



Title	A REVISION OF THE GENUS TUBERCULATUS MORDWILKO IN JAPAN WITH DESCRIPTION OF A NEW SPECIES (HOMOPTERA : APHIDIDAE)
Author(s)	Higuchi, Hiromichi
Citation	Insecta matsumurana, 32(2), 111-123
Issue Date	1970-01
Doc URL	http://hdl.handle.net/2115/9765
Type	bulletin (article)
File Information	32(2)_p111-123.pdf



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A REVISION OF THE GENUS *TUBERCULATUS* MORDWILKO IN JAPAN WITH DESCRIPTION OF A NEW SPECIES (HOMOPTERA : APHIDIDAE)

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Recently, Richards (1968) has published a revision of the genus *Tuberculatus* Mordwilko. Owing to his excellent publication, one can fully understand this genus. The Japanese species of this genus have been studied by Matsumura (1917, 1919), Essig & Kuwana (1918), Takahashi (1923), Shinji (1941), etc. Insofar as the present investigation goes, nine species have known to occur in Japan, of which one is new to science and another one new to Japan. The types of the new species described in this paper are deposited in the collection of the Entomological Institute, Hokkaido University.

Genus *Tuberculatus* Mordwilko

Tuberculatus Mordwilko, Trav. Lab. Zool. Kab. Univ. Varsov. 1: 136, 1894 [type-species: *Aphis quercea* Kaltenbach, 1843].

Acanthocallis Matsumura, Jour. Coll. Agr., Tohoku Imp. Univ. Sapporo: 7 (6): 367, 1917 [type-species: *Acanthocallis quercicola* Matsumura, 1917].

Arakawana Matsumura, Jour. Coll. Agr., Tohoku Imp. Univ. Sapporo 7 (6): 375, 1917 [type-species: *Arakawana stigmata* Matsumura, 1917].

This genus is widely distributed in the Holarctic region. It is readily distinguished from related genera, namely *Myzocallis* and *Tuberculoides*, by the following features:—Head and thorax with tubercles, which are sometimes obsolete; abdomen always with spinal tubercles, with apical setae on lateral tubercles, and with more than 4 spinal setae (only 2 spinal setae in *kashiwae*).

Insofar as their habits are known the species of this genus appear to attack plants belonging to *Quercus*, rarely to *Lithocarpus*.

The species occurring in Japan may be distinguished by the following key:—

Key to the Japanese species of *Tuberculatus*

1. Pronotum without spinal tubercles. 2
- Pronotum with spinal tubercles. 4
2. Head with frontal and anterior discal setae capitate (Fig. 4); pronotum with 2 posterior spinal setae; 1st-3rd abdominal segments with a pair of spinal tubercles which are not united on basal part, the tubercles on 3rd segment being sometimes much smaller than the rest. *kashiwae* (Matsumura)
- Head with frontal and anterior discal setae pointed (Figs. 5, 8); pronotum with 4-16 posterior

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- spinal setae; 1st-3rd abdominal segments with a pair of spinal tubercles which are united and expanded on basal part, the tubercles on 3rd segment being much larger than the rest. . . . 3
3. Stigma with a conspicuously pigmented crescent patch posteriorly; eyes rather small; frontal tubercles well developed; frontal setae shorter than 1st and 2nd antennal segments taken together; 3rd antennal segment with about 6 secondary sensoria; ventral abdominal setae longer than dorsal ones; cornicles spiculose. *stigmatus* (Matsumura)
- Stigma not marked as above; eyes large; frontal tubercles poorly developed; frontal setae as long as 1st and 2nd antennal segments taken together; 3rd antennal segment with about 15 secondary sensoria; ventral abdominal setae shorter than dorsal ones; cornicles smooth. *pilosus* (Takahashi)
4. Pronotum with a pair of spinal tubercles. 5
- Pronotum with 2 pairs of spinal tubercles. 6
5. Head with middle discal setae subequal to frontal setae in length and shape (Fig. 7); 3rd antennal segment with setae as long as those of the 1st; cornicles smooth. *querciformosanus* (Takahashi)
- Head with middle discal setae shorter than frontal setae (Fig. 9); 3rd antennal segment with setae shorter than those of the 1st; cornicles spiculose on distal half. *yokoyamai* (Takahashi)
6. Mesonotum without spinal tubercles; 6th antennal segment with processus terminalis 1.7-1.9 times as long as base; 1st-3rd abdominal segments with a pair of spinal tubercles. *capitatus* (Essig & Kuwana)
- Mesonotum with spinal tubercles; 6th antennal segment with processus terminalis 0.8-1.6 times as long as base; all abdominal segments with a pair of spinal tubercles, of which those of 1st-3rd segments much larger than the rest. 7
7. Frontal setae conspicuously or slightly capitate, as long as 1st antennal segment, shorter than 2nd segment of hind tarsus; hind femora with capitate setae; cornicles smooth. *japonicus*, sp. nov.
- Frontal setae pointed, longer than 1st antennal segment, as long as 2nd segment of hind tarsus; hind femora with pointed setae; cornicles spiculose. 8
8. Metanotum with spinal tubercles; head with 5 or 6 posterior discal setae on either side (Fig. 6); 3rd antennal segment with 16-20 setae; pronotum with 4-6 anterior pleural setae on either side; cells of fore wings with many pointed setae. *quercicola* (Matsumura)
- Metanotum without spinal tubercles; head with 2 posterior discal setae on either side (Fig. 2); 3rd antennal segment with 7-10 setae; pronotum with 2 anterior pleural setae on either side; cells of fore wings without setae. *fulviabdominalis* (Shinji)

***Tuberculatus capitatus* (Essig & Kuwana)**

Myzocallis capitata Essig & Kuwana, Proc. Calif. Acad. Sci. 8(3): 89, 1918.

Tuberculoides capitata: Shinji, Monog. Japan. Aphid. p. 366, 1941; Tao, Q. Jour. Taiwan Mus. 17: 215, 1964; Paik, Aphid. Korea p. 41, 1965.

Tuberculatus capitatus: Moritsu, Bull. Fac. Agr. Yamaguti Univ. 4: 2, 1953; Richards, Canad. Ent. 100(6): 566, 1968.

