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# A PRELIMINARY REVISION OF SPECIES OF TRIOXYS HALIDAY OCCURRING IN JAPAN, WITH DESCRIPTIONS OF EIGHT NEW SPECIES

(Hymenoptera : Aphidiidae)

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The genus *Trioxys* Haliday is a moderate group of the Aphidiidae, being represented by about 50 species in the Holarctic region. So far as I am aware, however, no species of the genus has hitherto been recorded in Japan. In this paper will be given eleven species occurring in Japan, of which eight are new to science.

On this occasion I wish to express my sincere thanks to Prof. C. Watanabe of Hokkaido University for his continuous kind direction. Thanks are also due to Dr. V. F. Eastop of the British Museum (N. H.) for his kindness in identifying aphids. The type specimens of the new species are deposited in the collection of the Entomological Institute of Hokkaido University.

## Genus *Trioxys* Haliday

*Trioxys* Haliday, Ent. Mag. 1: 261 & 488, 1833. [Type-species: *Aphidius (Trioxys) cirsii* Curtis, 1831].

This genus is easily distinguishable from any other genera by the following combination of characters.

Fore wing: cubitus, intercubitus and recurrent vein entirely effaced; radius distinct, about as long as stigma. Antennae with 11 or 12 segments in female and with 13 in male. Terminal sternite with anal prong in female.

On the basis of the shape of the petiole the Japanese species may be arranged in 3 groups as mentioned in the following pages.

### Key to the Japanese Species of *Trioxys* (♀♀)

1. Petiole with only 1st lateral tubercle (=spiracular tubercle) on each side. . . . . 2
- Petiole with both 1st and 2nd lateral tubercles on each side. . . . . (Group III) 7
2. Petiole dilated from 1st lateral tubercle to apex. Maxillary palpus distinctly shorter than basal breadth of mandible. Flagellar segments stouter, the 1st being 2.5 times as long as greatest breadth and the 6th a little less than 2 times so. . . . . (Group I) 1. *brevipalpus*, sp. nov.
- Petiole almost parallel-sided or contracted from 1st lateral tubercle to apex. Maxillary palpus distinctly longer than basal breadth of mandible. Flagellar segments slender, the 1st being 4 times or more as long as greatest breadth and the 6th at least a little less than 3 times so. . . . . (Group II) 3

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3. Eyes moderate in length; face moderate in breadth, 1.3 times as broad as long and  $1/2.7$  as broad as head. Stigma of fore wing 3.5 times or less as long as broad. Flagellar segments slightly thickened towards apex, the 1st being 4 times as long as greatest breadth, the 6th a little less than 3 times so and the last 5 times so. Temples almost parallel behind eyes. . . . . 4  
 Eyes large; face narrower in breadth,  $5/6$  as broad as long and  $1/3.5$  as broad as head. Stigma of fore wing narrow, 4 times as long as broad. Each flagellar segment (except for the last longer) equal both in length and in breadth, slender, 5 times as long as greatest breadth. Temples very weakly converging behind eyes. . . . . 6
4. Propodeum: 2 oblique carinae joining together at or just behind anterior margin; ante-median longitudinal carina completely absent or much shorter than oblique carina. Ovipositor sheath stout (fig. 46). . . . . 4. *euceraphis*, sp. nov.  
 Ante-median longitudinal carina of propodeum distinctly longer than oblique carina. Ovipositor sheath slender (figs. 44 & 45). . . . . 5
5. Stigma of fore wing 2.7 times as long as broad. Petiole 2.5 times as long as broad at spiracles. Scutum falling perpendicularly into pronotum. Propodeum completely areolated. Anal prong with 2 claw-shaped bristles at apex. . . . . 2. *shivaphis*, sp. nov.  
 Stigma of fore wing 3.5 times as long as broad. Petiole 2 times as long as broad at spiracles. Scutum falling less steeply into pronotum. Ante-median longitudinal carina and anterior parts of oblique ones of propodeum indistinct. Anal prong with 2 medium-sized bristles at apex. . . . . 3. *auctus* (Haliday)
6. Anal prong gradually curved upwards, with 5 long hairs on dorsal surface and 2 medium-sized bristles at apex. Ovipositor sheath slender, the lower edge being bluntly concave. Propodeum completely areolated. Antennae with 11 segments. . . . . 5. *artistigma*, sp. nov.  
 Anal prong straight on whole length, with 4 long hairs on dorsal surface and a claw-shaped bristle and 2 short hairs at apex. Ovipositor sheath stouter, the lower edge being sharply concave. Ante-median longitudinal and oblique carinae of propodeum faint. Antennae with 12 segments. . . . . 6. *japonicus*, sp. nov.
7. Distance between 1st and 2nd lateral tubercles of petiole distinctly shorter than that between 2nd tubercle and posterior margin. . . . . 8  
 Distance between 1st and 2nd lateral tubercles of petiole as long as or longer than that between 2nd tubercle and posterior margin. . . . . 9
8. Radius of fore wing about as long as stigma. Flagellar segments slightly thickened towards apex, the 1st being 3 times as long as greatest breadth, the 6th a little more than 2 times so and the last 4 times so. Clypeus 2 times as broad as long; face 1.3 times as broad as long. Distance between posterior ocelli 2.5 times as long as short axis of an ocellus. Thorax reddish brown; pronotum, propleura on lower part and propodeum yellowish. Legs dirty yellow. . . . . 7. *glycines*, sp. nov.  
 Radius of fore wing distinctly shorter than stigma. Flagellar segments more sharply thickened towards apex, the 1st being 3 times as long as greatest breadth, the 6th distinctly less than 2 times so and the last 3 times so. Clypeus longer in height, 1.7 times as broad as long; face shorter in height, 2 times as broad as long. Distance between posterior ocelli longer, 3.5 times as long as short axis of an ocellus. Thorax entirely dark brown. Legs brown. . . . . 8. *capitophori*, sp. nov.
9. Distance between 1st and 2nd lateral tubercles of petiole as long as that between 2nd tubercle and posterior margin. Anal prong with 7 long hairs on dorsal surface. Vertex and gena feebly rugose posteriorly. Body generally yellowish brown. . . . . 9. *centaureae* (Haliday)  
 Distance between 1st and 2nd lateral tubercles of petiole distinctly longer than that between 2nd tubercle and posterior margin. Anal prong at most with only 4 long hairs on dorsal surface. Vertex and gena entirely smooth. Body generally dark brown. . . . . 10
10. Eyes moderate in length; face moderate in breadth, about 1.3 times as broad as long and

1/2.5 as broad as head. Scutum falling perpendicularly into pronotum, not covering the latter in lateral view. Ovipositor sheath slenderer, narrowed towards apex. Anal prong slender. Temples a little shorter than dorsal length of an eye. . . . . 10. *toxopterae*, sp. nov. Eyes smaller; face broader, about 1.7 times as broad as long and 1/2.2 as broad as head. Scutum strongly prominent anteriorly, covering pronotum in lateral view. Ovipositor sheath semicircular. Anal prong broader. Temples as long as dorsal length of an eye. . . . .  
 . . . . . 11. *confucius* (Mackauer)

### Group I

This group is represented only by the following species.

#### 1. *Trioxys brevipalpus*, sp. nov.

♀. Dark brown. Face and clypeus brown; mandibles (except for brown tip) and palpi yellowish brown. Antennae brown; first 4 segments yellowish. Abdomen brown; petiole yellowish on the apical 2/5 and on surface within anterior depression; 2nd suture, 2nd to 5th tergites medially, and 6th and succeeding segments including anal prong, ovipositor and ovipositor sheath yellowish brown. Wings hyaline; stigma and veins brown. Legs yellowish brown; coxae and femora of hind legs somewhat darkened above; tarsi of all legs darkened towards claws.

