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Taxonomic review of the genus *Taeniogonalos* Schulz (Hymenoptera: Trigonalyoidea: Trigonalyidae) from Korea, with a description of the male of *T. sauteri*

Jeong-Kyu Kim[1,*] and Pierre Tripotin[2,*]

[1]*Department of Bio Environment Health, Dongnam Health University, Suwon-si, Gyeonggi-do 16328, Republic of Korea*
[2]*Pyeongsan-gil 28, Dongi-myeon, Okcheon-gun, Chungcheongbuk-do 29024, Republic of Korea*

**Co-correspondent: hymjkk@dongnam.ac.kr (J.-K. Kim), pierretripotin@gmail.com (P. Tripotin)*

The family Trigonalyidae Cresson, 1887, is a small group of parasitic wasps (Hymenoptera: Apocrita) comprising around 150 species worldwide. Among them, the genus *Taeniogonalos* Schulz, 1906 is the richest in species and the most widely distributed. Four species, namely *T. fasciata*, *T. mongolica*, *T. subtruncata* and *T. tricolor*, were recorded from the Korean Peninsula. The genus is studied here on the basis of a larger collection of material from South Korea. Six species of *Taeniogonalos* are recognized, including three species that are newly recorded: *T. formosana*, *T. sauteri* and *T. taihorina*. The published record of *T. mongolica* in Korea currently seems groundless, and this species should be excluded from the Korean fauna. A key to species identification is provided, with illustrations and description of each species. The hitherto unknown male of *T. sauteri* is described. We also present new biological data on *T. sauteri* and *T. formosana*, including the record of a new family of Diptera as secondary hosts for the family.

Keywords: biology, new records, *T. formosana*, *T. sauteri*, *T. taihorina*, Trigonalid wasps

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Introduction

The family Trigonalyidae is a peculiar group of about 150 uncommon parasitic wasps that is distinct and distant from all other Parasitica, justifying the placement in its own superfamily Trigonalyoidea. Of which all members share a special combination of morphological characters (Carmean and Kimsey, 1998), and a remarkable biology.

As a general pattern, female Trigonalids lay thousands of micro-type eggs randomly on foliage, and the eggs must be ingested by a phytophagous larva (that becomes the primary host, either a Lepidoptera or Symphyta larva). The primary host must then be secondarily attacked by a parasitoid larva (either a Tachinid fly, an Ichneumonid or a non-gregarious Braconid, called the secondary host), which the Trigonalid larva will attack and consume to complete its development. This improbable succession of events explains the scarcity of most species in the wild.

Trigonalids are spread all over the warmer parts of the world, with a predominance in humid, forested areas (a noticeable exception being Western Europe, with only one pan-palearctic species). According to the recent revision of the Chinese fauna (Chen *et al*., 2014), Eastern Asia in general and China in particular appear to have the largest and the more diverse fauna of Trigonalids yet described, with eight genera and over 40 species for China alone (Taiwan included).

Among Trigonalyidae, the genus *Taeniogonalos* Schulz, 1906 occurs in all biogeographical regions except Western Europe. It is by far the largest genus of the family, with around 55 species recognized worldwide (Carmean and Kimsey, 1998; Chen *et al*., 2014; Tan *et al*., 2017; Chen *et al*., 2020; Zhang *et al*., 2022).

In terms of biology, the genus *Taeniogonalos* follows the general host relationship of the family described above: a large range of phytophagous larvae as primary hosts (sawfly and lepidopteran larvae, with even the strange record of a detrivorous Tipulid larva), and a wide range of Ichneumonid and Braconid wasps or Tachinid flies as final hosts.

A noticeable and striking exception is the well-established record of two Australian species (*T. venatoria* and *T. maculata*), acting as simple parasitoids of several spe-

cies of Pergidae sawflies, for which they can cause a significant reduction of populations (Weinstein and Austin, 1991; Carmean and Kimsey, 1998).

The genus *Taeniogonalos* is morphologically separated from all other Trigolalids by the following combination of characters: antenna 20−26 segmented, without whitish flagellomeres, the males with a series of linear tyloids in the mid segments; frontal area above antennal sockets flat (unlike areas lateral to antennal sockets, not depressed), supra-antennal elevation weakly developed, in dorsal view, much broader than high, dull triangle, and the shelf between them roundly concave; hind trochanter vertically grooved subapically, forming an apical right-angled triangular compartment, and thus appearing bi-segmented; metasomal sternum 2 sometimes with an apicomedian armature; metasomal sternum 3 without ledge anteriorly, at most with an apicomedian tubercle; anterior propodeal sulcus smooth laterally without bottom keel, and medially narrow slit-like.

So far, four species of the genus, namely *T. fasciata*, *T. mongolica*, *T. subtruncata* and *T. tricolor*, were recognized in Korea based on historical records of a reduced number of specimens, as follows. *Taeniogonalos fasciata* was first known in Korea as *Nanogonalos magnifica* Teranishi, 1929, established with two types specimens from Mt. Geumgangsan (North Korea: Gangwon-do), but the latter was subsequently synonymized with the former by Carmean and Kimsey (1998). Another species, *Nanogonalos flavocincta* Teranishi, 1929, was described based on a single male holotype from Suwon (South Korea), but replaced with *T. subtruncata* by Chen *et al*. (2014). Carmean and Kimsey (1998) first added *T. tricolor* to the Korean fauna, unfortunately without geographic information. *Taeniogonalos mongolica* was first included in the Korean fauna by Lelej (2003). However, this species should be excluded from the Korean fauna, as will be discussed below.

In this study, a taxonomic review of the genus *Taeniogonalos* from Korea is presented. We recognize six species. Among them, three species (*T. formosana*, *T. sauteri* and *T. taihorina*) are newly recorded from Korea. Also, the male of *T. sauteri* is described for the first time. A key to species identification is provided, with illustrations and a description of each species. What we know of the biology of each species is also presented.

Materials and Methods

The list of synonyms in each species includes the taxonomic information of the original citation, the related primary taxonomic issues, and the published records of occurrences in Korea.

The terminology for the body structures primarily follows Carmean and Kimsey (1998).

All specimens were measured and photographed (and stacked) with an image analyzer and a digital camera equipped with a Leica DMS 1000a. Measurements of body parts were taken at their largest portion; body length was measured in dorsal view, thus usually the three apical segments that bend backwards to S2 (or downwards) were not visible and not included in the measurement; the distance between supra-antennal elevations (DSAE) is the distance between the tops of the supra-antennal tubercles in dorsal view.

For this study we examined over 700 specimens of *Taeniogonalos* from South Korea, without mentioning all of them for the common species. They are housed in the two authors' private collections, and a part of this material will be deposited in the National Institute of Biological Resources, Incheon, South Korea.

The morphological abbreviations are as follows: **DC** - discoidal cell; **DSAE** - distance between supra-antennal elevation; **F** - flagellomere; **PO** - posterior ocelli; **T** - metasomal tergum; **S** - metasomal sternum; **SAE** - supra-antennal elevation; **SMC** - submarginal cell.

The provincial names of South Korea are abbreviated as follows: **GW** - Gangwon-do; **GG** - Gyeonggi-do; **CB** - Chungcheongbuk-do; **CN** - Chungcheongnam-do; **DJ** - Daejeon Metropolitan City; **DG** - Daegu Metropolitan City; **GB** - Gyeongsangbuk-do; **GN** - Gyeongsangnam-do; **IC** - Incheon Metropolitan City; **JB** - Jeollabuk-do; **JJ** - Jeju-do; **JN** - Jeollanam-do; **SL** - Seoul.

Results

Order Hymenoptera Linnaeus, 1758
Superfamily Trigonalyoidea
Family Trigonalyidae Cresson, 1887

***Taeniogonalos* Schulz, 1906**

Taeniogonalos Schulz, 1906: 212; Weinstein and Austin 1991: 416; Carmean and Kimsey 1998: 65; Chen *et al*., 2014: 95. Type species (by monotypy): *Trigonalys maculata* Smith, 1851.

Poecilogonalos Schulz, 1906: 212; Marshakov, 1981: 105; Tsuneki, 1991: 46; Weinstein and Austin, 1991: 422; Lelej, 1995: 14. Type species (by monotypy): *Trigonalys thwaitesii* Westwood, 1874. Synonymized by Carmean and Kimsey, 1998.

Nanogonalos Schulz, 1906: 211; Teranishi, 1929: 150; Marshakov, 1981: 107; Weinstein and Austin, 1991: 421. Type species (by monotypy): *Nanogonalos enderleini* De Santis, 1980. Synonymized by Carmean and Kimsey, 1998.

Ischnogonalos Schulz, 1907: 11; Schulz, 1908: 33; Bischoff, 1933: 482; Bischoff, 1938: 11; Weinstein and Austin, 1991: 413; Carmean and Kimsey, 1998: 65. Type species (by monotypy): *Trigonalys dubia* Magretti, 1997. Synonymized by Chen *et al*., 2014.

Lycogastroides Strand, 1912: 129; Weinstein and Austin, 1991: 413. Type species (by original designation): *Lycogastroides gracilicornis* Strand, 1912. Synonymized by Carmean and Kimsey, 1998.

Lycogonalos Bischoff, 1913: 155; Weinstein and Austin, 1991: 415. Type species (by original designation): *Lycogonalos flavicincta* Bischoff, 1913. Synonymized by Carmean and Kimsey, 1998.

Taiwanogonalos Tsuneki, 1991: 35. Type species (by original designation): *Taiwanogonalos alishana* Tsuneki, 1991. Synonymized by Carmean and Kimsey, 1998.

Diagnosis (characteristics applicable for both sexes unless sex specified). Body length 4.0−13.0 mm. Antenna 20−26 segmented (variable even in the same species), flagellomeres without whitish segments forming a band; male with a series of linear tyloids on mid flagellomeres. Clypeus semi-elliptically notched apicomedially. Lower frontal areas lateral to antennal sockets depressed, but those above antennal sockets flat. SAE, in dorsal view, low, usually dull triangular, and shelf between SAE weakly and roundly concave. Temple sparsely punctate (especially in posterior part) to punctate-reticulate, and more or less shiny. Occipital carina usually forming regular thin lamina complete to hypostomal carina at level of mandibular base, or sometimes dorsomedially forming a broadened lamina filling the excavated occiput. Vertex flattened without median depression dorsally. Apical segment of labial palp widened and obtuse, more or less triangular. Mandibles not distinctly separated from eye, malar space at most as long as length of antennal pedicel. Mesoscutum and scutellar disc distinctly sculptured (mostly punctate-reticulate and partially ridged) except on a smooth anteromedial declivity of the mesoscutum; scutellar trough with several distinct longitudinal ridges. Metanotal disc slightly convex laterally, and often sculptured. Anterior propodeal sulcus smooth laterally without bottom keel, and narrowed slit-like medially. Forewing fuscous in anterior apical part to anterior half. Hind trochanter vertically grooved subapically, forming an apical right-triangle compartment, and appearing to be made of two segments; fore trochanter not distinctly broadened apically in lateral view, and distinctly longer than hind trochanter (reaching twice as long as); hind tarsus slightly or not modified. Propodeal foramen triangular in shape and more or less arched dorsomedially, bordered by a dull but strong carina. T1 largely concave medially, with arcuate fine ridges in the anterior part of concavity. T2 basomedially depressed, more or less flattened, often shiny and less punctured, and sometimes depression extending posteriorly. In females, S2 distinctly convex (as in T2), sometimes with an apicomedian production (but always not forming paired small teeth); in males, S2 much less swollen than in females, and its larger apicomedian part flat to weakly concave with sparser punctures than remainder S2; S3 short, rarely with a vertical tubercle subapically, but always without a distinct ledge anteriorly. Last three metasomal segments bent backwards to S2 or downwards.

Key to species occurring in Korea

− S2 strongly swollen in profile, not flattened apicomedially. Antennae without tyloids ····· ♀♀

− S2 less convex in profile and flattened or weakly concave. Antenna with linear tyloids····· ♂♂

Females

1. S3 apicomedially with a strong vertical tubercle (arrows of Fig. 4B, D), apical margin of tubercle weakly notched medially, forming a pair of dull teeth. Anterior half of forewing deeply fuscous (Fig. 4E): costal cell, radial cell, SMC1, SMC2, SMC3, SMC4 and upper two-third of DC1 clearly fuscous. T4−6 with large hat-like to semicircular markings (Fig. 4A) ····· *T. subtruncata* Chen *et al*.