On the basis of the specimens examined a redescription will be given below:—

Alate viviparous female: Body greenish yellow or whitish yellow in life (after Moritsu, 1953). Body about 2.6 mm. including cauda, with pointed or blunt setae on dorsum. Frontal tubercles not well developed. Head with setae shown in Fig. 1; frontal setae on either side of frontal ocellus blunt or slightly capitate, longer than 1st antennal segment; anterior setae about equal to frontal setae in length and shape; middle setae about equal to posterior setae in size and shape; posterior setae arranged in a line between eyes, shorter than frontal setae. Antennae about 0.7 times as long

as body including cauda; 1st segment shorter than wide; 3rd segment with 5–8 capitate setae on inner side and 3 or 4 short pointed setae on outer side, with 4 or 5 secondary sensoria in a row on basal two-fifths; relative length of antennal segments as follows: I–5.0; II–4.0; III–34.0; IV–21.5; V–19.0; VI–10.5+18.0. Antennal setae capitate or pointed; setae on 1st and 2nd segments shorter than frontal setae; longest seta on 3rd segment a little shorter than any one on basal 2 segments, 1.5–1.9 times as long as middle breadth of the segment; setae on 4th and 5th segments about 0.5 times as long as middle breadth of 3rd antennal segment. Rostrum not reaching middle coxae; ultimate segment as long as 2nd segment of hind tarsus, with 6–10 secondary setae. Legs: femora with many long, pointed, hair-like setae shorter than middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus shorter than basal part of 6th antennal segment. Pronotum with 1 posterior lateral seta and sometimes 1 or 2 anterior pleural setae on either side, with 2 pairs of spinal tubercles, the hind pair being larger than the frontal one, and each tubercle bearing 2–5 pointed setae. Mesonotum without spinal tubercles, with long, pointed or blunt setae subequal to frontal setae in length and shape. Metanotum without spinal tubercles. Abdomen with 1st–3rd segments bearing a pair of spinal tubercles, which are imbricated, not united on basal part, with 2 pointed setae on distal part. Lateral tubercles conspicuous, smaller than spinal tubercles on pronotum, smaller than cornicles, with about 3 pointed setae. Ventral abdominal setae numerous in number, longer than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 19, the setae being pointed. Cornicles smooth, expanded towards base, longer than wide, shorter than spinal tubercles on 2nd abdominal segment, with flange poorly developed. Cauda knobbed, normal in shape, with many pointed setae about as long as frontal setae. Anal plate bilobed, with many long setae.

Specimens examined: 2 alate viviparous females and alatoid nymphs (syntypes of *Myzocallis capitata* Essig & Kuwana) taken at Tokyo, 26–v–1913, S. I. Kuwana leg.; many alatae taken from the following localities: Honshu—Tokyo, 8–viii–1958, R. Takahashi leg.; Ôsaka, 21–vi–1959, R. Takahashi leg.

Host plants: *Quercus acutissima* Carruthers, *Q. dentata* Thunb., *Q. mongolica* var. *grosseserrata* Blume, *Q. serrata* Thunb., *Q. variabilis* Blume, and *Q. sp.* In Korea *Quercus acutissima* and *Q. aliena* have been recorded as hosts (after Paik, 1965).

Distribution: Japan; Korea; China; Formosa.

Having examined syntypes of *capitatus* Essig & Kuwana and many other specimens, I have found the following characters which are different from the characters mentioned in Richards' redescription (1968) of this species. (1) Meso- and metanotum without spinal tubercles. (2) Antennal setae conspicuously capitate, but sometimes faintly capitate or pointed.

***Tuberculatus fulviabdominalis* (Shinji), comb. nov.**

Tuberculoides fulviabdominalis Shinji, Monog. Japan. Aphid. p. 368, 1941.

Tuberculoides quercicola: Paik, Aphid. Korea p. 42, 1965.

On the basis of the specimens examined a redescription will be given below:—

Alate viviparous female: Reddish yellow in life (after Shinji, 1941). Body about 2.2 mm. including cauda, with pointed, hair-like setae on dorsum. Frontal tubercles not well developed. Head with setae shown in Fig. 2; frontal setae on either side of

frontal ocellus pointed, longer than 1st antennal segment, as long as 2nd segment of hind tarsus; anterior setae about equal to frontal setae in length and shape; middle setae about equal to posterior setae in length and shape; posterior setae arranged in a line between eyes, shorter than frontal setae. Antennae about 0.7 times as long as body including cauda; 1st segment a little shorter than wide; 3rd segment imbricated, with 7-10 setae, with 3-7 (mostly 5) secondary sensoria in a row on basal seven-tenths; relative length of antennal segments as follows: I-4.5; II-4.0; III-29.7; IV-17.7; V-17.2; VI-9.6+12.9. Antennal setae pointed; setae on 1st and 2nd segments shorter than frontal setae; longest seta on 3rd segment as long as any one on basal 2 segments, 1.7-2.8 times as long as middle breadth of the segment; setae on 4th and 5th segments 0.6-0.9 times as long as middle breadth of 3rd antennal segment. Rostrum extending to midway between fore and middle coxae; ultimate segment about 1.1 times as long as 2nd segment of hind tarsus, with 6-8 secondary setae. Legs: femora with pointed setae at most as long as or a little shorter than middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus a little shorter than basal part of 6th antennal segment. Pronotum with 2 anterior pleural setae and 3 posterior lateral setae on either side, with 2 pairs of spinal tubercles, the hind pair being larger than the frontal one, and each tubercle bearing 1-3 setae. Mesonotum with a pair of spinal tubercles bearing 2 or 3 setae. Metanotum without spinal tubercles. Abdomen with each segment bearing a pair of spinal tubercles, the tubercles on 1st-3rd segments imbricated, larger than those on 4th-7th segments, with 2 or 3 setae. Lateral tubercles conspicuous, imbricated, smaller than cornicles, with about 4 setae. Ventral abdominal setae numerous in number, a little longer than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 20, the setae being pointed. Cornicles imbricated, longer than wide, shorter than spinal tubercles on 2nd abdominal segment, with flange poorly developed. Cauda knobbed, normal in shape, with many pointed setae as long as frontal setae. Anal plate bilobed, with many long setae.