Head smooth and polished, sparsely haired, transverse dorsally, and broader than thorax at tegulae; temples a little shorter than dorsal length of an eye, almost parallel behind eyes; frons hardly haired. Ocelli oval; distance between posterior ocelli 1.5 times as long as short axis of an ocellus. Eyes moderate in length; face moderate in breadth, 1.3 times as broad as long and 1/2.6 as broad as head. Clypeus 2.5 times as broad as long; malar space 1/6 as long as basal breadth of mandible. Maxillary palpus distinctly shorter than basal breadth of mandible, with 4 segments, the 2nd being swollen, and the 4th 3 times as long as greatest breadth and much longer than the 3rd, 2 : 1. Labial palpus with 2 segments, the 2nd being decidedly longer than the 1st. Antennae filiform, densely haired, with 11 segments (1♀); scape a little longer than breadth, 6 : 5, and much longer than pedicel, 2 : 1; flagellar segments rather stout, weakly thickened towards apex, the 1st being 2.5 times as long as greatest breadth, the 6th a little less than 2 times so, and the last longer, about 4 times so and 2 times as long as the preceding one. Thorax smooth and polished, scatteringly haired; scutum falling into pronotum, with comparatively gentle grade, sparsely haired along notaulices and on lateral sides; notaulices distinct only on perpendicular part, thence tending to disappear towards posterior end; scutellum weakly prominent. Propodeum (fig. 12) smooth and polished, somewhat rugose only on surface within pentagonal areola just before petiole, sparsely haired and incompletely areolated, the ante-median longitudinal and oblique carinae being very feebly defined. Abdomen lanceolate, longer than head and thorax together; petiole (fig. 23) smooth and polished, with 3 hairs on each lateral side behind spiracle, 2.5 times as long as broad at spiracles and flat as seen laterally, the lateral margins being slightly concave before 1st lateral tubercle which is situated at the basal 3/7, thence gradually divergent towards apex; 2nd and succeeding tergites smooth and polished, with sparse hairs. Genitalia (fig. 40): anal prong (fig. 52A) straight at the basal 2/3, thence slightly curved upwardly, with 4 long hairs on dorsal surface and 2 medium-sized bristles at apex; ovipositor strongly curved downwards;

ovipositor sheath (fig. 52 B) comparatively slender, almost straight, with moderate hairs, the lower edge being moderately concave. Fore wing (fig. 1): stigma 3 times as long as broad and much longer than metacarp, 5 : 2; radius about as long as stigma. Hind wing without any enclosed cell. Legs of normal form.

Length: body 1.8 mm., antenna 0.9 mm.

♂. Differs from the female in the following characters except for general sexual differences:—

Body and legs darker in colour. Antennae dark brown; pedicel and 1st flagellar segment at base obscurely yellowish. Abdomen entirely dark brown, except for petiole on extreme apex yellowish. Eyes smaller; face broader, 1.5 times as broad as long and 1/2.1 as broad as head. Antennae with 13 segments (3♂♂); flagellar segments stouter. Lateral margins of petiole concave from 1st lateral tubercle to apex, the tubercle being more strongly prominent laterally.

Length: body 1.6 mm., antenna 1.3 mm.

Holotype ♀: 19-vi-64, Sapporo, Hokkaido, H. Takada leg. Paratypes: 3♂♂, 25-vi-64, Tomakomai, Hokkaido, M. Miyazaki leg. All the specimens were reared from *Myzus momonis* on *Prunus Maximowiczii*.

Host: *Myzus momonis* Matsumura on *Prunus Maximowiczii*.

Distribution: Japan (Hokkaido).

Parasitized aphids are found one by one in the curled leaves of host plants, the empty skin becoming dark brown.

This species is closely allied to *T. macroceratus* Mackauer, 1960, from which it is easily differentiated by the shape of the ovipositor sheath and by the structure of the petiole.

## Group II

The group is essentially characterized by the following features. (1) Petiole with only 1st lateral tubercle on each side, the lateral margins being almost parallel or convergent from 1st lateral tubercle to apex. (2) Maxillary palpus distinctly longer than basal breadth of mandible. (3) Flagellar segments slender, the 1st being 4 times or more as long as greatest breadth and the 6th at least a little less than 3 times so.

The following 5 species fall in this group.

### 2. *Trioxys shivaphis*, sp. nov.

♀. Very variable in colour. Head dark brown; clypeus, mandibles (except for brown tip) and palpi yellow. Antennae dark brown, a little paler than head; first 4 segments yellow, in some specimens the 4th darkened. Thorax entirely concolorous with head, except for pronotum and propleura on lower part somewhat paler; in only 5 specimens [2♀♀, Kumamoto (16-v-65) and 3♀♀, Kyoto (15-ix-65)] thorax more or less bicolorous, that is, pronotum, scutum on lateral side, pro-, meso- and metapleura, and propodeum yellowish brown and otherwise brown, decidedly paler than head. Abdomen brown; petiole yellow; 2nd tergite broadly on middle area, 2nd suture, and 5th and succeeding segments including anal prong, ovipositor and ovipositor sheath yellowish brown; in some specimens 3rd and 4th tergites with narrow yellowish patch medially, and rarely apical tergite and ovipositor sheath somewhat darkened. Wings hyaline;

stigma and veins pale brown. Legs generally dirty yellow; 5th tarsal segments and claws of all legs somewhat darkened.

Head smooth and polished, sparsely haired, transverse dorsally and a little broader than thorax at tegulae; temples a little shorter than dorsal length of an eye, 4:5 and almost parallel behind eyes; frons hardly haired. Ocelli oval; distance between posterior ocelli 3 times as long as short axis of an ocellus. Eyes moderate in length; face moderate in breadth, 1.3 times as broad as long and  $1/2.7$  as broad as head, with moderate hairs. Clypeus about 2 times as broad as long; malar space  $1/5$  as long as basal breadth of mandible. Maxillary palpus slender, much longer than basal breadth of mandible, 3:2, with 4 segments, the 2nd being swollen, and the 4th 5 times as long as greatest breadth and longer than the 3rd, 3:2. Labial palpus with 2 segments, the 2nd being markedly longer than the 1st. Antennae filiform, densely haired, with 11 or 12 segments [11 (25♀), 12 (1)]; scape almost quadrate, a little longer than breadth, 6:5, and distinctly longer than pedicel, 3:2; flagellar segments slightly thickened towards apex, the 1st being 4 times as long as greatest breadth and the 6th a little less than 3 times so, and the last longer, 5 times so and 1.5 times as long as the preceding one. Thorax smooth and polished, scatteringly haired; scutum falling perpendicularly into pronotum, not covering the latter in lateral view, sparsely haired along notaulices and on lateral sides; notaulices distinct only on perpendicular part, thence tending to disappear towards posterior end; scutellum weakly prominent. Propodeum (fig. 13) almost smooth and polished, sparsely haired, completely areolated, with pentagonal areola just before petiole, the ante-median longitudinal carina being distinctly longer than the oblique carina, at least 5:4. Abdomen lanceolate, longer than head and thorax together; petiole (fig. 24) almost smooth and polished, with 2 or 3 hairs on each lateral side behind spiracle, 2.5 times as long as broad at spiracles and rather flat as seen laterally, the lateral margins being slightly concave before 1st lateral tubercle which is situated at the basal  $2/5$ , thence almost parallel towards apex; 2nd and succeeding tergites smooth and polished, with sparse hairs. Genitalia (fig. 44): anal prong (fig. 53 A) straight at the basal  $3/4$ , thence slightly curved upwards, with 5 or 6 long hairs on dorsal surface and 2 claw-shaped bristles at apex; ovipositor strongly curved downwards; ovipositor sheath (fig. 53 B) slender, weakly curved downwards, with dense hairs, the lower edge being moderately concave. Fore wing (fig. 2): stigma 2.7 times as long as broad and much longer than metacarp, 5:2; radius distinctly longer than stigma. Hind wing without any enclosed cell. Legs of normal form.

Length: body 1.7-2.4 mm., antenna 1.3-1.6 mm.

♂. Closely resembles the female, from which it is differentiated by the following points except for usual sexual differences:—

Body and legs darker in colour; yellowish parts in the female dirty yellow; antennae almost entirely dark brown, slightly paler towards base. Eyes smaller; face broader, 1.6 times as broad as long and  $1/2.2$  as broad as head. Antennae with 13 segments (18♂♂); flagellar segments stouter. Stigma of fore wing a little broader.