− S3 simple apically, without tubercle. Only costal cell (often hyaline) and anterior apical part of forewing (usually including marginal cell and upper marginal part of SMC4) fuscous, or *if* more largely fuscous *then* at least DC1 and SMC1 hyaline (Figs. 1C, 5B). T4−6 without marking (Figs. 1A, 5A), or with apical band (Fig. 6A) or paired markings (Fig. 2A)····· 2

2. S2 with a flat obtuse triangular or semi-circle apicomedian protuberance (arrow in Fig. 3B and in red circle of Fig. 3D); upper frons with both transverse stripes (connecting to inner orbital markings) lateral to PO and a large cordate spot anterior to anterior ocellus (Fig. 3C)····· *T. sauteri* Bischoff

− Apical margin of S2 simple, without median tubercle. Upper frons without such stripes (Figs. 1B, 2C, 4C, 5C), or *if* any (stripes often connected to spot anterior to median ocellus, and thus forming a bi-convex stripe across upper frons as in Fig. 6A, B) *then* T2−6 with bi-colored apical bands and paired markings that are reddish orange anteriorly and yellow posteriorly (Fig. 6A, B)····· 3

3. In a majority of specimens, almost entire mesoscutum (sometimes except median blackish part), axillae, scutellum, and very often upper half of mesopleuron and metapleuron concolorous pale to dark reddish (Fig. 1A, C); in a minority of specimens, mesosomal

coloration much reduced, but still with traces of dark reddish coloration ····· *T. fasciata* (Strand)
– Corresponding parts of mesosoma not red to dark reddish colored, at most partially yellow to reddish orange ····· 4
4. SAE largely black, sometimes ferruginous apically, but a narrow apical rim opaque; SAEs more distantly spaced each other, DSAE ca. 0.44 × as long as distance between eyes at level of SAE (Fig. 5C, D). Notauli distinctly interrupted by transverse keels in its entire length. Head and mesosoma almost entirely black, with yellow marks reduced: at most mandible subapically, short stripes along inner and outer orbits, and spots on upper lateral margins of median lobe of mesoscutum yellow; only T1 (sometimes absent) and T2 with a distinct apical band (Fig. 5A, D) ····· ····· *T. taihorina* (Bischoff)
– SAE yellow, with a broad translucent apical lamella; SAEs more closely spaced, DSAE ca. 0.33 × as long as distance between eyes at level of SAE (Fig. 2C, D). Notauli not distinctly interrupted by transverse keels, at most with indistinct bottom keel in its apical quarter. Head and mesosoma largely colored: at least clypeus, lower frons lateral to antennal sockets, lateral margins of median lobe of mesoscutum, axillae, scutellum, metanotum and propodeum with yellow to orange markings; metasomal terga largely colored, T1–3 with apical bands, T4–6 with paired large triangular spots (sometimes apical bands) (Fig. 2A–D; Fig. 6A, B) ····· 5
5. Upper frons with transverse stripes lateral to PO, stripes often connecting to inner orbital markings and forming bi-convex stripe touching ocelli (Fig. 6A, B); scutellar disk colored at least laterally (Fig. 6A); apical markings of T2–6 bi-colored, reddish orange anteriorly and yellow posteriorly (Fig. 6A) ····· ····· *T. tricolor* (Chen)
– Upper frons without such marking, at most with small spots lateral to PO (Fig. 2C); scutellar disk not colored (Fig. 2A); apical bands or markings of terga not bi-colored but concolorous deep yellow (Fig. 2A, D) ····· *T. formosana* (Bischoff)

Males

1. F9–13 with tyloids, that on F9 variable in length (but usually developed in middle part of F), those on F10–12 developed in almost entire length of each F except basally and apically, and that on F13 maximally in basal half (Fig. 1D). Almost entire mesoscutum (sometimes except median blackish part) and scutellum concolorous, pale to dark reddish; in a minority of specimens, reddish mesonotal coloration much reduced, rarely completely black, but still antennae with tyloids on F9–13 (see also Diagnosis under this species) ····· *T. fasciata* (Strand)
– More flagellomeres with tyloids, at least F8 with a well-developed tyloid. Mesoscutum and scutellum neither entirely colored nor reddish, their markings yellow to reddish orange ····· 2
2. Anterior half of forewing (including costal cell, radial cell, SMC1, SMC2, SMC3, SMC4, and upper half of DC1) deeply fuscous (Fig. 4E). Each of T4–6 with a large hat-like to semicircular markings. [F8–14 with tyloids, those on F8–12 developed in almost entire length (except basally and apically) of each F, that on F13 in basal two-thirds, and that on F14 in basal one-third (Fig. 4F)] ····· *T. subtruncata* Chen *et al*.
– Forewing with an anterior apical darkened patch (anterior one-third of forewing weakly fuscous in sole specimen of *T. tricolor*, but DC1 hyaline). T4–6 without such markings: completely black or with discontinuous paired markings ····· 3
3. SAE largely black, sometimes ferruginous apically, but narrow apical rim opaque; SAEs more distantly spaced each other, DSAE ca. 0.44 × as long as distance between eyes at level of SAE. Head and mesosoma almost entirely black, with yellow marks reduced: at most mandible subapically, and short stripes along inner and outer orbits yellow; only T1–2 with apical markings: a continuous band on T1 (often absent), and a pair of oval spots distantly spaced on T2. [F8–13 with tyloids, those on F8–11 developed in almost entire length of each F, that on F12 in basal two-thirds, and that on F13 in basal one-fifths (Fig. 5E)] ····· ····· *T. taihorina* (Bischoff)
– SAE yellow, with a broad translucent apical lamella; SAEs more closely spaced each other, DSAE at most 0.37 × as long as distance between eyes at level of SAE. Head and mesosoma largely colored: at least clypeus, lower frons lateral to antennal sockets, lateral margins of median lobe of mesoscutum, axillae, scutellum, metanotum and propodeum with yellow to orange markings; all terga colored apically ····· 4
4. F8–16 with tyloids, those on F8–14 developed in almost entire length of each F, that on F15 in basal two-thirds, and that on F16 in basal half (Fig. 2E). Upper frons lateral to PO without transverse stripe, at most with small spots anterolateral to PO; scutellar disk not colored ····· *T. formosana* (Bischoff)
– At most F8–14 with tyloids (Figs. 5E, 6D). Upper frons lateral to PO with transverse stripes connecting to inner orbital markings; scutellar disk yellow to reddish yellow at least laterally ····· 5
5. Apical markings on metasomal terga bi-colored, reddish orange anteriorly and yellow posteriorly. Larger species, more than 8 mm in body length ····· ····· *T. tricolor* (Chen)
– Apical markings on terga not bi-colored but concolor

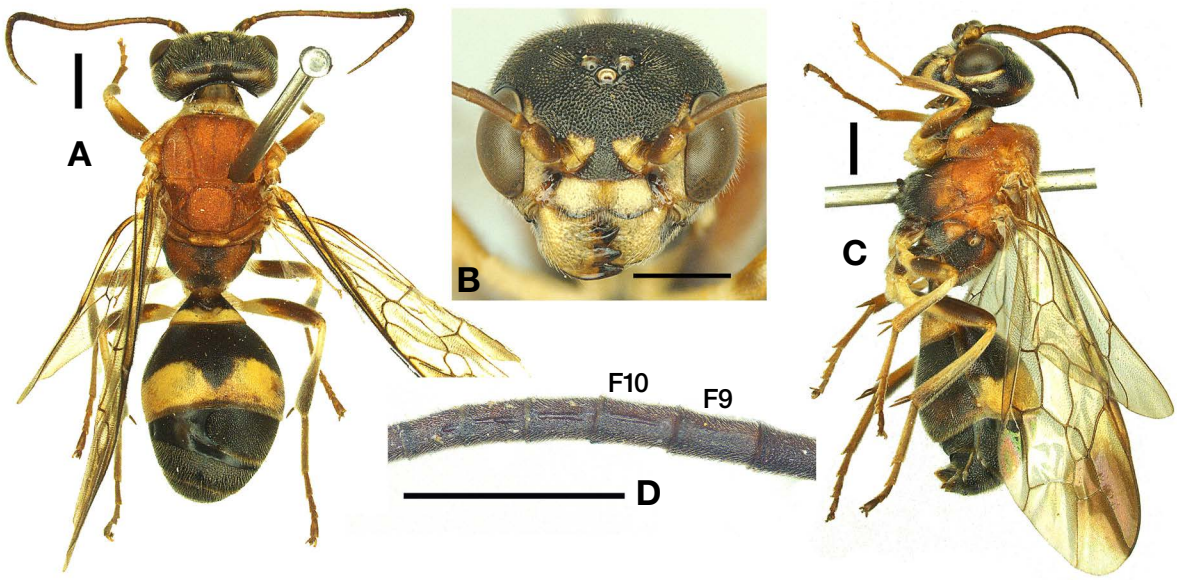

Fig. 1. *Taeniogonalos fasciata* (Strand). A, General habitus in dorsal view, ♀. B, Head in frontal view, ♀. C, General habitus in lateral view, ♀. D, F8–14, ♂. Scale bars: 1 mm.

yellow, at most apical band of T2 anteriorly evanescently tinged with reddish brown. Smaller species, less than 6 mm in body length·····*T. sauteri* Bischoff

***Taeniogonalos fasciata* (Strand, 1913)**

Deung-ppal-gan-gal-go-ri-beol (Fig. 1A–D)

Poecilogonalos fasciata Strand, 1913: 97, ♀ (holotype), ♂ (paratype), Taiwan: Taihorn and other localities [Senckenberg Deutsche Entomologische Institut, Müncheberg, Germany].

Nanogonalos magnifica Teranishi, 1929: 144 (in key), 147, ♂ (holotype, not ♀ as in original description), North Korea: "Mt. Gongo" (Geumgangsan) [Osaka Museum of Natural History, Japan]; Weinstein and Austin, 1991: 421. Combined to *Poecilogonalos* by Marshkov (1981), and re-combined to *Taeniogonalos* and synonymized with *Taeniogonalos fasciata* by Carmean and Kimsey (1998).

Poecilogonalos magnifica: Marshakov, 1981: 105 (new combination); Tsuneki, 1991: 46 (in key), 50 (type examined); Lelej 1995: 14 (incl. Korea in distribution).

Taeniogonalos fasciata: Carmean and Kimsey, 1998: 67 (new combination); Lelej, 2003: 5 (incl. Korea in Distribution); Chen *et al*., 2014: 117 (incl. Korea in distribution); Watanabe and Yamane, 2017: 12 (incl. Korea in distribution); Tan *et al*., 2017: 53 (incl. Korea in Distribution).

Diagnosis. *Taeniogonalos fasciata* is readily distinguished by the more or less extended reddish coloration of the thorax. As far as known, any Korean specimen with red or dark reddish marks on the thorax belongs to this species. The coloration can be reduced to almost nothing in some rare cases, especially on minute males. In this case the reduced number of tyloids to F9–13 will confirm the identification.

Description. Female. Body length 3.6–12.7 mm, forewing length 5.1–11.3 mm.

Head. SAEs yellow, with broad translucent apical lamella; in dorsal view, DSAE 0.33 × as long as distance between eyes at level of SAE. Occipital carina narrow in its entire length. Frons punctate-reticulate; mandible, vertex, temple, and gena anteriorly densely punctate, but vertex submedially more sparsely punctate; clypeus feebly punctate; gena posteriorly and occiput shiny, with setigerous tiny sparse punctures; areas anterior to anterior ocellus and lateral to posterior ocelli smooth.

Mesosoma. Notauli usually fine, narrow, without bottom keel (but a minority of specimens with several bottom keels in its apical half). Mesoscutum and scutellar disc irregularly reticulate (partially forming sinuous longitudinal ridges); pronotal side longitudinally ridged, ridges more or less sinuous; dorsal mesopleuron irregularly reticulate except posterior lower half; ventral mesopleuron densely punctate-longitudinally ridged; metapleuron densely punctate; scutellar trough smooth, with several longitudinal ridges; propodeal dorsum densely punctate to punctate-reticulate, often with oblique ridges in its basal half; propodeal side longitudinally ridged in its anterior half, and punctate-reticulate or irregularly reticulate posteriorly.

Metasoma. T1 0.6 × as broad as T2, often with shallow median longitudinal depression in its basal three-fourths.

S1 1.2 × as broad as long. S2 almost evenly convex in profile, slightly more beveled apicomedially. T1 largely smooth with punctures laterally; T2 densely punctate, appearing to be punctate-reticulate, but getting sparser centrally; T3–6 punctate-reticulate; S1–2 moderately punctate, punctures not contiguous, spaced by 1PD or slightly less than; S3–5 punctate-reticulate.