Specimens examined: Many alatae taken from the following localities: Honshu—Morioka, Iwate-ken, 4-viii-1960, R. Takahashi leg.; Tsumagoi, Gumma-ken, 11-ix-1959, K. Shibata leg.; Takayama, Gifu-ken, 13-vii-1959, R. Takahashi leg.; Mt. Iwawaki, Ōsaka, 29-v-1960, R. Takahashi leg.

Host plants: *Quercus dentata* Thunb., *Q. mongolica* var. *grosseserrata* Blume, *Q. serrata* Thunb., and *Q. sp.*

Distribution: Japan (Honshu); Korea.

Tuberculoides fulviabdominalis should be transferred to *Tuberculatus*, because 5-8 spinal setae are apparently seen on each abdominal segment in this species. The aphid mentioned under the name of *Tuberculoides quercicola* by Paik (1965) seems to be referred to the present species.

***Tuberculatus japonicus*, sp. nov.**

Alate viviparous female: Yellow in life. Body about 2.9 mm. including cauda, with conspicuously or slightly capitate setae on dorsum. Frontal tubercles not well developed. Head with setae shown in Fig. 3; frontal setae on either side of frontal ocellus capitate, as long as 1st antennal segment, shorter than 2nd segment of hind tarsus; anterior setae about equal to frontal setae in length and shape; middle setae about equal to posterior setae in length and shape; posterior setae arranged in a line

between eyes, shorter than frontal setae. Antennae about 0.7 times as long as body including cauda; 1st segment as long as wide; 3rd segment with 4-7 setae, with 6-8 secondary sensoria in a row on basal four-fifths; relative length of antennal segments as follows: I-5.5; II-4.7; III-43.4; IV-27.5; V-23.0; VI-12.4+12.4. Antennal setae capitate; setae on 1st and 2nd segments shorter than frontal setae; longest seta on 3rd segment a little shorter than any one on basal 2 segments, 0.8-1.5 times as long as middle breadth of the segment; setae on 4th and 5th segments 0.4-0.8 times as long as middle breadth of 3rd antennal segment. Rostrum not reaching middle coxae; ultimate segment about 1.2 times as long as 2nd segment of hind tarsus, with 8-10 secondary setae. Legs: femora with capitate setae shorter than middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus shorter than basal part of 6th antennal segment. Pronotum with 0-2 anterior pleural setae and 3 or 4 posterior lateral setae on either side, with 2 pairs of spinal tubercles, the hind pair being larger than the frontal one, and each tubercle bearing 1-4 setae. Mesonotum with a pair of spinal tubercles, each tubercle bearing about 4 setae. Metanotum with a pair of small spinal tubercles, each tubercle bearing 2 setae. Abdomen with each segment bearing a pair of spinal tubercles, which are imbricated, with 3 or 4 setae, the tubercles on 1st-3rd segments being much larger than the rest. Lateral tubercles conspicuous, smaller than cornicles, with about 4 setae. Ventral abdominal setae numerous in number, pointed, as long as or longer than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 21, the setae being capitate. Cornicles smooth, as long as or longer than wide, shorter than spinal tubercles on 2nd abdominal segment, with flange poorly developed. Cauda knobbed, normal in shape, with many pointed setae as long as or longer than frontal setae. Anal plate bilobed, with many long setae.

Specimens examined (syntypes): Some alate viviparous females, Obihiro, Hokkaido, 17-vi-1965, H. Higuchi leg.

Host plants: *Quercus dentata* Thunb.

Distribution: Japan (Hokkaido).

This species is characterized by the following features:—(1) Frontal setae conspicuously or slightly capitate, as long as 1st antennal segment, shorter than 2nd segment of hind tarsus. (2) Antennal setae capitate. (3) Processus terminalis as long as basal part of 6th antennal segment. (4) Cornicles smooth.

***Tuberculatus kashiwae* (Matsumura), comb. nov.**

Myzocallis kashiwae Matsumura, Jour. Coll. Agr. Tohoku Imp. Univ. Sapporo 7 (6): 371, 1917.

On the basis of the specimens examined a redescription will be given below:—

Alate viviparous female: Yellow in life. Body about 1.8 mm. including cauda, with pointed setae on dorsum. Frontal tubercles fairly well developed. Head with setae shown in Fig. 4; frontal setae on either side of frontal ocellus conspicuously or faintly capitate, as long as 1st antennal segment, shorter than 2nd segment of hind tarsus; anterior setae about equal to frontal setae in length and shape; middle setae about equal to posterior setae in length and shape; posterior setae arranged in a line between eyes, shorter than frontal setae. Antennae about 0.9 times as long as body including cauda; 1st segment longer than wide; 3rd segment imbricated, with 3-6 (mostly 3) secondary sensoria in a row on basal two-fifths; relative length of antennal segments

as follows: I-4.6; II-3.3; III-29.0; IV-18.6; V-17.8; VI-10.8+17.1. Antennal setae short, blunt or slightly capitate; setae on 1st and 2nd segments shorter than frontal setae; setae on 3rd segment very short, 0.4-1.0 times as long as middle breadth of the segment; setae on 4th and 5th segments very few in number, as long as those on 3rd segment. Rostrum extending to midway between fore and middle coxae; ultimate segment about 0.8 times as long as 2nd segment of hind tarsus, with 6-8 secondary setae. Legs: femora spiculose, with pointed setae shorter than middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus shorter than basal part of 6th antennal segment. Pronotum with 1 anterior spinal seta, 1 posterior spinal seta and 2 posterior lateral setae on either side, without spinal tubercles. Meso- and metanotum without spinal tubercles. Abdomen with 1st-3rd segments bearing a pair of spinal tubercles, which are imbricated, not united on basal part, with 1 short blunt seta on distal part, the tubercles on 3rd segment being sometimes much smaller than the rest. Lateral tubercles conspicuous, spiculose, smaller than cornicles, with 2 or 3 setae. Ventral abdominal setae numerous in number, longer than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 22, the setae being blunt. Cornicles spiculose on distal half, longer than wide, longer than spinal tubercles on 2nd abdominal segment. Cauda knobbed, normal in shape, with many pointed setae shorter than frontal setae. Anal plate bilobed, with many long setae.

