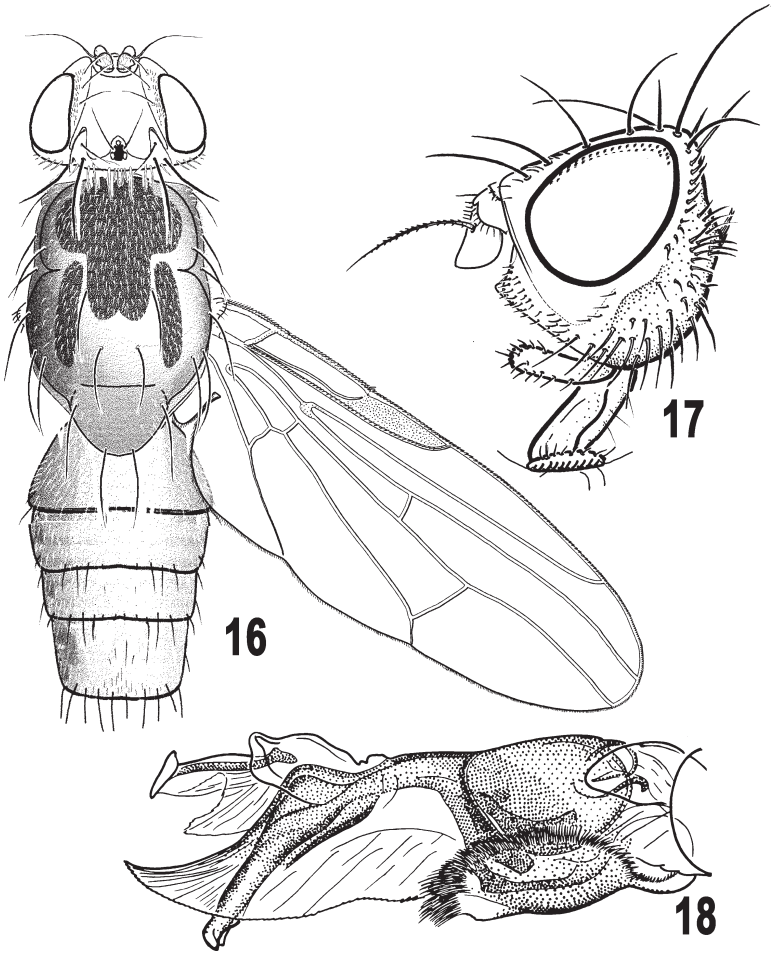
Material examined

Holotype ♀, AFGHANISTAN: "J. Klapp.[erich] / Schiva, Hochsteppe / 2900 m, 11.7.[19]53 / Badakhschan / No-Afghanistan", "Galada n. g. / vilis m. Type! / det. Hering 1960 / 1 Stück behalten" [Hering's handwriting, violet ink], double carton rectangle with a slide of the right wing (ZFIB) (examined: mostly destroyed, only 3 legs glued to carton and a slide of the right wing remained). Paratype: "Afghanistan, Sarekanda-Gebirge, 3500 m", 26.vii.1953 (1♀; BMNH) (examined on my request by Dr. I.M. White).

Other material examined: TADJIKISTAN: "Khrebet Petra Velikogo [Peter-the-Great Range], pereval [pass] Gardan-I-Kaftar, " 19.vii.1911, Hohlbeck (1♂, ZISP) (examined).

Host plants

Unknown.



Figs. 16-18. *Terellia matrix* Korneyev. 16. holotype ♂, habitus, dorsal view. 17. Head (lateral view). 18. Glans, lateral view.

Distribution

Tadjikistan, Afghanistan.

***Terellia matrix* Korneyev**

(Figs. 16-18)

Korneyev, 1988: 872; Norrbom *et al*., 1999: 222.

Diagnosis

Wing hyaline. Thorax without black spots at bases of setae. Abdomen without dark spots. Eye 2.4 times as high as gena. Glans with long terminal filaments of acrophallus.

Redescription

Head (Fig. 17). HR = 1.0:1.1:1.3; FR = 1. Fronto-orbital plate with black setulae. Gena as high as flagellomere 1 long and 0.41 times as high as eye. Subvibrissal and genal setulae all brown to black.

Thorax. Scutum with lyrate pattern brown to black, sparsely microtrichose; vittae fused, central mark reaching posteriorly mid-distance between dorsocentral and prescutellar seta levels; dorsocentral seta inserted in black field, and prescutellar acrostichal seta in yellow field, without distinct spots; pleuron with black marks on katepisternum and meron obscured by gray microtrichia; scutellum with anterolateral corners brown; mediotergite black, microtrichose except narrow medioventral spot. Setae yellow to light brown.

Wing (Fig. 16). Three times as long as wide, hyaline, without any dark pattern, but pterostigma yellow; ultimate section of vein M 1.9 times as long as penultimate section.

Abdomen (Fig. 16). General color grayish or greenish yellow, without dark spots; all tergal setulae white, tergite 5 posteromedially with black setulae; marginal setae brownish black; male tergite 5 about 0.4 times as long as abdomen.

Male terminalia. Glans as in Fig. 18, large, with wide tubular base of acrophallus and long apical semitubular lobes, wall of preputium sclerotized only dorsally. Epandrium not dissected; yellow, elliptic, black and yellow setulose.

Female. unknown.

Measurements. WL♂ = 4.5 mm.

Material examined

Holotype ♂, [TADJIKISTAN:] "Rushan (Pamir oc.) Jugum Jazgulem fauces fl. Rav-Dara, 3.100-3.400 m, 27.VII.1937, L. Sheljuzhko, N. Pavlitskaya leg." (SIZK).

Host plants

Unknown.

Distribution

Tadjikistan.

Terellia tarbinskiorum Korneyev, n. sp.

(Figs. 19-26)

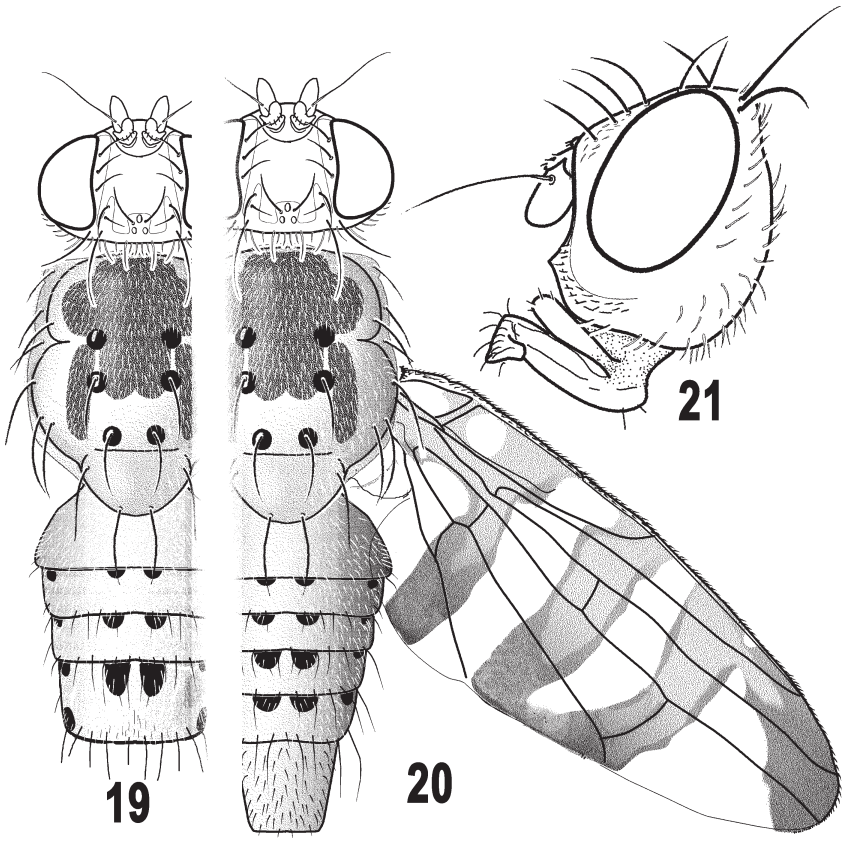
Diagnosis

Wings with 4 brownish-yellow crossbands. Mesonotal scutum with 3 pairs of large shining black spots: at transverse suture and at bases of dorsocentral and prescutellar acrostichal setae. Abdominal tergites with 2 pairs of dark spots and additional apicolateral spot on male tergite 5. Aculeus rather bluntly pointed, with apex 1.5 times as long as wide.