Length: body 1.4-1.9 mm., antenna 1.3-1.5 mm.

Holotype ♀ and paratypes 5♀♀, 4♂♂: 20-iv-64, Kyoto, Honshu, H. Takada leg. Paratypes: 2♂♂, 15-iv-64, 6♀♀, 8♂♂, 18-iv-64, 4♀♀, 1♂, 24-iv-64, 9♀♀, 2♂♂, 28-iv-64, 3♀♀, 15-ix-65, Kyoto, H. Takada leg.; 2♀♀, 4♂♂, 16-v-65, Kumamoto, Kyushu, reared from *Shivaphis celti* on *Celtis* sp. by H. Takada.

Host: *Shivaphis celti* (Shinji) on *Celtis* sp.

Distribution: Japan (Honshu and Kyushu).

Parasitized aphids are attached one by one on some places a little away from the leaves of host plants on which *Shivaphis celti* lives, such as stems of host plants, neighbouring plants, fallen leaves, stones, walls of houses and others, the empty skin becoming pale brown.

The species closely resembles *T. cirsii* (Curtis, 1831), but it differs from the latter in having the ovipositor sheath which is slenderer, weakly curved downwards and more densely haired.

### 3. *Trioxys auctus* (Haliday)

*Aphidius* (*Trioxys*) *auctus* Haliday, Ent. Mag. 1: 489, 1833.

*Aphidius auctus*: Thompson, Opusc. Ent. 20: 2335, 1895.

*Trioxys auctus*: Marshall, Spec. Hym. Eur. 5: 550, 1891; Dalla Torre, Cat. Hym. 4: 13, 1898; Marshall, Trans. Ent. Soc. London 1899: 28, 1899; Szépligeti, Gen. Ins. 22: 190, 1904; Quilis, Anal. Inst. nac. Valencia, 2<sup>o</sup> ser. Hist. Nat. 20: 34, 1931.

*Trioxys* (*Trioxys*) *auctus*: Mackauer, Beitr. Ent. 9: 154, 1959, 10: 149, 1960 & 11: 145, 1961; Narayanan et al., Beitr. Ent. 12: 714, 1962.

This species is new to Japan. On the basis of the present specimens a brief redescription may be given as follows:—

♀. Dark reddish brown. Clypeus, mandibles (except for brown tip), palpi and first 2 antennal segments yellow; face, 1st flagellar segment, pronotum and propleura yellowish brown. Abdomen brown; petiole yellow; 2nd and succeeding tergites with narrow yellowish patch medially; apical segments including anal prong, ovipositor and ovipositor sheath obscurely yellowish brown. Legs generally dirty yellow; 5th tarsal segments and claws of all legs darkened.

Antennae with 12 segments (2♀♀). Scutum (fig. 37) falling less steeply into pronotum. Propodeum (fig. 14): the ante-median longitudinal carina and anterior parts of the oblique ones indistinct. Petiole (fig. 25) 2 times as long as broad at spiracles. Genitalia (fig. 45): anal prong (fig. 55 A) straight at the basal 4/5, thence slightly curved upwardly, with 5 long hairs on dorsal surface and 2 medium-sized bristles at apex; ovipositor sheath (fig. 55 B) less slender, weakly curved downwards, with dense hairs. Fore wing (fig. 4): stigma 3.5 times as long as broad.

Length: body 1.3–1.5 mm., antenna 1.0–1.1 mm.

♂. Body and legs generally darker in colour than the female; antennae entirely concolorous with head.

Length: body 1.3 mm., antenna 1.3 mm.

Specimens examined: 2♀♀, 1♂, 5-vi-62, Niigata, Honshu, reared from *Rhopalosiphum padi* on wheat by A. Ôtake.

Host: *Rhopalosiphum padi* (Linné) on wheat (in Japan).

Furthermore, in Europe the following aphids have been recorded as hosts:—*Aphis evonymi* Fabricius, *Cerosipha franfulae* (Kaltenbach) and *Cerosipha gossypii* (Glover) (after Mackauer, 1959).

Distribution: Japan (Honshu); Europe.

### 4. *Trioxys euceraphis*, sp. nov.

Differs from *T. shivaphis*, sp. nov. as follows:—

♀. Dark brown. Clypeus, mandibles (except for brown tip), palpi, first 3 antennal segments and petiole yellowish; 2nd tergite medially and the 3rd basally obscurely yellowish brown; anal prong, ovipositor and ovipositor sheath somewhat paler. Legs generally yellow; coxae, 5th tarsal segments and claws of all legs darkened.

Distance between posterior ocelli 3.5 times as long as short axis of an ocellus. Antennae with 11 or 12 segments [11 (2♀♀), 12 (2)]. Propodeum (fig. 15): 2 oblique carinae joining together at or just behind the anterior margin; the ante-median longitudinal carina completely absent or much shorter than the oblique carina. Petiole (fig. 26) 2 times as long as broad at spiracles. Genitalia (fig. 46): anal prong (fig. 54 A) straight, the apex being slightly curved upwards, with 5 long hairs on dorsal surface and 2 claw-shaped bristles at apex; ovipositor sheath (fig. 54 B) stouter, very weakly curved downwards, with 2 long hairs basally and moderate hairs evenly. Fore wing (fig. 3): stigma about 3 times as long as broad; radius about as long as stigma.

Length: body 2.2-2.4 mm., antenna 1.6-1.7 mm.

♂. Body and legs generally darker in colour than the female. Petiole more strongly prominent laterally at 1st lateral tubercle.

Length: body 1.8-1.9 mm., antenna 1.6-1.8 mm.

Holotype ♀ and paratypes 3♀♀, 2♂♂: 17-vii-64, Sapporo, Hokkaido, reared from *Euceraphis punctipennis* on *Betula* sp. by H. Takada.

Host: *Euceraphis punctipennis* (Zetterstedt) on *Betula* sp.

Distribution: Japan (Hokkaido).

Aphids attacked by the parasite are found one by one on the leaves of host plants, the empty skin becoming brown.

This species is quite close to *T. pallidus* (Haliday, 1833), from which it is readily distinguishable by the broader petiole and the stouter ovipositor sheath.

##### 5. *Trioxys artistigma*, sp. nov.

Differs from *T. shivaphis*, sp. nov. as follows:—

♀. Dark brown. Clypeus, mandibles (except for brown tip), palpi, petiole, anal prong, ovipositor and ovipositor sheath yellowish; propleura on lower part and 2nd tergite medially yellowish brown. Antennae dark brown, paler than head; first 4 segments yellow. Legs yellow; 5th tarsal segments and claws of all legs darkened.

Temples very weakly converging behind eyes. Distance between posterior ocelli 1.8 times as long as short axis of an ocellus. Eyes larger; face narrower in breadth, 5/6 as broad as long and 1/3.5 as broad as head. Clypeus a little broader than length. Antennae with 11 segments (3♀♀); each flagellar segment about equal both in length and in breadth, slender, 5 times as long as greatest breadth, except for the last which is 6 times so and 1.5 times as long as the other. Propodeum (fig. 16): the ante-median longitudinal carina as long as the oblique carina. Petiole (fig. 27) 2.3 times as long as broad at spiracles, which are situated just before the middle. Genitalia (fig. 47): anal prong (fig. 56 A) gradually curved upwards, with 5 long hairs on dorsal surface and 2 medium-sized bristles at apex; ovipositor sheath (fig. 56 B) slender, very weakly curved downwards, with sparse hairs, the lower edge being bluntly concave. Fore wing (fig. 5): stigma narrow, 4 times as long as broad.

Length: body 1.7-2.2 mm., antenna 1.6-1.8 mm.

♂. Unknown.

Holotype ♀ and paratypes 2♀♀: 15-vi-65, Kyoto, Honshu, H. Takada leg.

Host: Unknown.

Distribution: Japan (Honshu).

This species is very similar to *T. falcatus* Mackauer, 1959, but it is separated from the latter by the slenderer and more weakly curved ovipositor sheath, and by the darker abdomen.