Specimens examined: 4 alate viviparous females (types of *Myzocallis kashiwae* Matsumura), Sapporo, Hokkaido, 12-ix-1915, S. Matsumura leg.; many alatae taken from the following localities: Hokkaido—Sapporo, 8-vi-1967, H. Higuchi leg. Honshu—Morioka, Iwate-ken, 4-viii-1960; Hirayu, Gifu-ken, 12-viii-1959, R. Takahashi leg.; Oku-kinu, Tochigi-ken, 11-viii-1967; Nikko, Tochigi-ken, 10-viii-1967; Mt. Yatsugatake, Yamanashi-ken, 30-vii-1967, H. Higuchi leg.

Host plants: *Quercus dentata* Thunb., *Q. mongolica* var. *grosseserrata* Blume, *Q. serrata* Thunb., and *Q. sp.*

Distribution: Japan (Hokkaido; Honshu).

This species is closely allied to *yokoyamai* (Takahashi), but is easily differentiated from the latter by the absence of the spinal tubercles on the pronotum. Judging from the literature the aphids stated by Shinji (1941) and Paik (1965) under the name *Tuberculoides kashiwae* seem to be not this species.

Tuberculatus pilosus (Takahashi), comb. nov.

Myzocallis pilosus Takahashi, Trans. Nat. Hist. Soc. Formosa 19(102): 256, 1929.

Tuberculoides pilosus: Tao, Q. Jour. Taiwan Mus. 17: 216, 1964.

This species is new to Japan. On the basis of the specimens examined a redescription will be given below:—

Alate viviparous female: Yellowish brown in life (after Takahashi, 1929). Body about 1.9 mm. including cauda, with long pointed, hair-like setae on dorsum. Frontal tubercles poorly developed. Head with setae shown in Fig. 5; frontal setae on either side of frontal ocellus pointed, as long as length of 1st and 2nd antennal segments taken together; anterior and middle setae about equal to frontal setae in length and shape; posterior setae 4 in number, of which inner 2 are much longer than the rest. Antennae about 1.1 times as long as body including cauda; 1st segment shorter than wide, almost smooth; 3rd segment not imbricated, with 11-20 pointed setae, with 12-

16 secondary sensoria in a row on basal four-fifths; relative length of antennal segments as follows: I-5.0; II-4.0; III-54.6; IV-28.0; V-23.3; VI-10.5+12.5. Antennal setae pointed; setae on 1st and 2nd segments shorter than frontal setae; longest seta on 3rd segment a little shorter than any one on basal 2 segments, 2.3-2.9 times as long as middle breadth of the segment; setae on 4th and 5th segments 0.3-0.4 times as long as middle breadth of 3rd antennal segment. Rostrum not reaching middle coxae; ultimate segment about 1.3 times as long as 2nd segment of hind tarsus, with 4-6 secondary setae. Legs: femora with many long pointed, hair-like setae as long as middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus a little longer than basal part of 6th antennal segment. Pronotum with 1 anterior spinal seta, 2 or 3 posterior spinal setae, and 1 posterior lateral seta on either side, without spinal tubercles. Meso- and metanotum without spinal tubercles. Abdomen with blunt tubercles on 1st-4th segments bearing 3 or 4 long setae on distal part, the tubercles on the 3rd segment being especially large, united and expanded on basal part. Three lateral tubercles in front of cornicles expanded and bearing many long setae on basal part, with 3 or 4 similar setae at apex. Ventral abdominal setae numerous in number, shorter than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 23, the setae being pointed, hair-like. Cornicles rather large, longer than wide, expanded towards base, constricted near apex, not reticulated, longer than lateral tubercles. Cauda knobbed, normal in shape, with many pointed setae shorter than frontal setae. Anal plate not deeply bilobed, much wider than long, with many long pointed setae.

Specimens examined: Many alatae taken from the following localities: Honshu—Ōsaka, 10-, 14-vi-1959, R. Takahashi leg.; Kyoto, 17-v-1966, H. Takada leg.

Host plants: *Quercus phillyraeoides* A. Gray and *Q.* sp.

Distribution: Japan (Honshu); Formosa.

This species is readily distinguished from any other related ones by the following characters: (1) Frontal tubercles poorly developed. (2) Third antennal segment with about 15 secondary sensoria. (3) Dorsal abdominal setae about 2.3-3.4 times as long as the middle breadth of 3rd antennal segment. (4) Spinal tubercles on 4th abdominal segment as large as or larger than those on 1st segment.

***Tuberculatus quercicola* (Matsumura)**

Acanthocallis quercicola Matsumura, Jour. Coll. Agr., Tohoku Imp. Univ. Sapporo 7 (6): 368, 1917.

Myzocallis macrotuberculata Essig & Kuwana, Proc. Calif. Acad. Sci. 8 (3): 90, 1918.

Tuberculoides macrotuberculata: Shinji, Monog. Japan. Aphid. p. 378, 1941; Paik, Aphid. Korea p. 41, 1965.

Tuberculatus quercicolus: Richards, Canad. Ent. 100 (6): 584, 1968.

On the basis of the specimens examined a redescription will be given below:—

Alate viviparous female: Green in life. Body about 2.9 mm. including cauda, with pointed, hair-like setae on dorsum. Eyes rather large. Frontal tubercles not well developed. Head with setae shown in Fig. 6; frontal setae on either side of frontal ocellus pointed, longer than 1st antennal segment, as long as 2nd segment of hind tarsus; anterior and middle setae about equal to frontal setae in length and shape; posterior setae 10-14 in number, arranged in a transverse row between eyes, a little shorter than frontal setae. Antennae about 0.6 times as long as body including cauda;