Description

Head (Fig. 21). HR = 1:1.3:1.6; FR = 0.9. Fronto-orbital plate with all setulae white or setulae anteriorly mixed white and brownish yellow. Subvibrissal and genal setulae brownish yellow to brownish black. Postocular setae white, except 1-3 ventralmost setae brown to black.

Thorax (Figs. 19-20). Scutum with black lyrate pattern, densely covered by white microtrichia, vittae broadly fused; central mark somewhat exceeding posteriorly level of dorsocentral seta; black shining spots at suture and at bases of dorsocentral and prescutellar acrostichal setae large; pleuron yellow except black triangular mark on katepisternum which is obscured by gray



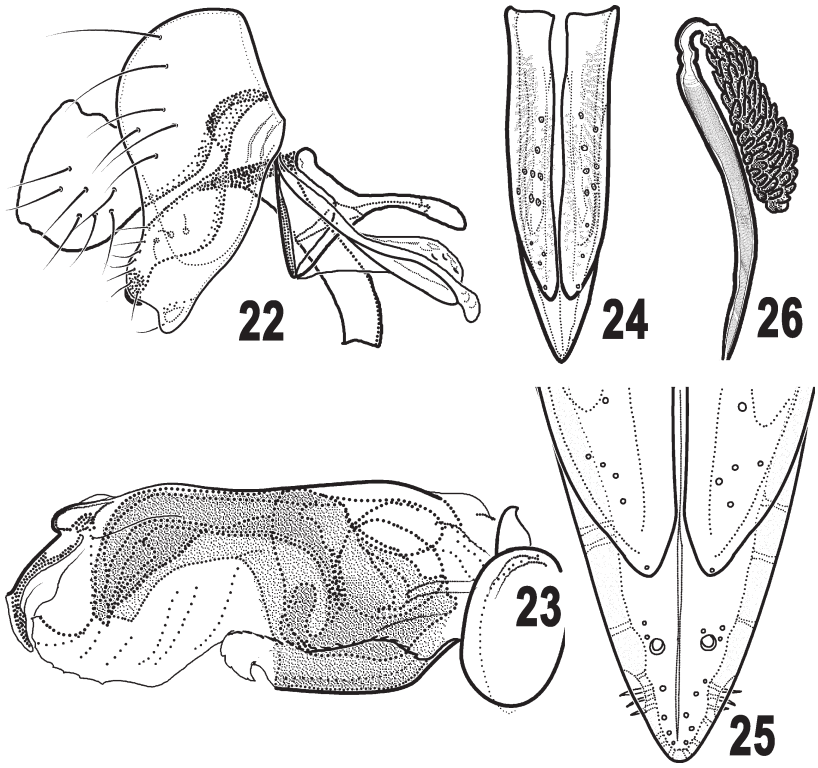
Figs. 19-21. *Terellia tarbinskiorum* n. sp. 19. ♂, habitus, dorsal view (wings omitted). 20. ♀, same (left wing omitted). 21. Head, lateral view.

microtrichia, not striated; scutellum subshining yellow; anterolateral corner slightly darkened, bases of scutellar setae in yellow field.

Wing (Fig. 20). 2.8-2.9 times as long as wide, hyaline with well-developed yellow to brownish pattern of 4 partly fused crossbands; discal and subapical crossbands either separated or partly fused posteriorly; basal costal, costal and subcostal cells yellow, with apical half of costal cell and apical third of subcostal cell brownish yellow; basal half of basal radial cell yellow; subapical and apical crossbands fused along vein R_{2+3}, sometimes to vein R_{4+5}; ultimate section of vein M 1.5-2.0 (average 1.80; n = 20) times as long as penultimate section.

Abdomen. General color dark yellow; marginal setae on tergites 3-6 black; tergal setulae mostly white, black on posteromedial portion of male tergite 5; tergites 3-5(-6) with 2 pairs of black spots at anterior margin; male tergite 5 0.3 times as long as abdomen, with 6 black spots, 2 pairs at anterior margin and 1 pair at posterolateral margin (Fig. 19).

Male terminalia. Epandrium oval, with posterior lobe of lateral surstylus well protruding and moderately setulose (Fig. 22). Basiphallus produced posteriorly, oval, ligula well-developed



Figs. 22-26. *Terellia tarbinskiorum* n. sp. 22. Epandrium and hypandrium, lateral view (phallus removed). 23. Glans, lateral view. 24. Aculeus, ventral view. 25. Apex of aculeus, enlarged. 26. Spermatheca (1 of 2).

and sclerotized; glans large, with wide tubular base of acrophallus and rather large and wide apical semitubular lobes, sclerotized wall of preputium restricted to its dorsal part (Fig. 23).

Female terminalia. Oviscape orange yellow, about as long as preceding 2-3 abdominal tergites, as long as costal cell (Fig. 20). Eversible membrane with uniformly blunt scales; 4 pretaenial setulae. Aculeus rather bluntly pointed, with apex 1.5 times as long as wide (Figs. 24-25); spermathecae as in Fig. 26.

Measurements. WL ♂ = 3.5-4.3 mm; WL ♀ = 3.2-4.6 mm; AL = 0, 63-1.2 mm (average 0.95); AL/C2 = 0.71-0.98 (average 0.83) (n = 5).

Material examined

Holotype ♀, KYRGHYZSTAN: N 42º35.9' E 73º52.1', h 2000 m, Kyrghyz Alatau Range, Ala-Archa River valley, 30 km S of Bishkek, 22.vi.1999, swept from *Echinops* sp., Korneyev (MHNG).

Paratypes: KYRGHYZSTAN: same collection data as in holotype, Korneyev (8♂, 6♀; SIZK); N 42º35.9' E 75º47.4', h 1900 m, Kyrghyz Alatau Range, Boom Ravine, swept from *Echinops tianshanicus*, 25.vi.1996, Korneyev (1♀; SIZK); same data, but reared from flowerhead of *E. tianshanicus*, 28.viii.1996 — emerged iv.1997, Korneyev (1♀; SIZK); Issyk-Kul, near Teplokljuchenka (=Aksu), h 1900-2000 m, 07.vii.1994, Milko (1♂, 2♀; MHNG); NE

Fergana Range, h 2000 m, Urumbash River, 14.vi.1995, Milko (1♂; MHNG); N 41º13.6' E 73º29.3', h 1650 m, Fergana Range, Urumbash River valley, 53 km NE of Jalal-Abad, 9.vii.1998, swept from *Echinops* sp., Korneyev (11♂, 11♀; SIZK; MHNG); SE KAZAKHSTAN: [ca. N 44º54' E 76º00'] Ili River, N of Bakanas, '74-245', reared [host plant not indicated], emerged ii.1975, (Ivannikov) (1♂, 2♀; SIZK), same locality, 14.iv, 10.v.1977, (Ivannikov) (3♂, 1♀; SIZK).