Coloration. Body extensively colored in a majority of specimens. Following parts/markings pale to dark reddish: pronotum except for anterior neck (pale yellow), mesoscutum. scutellum, metanotum except anterior and lateral margins, upper two-thirds to three-fourths of mesopleuron and metapleuron, and larger lateral portions of propodeal dorsum (sometimes reduced and tinged with yellow). Following parts creamy to pale yellow: SAE except semi-transparent apical rim, clypeus except margin, mandible except apical teeth, antennal scape ventrally, thickened stripes of lower frons along inner orbits, genal stripes along outer orbits, posterior margin of vertex (forming a pair of transverse bands or a transverse band anteriorly with two pairs of longitudinal stripes extended to ocellar region), neck of pronotum, margin of metanotal disc, inner faces of all coxae, all trochanter, and all trochantellus, basal and apical parts of all femora. Following parts/markings pale yellow to yellow: fore femur (except basal and apical creamy yellow), all tibiae, fore tarsomeres, apical bands of T1–2 (that of T1 in apical one-third of T, that of T2 in apical half except anterior median v-notch), apical band of S1 (almost as thick as that on T1). Pronotal dorsum and tegula brownish yellow. Scape dorsally, pedicel, and antennal flagellomeres (darkened in apical segments) reddish yellow. Spots anterolateral to anterior ocellus and propleuron rufous.

In a minority of specimens, SAE black and other maculation of head reduced in size; mesosomal reddish coloration also reduced to confine mesoscutum.

Male. Much as in female except usual sexual dimorphic structures. Body length 6.1–11.2 mm, forewing length 5.3–9.5 mm. Antennae with tyloids as mentioned in the key. S2 flattened apicomedailly.

Biology. *Taeniogonalos fasciata* is the most commonly encountered *Taeniogonalos* in Korea and the most noticeable at first sight due to its bright red coloration. It flies all around the year from mid-May to late October. In open forest or semi-shaded areas, one can observe the females laying eggs near the ground on any sort of low plants they encounter, obviously without choosing them. On cloudy days, the females are more likely to be seen in the open area, ovipositing on forest edges, low trees, and even in vegetable gardens. The males seem to exhibit a territorial behavior, on sunny days flying higher and more vigorously around the trees, resting for only a few seconds in the sunny spots on the vegetation.

Both males and females of this species is variable in size, which indicates a probable great range of hosts. The smaller specimens are likely to have emerged from Tachinids pupae, and the larger from Ichneumonids.

Despite this abundance, the published host records are very scarce: *T. fasciata* was recorded in Japan from the Tachinid fly *Sturnia bella* (Meigen) emerging from *Parantica sita* (Moore) (Hirai and Ishi, 1995).

Material examined (Over 350 specimens from all parts of South Korea, including the following). South Korea · **[SL]** ♀, Heoninleung, Gangnam-gu, 30 x 1984 (YG Min); ♀, Mt. Umyeonsan, 4 x 1988 (YS Lee); 2♀♀, Mt. Daemosan, Seocho-gu, 29 vi 1990 (JY Han); ♀, Cheonggye, Seocho-gu, 30 vi 1990 (SD Kim); ♀, Uidong, Dobong-gu, 1 vi 1996 (IH Im); ♀, Mt. Bukhansan, Dobong-gu, 13 viii 1996 (EG An); ♀, Mt. Bulamsan, Nowon-gu, 9 vi 1999 (K Cho) **[GG]** ♀, Aengmubong, Yangju-si, 12 viii 1977 (BG Jeong); ♂, Mt. Chukryeongsan, Sudong-myeon, Namyangju-si, 28 ix 1980 (HG Park); ♀, Mt. Baekunsan, Pocheon-si, 6 viii 1984 (TY Moon); ♂, Mt. Soyosan, Pocheon-si, 12 vi 1988 (JH Jeong); ♀, Mt. Myeongjisan, Gapyeong-gun, 25 vi 1991 (JH Kim); ♀, Namhansanseong, Gwangju-si, 31 viii 1991 (SR Yoon); ♀, Anyang-si, 25 v 1992 (OSR); ♂, Mt. Myeongjisan, Gapyeong-gun, 23 viii 1996 (CH Lee); ♀, Seooleung, Goyang-si, 27 v 1988 (YH Gang); ♀, Mt. Jeongbalsan, Ilsan-gu, Goyang-si, 25 ix 1999 (WS Kang) **[IC]** ♀, Mt. Hobongsan, Buk-gu, 25 ix 1994 (JY Yoon); ♀, Jeongsusa, Mt. Manisan, Ganghwa-gun, 10 ix 1995 (HS Won); ♀, Is. Muui, Muui-dong, Jung-gu (37°23′46.09″N 126°24′36.38″E), 22 vi–6 vii 2017 (Malaise trap) (J-K Kim) **[GW]** ♀, Cheoeunsa-Sipjabong, Kyirae-myeon, Wonju-si, 15 vi 1997 (D-J Cha *et al.*); ♀, same locality, 18 viii 1997 (HY Han *et al.*); ♂, Hwachon, Maeji-ri, Wonju-si, 21 vii 1997 (HW Byun & DS Choi); ♀, same locality, 12 vi 1998 (HY Han & SK Kim); ♂, Yongsugol, Seogok-ri, Panbu-myeon, Wonju-si, 7 vii 1998 (DS Choi & DE Kim); ♂, Mt. Mindungsan, Nam-myeon, Jeongseon-gun, 29 viii 2008 (SW Suk *et al.*); ♀, Mt. Dohwasan, Dogye-eup, Samcheok-gun, 6 vi 2003 (DS Choi *et al.*); ♀, Inje-gun, viii 2004 (JK Kim); ♂, Mt. Gachilbong, Nae-myeon, Hongcheon-gun, 7 vii 2007 (HS Lee & YB Lee); ♀, Yonsei Univ. Campus, Maeji-ri, Heungeop-myeon, Wonju-si, 6 vii 1999 (MK Choi); ♀, same locality, 6 ix 1999 (CH Park); ♀, same locality, 17 ix 1999 (WS Kang); ♀, same locality, 13 ix 2002 (HS Lee & MH Lim); ♀, same locality, 14 ix 2003 (OY Lim); ♀, same locality, 19 viii 2007 (HS Lee); ♀, same locality, 9 vii 2008 (JS Lim *et al.*); ♀, same locality, 9 viii 2008 (D-J Cha); ♀, Samhwa-ri, Hanam-myeon, Hwacheon-gun (38°3′35.76″N 127°43′46.53″E), 30 v–12 vi 2018 (Malaise trap) (SW Yang) **[CB]** ♂, Danyang, 8 vii 1981 (SM Ryu); ♀, Jeolgol, Songgye-ri, Jecheon-si, 29 vi 1997 (HW Byun & DS Choi); ♀, Mt. Sobaeksan, Sunheung-myeon, Yeongju-si, 27 vii 2001 (DS Choi *et*

al.) **[DJ]** ♀, Yongeun-dong, 17 v 1995 (US Eom); ♀, Mt. Sikjangsan, 25 viii 1996 (MH Sim). **[CN]** ♀, Chwipyeong-ri, Buseok-myeon, Seosan-si, 19 vi 2007 (SB Ha); ♀, Jugok-ri, Gyeryong-myeon, Gongju-si, 8 ix 2007 (JK Kim); ♀, Hanseo University, Haemi-myeon, Seosan-si, 24 vi 2010 (EA Kim); ♀, Seongju-ri, Seongju-myeon, Boryeong-si, 13 ix 2013 (OC Kwon); ♀, Jangseung-ri, Cheongyang-gun, 22 vi 2014 (OC Kwon); 2♀♀, National Institute of Ecology, Maseo-myeon, Seocheon-gun (36°01′47.21″N 126°43′36.027″E), 16 vi–5 vii 2017 (Malaise trap) (OC Kwon); ♀, Songnae-ri, Maseo-myeon, Seocheon-gun (36°01′47.19″N 126°43′35.77″E), 8–22 viii 2018 (Malaise trap) (OC Kwon); ♀, same locality, 7 ix 2020–14 ix (Malaise trap) (OC Kwon) **[GB]** ♂, Daehyeon-ri, Seokpo-myeon, Bonghwa-gun, 24 vii 1986 (GS Jang); ♂, Huibangsa, Mt. Sobaeksan. Yongju-si, 29 vii 1988 (KHK); ♀, Yeongnam Univ. Campus, Gyeongsan-si, 25 vi 1994 (MH Nam); ♀, ♂, Mt. Baekamsan, Uljin-gun, 20 vi–12 vii 1999 (DS Gu); ♀, Sogwang-ri, Seo-myeon, Uljin-gun, 2–6 viii 1999 (JK Kim); ♀, Dangu-ri, Gangdong-myeon, Gyeongju-si (36°09′489.06″N 126°16′16.25″E), 9–25 v 2017 (Malaise trap) (OC Kwon) **[DG]** ♀, Mt. Apsan, 19 vi 1992 (YH Kim); ♀, Mt. Palgongsan, 245 vi 1994 (HY Park) **[GN]** ♂, Mt. Geomosan, Gyoryong-ri, Hadong-gun, 11 vii 1999 (HG Ju) **[JB]** 5♂♂, Sinjeong-dong, Jeongeup-si, 15 vi 2004 (JK Choi); ♀, Naejang-dong, Jeongeup-si, 20 vii 2004 (KB Kim) **[JN]** ♀, Daechi, Mt. Jeamsan, Boseong-gun, 8 x 1999 (JK Kim); 2♀♀, Wolgok-ri, Gunseo-myeon, Yeongam-gun, 18 ix 2010 (JK Kim); ♀, Ssangung-ri, Bukha-myeon, Jangseong-gun, 4 vii 2013 (JK Kim); ♀, Mt. Bongjangsan, Jukcheong-ri, Bugi-myeon, Jangseong-gun, 22 ix 2013 (OC Kwon); ♀, Docheon-ri, Gundong-myeon, Gangjin-gun (34°37′12.43″N 126°50′09.94″E), 19 vi–3 vii 2017 (Malaise trap) (OC Kwon); ♀, Seokhyeon-dong, Suncheon-si (34°58′47.01″N 127°27′40.56″E), 20 vi–3 vii 2017 (Malaise trap) (OC Kwon); 2♀♀, Gabong-ri, Chunyang-myeon, Hwasun-gun (34°55′47.64″N 126°57′49.37″E), 19 vi–3 vii 2017 (Malaise trap) (OC Kwon).

Distribution. Korea (SL, GG, GW, CB, CN, DJ, GB, DG, GN, JB, JN), China (Jilin, Liaoning, Shaanxi, Henan, Anhui, Zhejiang, Taiwan, Fujian, Hunan, Guangdong, Guizhou, Guangxi, Hainan), Russia (Primorskii Krai), Japan (Honshu, Kyushu). Also reported from Iran, Malaysia and Indonesia (Carmean and Kimsey, 1998), but the occurrence in these countries needs reconfirmation (Chen *et al*., 2014).

Remarks. An extensive coloration of head and mesosoma (Fig. 1A–C) is usual in the majority of the Korean specimens, but it can be much reduced, as follows: pronotum, median part of scutellum, metanotum, propodeum, and lateral part of mesosoma not colored, and facial markings also much reduced (at most lateral smaller areas of clypeus, median parts of mandible and lower inner orbits yellow). However, we did not find any structural difference between those color forms, so we consider them to be in the range of the color variations for this species. The range of variation in size is also very great, as also observed in the Chinese material (Chen *et al*., 2014). In the extreme case of specimens being less than 4.0 mm long, both temple and gena are largely smooth, and the body maculation is pale yellowish.

***Taeniogonalos formosana* (Bischoff, 1913)**

Mu-nui-gal-go-ri-beol (new Korean name) (Fig. 2A–E)

Poecilogonalos formosana Bischoff, 1913: 151, ♀ (holotype), Taiwan: Taihorn [Zoologisches Museum, Humboldt Universität, Berlin, Germany].

Taeniogonalos formosana: Carmean and Kimsey, 1998: 67 (new combination).

Diagnosis. A black species with numerous yellow markings. It is distinct from the other Korean species of *Taeniogonalos* by the combination of a series of paired, well separated triangular spots on the T4–5, and a fully black scutellum.

Description. Female. Body length 4.4–13 mm, forewing length 3.7–11 mm.

Head. Occipital carina narrow in its entire length. Frons, vertex, temple, and gena anteriorly punctate-reticulate; mandible and clypeus densely punctate; gena posteriorly and occiput shiny, with moderate punctures; areas around posterior ocelli smooth.

Mesosoma. Mesoscutum punctate-reticulate, with longitudinal ridges posteriorly; scutellar disc longitudinally ridged anteriorly, irregularly reticulate posteriorly; propodeal dorsum obliquely ridged anteriorly, irregularly reticulate in remaining dorsum, propodeal side punctate-reticulate; propleuron densely punctate; pronotal side densely punctate anteriorly, longitudinally ridged posteriorly; mesopleuron punctate-reticulate, very often posterior declivity largely smooth and shiny; dorsal metapleuron moderately to densely punctate, ventral metapleuron sparsely to moderately punctate.

Metasoma. T1 0.56× as broad as T2. T2 without median longitudinal depression. S1 1.5× as broad as long. S2 more or less broadly and strongly beveled apicomedially, in profile, not evenly convex, highest posterior middle. T1 largely smooth, laterally scattered with punctures; T2–6 punctate-reticulate. S1 densely punctate laterally, moderately punctate medially; S2 densely punctate; S3 punctate-reticulate; S4–6 densely punctate.