#### 6. *Trixys japonicus*, sp. nov.

Differs from *T. shivaphis*, sp. nov. as follows:—

♀. Dark brown. Clypeus, mandibles (except for brown tip) and palpi yellowish brown; propodeum very slightly paler. Antennae concolorous with head but a little paler; first 3 segments and base of the 4th yellow. Abdomen dark brown, paler than thorax; petiole and anal prong yellow; 2nd and 3rd tergites medially, ovipositor, and ovipositor sheath obscurely paler. Legs yellow; claws of all legs darkened.

Temples very weakly converging behind eyes. Eyes larger; face (fig. 34) narrower in breadth, 5/6 as broad as long and 1/3.5 as broad as head. Clypeus a little broader than length. Antennae with 12 segments (3♀♀); each flagellar segment about equal both in length and in breadth, slender, 5 times as long as greatest breadth. Scutum (fig. 38). Propodeum (fig. 17) weakly rugose, the ante-median longitudinal and oblique carinae being faint. Petiole (fig. 28) about 2 times as long as broad at spiracles, the lateral margins being weakly convergent from 1st lateral tubercle to apex. Genitalia (fig. 48): anal prong (fig. 57 A) straight on whole length, with 4 long hairs on dorsal surface and a claw-shaped bristle and 2 short hairs at apex; ovipositor sheath (fig. 57 B) stouter, very weakly curved downwards, with sparse hairs, the lower edge being very sharply concave. Fore wing (fig. 6): stigma narrow, 4 times as long as broad.

Length: body 1.7–1.8 mm., antenna 1.6–1.7 mm.

♂. Unknown.

Holotype ♀: 10–vii-65, Sapporo, Hokkaido, H. Takada leg. Paratypes 2♀♀: 8–vii-65, Sapporo, H. Takada leg.

Host: Unknown.

Distribution: Japan (Hokkaido).

This species is closely allied to *T. hincksi* Mackauer, 1960, from which it is differentiated by the following characters. (1) Propodeum normally areolated, though effaced on anterior surface. (2) Stigma narrower, 4 times as long as broad. (3) Antennae with 12 segments in female. (4) Lower edge of ovipositor sheath more sharply concave.

### Group III

The group is clearly characterized by the petiole having the 1st and 2nd lateral tubercles on each side.

The following 5 species belong to this group.

#### 7. *Trixys glycines*, sp. nov.

♀. Reddish brown. Mandibles, palpi and first 3 antennal segments yellowish; face, clypeus, pronotum, propleura on lower part and propodeum somewhat pale. Abdomen almost entirely pale reddish brown; petiole and middle area of 2nd tergite broadly yellow.

lowish. Wings hyaline; stigma and veins pale brown. Legs dirty yellow; femora of all legs somewhat darkened above; claws dark brown.

Head smooth and polished, scatteringly haired, transverse dorsally and a little broader than thorax at tegulae; temples a little shorter than dorsal length of an eye, almost parallel behind eyes. Ocelli oval; distance between posterior ocelli 2.5 times as long as short axis of an ocellus. Eyes moderate in length; face moderate in breadth, about 1.3 times as broad as long and  $1/2.5$  as broad as head, with sparse hairs. Clypeus about 2 times as broad as long; malar space  $1/4$  as long as basal breadth of mandible. Maxillary palpus slender, decidedly longer than basal breadth of mandible, with 4 segments, the 2nd being somewhat swollen, and the 4th 4 times as long as greatest breadth and longer than the 3rd, 3:2. Labial palpus with 2 segments, the 2nd being decidedly longer than the 1st. Antennae filiform, densely haired, with 11 or 12 segments [11 (12♀♀), 12 (2)]; scape 1.5 times as long as broad and longer than pedicel, 3:2; flagellar segments slightly thickened towards apex, the 1st being about 3 times as long as greatest breadth, the 6th a little more than 2 times so, and the last longer, 4 times so and 2 times as long as the preceding one. Thorax smooth and polished, scatteringly haired; scutum falling fairly steeply into pronotum, not covering the latter in lateral view; notaulices distinct only on perpendicular part, thence tending to disappear towards posterior end; scutellum weakly prominent. Propodeum (fig. 18) smooth and polished, somewhat rugose laterally on posterior surface, sparsely haired, completely areolated, with pentagonal areola just before petiole, the ante-median longitudinal carina being about as long as the oblique carina. Abdomen lanceolate, longer than head and thorax together. Petiole (fig. 29) weakly rugose, with 2 hairs on each lateral side just behind 2nd lateral tubercle, 2.4 times as long as broad at spiracles and weakly convex in lateral view, the lateral margins being slightly concave towards 1st lateral tubercle, which is situated just before the middle, thence almost parallel towards apex; distance between 1st and 2nd lateral tubercles distinctly shorter than that between 2nd tubercle and posterior margin, 1:2; 2nd and succeeding tergites smooth and polished, with sparse hairs. Genitalia (fig. 50): anal prong (fig. 58 A) straight, the apex being weakly curved upwards, with 4 long hairs on dorsal surface and 2 medium-sized bristles at apex; ovipositor strongly curved downwards; ovipositor sheath (fig. 58 B) slender, very weakly curved downwards, with moderate hairs, the lower edge being moderately concave. Fore wing (fig. 7): stigma a little more than 3 times as long as broad and much longer than metacarp; radius about as long as stigma. Hind wing without any enclosed cell. Legs of normal form.

Length: body 1.5-1.6 mm., antenna 1.1-1.2 mm.

♂. Similar to the female, but differs from the latter in the following aspects except for usual sexual differences:—

Body and legs generally darker in colour; antennae entirely dark brown, becoming slightly pale towards base. Eyes smaller; face broader, 1.7 times as broad as long and  $1/2$  as broad as head. Antennae with 13 segments (7♂♂); flagellar segments stouter.

Length: body 1.2-1.5 mm., antenna 1.1-1.5 mm.

Holotype ♀: 29-vii-38, Sapporo, Hokkaido. Paratypes: 4♀♀, 3♂♂, 20-vii-38, 1♀, 1♂, 27-vii-38, 9♀♀, 4♂♂, 30-vii-38, Sapporo. All the specimens were bred from *Aphis glycines* on *Glycine Max* by C. Watanabe.

Host: *Aphis glycines* Matsumura on *Glycine Max*.

Distribution: Japan (Hokkaido).

Aphids parasitized by the species are attached one by one on the leaves and stems of soy bean, the empty skin becoming pale brown.

On account of the structure of the female genitalia and the shape of the petiole this species is closely related to *T. rietscheli* Mackauer, 1959, but judging from the original description it is differentiated from the latter by the following characters:—(1) Vertex entirely smooth and polished, not rugose. (2) Stigma narrower, apparently more than 3 times as long as broad. (3) Proportion of length of body to antenna (1.5–1.6 : 1.1–1.2) more than in *rietscheli* (1.7–1.8 : 0.9). (4) Head and thorax paler in colour, reddish brown.

8. *Trioxys capitophori*, sp. nov.

Differs from *T. glycines*, sp. nov. as follows:—

♀. Head and thorax entirely dark brown; mandibles (except for brown tip), palpi and first 3 antennal segments dirty yellow. Abdomen dark brown; petiole on the basal 2/5 and extreme apex, and anal prong yellowish; 2nd suture, ovipositor and ovipositor sheath obscurely pale. Legs brown, generally darker above, trochanters, femora distally, tibiae proximally and tarsi proximally being yellowish.

Distance between posterior ocelli longer, 3.5 times as long as short axis of an ocellus. Clypeus longer in height, 1.7 times as broad as long; face shorter in height, 2 times as broad as long. Antennae with 11 segments (2♀♀); flagellar segments more sharply thickened towards apex, the 1st being 3 times as long as greatest breadth, the 6th distinctly less than 2 times so and the last 3 times so. Propodeum (fig. 19) with rugose-striations outwards. Petiole (fig. 30) about 2 times as long as broad at spiracles; distance between 1st and 2nd lateral tubercles shorter than that between 2nd tubercle and posterior margin, 2 : 3. Genitalia (fig. 41): anal prong (fig. 59 A); ovipositor sheath (fig. 59 B). Fore wing (fig. 8): stigma a little less than 3 times as long as broad; radius distinctly shorter than stigma, 3 : 4.