Etymology. This species is named for the entomologists Sergei Petrovich (1902-1941), Seraphim Petrovich (1907-1966) and Yuriy Seraphimovich Tarbinski (alternative spelling: Tarbinskiy) (1938-2003), in recognition of their contribution to the study of the insect fauna in Middle Asia.

Host plants

Echinops tianshanicus.

Distribution

Kazakhstan, Kyrghyzstan.

Terellia bushi Korneyev, n. sp.

(Figs. 27-29)

Diagnosis

Wings with 4 brownish-yellow crossbands. Scutum with 3 pairs of large shining black spots: at transverse suture and at bases of dorsocentral and prescutellar acrostichal setae. Abdominal tergites with 2 pairs of dark spots. Aculeus rather long and acutely pointed, with apex 2.0 times as long as wide.

Description

Head (Fig. 27). HR = 1:1.25:1.5; FR = 1.0. Fronto-orbital plate with white setulae. Subvibrissal setulae dark brown.

Thorax. Coloration and microtrichia as in *T. tarbinskiorum* n. sp.; mediotergite black, microtrichose except medioventrally. Legs yellow.

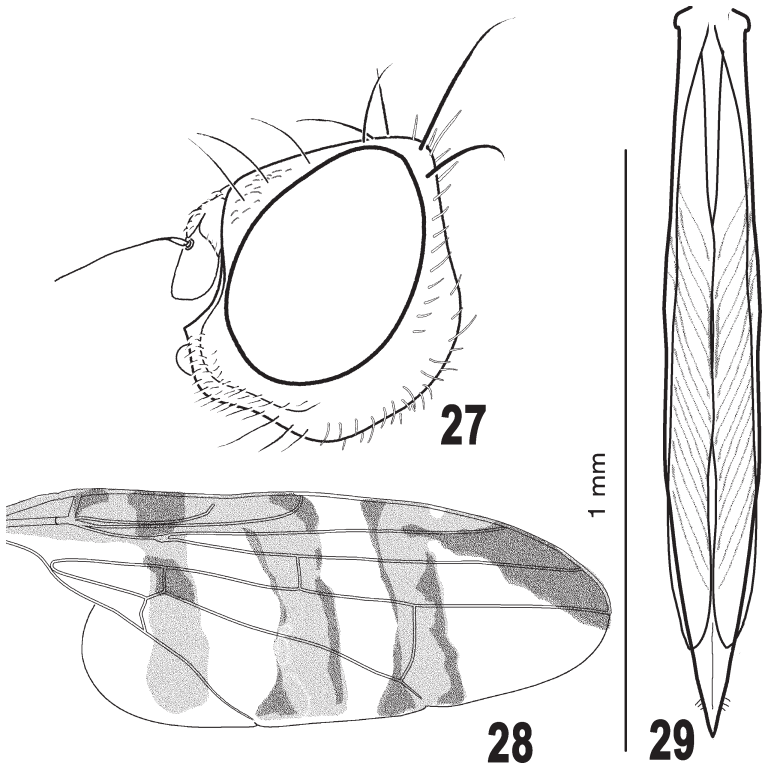
Wing (Fig. 28). 2.8 times as long as wide, with pattern similar to *T. tarbinskiorum* n. sp.; basal costal, costal and subcostal cells yellow, with apical half of costal cell and apical third of subcostal cell brownish yellow; basal half of cell br yellow; ultimate section of vein M twice as long as penultimate section.

Abdomen. General color dark yellow; marginal setae on tergites 5-6 black; tergal setulae white; tergites 3-6 each with 2 pairs of black spots at anterior margin; syntergite 1 + 2 with 2 submedial spots at suture.

Female terminalia (not dissected). Oviscape yellow, slightly longer than 4 preceding tergites. Aculeus (completely exposed) rather long and acutely pointed, with apex 2.0 times as long as wide (Fig. 29); AL/C2 = 1.6; spermathecae not examined.

Male. unknown.

Measurments. WL/ = 3.3 mm; AL = 1.05 mm; AL/C2 = 1.6 (*n* = 1).



Figs. 27-29. *Terellia bushi* n. sp. 27. Head, lateral view. 28. Wing. 29. Aculeus, ventral view (semi-schematic), drawn from specimen in situ.

Material examined

Holotype ♀, KYRGHYZSTAN: N 42º21.5' E 73º52.1', h 2430 m, Talas Alatau Range, Maidan-Tal River valley, 22 km S of Kok-Sai [= Këk-Say], swept from *Echinops* sp., 25.vi.1998, Korneyev (SIZK).

Etymology. This species is named in honor of Guy Lewis Bush, for his contribution to the taxonomy of fruit flies.

Host plants

Possibly *Echinops* sp. (not reared).

Distribution

Kyrghyzstan.

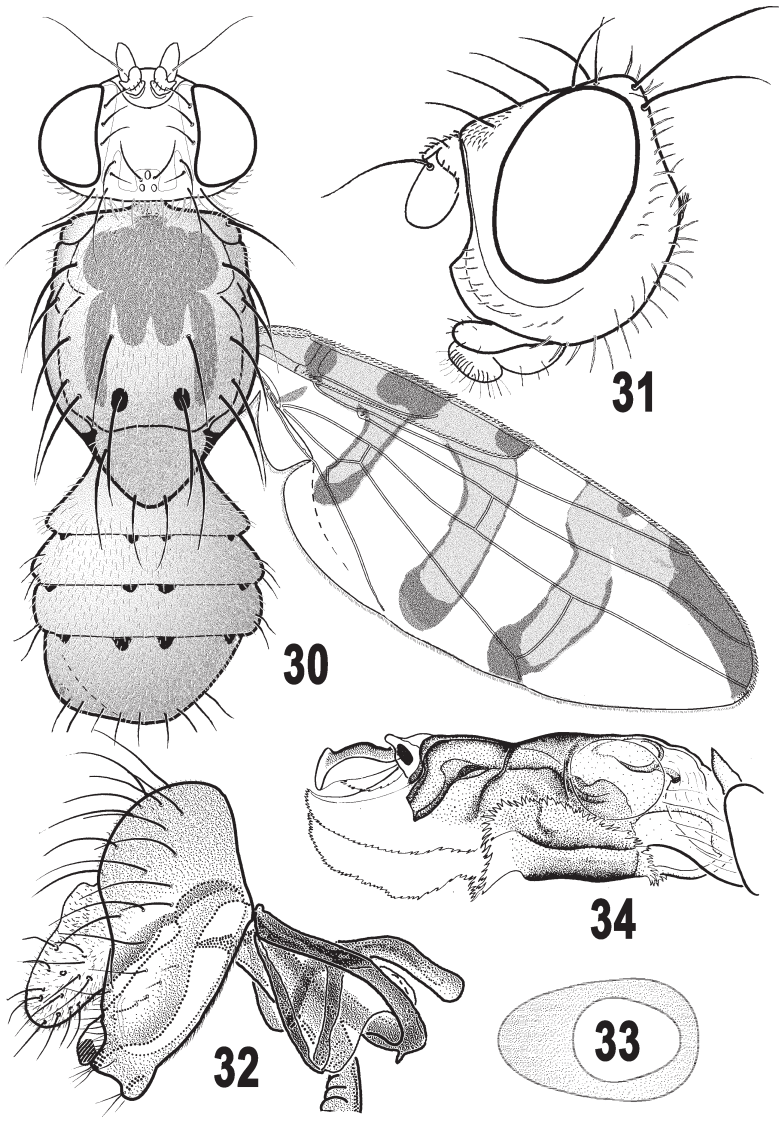
Terellia deserta Korneyev

(Figs. 30-38)

Korneyev 1985: 632; 1988: 873; Norrbom *et al*. 1999: 222.