Coloration. Body extensively pale yellow, yellow, deep yellow, or partially orange yellow in the following parts/markings: posterior flat face of mandible, large lateral spots on clypeus, lower frons lateral to antennal sockets (linearly extending above along inner orbits), small spots

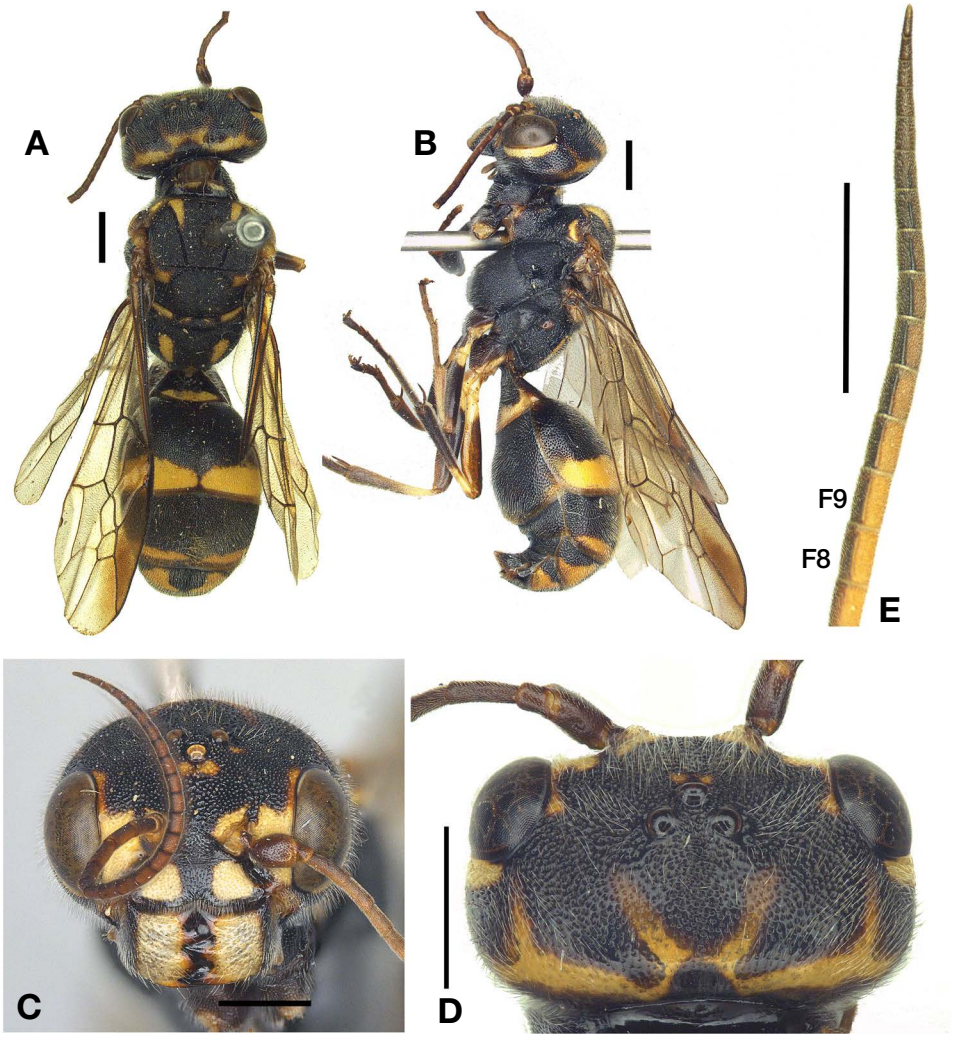

Fig. 2. *Taeniogonalos formosana* (Bischoff). A, General habitus in dorsal view, ♀. B, General habitus in lateral view, ♀. C, Head in frontal view, ♀. D, Head in dorsal view, ♀. E, F7–21, ♂. Scale bars: 1 mm.

anterior to anterior ocelli and anterolateral to posterior ocelli, paired transverse bands on vertex posteriorly (sometimes tinged with orange yellow, or almost entirely orange yellow, or much reduced) or a transverse band often with paired submesal and sublateral longitudinal stripes extending to ocellar region, stripes along outer orbits, pronotal dorsum, margins of lateral half of median lobe of mesoscutum, tegula, axillae, scutellum anterolateral to scutellar disc (sometimes lost), metanotal disc laterally, longitudinal thick sublateral stripes on propodeal dorsum, apical bands of T1–3 (that on T2 broadest; often those on T2–3 interrupted medially; in small specimens less than 4.0 mm in body length, apical band of T2 lost), paired large triangular spots on T4–5, T6 except medially, apical band of S1, apicolateral spots of S2. Inner face of all coxae, almost entire trochanters and trochantellus of all legs, basal and apical parts of all femora, inner faces of fore and mid tibia, and hind tibia basally pale yellow to yellow.

Antennae reddish brown ventrally, blackish brown dorsally. Legs except yellow coloration parts above mostly ferruginous.

Male. Much as in female except usual sexual dimorphic structures. Body length 6.5–9.2 mm, forewing length 5.5–8.0 mm. Antennae with tyloids as mentioned in the key. Larger apicomedian part of S2 very often weakly concave. Apical band of T2 often lost, or limited small apicolateral spots.

Biology. *Taeniogonalos formosana* is the second most commonly collected Trigonalid in Korea. It appears from mid-May to the end of September, and varies greatly in size, both clues pointing towards a wide range of potential hosts.

PT has studied the parasitoid complex of the Korean

potter wasps (Vespidae: Eumeninae) by collecting mud nests in winter, and has obtained this species on six occasions (seven specimens): four from *Oreumenes decoratus* nests, one from a small *Eumenes* sp. cell, the last from the nest of another, unidentified genus of Eumenid wasps.

On three occasions, one imago of *T. formosana* was found enclosed and dead in the cell, unable to get through the mud wall that apparently represented a deadly barrier. Due to poor collecting conditions, no remains, or evidence on the nature of the secondary host where collected, and it could not be determined with certainty. We have not secured clear evidence of the Trigonalid wasps having consumed any of the Eumenid larvae. It may also have emerged from a parasitoid (wasp or fly) present internally in one of the preys.

On the last three occasions, the Trigonalid wasp emerged from one of the fly pupae present in the parasitized cell, all in *O. decoratus* nests. On each case the batch of fly larvae that occupied the cell had devoured all the contents before pupation. On one occasion the fly larvae had invaded the adjacent cell by boring a hole in the partition wall.

Surprisingly, these flies are not Tachinidae, as expected, but are belongs to the closely related family Sarcophagidae, subfamily Miltogramminae (Fig. 7), a group of kleptoparasitic flies known to deposit their eggs or young larvae in the open cells of solitary wasps and bees, or on the prey they carry in. This fly family has never been mentioned in literature as a potential host of Trigonalids; all Diptera yet recorded as secondary hosts belong to the family Tachinidae, and therefore entered the nest as an internal parasitoid of one of the stored prey.

Despite a relatively large number of Miltogramminae pupae present in each contaminated cell (20, 12 and 4), usually only one specimen of *T. formosana* emerged from the cell (2 in one case). The flies are of medium size (body length 6.5–7 mm, quite large for Miltogramminae) and the *T. formosana* imagos were almost of the same size (6–7 mm long), showing that they had absorbed the full content of the fly larvae.

Three Trigonalid wasps emerged in spring, in synchrony with the flies, by digging an emergence hole in the pupa. On another occasion, the Trigonalid imago was found already fully formed but dead in the pupa in late fall, at the moment of collecting the nest. Three other similar pupae were found in the cell, from which the Miltogramminae flies emerged normally in the next spring.

The occurrence of this species in mud nests seems to be accidental, and may not be beneficial to it, as suggested by the numerous occasions where the adult wasp was found dead in the cell. This species seems poorly adapted to escape the mud nests. As a general rule, the accidental trapping of parasitoids is common in potter wasp nests (Johnson *et al*., 2023).

Breeding records. South Korea · **[DJ]** ♀? (minute), Wadong, found dead on 20 iii 1995 in *Oreumenes decoratus* nest; ♀, Wadong (vegetable garden in forested area), found dead on 27 iv 1995 in the closed cell of a small *Eumenes* sp. **[CN]** ♀, Kapsa, Gongju-si, found dead on 25 ii 1996 in the mud nest of an unidentified Eumenid (not *Eumenes* or *Oreumenes*) **[CB]** ♂, Pyeongsan-ri, Dongi-myeon, Okcheon, emerged 17 iv 2022, ♀ emerged 27 iv 2022 from a single cell of *O. decoratus* containing 12 Miltogramminae pupae.; Saesan-ri, Dongi-myeon, Okcheon, ♂ emerged 27 iv 2022 from an *O. decoratus* nest of 4 connected cells, containing about 20 Miltogramminae pupae; Hangok-ri, Yongsan-myeon, Yeongdong, ♀ dead on 5 iii 22 in a Miltogramminae pupa among a batch of 4 pupae found in a cell of *O. decoratus* in forest.

Material examined (around 250 specimens from South Korea, including the following). South Korea · **[SL]** Mt. Daemosan, Gangnam-gu, 23 vii 1996 (SH Kim) **[GG]** ♀, Mt. Chukryeongsan, Sudong-myeon, Namyangju-si, 12 vii 1980 (JI Kim); ♀, same locality, 28 ix 1980 (HG Park); ♀, Gunpo-si, 24 vi 1986 (JJ An); ♀, Gwangleung, Pocheon-si, 22 ix 1990 (EJ Ryu); ♀, Gangssibong, Pocheon-si, 28 vi 1998 (JD Yeo); ♀, Gwonseon-gu, Suwon-si, 2 ix 2000 (JN Gang); ♀, Palya-ri, Jinjeop-eup, Namyangju-si, 12 ix 2007 (SB Ha); ♀, Mt. Maguksan, Anseong-si, 23 vi 2009 (JK Kim); ♀, Osammi-dong, Osan-si, 6 ix 2011 (JK Kim); ♀, Bangchuk-ri, Hyeondeok-myeon, Pyeongtaek-si, 21 vi 2014 (OC Kwon); ♀, Geumchon-ri, Sinpyeong-myeon, Dangjin-si, 24 viii 2014 (OC Kwon) **[GW]** ♀, Gangchon, 4 ix 1982 (HG Kim); 2♀♀, Yonsei Univ. Campus, Maeji-ri, Wonju-si, 11 vii 1996 (HW Byun); ♀, same locality, 19 vii 1996 (HW Byun); ♀, same locality, 15 vi 2007 (HW Byun & HY Han); 2♀♀, Mt. Balgyosan, Eoron-ri, Hongcheon-gun, 4 ix 1998 (YG Park); ♀, Yongmunsa, Yangpyeong-gun 5 ix 1998 (YG Park); Duwibong, Dangok, Chodong-ri, Sindong-eup, Jeongseon-gun, 22 vii 2000 (ES Kim); ♀, Durobong, Yeongok-myeon, Gangleung-si, 19 viii 2001 (WM Kim); ♀, Seo-myeon, Chuncheon-si, 20 v 2004 (JM Go & JY Yang); ♀, Muleunggyegok, Samhwa-dong, Donghae-si (37°28′02″N 129°01′53″E), 1 ix 2009 (SW Suk & YB Lee) **[CB]** ♀, Mt. Minjujisan, Yeongdong-gun, 3 vi 1989 (GC Jeong); ♀, Uipung-ri, Danyang-gun, 3 viii 1995 (JY Cha); ♀, Mt. Namsan, Chungju-si, 28 viii 2000 (JD Yeo); ♀, Gacheon-ri, Eomjeong-myeon, Chungju-si, 28 ix 2005 (JS Lee) **[DJ]** ♀, Yongeun-dong, 9 vi 1988 (GH Choi) **[CN]** ♀, Hwahak-ri, Annam-myeon, Okcheon-gun, 17 ix 2007 (SB Ha); ♀, Daegok-ri, Haemi-myeon, Seosan-si, 22 vi 2013 (CH Jang); 2♀♀, Dongmun-ri, Taean-gun, 21 viii 2014 (JK Kim); ♀, Yonghyeon-ri, Unsan-myeon, Serosan-si, 24 viii 2014 (JK Kim); 2♀♀, ♂, National Institute of Ecology, Maseo-myeon, Secheon-gun (38°01′47.21″N