1st segment as long as wide; 3rd segment with 16-20 pointed setae, with 6-9 secondary sensoria in a row along whole length; relative length of antennal segments as follows: I-5.2; II-4.5; III-35.4; IV-23.7; V-20.0; VI-8.8+8.6. Antennal setae very long, pointed, hair-like, numerous in number; setae on 1st and 2nd segments shorter than frontal setae; longest seta on 3rd segment as long as any one on basal 2 segments, 1.3-2.5 times as long as middle breadth of the segment; setae on 4th and 5th segments 0.8-2.0 times as long as middle breadth of 3rd antennal segment. Rostrum reaching or surpassing middle coxae; ultimate segment about 1.4 times as long as 2nd segment of hind tarsus, with 10-16 secondary setae. Legs: femora spiculose, with pointed setae a little shorter than middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus a little longer than basal part of 6th antennal segment. Pronotum with 2-5 (mostly 4) posterior lateral setae and 4-6 (mostly 6) anterior pleural setae on either side, with 2 pairs of spinal tubercles, which bear 3-10 pointed setae, the tubercles of hind pair being larger than frontal ones. Mesonotum with a pair of spinal tubercles bearing 4-6 setae. Metanotum without spinal tubercles. Abdomen with each segment bearing a pair of spinal tubercles, which are imbricated, with 4-6 pointed setae, the tubercles on 1st-3rd segments being much larger than the rest. Lateral tubercles conspicuous, imbricated, smaller than cornicles, with about 4 setae at apex. Ventral abdominal setae numerous in number, shorter than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 24, the setae being pointed, hair-like. Cornicles spiculose, constricted at middle, longer than wide, shorter than spinal tubercles on 2nd abdominal segment, with flange at apex. Cauda knobbed, normal in shape, with many pointed setae as long as frontal setae. Anal plate bilobed, with many long setae.

Specimens examined: An alate viviparous female with some alatoid nymphs (type of *Myzocallis macrotuberculata* Essig & Kuwana), Tokyo, 19-v-1913, S. I. Kuwana leg.; many alatae taken from the following localities: Hokkaido—Sapporo, 2-viii-1960, R. Takahashi leg.; Shimamatsu, 12-vi-1967, K. Kusigemati leg.; Saroma, 22-vi-1965, H. Higuchi leg. Honshu—Sugadaira, Nagano-ken, 29-vii-1961, R. Takahashi leg.

Host plants: *Quercus acutissima* Carruthers, *Q. dentata* Thunb., and *Q. sp.* In Korea *Quercus acutissima* and *Q. variabilis* have been recorded as hosts (after Paik, 1965).

Distribution: Japan (Hokkaido; Honshu); Korea.

This species is characterized in having many pointed setae on the cells of fore wings. Having examined the type of *Myzocallis macrotuberculata* Essig & Kuwana, I have come to the conclusion that *macrotuberculata* should be suppressed as a synonym of *quercicola* as Matsumura (1919) already pointed out.

***Tuberculatus querciformosanus* (Takahashi)**

Myzocallis querciformosanus Takahashi, Agr. Exp. Sta. Govt. Formosa, Extra Rept. 20: 72, 1921; Takahashi, Phil. Jour. Sci. 24: 713, 1924; Takahashi, Dept. Agr. Govt. Res. Inst. Formosa, Rept. 22: 19, 1927.

Tuberculoides querciformosanus: Takahashi, Dept. Agr. Govt. Res. Inst. Formosa, Rept. 53: 82, 1931.

Tuberculatus querciformosanus: Moritsu, Bull. Fac. Agr. Yamaguti Univ. 4: 8, 1953; Richards, Canad. Ent. 100(6): 586, 1968.

On the basis of the specimens examined a redescription will be given below:—

Alate viviparous female: Yellow in life. Body about 2.4 mm. including cauda, with capitate setae on dorsum. Eyes rather large. Frontal tubercles not well developed. Head with setae shown in Fig. 7; frontal setae on either side of frontal ocellus capitate, longer than 1st antennal segment, a little shorter than 2nd segment of hind tarsus; anterior and middle setae about equal to frontal setae in length and shape; posterior setae arranged in a line between eyes, shorter than frontal setae. Antennae about 0.8 times as long as body including cauda; 1st segment as long as wide; 3rd segment with 3-6 capitate setae, with 5 or 6 secondary sensoria in a row on basal half; relative length of antennal segments as follows: I-5.5; II-4.0; III-37.0; IV-25.0; V-24.2; VI-11.3+22.0. Antennal setae capitate; setae on 1st and 2nd segments shorter than frontal setae; longest seta on 3rd segment as long as any one on basal 2 segments, 1.2-1.6 times as long as middle breadth of the segment; setae on 4th and 5th segments 0.5-0.7 times as long as middle breadth of 3rd antennal segment. Rostrum extending to midway between fore and middle coxae; ultimate segment about 1.4 times as long as 2nd segment of hind tarsus, with 4-6 secondary setae. Legs: femora with capitate setae shorter than middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus a little shorter than basal part of 6th antennal segment. Pronotum with 1 or 2 capitate anterior spinal setae and 1 or 2 short capitate posterior lateral setae on either side, with a pair of elongate posterior spinal tubercles, each tubercle bearing 2 short capitate setae at apex; Meso- and metanotum without spinal tubercles. Abdomen with 1st-3rd segments bearing a pair of spinal tubercles, which are imbricated, not united on basal part, with 2 short capitate setae on distal part; each segment with a pair of lateral tubercles, the tubercles on 3rd and 4th segments being much larger than the rest, but much smaller than cornicles. Ventral abdominal setae pointed, numerous in number, longer than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 25, the setae being capitate. Cornicles smooth, slightly constricted at middle, longer than wide, shorter than spinal tubercles on 2nd abdominal segment, with flange poorly developed. Cauda knobbed, normal in shape, with many pointed setae shorter than frontal setae. Anal plate bilobed, with many long setae.

Specimens examined: Some alatae taken from the following localities: Hokkaido—Obihiro, 17-vi-1965, H. Higuchi leg. Honshu—Totsuka, Kanagawa-ken, 10-v-1938, M. Moritsu leg.

Host plants: *Quercus dentata* Thunb. and *Q.* sp.

Distribution: Japan (Hokkaido; Honshu); Formosa.

This species is characterized in having three pairs of long capitate setae on the head.

***Tuberculatus stigmatus* (Matsumura)**

Arakawana stigmata Matsumura, Jour. Coll. Agr. Tohoku Imp. Univ. Sapporo 7 (6): 375, 1917.

Myzocallis quercicola: Takahashi, Dept. Agr. Govt. Res. Inst. Formosa, Rept. 4: 64, 1923.

Myzocallis nigra Okamoto & Takahashi, Ins. Mats. 1 (3): 143, 1926.