Diagnosis

Wing with 4 brownish yellow crossbands. Scutum with dark brown or black spots at bases of

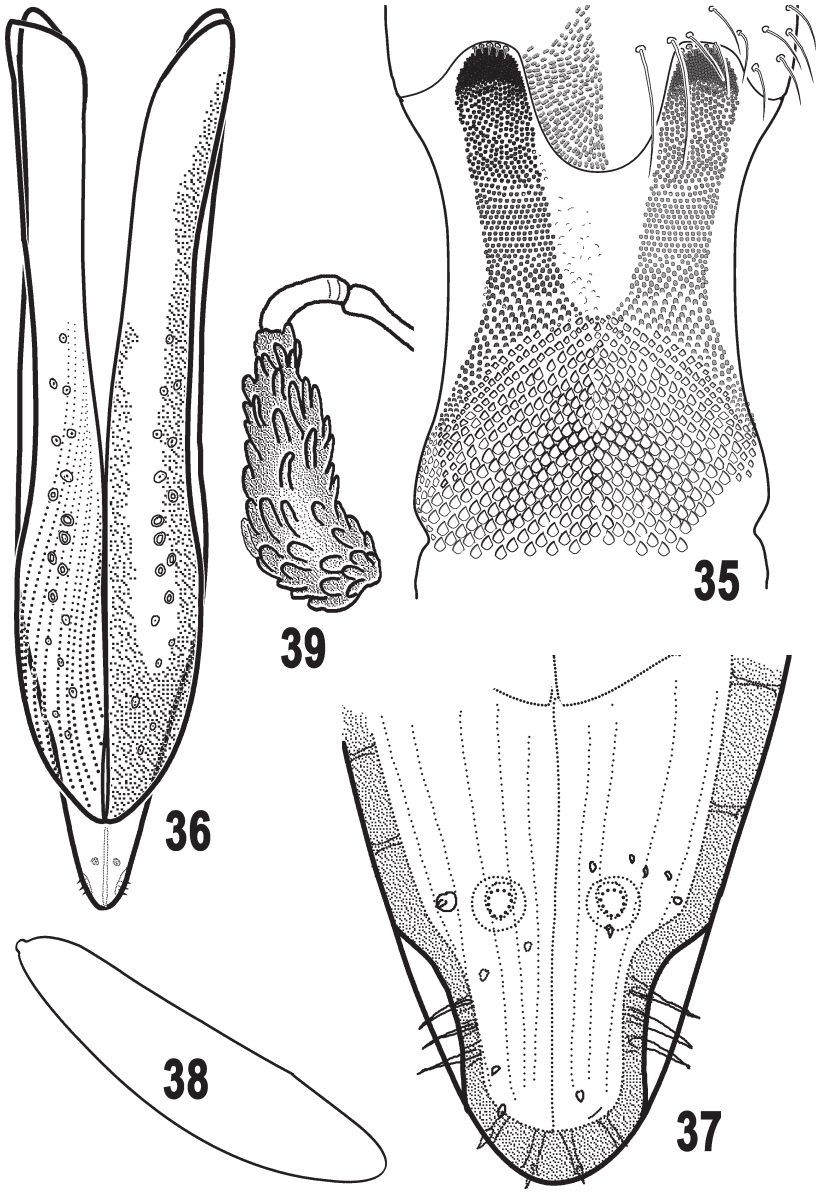


Figs. 30-34. *Terellia deserta* Korneyev, ♂. 30. Habitus, dorsal view. 31. Head, lateral view. 32. Epandrium and hypandrium, lateral view (phallus removed). 33. Basiphallus, dorsal view. 34. Glans, lateral view.

dorsocentral and prescutellar acrostichal setae but without shining black spots at transverse suture. Subvibrissal setulae and genal setulae whitish yellow. Abdominal tergites with 2 pairs of dark spots at bases, but without posterolateral spots on male tergite 5.

Redescription

Head (Fig. 31). HR = 1:1.2-1.3:1.5-1.6; FR = 1.0. Fronto-orbital plate with white setulae. Subvibrissal and genal setulae whitish yellow to white. Postocular setae white.



Figs. 35-39. *Terellia deserta* Korneyev, ♀. 35. Apex of oviscape and eversible membrane, ventral view. 36. Aculeus, ventral view. 37. Apex of aculeus, enlarged. 38. Egg. 39. Spermatheca (1 of 2).

Thorax (Fig. 30). Scutum with reddish-yellow to blackish-brown lyrate pattern, densely covered by white microtrichia, vittae broadly fused, except lateral postsutural vitta usually separate; central mark reaching level of dorsocentral seta; small dark brown spot at base of prescutellar acrostichal seta only. Pleuron yellow except reddish or brown triangular mark on katepisternum and meron obscured by gray microtrichia. Scutellum subshining yellow; anterolateral corner brown; mediotergite red to black, microtrichose except narrow

medioventral spot. Setae light brown to yellow.

Wing (Fig. 30). 2.5-2.8 times as long as wide, hyaline with yellow pattern of 4 partly fused crossbands similar to *T. tarbinskiorum*; basal costal, costal and subcostal cells yellow, with brownish yellow spots at apical portions of costal cell and pterostigma; basal half of cell br yellow; subapical and apical crossbands fused from vein R_{2+3} to vein R_{4+5}; discal crossband at crossvein R-M level as wide as crossvein R-M length; ultimate section of vein M 1.5-1.8 times as long as penultimate section.

Abdomen (Fig. 30). Yellow; all tergal setulae white; marginal setae brownish yellow; tergites 3-5(-6) with 1-2 pairs of small brown spots at anterior margin; male tergite 5 0.3 times as long as abdomen, with 2 pairs of brown spots at anterior margin, but without spots at posterolateral margin.

Male terminalia. Epandrium oval, only very slightly elongated dorso-ventrally in caudal view; posterior lobe of lateral surstylus conspicuously produced; setae at its posterior margin moderately developed, shorter than surstylus width in lateral view. Hypandrium anterior membrane not sculptured (Fig. 32). Basiphallus produced posteriorly, oval in dorsal view (Fig. 33); ligula well-developed and sclerotised; glans large, with wide tubular base of acrophallus and short apical semitubular lobes, sclerotised wall of preputium restricted to its dorsal portion (Fig. 34).

Female terminalia. Oviscape yellow, somewhat longer than 3 preceding tergites, 1.3-1.4 times as long as costal cell. Eversible membrane with dense and short, uniformly pointed, scales (Fig. 35) forming regular rows; 5 pretaenial setulae; apicomedial lobe of oviscape well-developed, microtrichose; aculeus as in Fig. 36-37, wide, with longitudinal wrinkles and gradually and bluntly pointed apex; 2 long papillose spermathecae (Fig. 39) with broadened apical portion of duct, as in *T. montana*.

Measurements. WL♂ = 4.7-5.0 mm; WL♀ = 4.5-5.2 mm; AL = 1.3-1.5 mm.