126°43′36.02″E), 22 v–5 vi 2017 (Malaise trap) (OC Kwon); ♀, 17♂♂, same locality, 16 vi–5 vii 2017 (Malaise trap) (OC Kwon); ♀, 3♂♂, same locality, 5–15 vii 2017 (Malaise trap) (OC Kwon); ♂, same locality, 15 vii–1 viii 2017 (Malaise trap) (OC Kwon); 2♀♀, same locality, 12–27 viii 2017 (Malaise trap) (OC Kwon); ♀, same locality, 27 viii–9 ix 2017 (Malaise trap) (OC Kwon); ♀, 30 v–14 vi 2018 (Malaise trap) (OC Kwon); 3♀♀, 2♂♂, same locality, 14–27 vi 2018 (Malaise trap) (OC Kwon); 2♂♂, same locality, 27 vi–16 vii 2018 (Malaise trap) (OC Kwon); 5♀♀, ♂, same locality, 16–24 vii 2018 (Malaise trap) (OC Kwon); ♀, 24 vii–8 viii 2018 (Malaise trap) (OC Kwon); ♂, 8–22 viii 2018 (Malaise trap) (OC Kwon); 3♀♀, same locality, 4–9 ix 2018 (Malaise trap) (OC Kwon); 3♀♀, same locality, 27 v–2 vi 2019 (Malaise trap) (OC Kwon); ♂, same locality, 2–9 vi 2019 (Malaise trap) (OC Kwon); 3♀♀, ♂, same locality, 9–17 vi 2019 (Malaise trap) (OC Kwon); ♀, ♂, 17–23 vi 2019 (Malaise trap) (OC Kwon); 3♀♀, 3♂♂, same locality, 23 vi–1 vii 2019 (Malaise trap) (OC Kwon); ♀, 5–12 viii 2019 (Malaise trap) (OC Kwon); 3♂♂, same locality, 12–19 viii 2019 (Malaise trap) (OC Kwon); ♂, same locality, 19–26 viii 2019 (Malaise trap) (OC Kwon); ♀, same locality, 5–9 ix 2019 (Malaise trap) (OC Kwon); ♀, same locality, 14–21 ix 2019 (Malaise trap) (OC Kwon); 2♂♂, same locality, 1–8 vi 2020 (Malaise trap) (OC Kwon); ♀, ♂, same locality, 8–15 vi 2020 (Malaise trap) (OC Kwon); ♀, ♂, same locality, 15–22 vi 2020 (Malaise trap) (OC Kwon); ♂, same locality, 22–29 vi 2020 (Malaise trap) (OC Kwon); ♀, same locality, 29 vi–6 vii 2020 (Malaise trap) (OC Kwon) **[GB]** Mt. Juwangsan, 30 vii 1983 (HG Park); ♀, Cheongpyeong, Cheongsong-gun, 16 vii 1988 (HJ Oh); ♀, Hyeonnae-ri, Gigye-myeon, Buk-gu, Pohang-si (36°11′06″N 129°04′03″E), 30 viii 2011 (SW Suk *et al.*); ♀, ♂, Dodeok-ri, Angye-myeon, Uiseong-gun (36°25′49.02″N 128°27′35.70″E), 21 vi–5 vii 2017 (Malaise trap) (JK Kim); ♂, same locality, 2–16 viii 2017 (Malaise trap) (OC Kwon) **[GN]** Jangdangol, Mt. Jirisan, Hadong-gun, 1 viii–8 ix 2001 (Malaise trap) (JW Lee); ♂, Baetaegogae, Yeongpo-ri, Wondong-myeon, Yangsan-si (36°26′23.2″N 128°57′28.2″E), 11–25 vi 2019 (Malaise trap) (JA Jeon) **[JN]** ♀, Sokhyeon-dong, Suncheon-si, (34°58′47.01″N 127°27′40.563″E), 4–18 vii 2017 (Malaise trap) (OC Kwon); ♀, same locality, 1–15 viii 2017 (Malaise trap) (OC Kwon); ♂, Ondang-ri, Gwanggui-myeon, Gurye-gun (35°17′17.77″N 127°26′40.03″E), 15–29 v 2018 (Malaise trap) (OC Kwon).

Distribution. Korea (SL, GG, GW, CB, DJ, CN, GB, GN, JN; new record), China (Jilin, Shaanxi, Ningxia, Henan, Fujian, Zhejiang, Guangdong, Sichuan, Yunnan, Guizhou, Tibet), Russian Far East (Amurskaya Oblast, Primorskii Krai, South Sakhalin, Kuril Islands: Kunashir, Shikotan), Japan (Hokkaido, Honshu), Taiwan.

Remarks. Chen *et al.* (2014) synonymized *T. intermedia* and *T. unifasciata* as color forms of *T. formosana*. Body markings of all the Korean materials herein are primarily yellow, as shown in *intermedia*- and *unifasciata*-form. No typical *formosana*-form with primarily reddish-orange coloration is found in Korea.

***Taeniogonalos sauteri* Bischoff, 1913**

Sa-u-teo-gal-go-ri-beol (new Korean name)
(Fig. 3A–D)

Taeniogonalos sauteri Bischoff, 1913: 153, ♀ (holotype), Taiwan: Hoozan [Zoologisches Museum, Humboldt Universität, Berlin, Germany].

Diagnosis. The females of this species are easily distinguished from the other Korean species by the apicomedian armature of S2 that forms a triangular or semicircular lamina directed backwards, and by the presence of reddish-orange markings on the scutellum. According to the sole male specimen described herein for the first time, the body coloration is much paler than in female (female vivid yellow), but its pattern is similar.

Description. Female. Body length 4.5–9 mm, forewing length 4.2–8.5 mm.

Head. SAEs yellow, with broad translucent apical lamella; in dorsal view, DSAE 0.33 × as long as distance between eyes at level of SAE. Occipital carina narrow in its entire length. Frons, vertex, temple, and gena anteriorly punctate-reticulate; flat face of mandible (except basal densely punctate vertical face), supraclypeal area, and clypeus shiny, with sparse to moderate punctures that are much smaller than those on frons; gena posteriorly and occiput shiny, with tiny sparse punctures; areas around ocelli smooth.

Mesosoma. Notauli not interrupted by transverse keels, at most a few bottom keels apically. Mesoscutum strongly, irregularly reticulate, reticulae particularly appearing to be transversely ridged in its median lobe; scutellar disc strongly, irregularly reticulate; propleuron, pronotal side densely punctate; anterior half of mesopleuron strongly, irregularly reticulate, posterior half shiny, scarcely with sparse punctures; anterior two-third of ventral mesopleuron densely punctate (sometimes partially forming sinuous linear vertical ridges), posterior half of mesopleuron shiny, scarcely with sparse tiny punctures; metapleuron largely shiny, mostly with sparse tiny punctures; propodeum mostly irregularly reticulate, dorsoanteriorly with dense oblique ridges and a small median smooth area, posterior marginal area (posterodorsal declivity above foramen) largely smooth.

Metasoma. T1 0.55 × as broad as T2. T2 without median longitudinal depression. S1 1.3 × as broad as long. S2, in profile, not evenly convex, weakly sloped anteriorly and almost straight posterior half. T1 smooth; S1 moderately punctate; remaining metasoma punctate-reticulate,

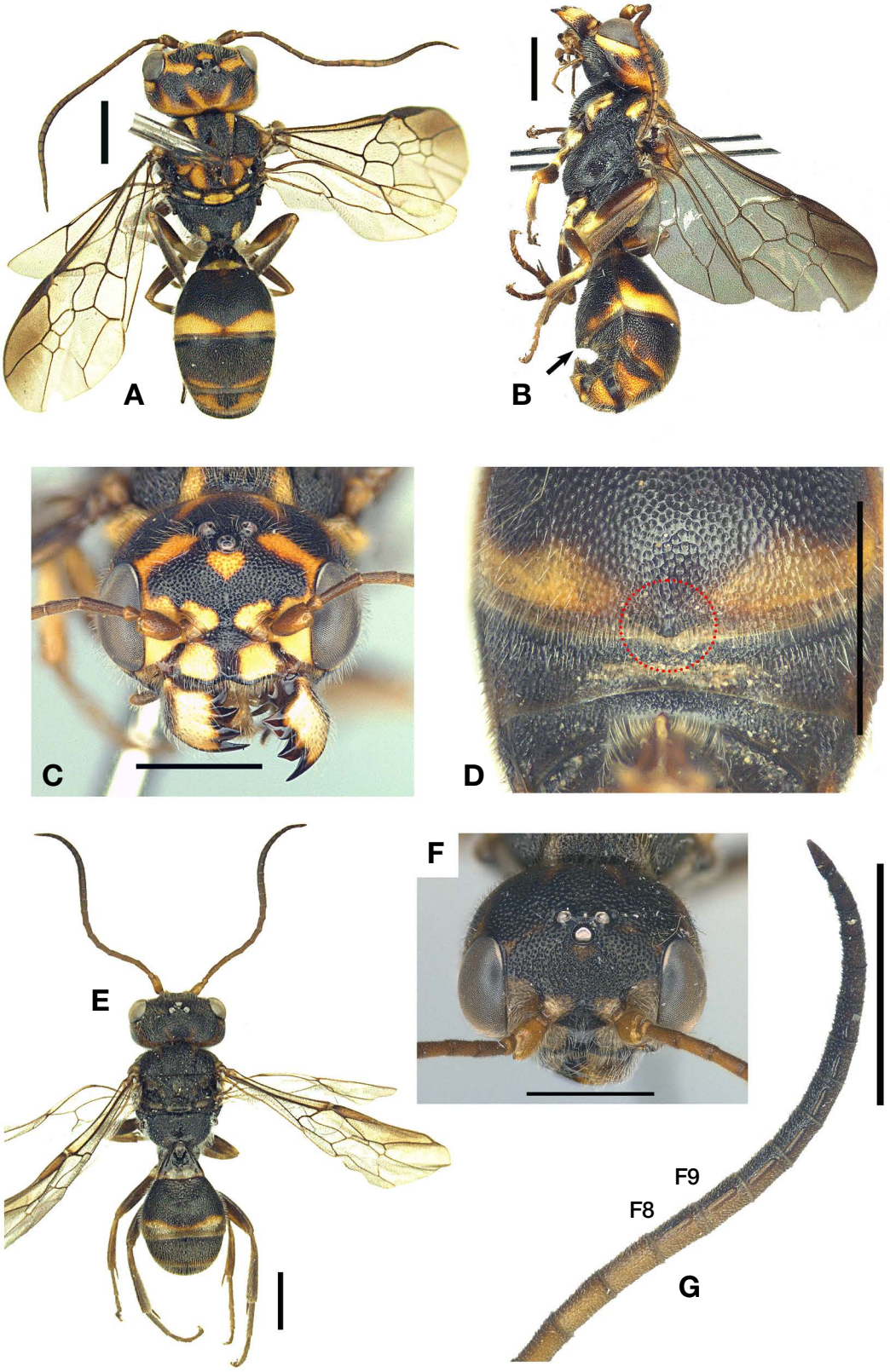

Fig. 3. *Taeniogonalos sauteri* Bischoff. A, General habitus in dorsal view, ♀. B, General habitus in lateral view, ♀. C, Head, in frontal view, ♀. D, S2−4 in ventral view, with semicircular flat production on apical margin of S2. E, General habitus in dorsal view, ♂. F, Head in front-dorsal view, ♂. G, F5−20, ♂. Scale bars: 1 mm.

but S2 densely punctate apicomedially.

Coloration. Body extensively pale yellow to deep yellow in the following parts/markings: mandible except apical teeth, clypeus except median broad black line, lower frons, triangular spot anterior to anterior ocellus, transverse stripes lateral to posterior ocellus that are continuous to inner orbital markings, outer orbit, posterior transverse band of vertex anteriorly with two pairs of longitudinal stripes extending toward ocelli and originating submesally (forming V-like marking, and shortly separated or connecting to upper frontal marking lateral to posterior ocelli) and laterally that are separated from or connecting to genal bands, pronotal neck, pronotal dorsum and upper margin of pronotal side, lateral margins of median lobe of mesoscutum, tegula, axillae, lateral margins of scutellum (in a specimen, entire scutellum colored), metanotum, paired spots on propodeal declivity, inner faces of all coxae, all trochanters and trochantellus, all femora both basally and apically, fore tibia except inner darkened face, basal outer faces of mid and hind tibiae, apical bands of T1–3 (that on T2 expanded sublaterally, and that on T3 narrower linear), paired larger triangular markings on T4–5, almost entire T6 except darkened rectangular marking medially, apical band of S1, spots of S2 laterally. Antennae mostly reddish brown.

Male (based on sole specimen). Body length 5.6 mm, forewing length 5.3 mm.

Head. Antenna 22 segmented. In dorsal view, DSAE 0.37 × as long as distance between eyes. Occipital carina narrow in its entire length. Frons, vertex, temple, and gena anteriorly densely punctate (almost appearing to be punctate-reticulate); apical half of mandible and clypeus shiny, with sparse to moderate tiny punctures; gena posteriorly and occiput shiny, with tiny sparse punctures; areas around ocelli smooth.