Length: body 1.6 mm., antenna 0.9 mm.

♂. Unknown.

Holotype ♀: 2-ix-65, Sapporo, Hokkaido. Paratype 1♀: 20-viii-65, Sapporo. All the specimens were reared from *Capitophorus hippophaes* on a Polygonaceous species by K. Kusigemati.

Host: *Capitophorus hippophaes* (Walker) on a Polygonaceous species.

Distribution: Japan (Hokkaido).

Parasitized aphids are found one by one on the leaves of host plants, the empty skin becoming brown.

This species is very similar to *T. rietscheli* Mackauer, 1959 and *T. heraclei* (Haliday, 1833), but it is readily distinguishable from those species by the petiole which is broader, 2 times as long as broad at spiracles.

9. *Trioxys centaureae* (Haliday)

*Aphidius* (*Trioxys*) *centaureae* Haliday, Ent. Mag. 1: 490, 1833.

*Trioxys centaureae*: Marshall, Spec. Hym. Eur. 5: 554, 1891; Dalla Torre, Cat. Hym. 4: 14, 1898; Marshall, Trans. Ent. Soc. London 1899: 30, 1899; Szépligeti, Gen. Ins. 22: 190, 1904.

*Trioxys* (*Trioxys*) *centaureae*: Mackauer, Beitr. Ent. 9: 157, 1959.

*Trioxys (Binodoxys) centaureae*: Mackauer, Beitr. Ent. 10: 141, 1960 & 11: 149, 1961; Narayanan et al., Beitr. Ent. 12: 710, 1962.

This species is new to Japan. On the basis of the specimens examined a brief redescription may be given as follows:—

♀. Yellowish brown with reddish tint. Dark brown parts: mandibles at tip, frons obscurely, ocelli and ocellar triangle, eyes, 4th and succeeding flagellar segments, scutum (except for a round obscurely yellowish patch on posterior surface medially), scutellum on disc, 2nd to 4th tergites laterally, ovipositor sheath, and 5th tarsal segments and claws of all legs.

Head feebly rugose on both vertex and gena posteriorly. Face (fig. 35) 1.4 times as broad as long and  $1/2.8$  as broad as head. Antennae with 11 segments (7♀♀); flagellar segments slenderer, the 1st being 4 times as long as greatest breadth, the 6th 3 times so and the last 5 times so. Propodeum (fig. 20) somewhat rugose on posterior surface, the ante-median longitudinal carina being distinctly longer than the oblique carina, 3:2. Petiole (fig. 31) about 3 times as long as broad at spiracles, the lateral margins being moderately concave from base to 2nd lateral tubercle (except for 1st lateral tubercle which is clearly prominent laterally), thence strongly concave towards apex; distance between 1st and 2nd lateral tubercles about as long as that between 2nd tubercle and posterior margin. Genitalia (figs. 49 & 51): anal prong (fig. 62 A) straight, the apex being weakly curved upwards, with 7 long hairs on dorsal surface and a claw-shaped and a medium-sized bristle at apex; ovipositor sheath (fig. 62 B) stout, with rather dense hairs. Fore wing (fig. 11): stigma 3 times as long as broad; radius a little longer than stigma.

Length: body 2.4–2.8 mm., antenna 1.6–1.8 mm.

♂. Dark brown. Mandibles (except for brown tip), palpi, scape, pedicel and petiole yellowish; clypeus, 1st flagellar segment, pronotum, propleura on lower part, propodeum and 2nd tergite on both extreme borders somewhat pale. Legs dirty yellow, femora distally, tibiae distally, 5th tarsal segments and claws being darkened. Face 1.6 times as broad as long and  $1/2.2$  as broad as breadth of head.

Length: body 1.8 mm., antenna 1.6 mm.

Specimens examined: 1♀, 25-iv-63, Kagoshima, Kyushu, 2♂♂, 1-v-63, Fukuoka, Kyushu, 1♀, 1♂, 6-v-63, Kyoto, Honshu, 5♀♀, 25-iv-65, Kōchi (Wakamiya), Shikoku, 1♀, 11-vi-65, Tsushima (Izuhara), Kyushu. All the specimens were reared from *Macrosiphum ibarae* on *Rosa* spp. by H. Takada.

Host: *Macrosiphum ibarae* Matsumura on *Rosa* spp.

Furthermore, in Europe this parasite has been known to be reared from *Brachycaudus helichrysi* (Kaltenbach) (after Mackauer, 1959).

Distribution: Japan (Honshu, Shikoku and Kyushu); Europe.

Aphids attacked by the parasite are attached one by one on the leaves of host plants, the empty skin becoming dark brown.

#### 10. *Trioxys toxopterae*, sp. nov.

Differs from *T. glycines*, sp. nov. as follows:—

♀. Head dark brown; clypeus, mandibles (except for brown tip) and palpi yellowish. Antennae concolorous with head but a little paler; first 3 segments yellow with the 4th paler. Thorax dark reddish brown; pronotum, propleura and propodeum somewhat

paler. Abdomen dark brown: petiole and middle area of 2nd tergite broadly dirty yellow; apical segments including anal prong, ovipositor and ovipositor sheath somewhat pale. Legs dirty yellow; femora and tibiae of hind legs distally above, and 5th tarsal segments and claws of all legs darkened.

Temples weakly converging behind eyes. Antennae with 11 segments (3♀♀); scape 2 times as long as pedicel. Propodeum (fig. 21) almost smooth and polished, the antemedian longitudinal carina being distinctly longer than the oblique carina, 7 : 5. Petiole (fig. 32) 3 times as long as broad at spiracles, the lateral margins being very slightly concave from base to 2nd lateral tubercle, thence strongly concave towards apex; distance between 1st and 2nd lateral tubercles distinctly longer than that between 2nd tubercle and posterior margin, 2 : 1. Genitalia (fig. 42): anal prong (fig. 60 A) straight, the apex being weakly curved upwards, with 4 long hairs on dorsal surface and 2 medium-sized bristles at apex; ovipositor sheath (fig. 60 B) slender, almost straight, with moderate hairs, the lower edge being bluntly concave. Fore wing (fig. 9): stigma about 3 times as long as broad; radius slightly longer than stigma.

Length: body 1.6–2.2 mm., antenna 1.0–1.6 mm.

♂. Face 1.9 times as broad as long and 1/2.1 as broad as head.

Length: body 1.4 mm., antenna 1.3 mm.

Holotype ♀: 13-iii-64, Amami-Ōshima (Hatsuno), Ryukyu, H. Takada leg. Paratypes: 2♀♀, 2♂♂, 14-iii-64, Amami-Ōshima (Taken), reared from *Toxoptera aurantii* on *Eurya emarginata* by H. Takada.

Host: *Toxoptera aurantii* (Boyer de Fonscolombe) on *Eurya emarginata*.

Distribution: Japan (Ryukyu).

Parasitized aphids are attached one by one on the leaves of host plants, the empty skin becoming dark brown.

The species is very similar to *T. angelicae* (Haliday, 1833), from which it is at once distinguishable by the ovipositor sheath which is more straight, with the lower edge more bluntly concave.

#### 11. *Trioxys confucius* (Mackauer)

*Binodoxys confucius* Mackauer, Entomophaga 7: 37, 1962; Takada, Ins. Mats. 28: 130, 1966.

This species is rather aberrant, being easily differentiated from any other species of the genus by the semicircular ovipositor sheath. On the basis of the present specimens a brief redescription may be given below:—

♀. Dark brown. Clypeus, mandibles (except for brown tip) and palpi yellowish brown. Antennae concolorous with head but a little paler; first 3 segments yellow. Abdomen dark brown, a little paler than thorax; petiole apically and 2nd tergite both on middle area and on extreme apex obscurely yellowish; 3rd tergite narrowly on middle area, the 4th on extreme base and anal prong somewhat pale. Legs yellow; femora above and tibiae of hind legs brownish; 5th tarsal segments of all legs darkened towards claws.