Egg (Fig. 38). Elongate-ellipsoidal, with peg-like pedicel at tapered anterior end. Dissected from female.

Material examined

Holotype ♂, TURKMENISTAN: Repetek, stand of white saksaul on sand hills, 15.vi.1976, Kaplin (ZISP). Paratype: Repetek, 27.v.1937, Kostylev (1♂; ZMUM).

Other material examined: Repetek, reared from flowerheads of *Jurinea derderioides*, xi.1984, emerged iii.1985, Kononova (1♂, 3♀; SIZK); same locality, swept, 27.iv.1992, Kotenko (1♂, 1♀; SIZK); same, 30.iv, 3, 12.v.1990, Ozerov and Shatalkin (5♂; ZMUM).

Host plants

Jurinea derderioides C. Winkl.

Distribution

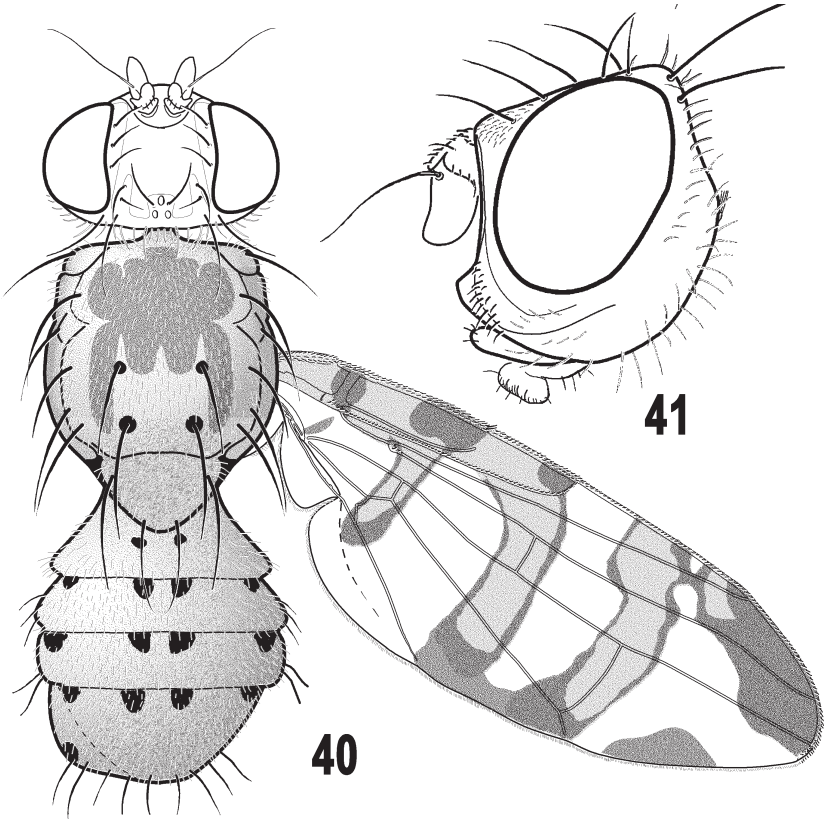
Turkmenistan.

Terellia montana Korneyev, n. sp.

(Figs. 40-50)

Diagnosis

Wing with 4 brownish-yellow crossbands. Scutum with dark brown or black spots at bases of dorsocentral and prescutellar acrostichal setae but without shining black spots at transverse



Figs. 40-41. *Terellia montana* n. sp., ♂. 40. Habitus, dorsal view (left wing omitted). 41. Head, lateral view.

suture. Subvibrissal setulae brown. Abdominal tergites with 2 pairs of dark spots at bases and additional posterolateral spot on male tergite 5.

Description

Head (Fig. 41). HR = 1:1.2 1.5; FR = 1.0. Fronto-orbital plate with white setulae. Subvibrissal setulae dark brown; genal setulae mostly brown or black, with 1-4 setulae white.

Thorax (Fig. 40). Scutum with brown to black lyrate pattern, densely covered by white microtrichia, vittae broadly fused, except lateral postsutural vitta usually separate; central mark somewhat exceeding posteriorly level of dorsocentral seta; small dark brown spot at base of dorsocentral seta, and larger spot at base of prescutellar acrostichal seta. Pleuron with black marks on katepisternum and meron obscured by gray microtrichia. Scutellum with anterolateral corners brown. Mediotergite black, microtrichose except narrow medioventral spot. Setae yellow to light brown.

Wing (Fig. 40). 2.5-2.7 times as long as wide, hyaline with yellow pattern of 4 partly fused crossbands, similar to *T. tarbinskiorum*; basal costal, costal and subcostal cells yellow, with brownish yellow spots at apical portions of costal and subcostal cells, sometimes with hyaline

spot in anterobasal part; basal half of cell br yellow; subapical and apical crossbands fused from vein R_{2+3} to vein $R_{4+5,}$ sometimes partly fused along vein R_{2+3} or completely separated; discal crossband at R-M level slightly wider than length of crossvein R-M; ultimate section of vein M 1.6-2.2 times as long as penultimate section.

Abdomen. General color yellow to greenish (in live specimens) or brownish yellow; tergal setulae (including posteromedial setulae on male tergite 5) white; marginal setae brownish yellow; tergites 3-5(-6), each with 2 pairs of rather large brown spots at anterior margin; male tergite 5 0.3 times as long as abdomen, with 2 pairs of brown spots at anterior margin and 2 posterolateral brown spots. Female tergite 6 sometimes with 2 additional posterolateral spots.

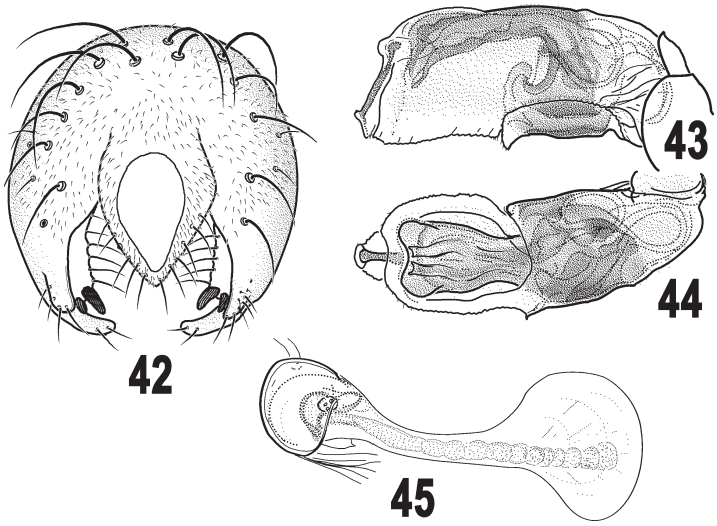
Male terminalia. Epandrium rounded in caudal view (Fig. 42); posterior lobe of lateral surstylus conspicuously protruding; setae at posterior margin of surstylus moderately sparse and long. Basiphallus oval; ligula well-developed and sclerotised; glans large, with wide tubular base of acrophallus and short apical semitubular lobes, wall of preputium sclerotised only at its dorsum (Figs. 43-44). Ejaculatory apodeme and perm pump (Fig. 45).

Female terminalia. Oviscape yellow, somewhat longer than 2 preceding abdominal tergites, as long as, or slightly shorter than, costal cell. Eversible membrane with dense, uniformly blunt scales, and apicomedial lobe of oviscape (Figs. 46-47), as in *T. deserta*; 4 or 5 pretaenial setulae; aculeus as in Fig. 48-49, wide, with longitudinal wrinkles, and distinctly pointed apically. Two rather long and densely papillose spermathecae with broad apical portion of duct, as in Fig. 50.