Mesosoma. Notauli not interrupted by transverse keels, at most with a few bottom keels apically. Mesoscutum and scutellar disc strongly, irregularly reticulate; anterior half of mesopleuron reticulate (reticulae more regular and weaker than those on mesocutum), posterior half shiny scarcely with sparse punctures; propleuron with sparse tiny punctures; pronotal side densely punctate; larger median flat area of ventral mesopleuron densely punctate posteriorly with linear vertical ridges, remaining anterior and posterior declivities shiny with sparse tiny punctures; metapleuron largely shiny, mostly with sparse tiny punctures; propodeum mostly irregularly reticulate with oblique ridges dorsolaterally, dorsomesial and posterior area around foramen smooth.

Metasoma. T1 0.45 × as broad as T2. T2 without median longitudinal depression prolonged from the broad basal depression. S1 1.60 × as broad as long. Apical half of S2 slightly concave medially. T1 smooth; S1 moderately punctate; T2–6 punctate-reticulate, but S2–3 densely punctate.

Coloration. Following parts/markings pale yellow to yellow: mandible except apical teeth, paired large rectangular markings on clypeus, lower frons, triangular spot anterior to anterior ocellus, transverse stripes lateral to posterior ocellus that are almost interrupted in its midlength, outer orbit, posterior transverse band of vertex anteriorly with two pairs of longitudinal stripes extending toward ocelli and originating submesally (forming V-like marking, and much separated from upper frontal marking lateral to posterior ocelli) and laterally that are connecting to genal band, pronotal neck, pronotal dorsum, lateral margins of median lobe of mesoscutum, tegula, axillae, posterolateral spots on scutellar disk, metanotum, paired small spots on propodeal declivity, apical bands of T1–3 (that on T2 expanded sublaterally and narrowly tinged with reddish brown anteriorly, that on T3 narrower linear), triangular markings on T4–5 (that on T4 much smaller than that on T5), T6 except median triangular darkened marking, narrow apical bands of S1–3. Antennae reddish brown and darkened toward apical segments. Coxa, trochanter and femora largely reddish brown to brownish black except pale yellow to yellow in areas of articulations and trochantellus; tibiae and tarsi mostly yellowish brown.

Tyloids in F8–14, those on F8–12 lengthened in longer mid parts except basally and apically, that on F13 in basal half, and that on F14 subbasal dot-like.

Biology. Clearly a rarely collected species in Korea. Adults, of small to medium size, have been collected from June to late September, in semi-open areas of forested areas. One female collected in late September survived four days in captivity and laid eggs plentifully. Another female was observed ovipositing on the large leaves of a young seeding of *Quercus dentata*, on the edge of a trail, 70 cm above the ground.

PT has obtained a small-sized female of *T. sauteri* from a Miltogramminae pupa found in an empty nest of the potter wasp *Oreumenes decoratus*. This species of unidentified Miltogrammine is probably the same as described above for *T. formosasa*, and the biology is also very similar. The succession of events can be reconstructed as follows: in fall, a contaminated moth larva is hunted and brought to the nest; the nest then becomes infested by the kleptoparasitic fly larvae, who devour the whole contents; one of the larva gets contaminated (probably by ingesting the minute Trigonalid larva); the Trigonalid devours the fly larva in the puparium; in spring, the Trigonalid emerges at the same time as the other flies.

As discussed under *T. formosana*, there is no doubt that in this case the Miltogramminae fly was the secondary host of *T. sauteri*, but the occurrence of this species in a potter wasp nest is probably accidental.

Beside Miltogramminae flies, this species can also use

a parasitic wasp as a secondary host. In China *T. sauteri* was reared from the Braconid *Phanerotoma flava* Ashmead, 1906, parasitoid of the Pyralid moth *Locastra muscosalis* (Walker) (He, 2004), both species also found in South Korea.

Breeding records. South Korea · **[CB]** ♀, Woljeon-ri, Gunseo-myeon, Okcheon, emerged iv 2022 from a Miltogramminae pupa in a 2-cells-nest of *Oreumenes decoratus* nest containing 12 Miltogramminae pupae.

Materials examined. South Korea · **[GG]** ♀, Cheonghak-ri, Byeollnae-myeon, Namyangju-si (37°42′24.7″N 127°07′43.9″E), 30 vi–20 vii 2019 (Malaise trap) (MG Paik) **[CB]** ♀, Giotong-ri, Okcheon-eup, Okcheon-gun (N 36° 19.85′, E 127° 35.707′), 29 vi 2021, ovipositing on *Quercus dentata* (P Tripotin) **[CN]** ♀, Songnae-ri, Maseo-myeon, Seocheon-gun (36°01′47.21″N 126°43′35.77″E), 22 v–6 vi 2017 (Malaise trap) (OC Kwon); ♀, same locality, 14 v–7 vi 2018 (Malaise trap) (OC Kwon); ♀, same locality, 2–9 vi 2019 (Malaise trap) (OC Kwon) **[GN]** ♂, Munsusa, Songjeon-ri, Hamyang (N 35° 24.739′, E 127° 43.818′), 9 vii–17 viii 2005 (Malaise trap in forested area) (P Tripotin) **[GB]** ♀, Dodeok-ri, Angye-myeon, Uiseong-gun (36°25′49.02″N 128°27′35.7″E), 19 vii–1 viii 2017 (Malaise trap) (OC Kwon) **[DJ]** ♀, Posoksa, Nami-myeon, Geumsan-gun, 18 ix 1998 (P Tripotin); ♀, same locality, 23 ix 2001 (dead on 27 ix 2001 after oviposition) (P Tripotin) **[DJ]** 3♀♀, Changdong, Daedok-gu, 19 vi– 24 vii 2007 (Malaise trap set on tombs and gardens on small forested hills) (P Tripotin).

Distribution. Korea (GG, CN, GB; new record), China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hunan, Jilin, Liaoning, Shaanxi, Zhejiang), Russian Far East (Primorskii Krai), Japan (Honshu, Kyushu, Ryukyus), Taiwan.

Taeniogonalos subtruncata Chen, van Achterberg, He & Xu, 2014

Bae-hok-gal-go-ri-beol (new Korean name)
(Fig. 4A–F)

Nanogonalos flavocincta Teranish, 1929: 150, ♂ (holotype), South Korea: "Suigen" (Suwon) [Osaka Museum of Natural History, Japan].

Poecilogonalos flavocincta: Marshakov, 1981: 107 (new combination); Lelej, 1995: 14 (*Poecilogonalos mongolica* syn. n.; incl. Korea in distribution).

Taeniogonalos flavocincta; Carmean and Kimsey, 1998: 67, ♀, ♂, Korea: no specific localities (re-combination).

Taeniogonalus subtruncata Chen *et al*., 2014: 165 (new name for *Taeniogonalos flavocincta*).

Taeniogonalos mongolica: Lelej, 2003: 6 (resurrected from Lelej, 1995 to replace the invalid name of *T. flavocincta*; incl. Korea in distribution).

Diagnosis. Both sexes of this species are readily distinguished by the dark band largely covering the anterior part of forewings, the deeply fuscous area is often extending largely over the first cubital cell. The female characteristically bears a prominent tubercle on the S3 apicomedially. The habitus is more elongated than in the other Korean *Taeniogonalos* species.

Description. Female. Body length 11.5 mm, forewing length 9.3 mm.

Head. SAEs yellow, with broad translucent apical lamella; in dorsal view, DSAE 0.33 × as long as distance between eyes at level of SAE. Occiput more or less concave medially but occipital carina narrow in its entire length (not broadened dorsdomedially, posterior margin of occipital carina also concave, fitting in occiput concavity). Frons, temple, vertex, and gena anteriorly punctate-reticulate; gena posteriorly densely punctate; occiput moderately punctate; clypeus densely punctate, but punctures smaller than those on frons; mandible sparsely punctate dorsally, densely punctate laterally (interspaces dully ridged).

Mesosoma. Entire length of notauli interrupted by thick keels. Almost entire mesosoma strongly, irregularly reticulate; posterior half of pronotal side longitudinally ridged; larger median propodeal declivity obliquely, sinuously ridged.

Metasoma. T1 0.5 × as broad as T2, without longitudinal depression. S1 1.1 × as broad as long. S2 not evenly convex in profile, weakly slopped in its anterior one-third, and more abrupt apically. T1 largely smooth medially, moderately to densely punctate laterally; T2–6 densely punctate; S1–3 densely punctate, S4–6 punctate-reticulate.

Coloration. Body largely black, following parts/markings deep yellow: lower frons lateral to inner orbits, genal stripes along lower two-third of outer orbits, anterior and posterior margins of pronotal dorsum, metanotum, narrow apical band of T1, broad apical band of T2 (ca. in apical one-third of T), small triangular apicomedian spot of T3, large hat-shaped spots of T4–5, almost entire T6, slender apical band of S1, paired lateral bands of S2, fore and mid trochanters, fore and mid femora apically, inner face of fore tibia, hind coxa apically, hind trochantellus and trochanter, and hind femur apically. Antennae and fore tarsus reddish to reddish yellow. Mandible and femora of all legs ferruginous.

Male. Much as in female except usual sexual dimorphic difference. Body length 10.3 mm, forewing length 7.8 mm. Antennae with tyloids as mentioned in the key. Apicomedian larger part of S2 more or less concave.

Biology. No breeding records are available for this rarely collected species. Adults appear in June and July, and are remarkably constant in size, a possible evidence for a more specialized range of hosts.

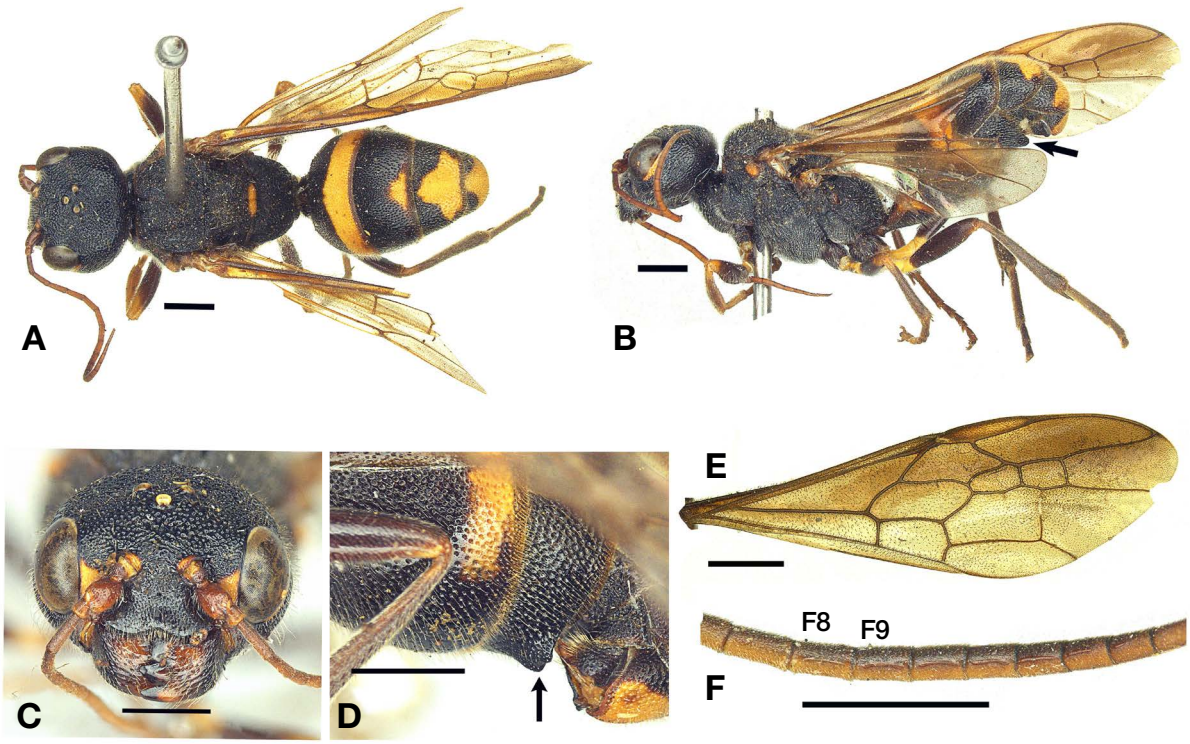

Fig. 4. *Taeniogonalos subtruncata* Chen *et al*. A, General habitus in dorsal view, ♀. B, General habitus in lateral view, ♀. C, Head in frontal view, ♀. D, S2−4, with a subapical tubercle on S3, ♀. E, Forewing, ♀. F, F6−15, ♂. Scale bars: 1 mm.

Material examined. South Korea · **[GG]** ♀, Bogwang-sa, Gwangtan-myeon, Paju-si, 17 vi 1977 (WH Lee); ♂, Gwangju-si, 5 vii 2001 (KSC); **[GW]** ♂, Magog-ri, Nam-myeon, Chuncheon, 13 vi−11 vii 2004 (Malaise trap set in sunny area along coniferous planted forest) (P Tripotin) **[DJ]** ♀, Changdong, Daedok-gu, 4 vii 1995 (on low shrub in open forest) (P Tripotin); ♀, same locality, 19 vi−24 vii 2007 (Malaise trap set along gardens, on Kudzu wine thicket) (P Tripotin) **[JB]** ♂, Yuyu-ri, Sannae-myeon, Buan-gun, 20 v−5 vii 2007 (Malaise trap set on low hill at edge of forest) (P Tripotin); ♂, same locality, 5 vii−14 viii 2007, (P Tripotin).