Temples as long as dorsal length of an eye. Ocelli almost round; distance between posterior ocelli 3 times as long as diameter of an ocellus. Eyes small; face (fig. 36) broader, about 1.7 times as broad as long and 1/2.2 as broad as head. Antennae with 11 segments (2♀♀). Scutum (fig. 39) strongly prominent anteriorly, covering pronotum in lateral view. Propodeum (fig. 22) entirely smooth and polished, the ante-

median longitudinal carina being distinctly longer than the oblique carina, 5 : 4. Petiole (fig. 33) almost smooth and polished entirely, a little more than 3 times as long as broad at spiracles; distance between 1st and 2nd lateral tubercles distinctly longer than that between 2nd tubercle and posterior margin, 2 : 1. Genitalia (fig. 43): anal prong (fig. 61 A) broad, almost straight, the apex being weakly curved upwards, with 3 hairs on dorsal surface; ovipositor strongly curved anteriorly; ovipositor sheath (fig. 61 B) semi-circular, with long hairs. Fore wing (fig. 10): stigma 2.7 times as long as broad; radius distinctly longer than stigma, 4 : 3.

Length: body 1.9–2.3 mm., antenna 1.2–1.3 mm.

♂. Unknown.

Specimens examined: 2♀♀, 21-iii-64, Amami-Ōshima (Shinokawa), Ryukyu, H. Takada leg.

Host: Unknown (in Japan).

According to Mackauer (1962) a specimen of this species has been reared from an aphid on citrus at Hongkong.

Distribution: Japan (Ryukyu); Hongkong.

#### Host list

Host	Parasite	Page
Callaphidinae		
* <i>Euceraphis punctipennis</i> (Zetterstedt) . . . . .	<i>T. euceraphis</i> Takada	28
* <i>Shivaphis celti</i> (Shinji) . . . . .	<i>T. shivaphis</i> Takada	26
Aphidinae		
<i>Aphis evonymi</i> Fabricius . . . . .	<i>T. auctus</i> (Haliday)	28
* <i>Aphis glycines</i> Matsumura . . . . .	<i>T. glycines</i> Takada	30
<i>Brachycaudus helichrysi</i> (Kaltenbach) . . . . .	<i>T. centaureae</i> (Haliday)	32
* <i>Capitophorus hippophaes</i> (Walker) . . . . .	<i>T. capitophori</i> Takada	32
<i>Cerosipha frangulae</i> (Kaltenbach) . . . . .	<i>T. auctus</i> (Haliday)	28
<i>Cerosipha gossypii</i> (Glover) . . . . .	"	28
* <i>Macrosiphum ibarae</i> Matsumura . . . . .	<i>T. centaureae</i> (Haliday)	32
* <i>Myzus momonis</i> Matsumura . . . . .	<i>T. brevivalpus</i> Takada	25
* <i>Rhopalosiphum padi</i> (Linné) . . . . .	<i>T. auctus</i> (Haliday)	28
* <i>Toxoptera aurantii</i> (Boyer de Fonscolombe) . . . . .	<i>T. toxopterae</i> Takada	33
An aphid on citrus . . . . .	<i>T. confucius</i> (Mackauer)	34

\* This relationship occurs in Japan.

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### Explanation of plates

**Plate XXI.** Fore wing of female. Fig. 1, *Trioxys brevipalpus*; 2, *T. shivaphis*; 3, *T. euceraphis*; 4, *T. auctus*; 5, *T. artistigma*; 6, *T. japonicus*; 7, *T. glycines*; 8, *T. capitophori*; 9, *T. toxopterae*; 10, *T. confucius*; 11, *T. centaureae*.

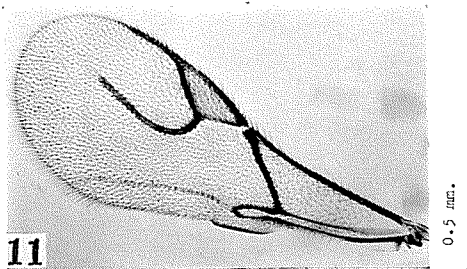
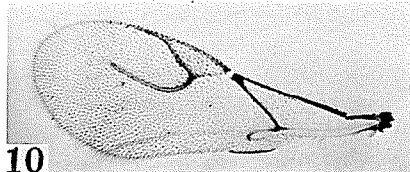
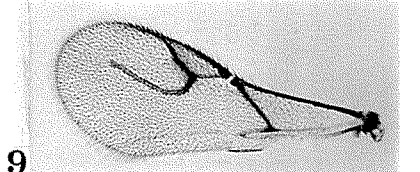
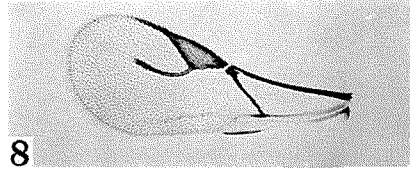
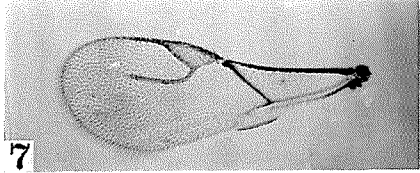
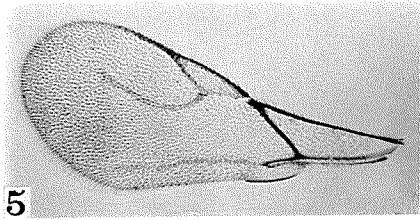
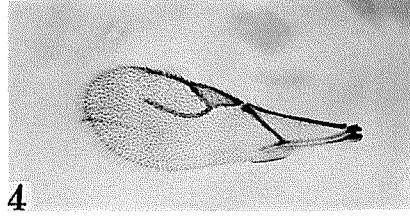
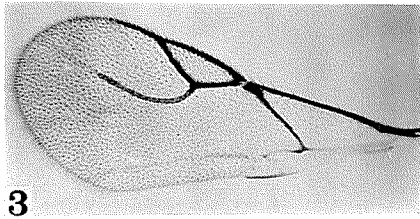
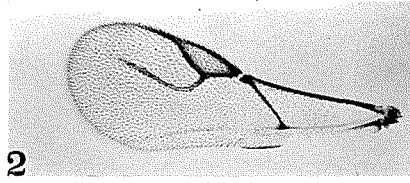
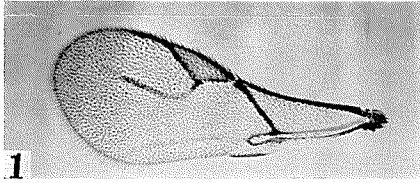
**Plate XXII.** Propodeum of female. Fig. 12, *Trioxys brevipalpus*; 13, *T. shivaphis*; 14, *T. auctus*; 15, *T. euceraphis*; 16, *T. artistigma*; 17, *T. japonicus*; 18, *T. glycines*; 19, *T. capitophori*; 20, *T. centaureae*; 21, *T. toxopterae*; 22, *T. confucius*.