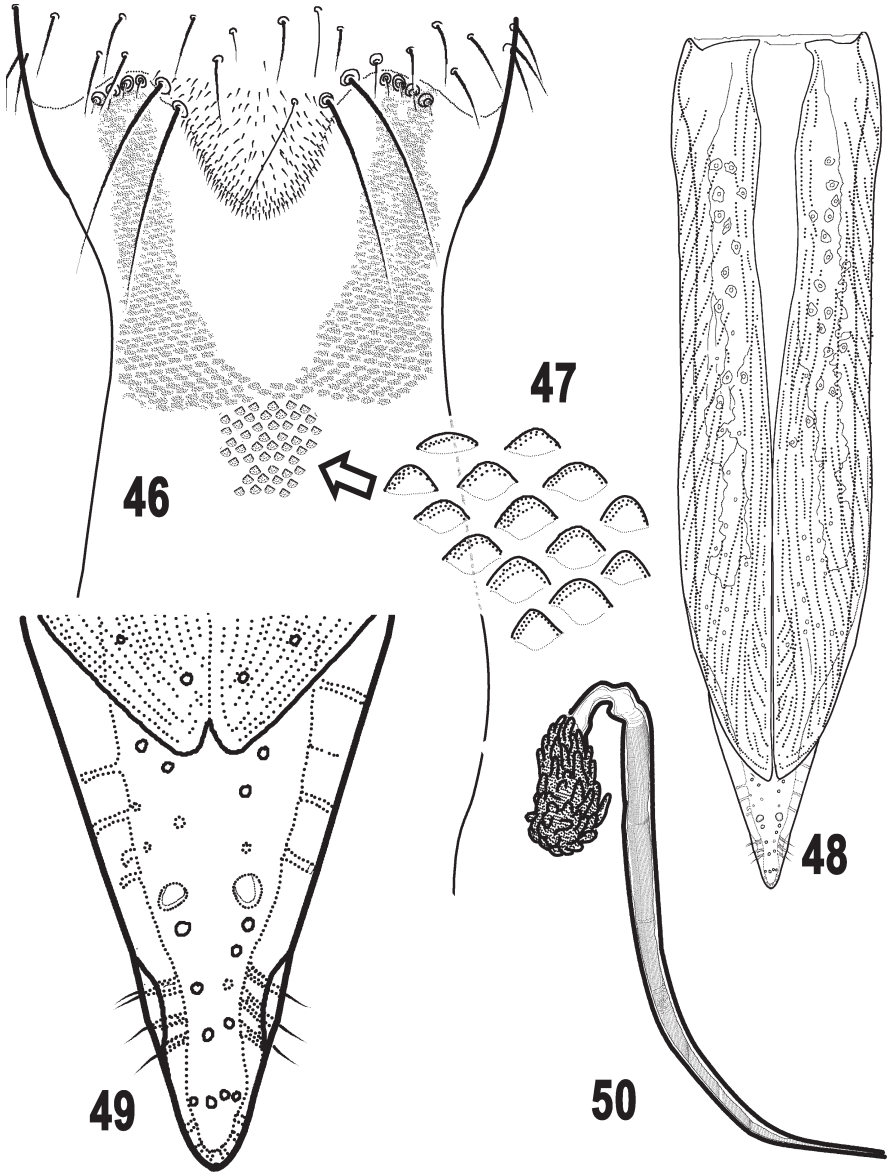
Measurements. WL ♂ = 3.8-4.1 mm; WL ♀ = 3.6-4.4 mm; AL = 0.75-0.82 mm.

Material examined

Holotype ♂, KAZAKHSTAN: 550-800 m, Kara-Tau Gebirge, 15 km N of Atabaj / [sample No]11[,] 9.v.1994, Merz (MHNG).



Figs. 42-45. *Terellia montana* n. sp., ♂. 42. Epandrium, caudal view. 43. Glans, lateral view. 44. Same, antero-ventral view. 45. Ejaculatory apodeme and sperm pump, lateral view.



Figs. 46-50. *Terellia montana* n. sp., ♀. 46. Apex of oviscape and eversible membrane, ventral view. 47. Scales of eversible membrane, enlarged. 48. Aculeus, ventral view. 49. Apex of aculeus, enlarged, ventral view. 50. Spermatheca (1 of 2).

Paratypes: KAZAKHSTAN: 550-700 m, Kara-Tau Gebirge, 15 km N of Atabaj / [sample No] 12[,] 9.v.1994, Merz (2♂, 2♀; MHNG); Karatau Mts., Aktobe River, 15 km N Atabaj, 750-800 m [swept from *Jurinea* sp.], 9.v.1984, Korneyev (5♂, 7♀; SIZK); "Pritoparye, Tau-Kumy" [= Tau Kum Desert], 22.iv.1977, [plant sample 70-77] (1♀; SIZK); same [?emerged], 10.v.1977 (1♂)

[locality not given, only sample number] "59-77", Ivannikov (4♂; SIZK); KYRGHYZSTAN: 10 km N Tash Kumyr [41°29'N 72°15'E], [swept from *Jurinea* sp.] 21.v.1994, Korneyev (1 ♂, 1♀; SIZK).

Additional specimen, not included as paratype: UZBEKISTAN: "Katta-Kurgan 16.V.929" (1♀; ZISP).

Host plants

Jurinea sp. A (possibly *multiceps* Iljin) (Karatau Mts.) and *J*. sp. B near *multiceps* Iljin (Tash Kumyr). The plant from Tash Kumyr is an undescribed species (G.A. Lazkov det.).

Distribution

Kazakhstan, Kyrghyzstan.

Terellia orheana Korneyev

(Figs. 51-60)

Korneyev, 1990: 67; Norrbom *et al*., 1999: 223.

Diagnosis

Wings hyaline. Thorax without black spots at bases of setae. Abdomen without dark spots. Eye 3.7-5.2 times as high as gena. Glans with very short terminal filaments of acrophallus.

Redescription

Head (Fig. 52). HR = 1.0:1.2:1.55; FR = 1.1. Fronto-orbital plate with white setulae. Subvibrissal and genal setulae yellowish white. Gena as high as flagellomere 1 long and 0.19-0.27 as high as eye.