Distribution. Korea (GG, DJ, JB), Russian Far East (Amurskaya Oblast, Primorskii Krai), China (Shaanxi).

***Taeniogonalos taihorina* (Bischoff, 1914)**

Geom-eun-gal-go-ri-beol (new Korean name)
(Fig. 5A−E)

Nanogonalos taihorina Bischoff, 1914: 93, ♀ (holotype), Taiwan: Taihorn [Zoologisches Museum, Humboldt Universität, Berlin, Germany].

Poecilogonalos maga Teranishi, 1929: 148, ♀ (holotype), ♂, Japan: Nagano: Shisijima, and Hokkaido: Sapporo [Osaka Museum of Natural History, Japan]; Marshakov 1981: 106 (new combination). Synonymized with *T. taihorina* by Tan *et al*. (2017).

Taeniogonalos taihorina: Carmean and Kimsey, 1998: 68 (new combination).

Taeniogonalos maga: Chen *et al*., 2014: 146−150 (redescription of types).

Diagnosis. Both sexes of this species can be separated from the other Korean *Taeniogonalos* by the most protruding, stout and distantly spaced SAE, the absence or great reduction of the yellow markings on the head and mesosoma, and the shiny appearance of the tegument (often T2 shiner and feebly punctate than other Ts, and other terga not distinctly punctate-reticulate). The dorsomedially broadened occipital carina is also characteristic for this species.

Description. Female. Body length 7.1−9.5 mm, forewing length 6.5−8.4 mm.

Head. In dorsal view, DSAE 0.44 × as long as distance between eyes. Occipital carina broadened dorsomedially, twice to thrice × as broad as that in lateral part. Frons, vertex, and temple punctate-reticulate, but areas surrounding ocelli smooth; clypeus, mandible, and gena anteriorly densely punctate; gena posteriorly and occiput sparsely to moderately punctate.

Mesosoma. Mesoscutum, scutellum, metanotum, and propodeum except dorsomedian part irregularly reticulate and sinuously ridged partially; propleuron and

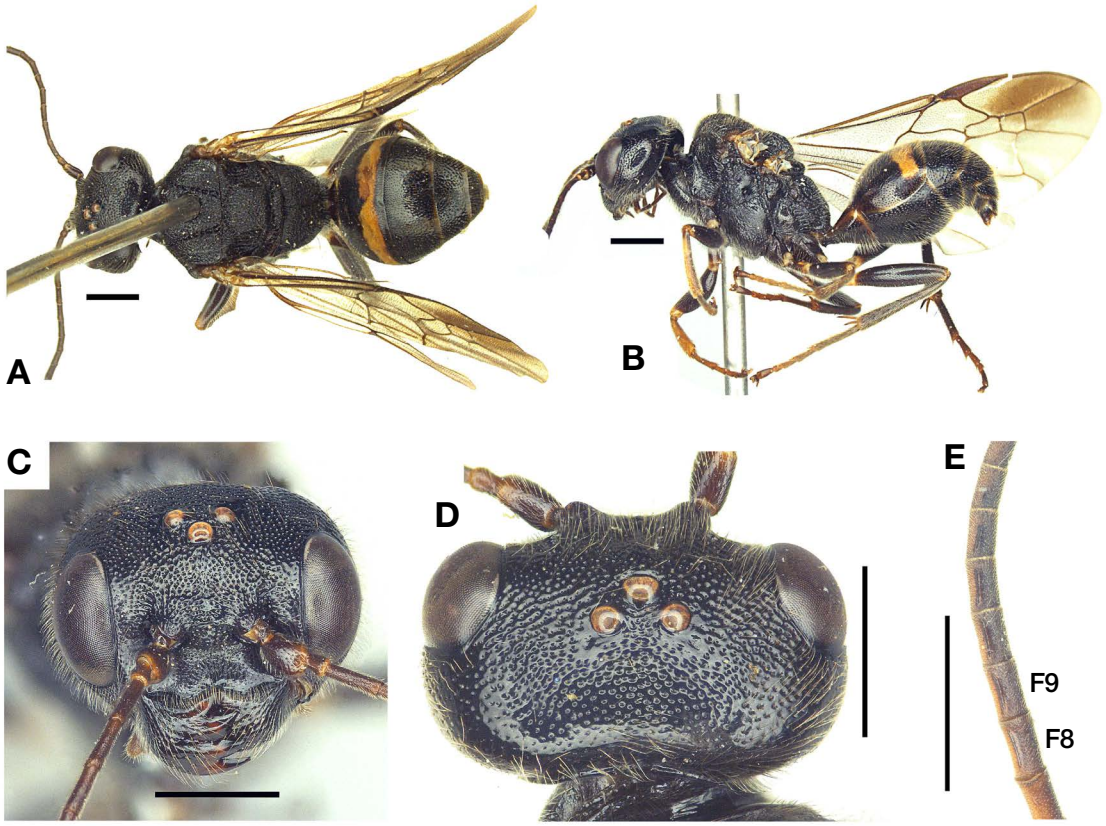

Fig. 5. *Taeniogonalos taihorina* (Bischoff). A, General habitus in dorsal view, ♀. B, General habitus in lateral view, ♀. C, Head in frontal view, ♀. D, Head in dorsal view, ♀. E, F7–14, ♂. Scale bars: 1 mm.

metapleuron moderately punctate; pronotal side punctate-reticulate anteriorly, longitudinally ridged posteriorly; mesopleuron except larger smooth posterior declivity irregularly reticulate

Metasoma. T1 0.6× as broad as T2. T2 without median longitudinal depression. S1 1.6× as broad as long. T1 smooth; T2 moderately punctate, punctures in dorsum much feebler than those on T3; T3–6 moderately to densely punctate (not punctate-reticulate); sterna densely punctate, but moderate in larger median part of S2.

Coloration. Body mostly black, mandible subapically (often lost), short stripes along inner and outer orbits (often lost), hind trochanter and trochantellus apically, and apical bands of T1–2 yellow. Antennae, apical teeth of mandible, and tarsomeres reddish brown.

Male. Much as in female except usual sexual dimorphic difference. Body length 6.0–8.1 mm, forewing length 5.0–6.7 mm. Antennae with tyloids as mentioned in the key. Notauli with bottom keels, but not completely interrupted unlike in female. Apicomedian larger part of S2 flattened to very weakly concave.

Biology. This species prefers the cooler temperatures of the mid-elevation areas. In Odaesan (GW) at 800–1000 m alt., it was the most abundant *Taeniogonalos*. Nevertheless, the species is also occasionally present in small number at low elevations.

Adults emerge continuously from mid-June to the end of September, with an important variation in size. However, we have noticed a constant scarcity of males in our collections compared to females (ratio 1/9). This difference is not observed in China or Japan.

Chen *et al*. (2014) mentioned the rearing of this species from a Tachinid fly (*Vibrissima turrita*) parasitizing the sawfly *Arge pullata* (Hymenoptera: Argidae).

Material examined (around 70 specimens from South Korea, including the following). South Korea · **[GG]** ♂, Mt. Chukryeongsan, Sudong-myeon, Namyangju-si, 28 ix 1980 (GS Jang); 3♀♀, Mt. Jugeumsan, Pocheon-si, 16 vi 1998 (JD Yeo); ♀, Mt. Yongmunsan, Yangpyeong-gun, 25 vi 1998 (JD Yeo); 2♀♀, Gangssibong, Pocheon-si, 28 vi 1998 (JD Yeo) **[GW]** ♀, Mt. Taebaeksan, Taebaek-si, 23 vii 1986 (GS Jang); ♀, Yongsugol, Seogok-ri, Wonju-si, 5 vii 1996 (HY Han & HW Byun); ♀, Yonsei Univ. Campus, Maeji-ri, Wonju-si, 8 vii 1996 (HW Byun); ♀, Cheoneunsa-Sipjabong, Kyirae-myeon, Wonju-si, 15 vi 1997 (HY Han & DS Choi); ♀, Jingdong-ri, Girin-myeon, Inje-gun (38°02′06.58″N 128°27′18.66″E), 22 vi–20 vii 2017 (Malaise trap) (OC Kwon) **[CN]** ♀, Mt. Gyery-

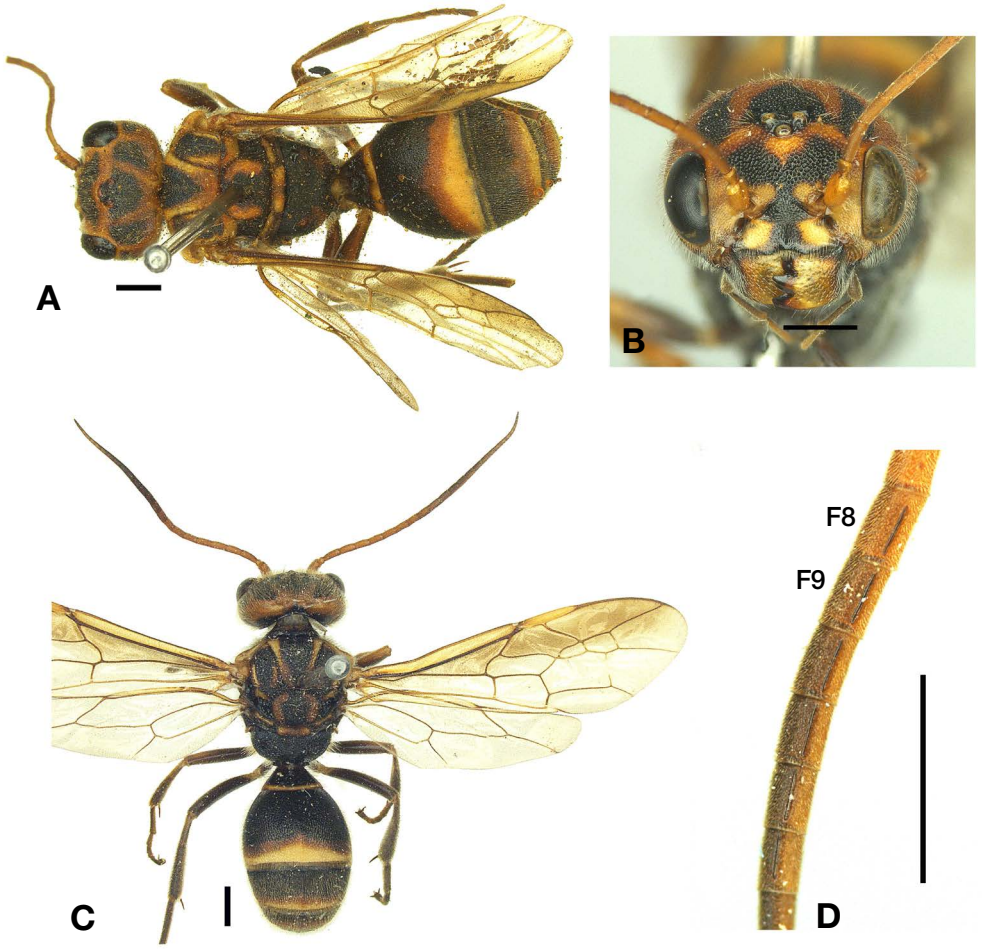

Fig. 6. *Taeniogonalos tricolor* (Chen). A, General habitus in dorsal view, ♀. B, Head in frontal view, ♀. C, General habitus in dorsal view, ♂. D, F7−14, ♂. Scale bars: 1 mm.

ongsan, Banpo-myeon, Gongju-si, 10 vi 1987 (TG Han) **[CB]** ♀, Odo-ri, Baekun-myeon, Jecheon-si, 2 vii 1996 (HY Han & HW Byun) **[GB]** ♀, Huibanggyegok, Mt. Sobaeksan, Yeongju-si, 14 vii 1997 (DK Chung); ♀, Ungilpokpo, Baekun-ri, Seongju-gun, 17 vi 2000 (JW Lee) **[GN]** ♂, Danjibong, Jungchon-ri, Gabuk-myeon, Geochang-gun, 1 vii 2000 (BE Mo); ♀, Yeongwonsa, Samjeong-ri, Macheon-myeon, Hamyang-gun, 12 vii 2002 (JS Park); 2♀♀, Cheondong, Danyang-eup, Danyang-gun (35°57′25.1″N 128°25′47.6″E), 12 vi−22 vii 2008 (Malaise trap) (JK Kim).

Distribution. Korea (GG, GW, CN, CB, GB, GN; new record), China (Fujian, Gansu, Guangxi, Heilongjiang, Ningxia, Shaanxi, Sichuan, Tibet, Yunnan, Zhejiang); Taiwan, Russia (Amurskaya Oblast, Primorskii Krai, South Sakhalin, Kuril Islands: Kunashir, Shikotan), Japan (Hokkaido, Honshu).