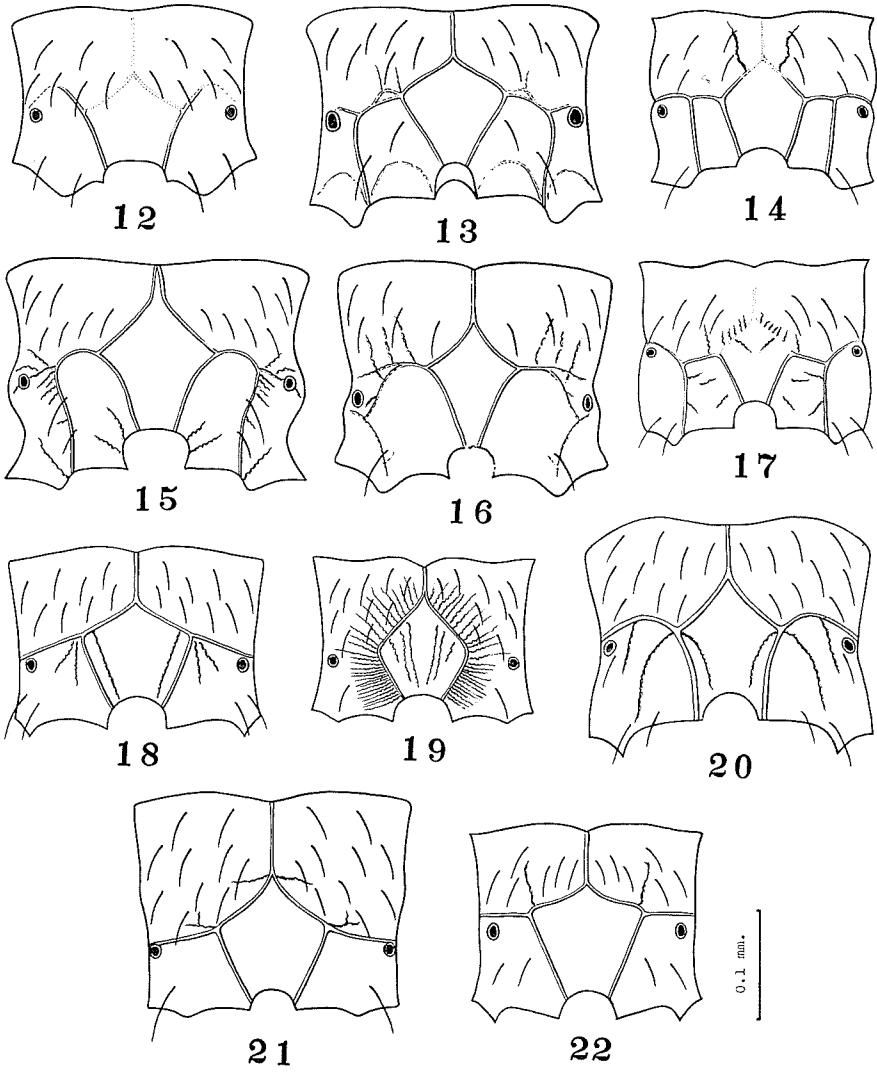
**Plate XXIII.** Petiole of female. Fig. 23, *Trioxys brevipalpus*; 24, *T. shivaphis*; 25, *T. auctus*; 26, *T. euceraphis*; 27, *T. artistigma*; 28, *T. japonicus*; 29, *T. glycines*; 30, *T. capitophori*; 31, *T. centaureae*; 32, *T. toxopterae*; 33, *T. confucius*.

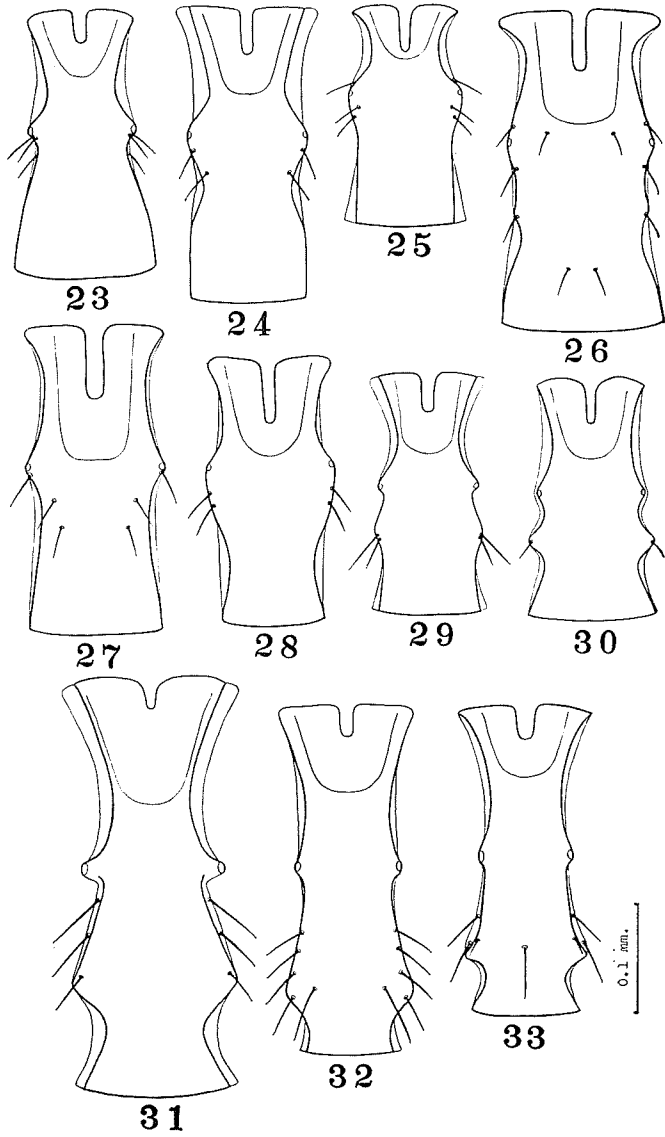
**Plate XXIV.** Head of female in frontal view (figs. 34-36), scutum of female in lateral view (figs. 37-39) and genitalia of female (figs. 40-43). Fig. 34, *Trioxys japonicus*; 35, *T. centaureae*; 36, *T. confucius*; 37, *T. auctus*; 38, *T. japonicus*; 39, *T. confucius*; 40, *T. brevipalpus*; 41, *T. capitophori*; 42, *T. toxopterae*; 43, *T. confucius*.

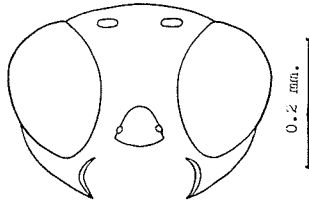
**Plate XXV.** Genitalia of female. Fig. 44, *Trioxys shivaphis*; 45, *T. auctus*; 46, *T. euceraphis*; 47, *T. artistigma*; 48, *T. japonicus*; 49 & 51, *T. centaureae*; 50, *T. glycines*.

**Plate XXVI.** Genitalia of female (A, anal prong; B, ovipositor sheath). Fig. 52, *Trioxys brevipalpus*; 53, *T. shivaphis*; 54, *T. euceraphis*; 55, *T. auctus*; 56, *T. artistigma*; 57, *T. japonicus*; 58, *T. glycines*; 59, *T. capitophori*; 60, *T. toxopterae*; 61, *T. confucius*; 62, *T. centaureae*.

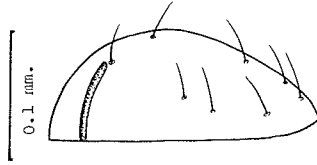




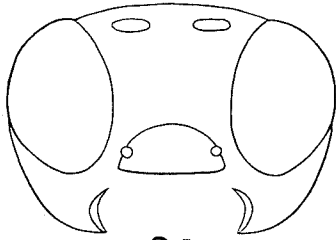




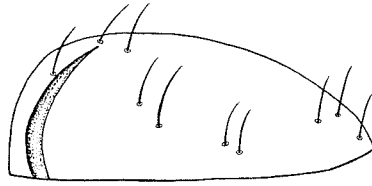
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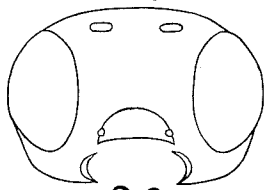
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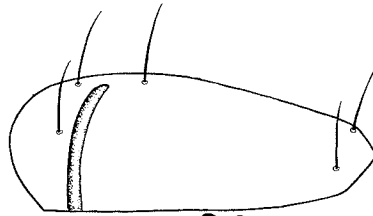
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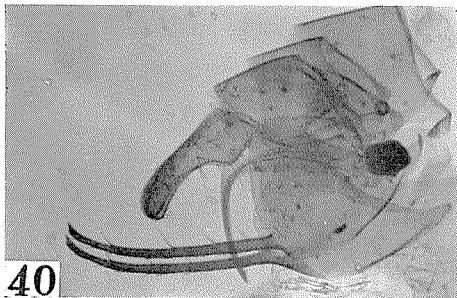
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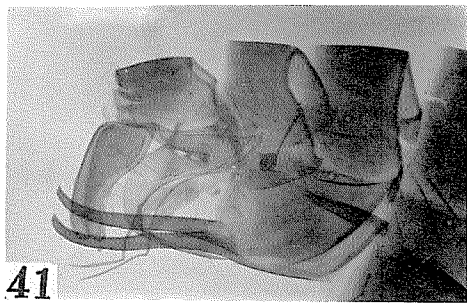
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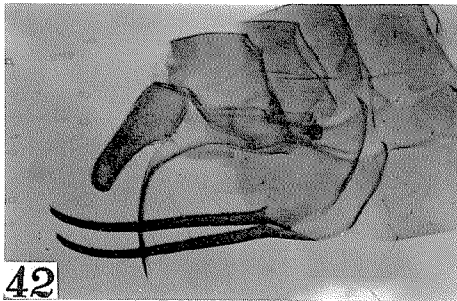
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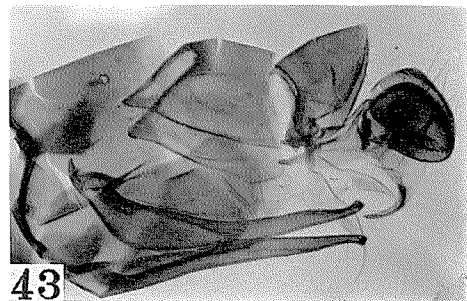
40