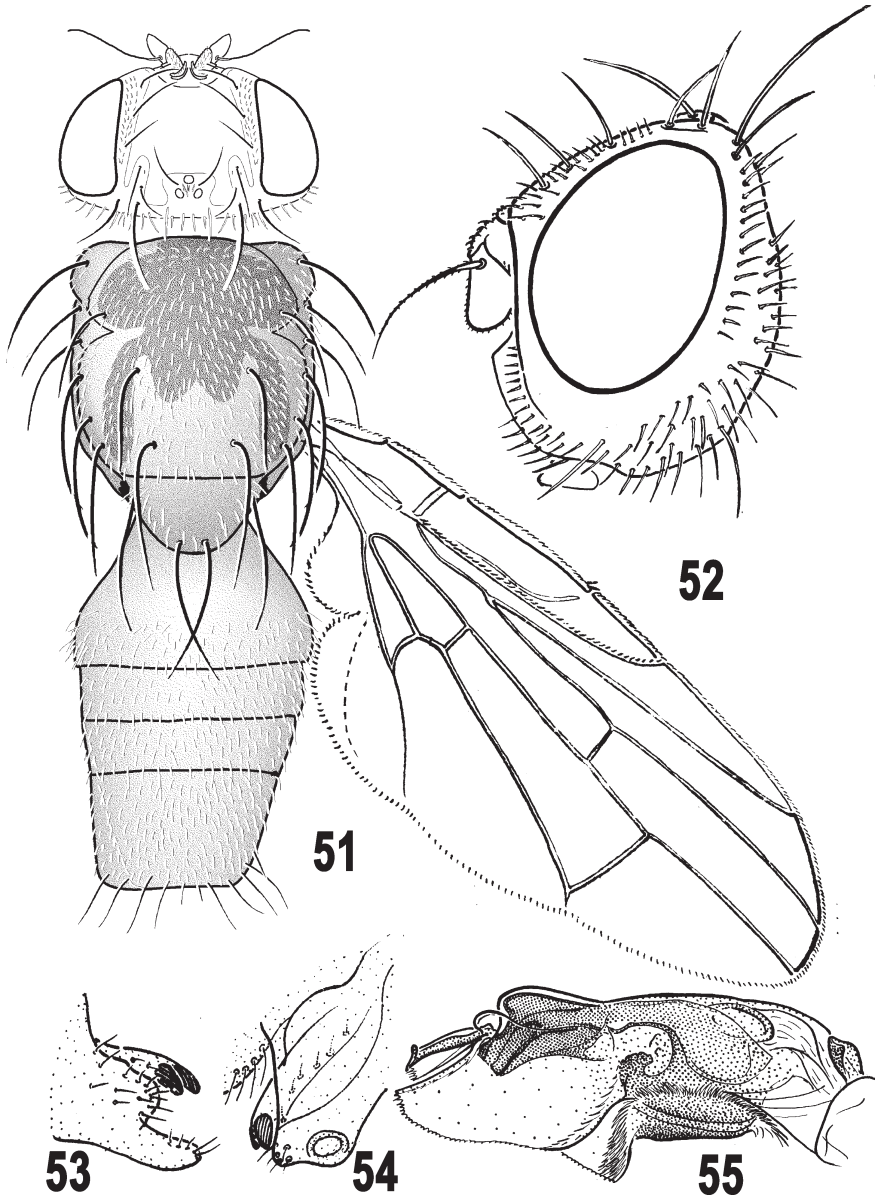
Thorax. Scutum with brownish black lyrate pattern, densely covered by white microtrichia, vittae fused; central mark reaching posteriorly mid-distance between level of dorsocentral and prescutellar setae; dorsocentral and prescutellar acrostichal setae without distinct shining spots at their bases (Fig. 51). Pleuron with black marks on katepisternum and meron obscured by gray microtrichia. Scutellum subshining yellow; anterolateral corner brown. Mediotergite black, microtrichose except narrow medioventral spot. Setae yellow to brown.

Wing (Fig. 51). 2.5-2.6 times as long as wide, hyaline, with yellowish stigma and without any dark pattern; ultimate section of vein M 1.8-2.2 times as long as penultimate section.

Abdomen. Brownish or greenish yellow; all tergal setulae white; marginal setae brownish black; tergites without dark spots (at most, female tergite 6 basally with tiny spots hidden under margin of tergite 5); male tergite 5 0.4 times as long as of abdomen (Fig. 51).

Male terminalia. Similar to those of *T. montana*; epandrium rounded in caudal view; posterior lobe of lateral surstylus conspicuously produced; setae at its posterior margin moderately sparse and long (Figs. 53-54). Hypandrium bottom smooth. Basiphallus produced posteriorly, oval; ligula well-developed and sclerotised; glans large, with wide tubular base of acrophallus and short apical semitubular lobes, wall of preputium sclerotised only at its dorsum (Fig. 55).

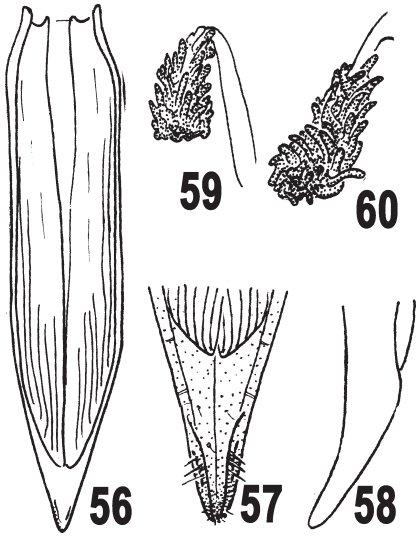
Female terminalia. Similar to those of *T. montana*. Oviscape yellow, as long as preceding 3 abdominal tergites, without dark markings. Eversible membrane with dense, uniformly blunt scales forming regular rows; aculeus as in Figs. 56-58, wide, with longitudinal wrinkles and



Figs. 51-55. *Terellia orheana* Korneyev, ♂. 51. Habitus, dorsal view (left wing omitted). 52. Head, lateral view. 53. Surstylus, caudal view. 54. Same, lateral view. 55. Glans, lateral view.

moderately pointed apically; two rather long and densely papillose spermathecae (Figs. 59-60) with broadened apical portion of duct.

Measurements. WL ♂ = 3.1-4.1 (average 3.7) (n = 5); WL ♀ = 3.7-4.2 (average 3.8) (n = 5); AL = 0.70-0.85 (average 0.75) (n = 5); C2/AL = 1.07-1.14.



Figs. 56-60. *Terellia orheana* Korneyev, ♀.56. Aculeus, ventral view. 57. Apex of aculeus, enlarged, ventral view. 58. Same, lateral view. 59-60. Spermathecae.

Material examined

Holotype ♂, MOLDOVA: Orghei, vicinity: Trebujeni [originally as "Trebugeni"] village (the Old Orghei Archaeological Reserve) cliffs of limestone denudations in Reut River canyon, reared from *Jurinea stoechadifolia* flower heads, collected 6.vii, emerged 13-15.vii.1988, collected 26.vii, emerged 13-15.viii.1988, Korneyev (SIZK).

Paratypes, same locality and date as in holotype (2♂, 6♀; SIZK).

Other material examined: UKRAINE: Odessa Oblast, right bank of Tilihul Lagoon, steppe slopes near Berezivka village, ex *Jurinea brachycephala*, collected 16.viii.1991, emerged 29.ii-1.iii.1992, Korneyev (3♂; SIZK).

Host plants

Jurinea stoechadifolia (M. Bieb.) DC. and *J. brachycephala* Klokov.

Distribution

Moldova, Ukraine.

DISCUSSION

The *quadratula* group includes species with the following characters: long and narrow, non-fan-like dilated apicodorsal rod of the glans; well-developed, broad acrophallus with wide, non-filament-like terminal lobes; well-sclerotised ligula between phallus stipe and glans, epandrium rather broad in caudal view, hypandrium bottom not sculptured; aculeus (not examined in *T. vilis* and *T. matrix*) longitudinally wrinkled and not sharply pointed at apex; abdominal tergites predominantly with white setulae. Some of these characters are believed to be plesiomorphic or of uncertain polarity, and none is clearly a synapomorphy, so the monophyly of the group is putative (Korneyev 1999).

Species included in the *quadratula* group do not share advanced features with the members

of other large clades of the Terelliini, such as the strongly modified type of phallic glans and long blunt aculeus characteristic of the subgenus *Cerajocera*; very large dilation of the vas deferens in the glans and association with Cichorieae hosts characteristic for *Orellia*; narrowly pointed apex of the aculeus and sculptured hypandrium bottom characteristic of *Terellia* s. str. + *Craspedoxantha* + *Chaetostomella* + *Chaetorellia*; or short ovoid reddish larvae and association with Centaureae hosts characteristic of the *Terellia colon* group of species. The *quadratula* group may therefore be the most primitive in the tribe Terelliini and in the subfamily Tephritinae.