Tuberculoidea stigmata: Shinji, Monog. Japan. Aphid. p. 386, 1941; Tao, Q. Jour. Taiwan Mus. 17: 216, 1964; Paik, Aphid. Korea p. 39, 1965.

Tuberculatus stigmatus: Moritsu, Bull. Fac. Agr. Yamaguti Univ. 4: 4, 1953; Richards, Canad. Ent. 100 (6): 589, 1968.

On the basis of the specimens examined a redescription will be given below:—

Alate viviparous female: Black in life. Body about 2.6 mm. including cauda,

with pointed, hair-like setae on dorsum. Eyes rather small. Frontal tubercles well developed. Head with setae shown in Fig. 8; frontal setae on either side of frontal ocellus pointed, a little longer than 1st antennal segment, as long as 2nd segment of hind tarsus; anterior setae about equal to frontal setae in length and shape; middle setae about equal to posterior setae in length and shape; posterior setae arranged in a line between eyes, shorter than frontal setae. Antennae about 0.7 times as long as body including cauda; 1st segment longer than wide; 3rd segment with 7-10 pointed setae; with 5-8 secondary sensoria in a row on basal four-fifths; relative length of antennal segments as follows; I-7.5; II-4.7; III-37.8; IV-22.4; V-20.1; VI-10.0+19.1. Antennal setae pointed; setae on 1st and 2nd segments shorter than frontal setae; longest seta on 3rd segment a little shorter than any one on basal 2 segments, 1.8-3.0 times as long as middle breadth of the segment; setae on 4th and 5th segments 0.5-0.8 times as long as middle breadth of 3rd antennal segment. Rostrum extending to midway between fore and middle coxae; ultimate segment as long as 2nd segment of hind tarsus, with 6-10 secondary setae. Legs: femora with many long pointed, hair-like setae a little longer than middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus a little longer than basal part of 6th antennal segment. Pronotum with 1 or 2 anterior spinal setae, 2-8 (mostly 2 or 3) posterior spinal setae, 0-3 anterior pleural setae, 0 or 1 anterior lateral seta, and 1-5 posterior lateral setae on either side, without spinal tubercles. Meso- and metanotum without spinal tubercles. Abdomen with 1st-3rd segments bearing large spinal tubercles, which are imbricated, united and expanded on basal part, with 3 or 4 setae on distal part, the tubercles on 3rd segment being much larger than the rest. Lateral tubercles conspicuous, imbricated, smaller than cornicles, with 3 or 4 setae at apex. Ventral abdominal setae numerous in number, longer than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 26, the setae being pointed, hair-like. Cornicles spiculose, constricted near apex, longer than wide, shorter than spinal tubercles on 2nd abdominal segment. Cauda knobbed, of normal shape, with many pointed setae as long as frontal setae. Anal plate bilobed, with many long setae.

Specimens examined: Many alatae taken from the following localities: Hokkaido—Sapporo, 2-viii-1960, R. Takahashi leg.; Jōzankei, 4-ix-1969, H. Higuchi leg. Honshu—Tokyo, 2-v-1969, H. Takizawa leg.; Ōsaka, 2-v-1954; Mt. Iwawaki, Ōsaka, 28-vi-1959, R. Takahashi leg.; Sōja, Okayama-ken, 18-viii-1967, H. Higuchi leg.

Host plants: *Quercus dentata* Thunb., *Q. mongolica* var. *grosseserrata* Blume, *Q. serrata* Thunb., and *Q. sp.* In Korea *Quercus acutissima*, *Q. aliena*, *Q. dentata*, *Q. mongolica*, *Q. serrata* var. *donarium* and *Q. variabilis* have been recorded as hosts (after Paik, 1965).

Distribution: Japan; Korea; China; Formosa.

This species is characterized in having the stigma with a conspicuously pigmented crescent patch posteriorly.

***Tuberculatus yokoyamai* (Takahashi)**

Myzocallis yokoyamai Takahashi, Dept. Agr. Govt. Res. Inst. Formosa, Rept. 4: 63, 1923.

Tuberculatus kashiwae: Moritsu, Bull. Fac. Agr. Yamaguti Univ. 4: 6, 1953.

Tuberculatus yokoyamai: Richards, Canad. Ent. 100 (6): 593, 1968.

On the basis of the specimens examined a redescription will be given below:—

Alate viviparous female: Yellowish green in life (after Takahashi, 1923). Body about 1.6 mm. including cauda. Frontal tubercles not well developed. Head with setae shown in Fig. 9; frontal setae on either side of frontal ocellus capitate, longer than 1st antennal segment, as long as or a little shorter than 2nd segment of hind tarsus; anterior setae about equal to frontal setae in length and shape; middle setae about equal to posterior setae in length and shape; posterior setae arranged in a line between eyes, shorter than frontal setae. Antennae about 0.9 times as long as body including cauda; 1st segment shorter than wide; 3rd segment with 3-5 setae, with 2-4 secondary sensoria in a row on basal two-fifths; relative length of antennal segments as follows: I-4.5; II-3.2; III-29.8; IV-16.8; V-15.0; VI-9.5+17.5. Antennal setae capitate; setae on 1st and 2nd segments shorter than frontal setae; longest seta on 3rd segment shorter than any one on basal 2 segments, 0.8-1.2 times as long as middle breadth of the segment; setae on 4th and 5th segments about 0.4 times as long as middle breadth of 3rd antennal segment. Rostrum extending to midway between fore and middle coxae; ultimate segment as long as 2nd segment of hind tarsus, with 4-8 secondary setae. Legs: femora with capitate or blunt setae shorter than middle breadth of hind femur; 1st segment of all tarsi with 6 setae ventrally and 2 dorsally; 2nd segment of hind tarsus shorter than basal part of 6th antennal segment. Pronotum with 1 anterior spinal seta, 1 anterior pleural seta, and 1 or 2 posterior lateral setae on either side, with a pair of posterior spinal tubercles, each tubercle bearing a seta at apex. Meso- and metanotum without spinal tubercles. Abdomen with 1st-3rd segments bearing a pair of spinal tubercles, which are imbricated, not united on basal part, with 1 or 2 short blunt setae. Lateral tubercles conspicuous, smaller than cornicles, with 2 or 3 blunt setae. Ventral abdominal setae pointed, hair-like, numerous in number, longer than dorsal ones. Dorsal abdominal chaetotaxy shown in Fig. 27, the setae being blunt. Cornicles spiculose on distal half, longer than wide, shorter than spinal tubercles on 2nd abdominal segment, expanded toward base. Cauda knobbed, of normal shape, with many pointed setae shorter than frontal setae. Anal plate bilobed, with many long pointed setae.