***Taeniogonalos tricolor* (Chen, 1949)**

Sam-saek-gal-go-ri-beol (Fig. 6A−D)

Poecilogonalos tricolor Chen, 1949: 16, ♀, ♂ (lecotype and paralectotype designated by Chen *et al*., 2014), China: Zhejiang [Institute of Zoology, Chinese Academy of Sciences, Beijing, China].

Taeniogonalos tricolour (!): Carmean and Kimsey, 1998: 68 (new combination; ♀, China, Korea, Thailand: no specific localities).

Taeniogonalos tricolor: Chen *et al*., 2014: 182−186 (incl. Korea in distribution).

Diagnosis. Both sexes of this species are easily identified by the apical bands or paired triangular markings on terga that appear bi-colored (the usual yellow markings being outlined anteriorly with bright reddish-orange markings). In a male specimen of this species, forewing is infuscate anteriorly and forms an unusual continuous band as in Fig. 6C. But DC1 is not fuscous, unlike in *T. subtruncata*.

Description. Female. Body length 9.5−12.5 mm, forewing length 8.0−11.0 mm.

Head. In dorsal view, DSAE 0.33 × as long as distance

between eyes at level of SAE. Occipital carina narrow in its entire length. Almost entire face of head punctate-reticulate; clypeus and mandible densely punctate; occiput with tiny, sparse punctures.

Mesosoma. Notauli without distinct transverse keel, at most apically with a few weak bottom keels. Propleuron densely punctate; msoscutum and scutellar disc punctate-reticulate to irregularly reticulate; scutellar trough longitudinally ridged to irregularly reticulate; pronotal side punctate-reticulate to punctate-obliquely ridged; mesopleuron except posterior marginal part punctate-reticulate, or punctate-reticulate medially and obliquely ridged in its anterior and posterior declivities; metapleuron densely punctate to mostly ridged longitudinally; propodeum irregularly reticulate, often reticulae weaker (than those on mesoscutum) or transversely ridged dorsomedially, with smooth area above foramen.

Metasoma. T1 0.6× as broad as T2, T2 without longitudinal depression. S1 1.3× as broad as long. S2 more or less evenly convex in profile, highest submedially. T1 smooth; T2–6 punctate-reticulate except anteromedial smooth area; S1 moderately punctate, S2 densely punctate, S3–6 punctate-reticulate.

Coloration. Body extensively colored, following parts/markings reddish orange, often tinged with deep yellow: all transverse or longitudinal stripes on frons and vertex connecting each other as in Fig. 6A and B (also refer to key herein), posterior half of dorsal mesopleuron, at least upper half of occiput, gena except posterior lower marginal part, lateral margins of median lobe of mesoscutum, margins of lateral lobes of mesoscutum, lateral margin of scutellar disk largely to entire face of scutellar disk, and outer bands of yellow apical bands or paired triangular markings of T1–6. Following parts/markings yellow to deep yellow: scape, SAE, lower frons laterally, clypeus laterally, mandible mostly, pronotal dorsum, tegula, metanotum, sublateral spots of propodeal dorsum, apical bands of T1–3, paired apical triangular spots of T4–6, apical bands of S1–2, femora apically, and ventral faces of fore and mid tibiae. Antennal flagellomeres reddish brown.

Male (Fig. 6C–E). Much as in female except usual sexual dimorphic difference. Body length 8.3–10.5 mm, forewing 7.5–9.3 mm. F8–13 with tyloids developed in almost entire length of each F, sometimes F14 also with a dot-like basal one (Fig. 6D). Apical bands of terga slenderer than in female. In a male specimen (Fig. 6C), forewing anteriorly fuscous, but first discal cell hyaline.

Biology. No host record is available for this uncommon species. All specimens have been collected in June and July. In an area covered with a low deciduous natural forest (near Posoksa, Geumsan-gun, CB, South Korea), this species was found regularly flying in the openings of the vegetation that were covered with patches of vines climbing on the trees (vine thickets), forming a natural continuation of the canopy towards the ground. Most specimens collected in this situation were males attracted by the parts of the vegetation exposed to the sun. One female was collected during ovipositing on *Vitis* sp, about 2 m above ground.



Fig. 7. *T. formosana* freshly emerged from the pupa of his Miltogramminae host, near a dead specimen of the fly.

This species seems to appreciate the forested areas, where it may prefer to occupy the lower parts of the canopy.

Material examined. South Korea · **[IC]** ♀, Deokjeokdo (Is.), Seopo-ri, Deokjeok-myeon, Onjin-gun, Incheon, 6 vii 1981 (SH Kim) **[GW]** ♀, Yonsei Univ. Campus, Maeji-ri, Wonju-si, 24 vii 1996 (HW Byun); ♀, Hudong-ri, Nam-myeon, Chuncheon, 14 vi–6 vii 2003 (Malaise trap) (P Tripotin) **[CN]** ♂, Posoksa, Nami-myeon, Geumsan-gun, 16 vi 1998 (P Tripotin); ♂, same locality, 22 vi 1998 (P Tripotin); ♂, same locality, 13 vi 1999 (P Tripotin); ♀, same locality, 30 vi 1999, ovipositing on *Vitis* sp. (P Tripotin); ♂, same locality, 3 vii 1999 (P Tripotin); ♂, same locality, 10 vii 1998 (P Tripotin); ♀, Pyohyeonsa, Seok-dong, Nami-myeon, Geumsan-gun (36°03′404″N 127°27′225″E), 8–24 vi 2005 (Malaise trap) (P Tripotin); ♀, Yongcheon-ri, Bibong-myeon, Cheongyang-gun, 22 vi 2014 (OC Kwon) **[DJ]** ♂, Wa-dong (36°24′47.6″N 127°25′28″E), 28 v–19 vi 2006 (Malaise trap) (P Tripotin); ♀, Changdong, Daedok-gu, 19 vi–24 vii 2007 (Malaise trap) (P Tripotin).

Distribution. China (Henan, Fujian, Guangxi, Guizhou, Hainan, Hubei, Jiangxi, Shaanxi, Sichuan, Yunnan, Zhejiang), Korea (IC, GW, CN, DJ), Laos, Thailand.

Discussion

The species *Taeniogonalos mongolica* (Popov, 1945), as a replaced name for *T. flavocinta* (Teranish, 1929) that was invalid in relation to *T. flavicincta* (Bischoff, 1913), was naturally included in the Korean fauna by Lelej (2003). However, Chen *et al*. (2014) regarded *T. mongoli-*

ca and *T. flavocincta* as two valid, morphologically distinct species, and accordingly replaced *T. flavocincta* with the new name *T. subtruncata* nom. n. As no Korean material of *T. mongolica* has been formally discovered, this species is excluded from the Korean fauna herein. At present, *T. mongolica* is the species known from eastern Mongolia (Popov, 1945) or eastern Mongolia and China (Marshakov, 1981; Chen *et al*., 2014), while *T. subtruncata* occurs in Korea, Russian Far East (Amurskaya Oblast, Primorskii Krai) and China (Shaanxi) (Teranish, 1929; Chen *et al*., 2014; this study).

As commented above, several specimens identified as *T. fasciata* present a greater variation in their coloration or puncture. Those forms being not structurally separable from the typical one, a molecular confirmation is desirable for the definite identification.

In this study, we discovered that two species of Korean *Taeniogonalos* are found regularly in the potter wasp nests, where they use as secondary host a member of the kleptoparasitic flies Miltogramminae (Diptera: Sarcophagidae), the first record of this type of host for the family Trigonalyidae (Fig. 7). Unfortunately, our identification is confined at present to the subfamily level. We will discuss the biology of the Korean Trigonalyidae with more details in a further article.

Conflicts of Interest

The authors of this paper have no affiliation with any interests and is solely responsible for the paper.

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References

Bischoff, H. 1913. Trigonaloiden aus Formosa. Archiv für Naturgeschichte Berlin 79(2), A:150-156.

Bischoff, H. 1914. Eine weitere neue Trigonaloide von Formosa. Archiv für Naturgeschichte Berlin 80(2), A:93-96.

Bischoff, H. 1933. Beiträge zur Kenntnis der Trigonaloiden. Mitteilungen aus dem Zoologischen Museum in Berlin 19:480-496.

Bischoff, H. 1938. Trigonaloidae. Hymenopterorum Catalogus 5:1-18.

Carmean, D. and L. Kimsey. 1998. Phylogenetic revision of the parasitoid wasp family Trigonalidae (Hymenoptera). Systematic Entomology 23:35-76.

Chen, H.-Y., C. van Achterberg, J.-H. He and Z.-F. Xu. 2014. A revision of the Chinese Trigonalyidae (Hymenoptera, Trigonalyoidea). ZooKeys 385:1-207.

Chen, H.-Y., C.-D. Hong, C. van Achterberg and P. Hong. 2020. New species and new records of Trygonalyidae (Hymenoptera) from Tibet, China. ZooKeys 918:83.

He, J.-H. 2004. Hymenopteran Insect Fauna of Zhejiang. Science Press, Beijing, China [in Chinese].

Hirai, N. and M. Hishii, 1995. Host relationships of the Tachinid fly, *Sturmia bella* (Diptera: Tachinidae) and the trigonalyid wasp, *Poecilogonalos fasciata* (Hymenoptera: Trigonalyidae), parasitizing the chestnut tiger butterfly, *Parantica sita* (Lepidoptera: Danaidae). Applied Entomology and Zoology 30:241-244.

Johnson, A.D., T. Rozenberg and M. Segoli. 2023. Notes on the parasitoids found within the nests of *Delta dimidiatipenne* (Hymenoptera, Vespidae). Journal of Hymenoptera Research 96:925-936.

Lelej, A.S. 1995. Fam. Trigonalidae - Trigonalid wasps. In: Kupianskaya, A.N., A.S. Lelej and N.A. Storozheva (eds.), Key to the insects of Russian Far East, St. Peterburg: Nauka, pp. 8-14. [in Russian]

Lelej, A.S. 2003. A review of the family Trigonalyidae (Hymenoptera) of the Palaearctic Region. Far Eastern Entomologist 130:1-7.

Marshakov, V.G. 1981. Trigonalidae (Hymenoptera) of the USSR fauna. In: B.A. Korotyaev (ed.), Morphology and Systematics of insects of the Far East, St. Peterburg: Nauka, pp. 100-107. [in Russian]

Popov, V.V. 1945. Zoogeography and morphology patterns of family Trigonalidae (Hymenoptera). Doklady Akademii nauk SSSR 48 (1):75-78. [in Russian].

Schulz, W.A. 1906. Die Trigonaloiden des Kőniglichen Zoologischen museums in Berlin. Mitteilungen aus dem Zoologischen Museum, Berlin 3:203-212.

Schulz, W.A. 1907. Hymenoptera. Fam. Trigonaloidae. In: P. Wytsman (ed.), Genera Insectorum 61, Bruxelles: Desmet-Verteneul, pp. 1-24.

Schulz, W.A. 1908. Die Trigonaloiden des Genueser Naturhistorischen Museums. Annali del Museo Civico di Storia Naturale di Genova Series 3 4(44):23-37.

Strand, E. 1912. Zoologische Ergebnisse der Expedition des Herrn G. Tessman nach Süd-Kamerun und Spanisch-Guinea. Trigonalidae. Mitteilungen aus dem Zoologischen Museum, Berlin 6:127-132.

Strand, E. 1913. H. Sauter's Formosa-Ausbeute. Fam. Trigonalidae (Hym.). Supplementa Entomologica 2:97-98.

Tan, J.-L., C. van Achterberg, Q.-Q. Tan and L.-P. Zhao. 2017. New species of Trygonalyidae (Hymenoptera) from NW China. ZooKeys 698:17-58.

Teranishi, C. 1929. Trigonaloidae from Japan and Korea (Hym.). Insecta Matsumurana 3(4):143-151 (2 pl.).

Tsuneki, K. 1991. Revision of the Trigonalidae of Japan and adjacent territories (Hymenoptera). Special Publications Japan Hymenopterists Association 37:1-68.

Watanabe, K. and Sk. Yamane. 1997. Notes on the Japanese Trigonalidae (Hymenoptera). Tsunekibachi 30:1-26 [in Japanese].

Weinstein, P. and J.D. Austin. 1991. The host relationships of trigonalyid wasps (Hymenoptera: Trigonalyidae), with a review of their biology and catalogue to world species. Journal of Natural History 25(2):399-433.

Zhang, B.-L., C.-J. Yan, C. van Achterberg, Y.-Q. Peng and H.-Y. Chen. 2022. Integrated taxonomy unveils new species of Trigonalyidae (Insecta, Hymenoptera) from Yunnan, China. Journal of Hymenoptera Research 90:101-128.

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