The long apicodorsal rod is a unique character, found only in members of the *quadratula* group. However, its polarity is uncertain, as no closely related outgroup with such a character is known. Another putative synapomorphy, the light yellow or white setulae on abdominal tergites is also of vague polarity and also occurs in distantly-related species of the *serratulae* and *virens* groups. Inside the *quadratula* group, *Terellia deserta*, *T. orheana* and *T. montana* share the shortened lobes of the acrophallus, somewhat apically pointed aculeus and association with perennial shrubs of the genus *Jurinea*, and they form a monophyletic subgroup. The remaining species of the *quadratula* group are either known or suspected to be associated with *Echinops* species. *Echinops* is a genus of the subtribe Echinopsidinae, with morphologically aberrant spherical inflorescences, that is assigned to Cardueae but is actually closer to the tribe Mutisieae (Kim and Jansen 1995). Association with *Echinops* is believed to be either a ground-plan biological feature of the tribe, or at least a very primitive character in this group shared by *Terellia quadratula*, *T. tarbinskiorum* and *T. bushi*, and quite probably *T. vilis* and *T. matrix*.

T. tarbinskiorum and *T. bushi* possibly form a monophyletic group, which is characterized by the presence of a shining black spot at the transverse suture of the mesonotum. However, this character is present in all the species of the genus *Orellia*, and may be also a synapomorphy of the *tarbinskiorum* + *bushi* + *Orellia* clade. These taxa also share the longitudinally wrinkled aculeus surface, but differ in the structure of the phallic glans and their host-plant association. It is also possible that the *tarbinskiorum* subgroup is a sister-group of *Orellia*.

Further studies of this hitherto poorly known group of species are required to clarify the phylogeny of the Terelliini and the subfamily Tephritinae.

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REFERENCES

Becker, T. 1905. Cyclorrhapha Schizophora: Holometopa. pp. 1-273. In: Becker, T., Bezzi, M., Kertész, K., and Stein, P. *Katalog der paläarktischen Dipteren*. Band IV. Budapest. 328 pp.

Foote, R.H. 1984. Family Tephritidae. pp. 66-149. In Soós, A., and Papp, L. (eds.). *Catalogue of Palaearctic Diptera*, Volume 9, *Micropezidae — Agromyzidae*. Akadémiai Kiádo, Budapest and Elsevier Science Publishers, Amsterdam. 460 pp.

Freidberg, A. and Kugler, J. 1989. *Fauna Palaestina*. *Insecta IV*. *Diptera*: *Tephritidae*. Israel Academy of Sciences and Humanities, Jerusalem. [vi] + 212 pp., 8 plates, 1 map.

Hendel, F. 1927. 49. Trypetidae. In: E. Lindner [ed.]. *Die Fliegen der palaearktischen Region*, Band 5, Lieferungen 16-19. Stuttgart, Schweizerbart. 221 pp., 17 plates.

Hering, E.M. 1961. Ergebnisse der Deutschen Afghanistan-Expedition 1956 der Landessammlungen für Naturkunde Karlsruhe, Trypetidae (Diptera) (56. Beitrag zur Kenntnis der Trypetidae). *Beiträge zur Naturkundlichen Forschung in Südwestdeutschland* 19: 319-331.

Kim, K.-J. and Jansen, R.K. 1995. ndhF sequence evolution and the major clades in the sunflower family. *Proceedings of the National Academy of Sciences of the USA* 92(October): 10379-10383.

Korneyev, V.A. 1985. Fruit flies of the tribe Terelliini Hendel 1927 (Diptera, Tephritidae) of the fauna of the USSR. *Entomologicheskoe Obozrenie* 64(3): 626-644. [In Russian]

Korneyev, V.A. 1988. A new and little known species of tephritid flies of the genus *Terellia* R.-D. (Diptera, Tephritidae) from middle Asia and Transcaucasia. *Entomologicheskoe Obozrenie* 67(4): 871-875. [In Russian]

Korneyev, V.A. 1990. A new species of the genus *Terellia* (Diptera, Tephritidae) from Moldavia. *Vestnik Zoologii* 1990(5): 67-69. [In Russian]

Korneyev, V.A. 1999. Phylogeny of the subfamily Tephritinae: relationships of the tribes and subtribes. pp. 549-580. In: Aluja, M. and Norrbom, A.L. (eds.) (2000). *Fruit flies (Tephritidae)*: *Phylogeny and evolution of behavior*. CRC Press, Boca Raton [16]+944 pp.

Korneyev, V.A. and Dirlbek, J. 2000. The fruit flies (Diptera: Tephritidae) of Syria, Jordan and Iraq. *Studia Dipterologica* 7(2): 463-482.

Kugler, J. and Freidberg, A.1976. A list of the fruitflies (Diptera: Tephritidae) of Israel and nearby areas, their host plants and distribution. *Israel Journal of Entomology* (1975) 10: 51-72.

Loew, H. 1869. Revision der europäischen Trypetina. *Zeitschrift für die Gesammten Naturwissenschaften* 34(7/8): 1-24.

Norrbom, A.L., Carroll, L.E. Thompson, F.C. White, I.M., and Freidberg, A.1999. Systematic database of names. pp. 65-299. In: Thompson, F.C. (ed.). *Fruit fly expert identification system and systematic information database*. *Myia* (1998) 9. Leiden: Backhuis Publishers: [vii] + 524 pp. and Diptera Data Dissemination Disk (CD-ROM) (1998) 1.

Richter, V.A. 1960. New and little-known species of fruit-flies (Diptera, Trypetidae) in the fauna of the USSR. *Entomologicheskoe Obozrenie* 39(4): 893-896. [In Russian]

Richter, V.A. 1965. On the fauna of fruit-flies (Diptera, Tephritidae) in USSR. *Zoologicheskii Zhurnal* 44(1): 136-138. [In Russian]

Richter, V.A. 1970. Tephritidae (Trypetidae) — pestrokrylki [Family Tephritidae (Trypetidae) — fruit flies]. pp.132-172. In: Bei-Bienko, G.Ya. (ed.). *Opredelitel' nasekomykh evropeyskoy chasti SSSR*. *Tom V*. *Dvukrylyye*, *blokhi*. *Chast' 2* [*Keys to the insects of the European part of the USSR*. *Vol*. *V*. *Diptera*, *Siphonaptera*. *Part 2*]. (Opredeliteli po faune SSSR, izdavayemye ZIN AN SSSR [Keys to the USSR fauna published by ZIN AN SSSR]. No. 103.) Nauka, Moscow and Leningrad: 943 pp. [In Russian]

White, I.M., Headrick, D.H., Norrbom, A.L., Carroll, L.E. 1999. 33. Glossary. pp. 881-924. In: Aluja, M. and Norrbom, A.L. (eds.) (2000). *Fruit flies (Tephritidae)*: *Phylogeny and evolution of behavior*. CRC Press, Boca Raton [16] + 944 pp.

Zaitzev, F.A. 1947. K faune plodovykh mukh (pestrokrylok) Kavkaza i sopredel'nykh stran (Diptera, Trypetidae) [On the fruit fly fauna of the Caucasus and bordering countries]. *Trudy Zoologicheskogo instituta AN GSSR*. 1947. 7: 1-15. [In Russian]