Specimens examined: Many alatae taken from the following localities: Hokkaido—Sapporo, 2-viii-1960, R. Takahashi leg.; Ōnuma, 16-vi-1967, H. Higuchi leg. Honshu—Tokyo, 28-vii-1958, R. Takahashi leg.; Mt. Yatsugatake, Yamanashi-ken, 29-vii-1967, H. Higuchi leg.

Host plants: *Quercus mongolica* var. *grosseserrata* Blume, *Q. serrata* Thunb., and *Q. sp.*

Distribution: Japan.

According to the literature the aphid stated by Moritsu (1953) under the name of *Tuberculatus kashiwae* is, in reality, to be referred to this species.

Host list

Host plant	Aphid (<i>Tuberculatus</i>)
<i>Quercus acutissima</i> Carruthers	<i>T. capitatus</i> (Essig & Kuwana)
”	<i>T. quercicola</i> (Matsumura)
** ”	<i>T. stigmatus</i> (Matsumura)

* This host-relationship is new to science.
 ** This host-relationship has not yet been known to occur in Japan.

** <i>Quercus aliena</i> Blume	<i>T. capitatus</i> (Essig & Kuwana)
** "	<i>T. stigmatus</i> (Matsumura)
<i>Quercus dentata</i> Thunberg	<i>T. capitatus</i> (Essig & Kuwana)
"	<i>T. fulviabdominalis</i> (Shinji)
* "	<i>T. japonicus</i> , sp. nov.
"	<i>T. kashiwae</i> (Matsumura)
"	<i>T. quercicola</i> (Matsumura)
"	<i>T. querciformosanus</i> (Takahashi)
"	<i>T. stigmatus</i> (Matsumura)
* "	<i>T. yokoyamai</i> (Takahashi)
** <i>Quercus mongolica</i> Fischer	<i>T. stigmatus</i> (Matsumura)
* <i>Quercus mongolica</i> var. <i>grosseserrata</i> Blume	<i>T. fulviabdominalis</i> (Shinji)
* "	<i>T. kashiwae</i> (Matsumura)
"	<i>T. quercicola</i> (Matsumura)
"	<i>T. stigmatus</i> (Matsumura)
* "	<i>T. yokoyamai</i> (Takahashi)
* <i>Quercus phillyraeoides</i> A. Gray	<i>T. pilosus</i> (Takahashi)
<i>Quercus serrata</i> Thunberg	<i>T. capitatus</i> (Essig & Kuwana)
"	<i>T. fulviabdominalis</i> (Shinji)
* "	<i>T. kashiwae</i> (Matsumura)
"	<i>T. stigmatus</i> (Matsumura)
* "	<i>T. yokoyamai</i> (Takahashi)
** <i>Quercus serrata</i> var. <i>donarium</i> Nakai	<i>T. stigmatus</i> (Matsumura)
<i>Quercus variabilis</i> Blume	<i>T. capitatus</i> (Essig & Kuwana)
** "	<i>T. quercicola</i> (Matsumura)
** "	<i>T. stigmatus</i> (Matsumura)
<i>Quercus</i> spp.	<i>T. capitatus</i> (Essig & Kuwana)
"	<i>T. fulviabdominalis</i> (Shinji)
"	<i>T. kashiwae</i> (Matsumura)
"	<i>T. pilosus</i> (Takahashi)
"	<i>T. quercicola</i> (Matsumura)
"	<i>T. querciformosanus</i> (Takahashi)
"	<i>T. stigmatus</i> (Matsumura)
"	<i>T. yokoyamai</i> (Takahashi)

Acknowledgements

I wish to express my sincere thanks to Prof. C. Watanabe of the Entomological Institute, Hokkaido University, for his continuous kind guidance. I am much indebted to Dr. F. W. Quednau of Forest Research Laboratory, Canada, for his helpful information in this study. Thanks are also due to Dr. Paul H. Arnaud of the Department of Entomology, California Academy of Sciences, U.S.A., for his kindness in giving me the opportunity to examine Essig & Kuwana's holotypes, and to Prof. M. Moritsu of Yamaguchi University, for the loan of specimens for comparison, and to Mr. M. Miyazaki, and Mr. H. Takizawa of Hokkaido University, for their kindness in offering valuable specimens.