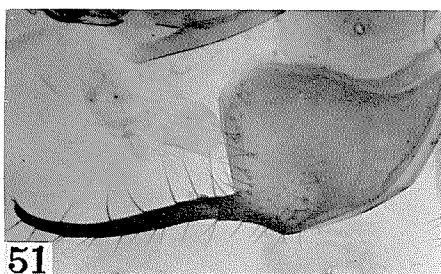
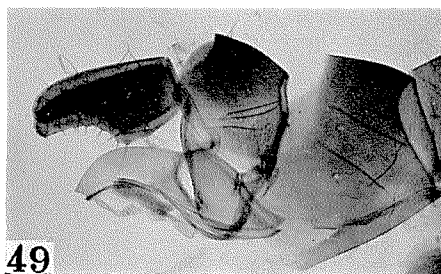
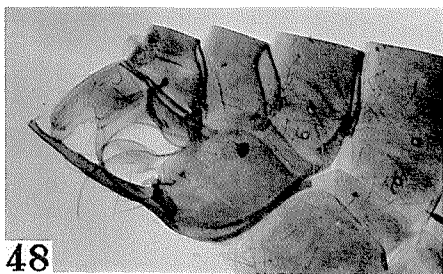
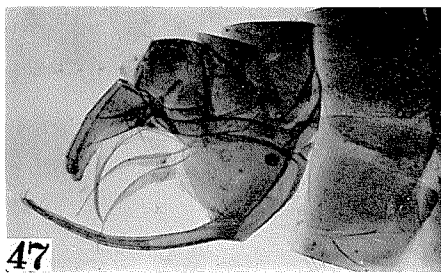
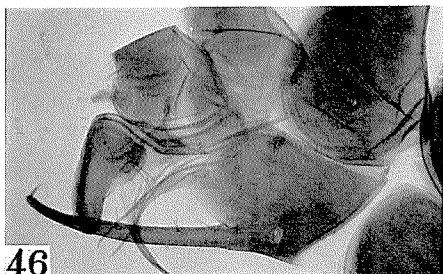
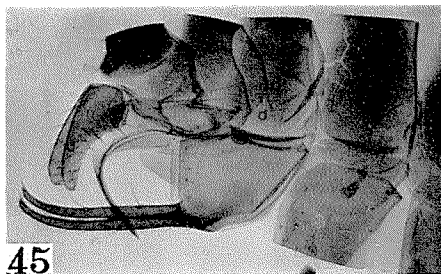
41



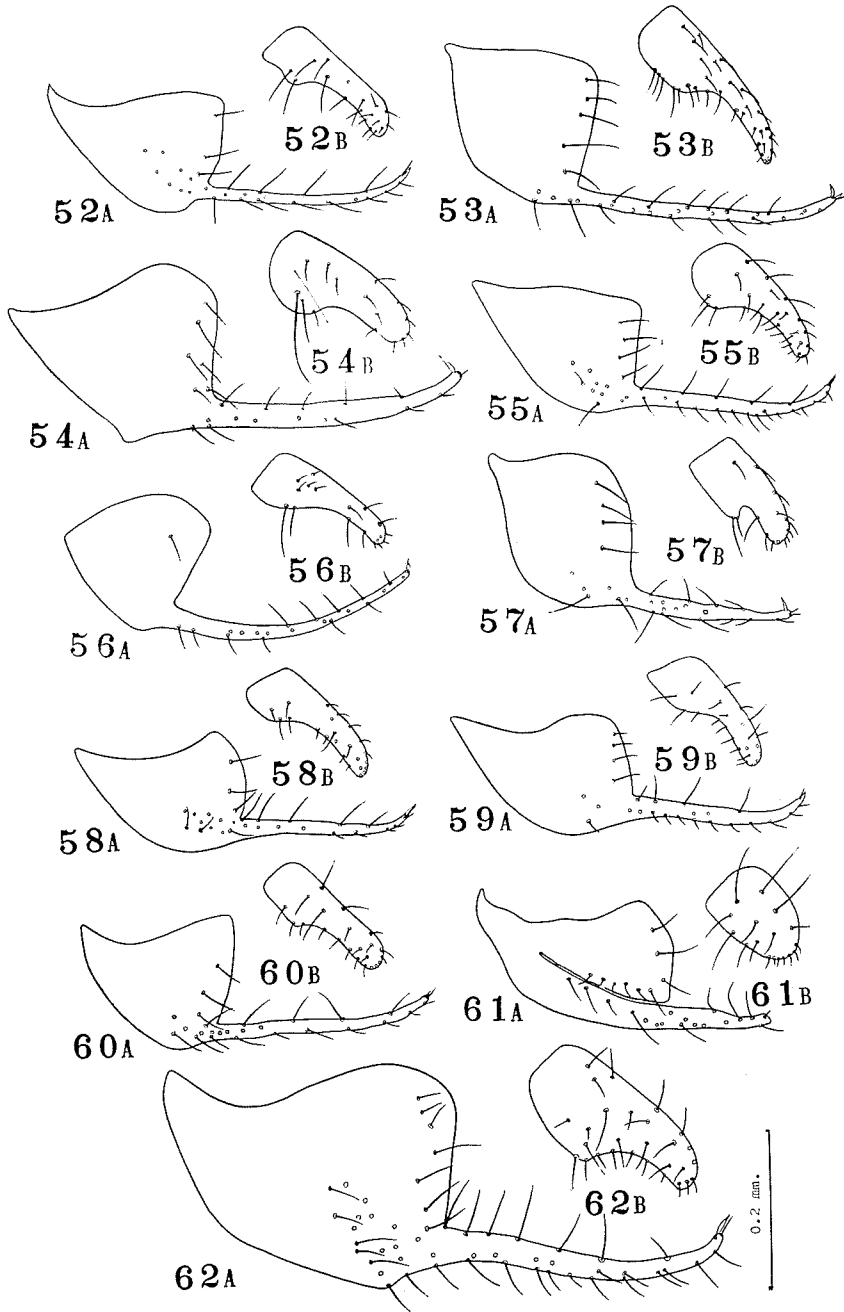
42



43



0.2 mm.



### **New Publication**

As a supplement to the *Insecta Matsumurana* (Journal of the Faculty of Agriculture, Hokkaido University. Series Entomology) the following publication is issued.

**A contribution to the knowledge of the larvae of Tenebrionidae occurring in Japan (Coleoptera : Cucujoidea).** *Insecta Matsumurana*, Supplement 1, 41 pp., 32 plates, 1966. By Nodoka Hayashi.

In this paper are given descriptions of the larvae of 58 species of the Tenebrionidae occurring in Japan and the key to the species based on the larvae.

### **Errata**

- Supplement 1, p. 30, line 15 from top, for "Shakadake" read "Shakudake".  
" p. 32, line 1 from top, for "Shakadake" read "Shakudake".  
" p. 33, line 12 from top, for "Ninth abdominal segment without" read "Ninth abdominal segment with".  
" p. 33, line 16 from top, for "bdan" read "band".

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