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Explanation of plates

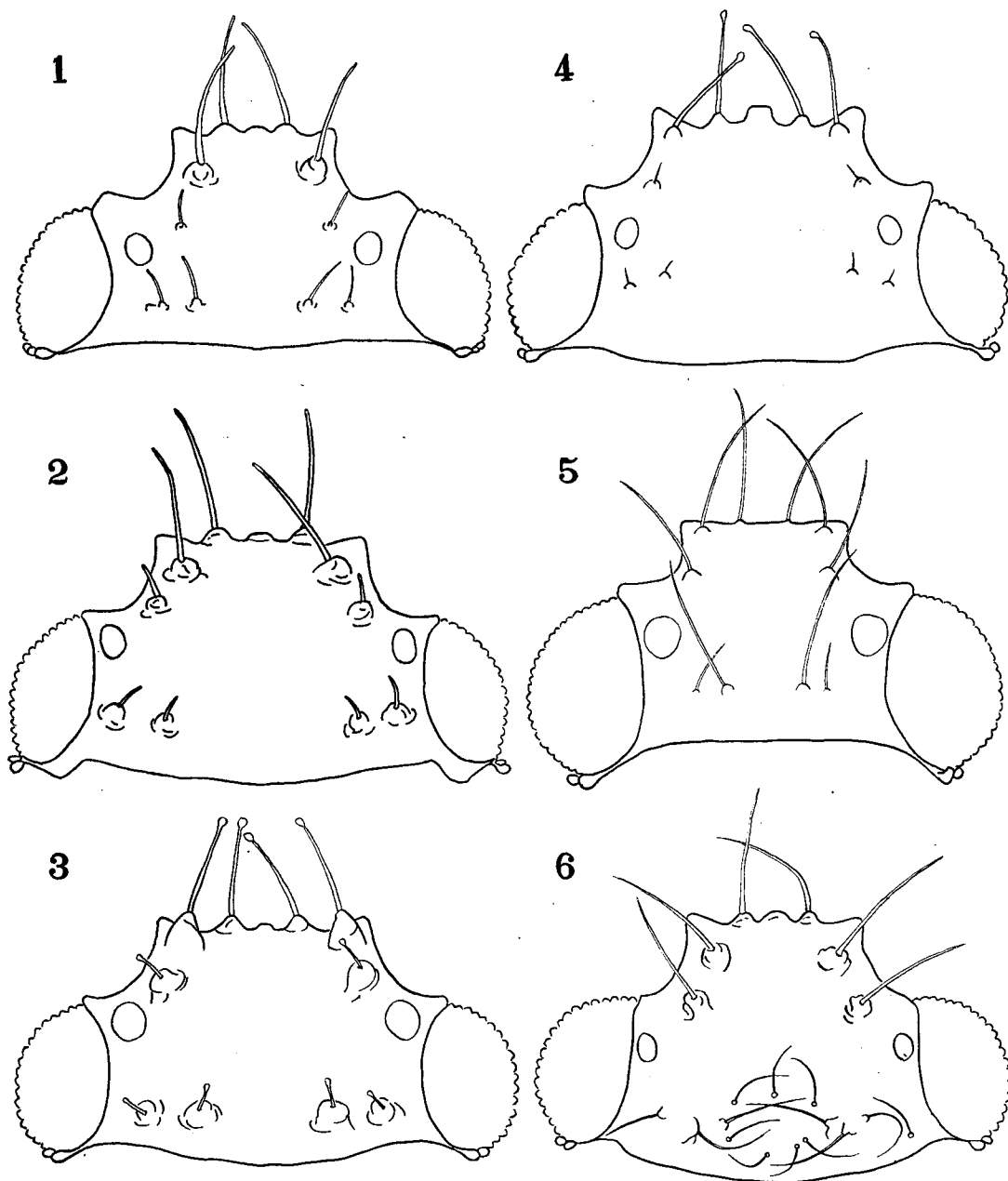
Plate I. Head. Fig. 1, *Tuberculatus capitatus*; 2, *T. fulviabdominalis*; 3, *T. japonicus*; 4, *T. kashiwae*; 5, *T. pilosus*; 6, *T. quercicola*.

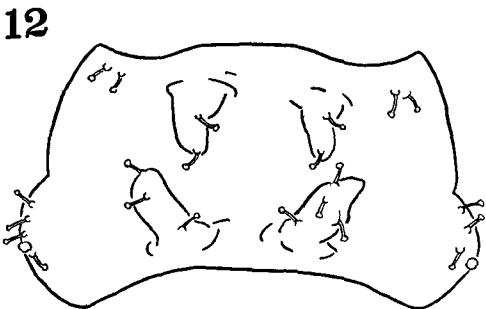
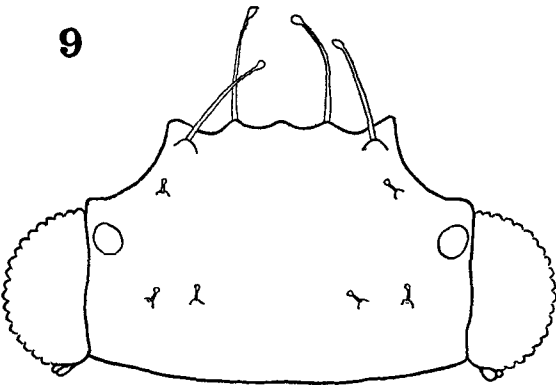
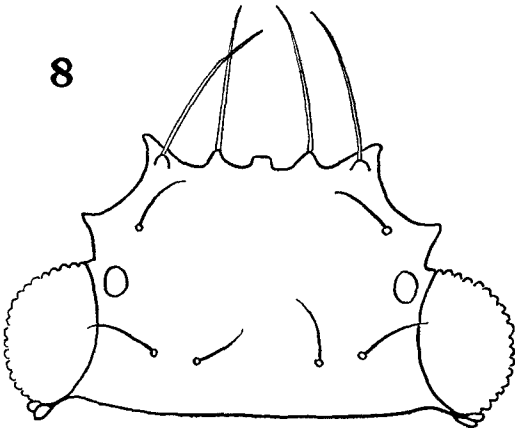
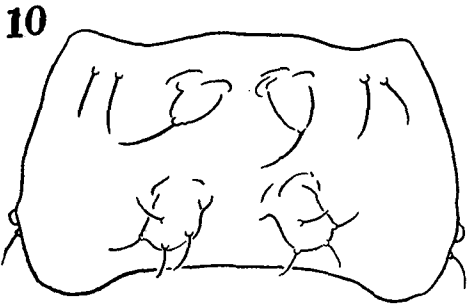
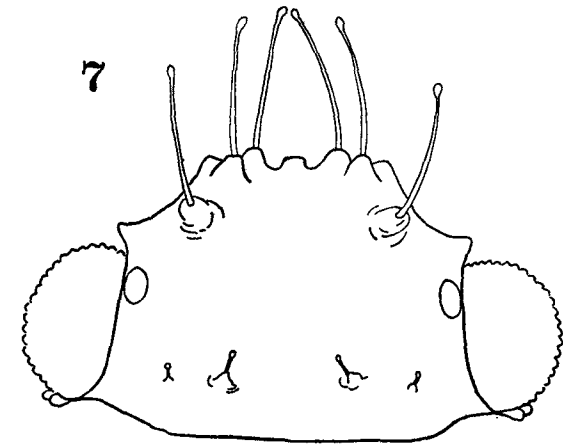
Plate II. Head (figs. 7-9) and pronotum (figs. 10-12). Fig. 7, *Tuberculatus querciformosanus*; 8, *T. stigmatus*; 9, *T. yokoyamai*; 10, *T. capitatus*; 11, *T. fulviabdominalis*; 12, *T. japonicus*.

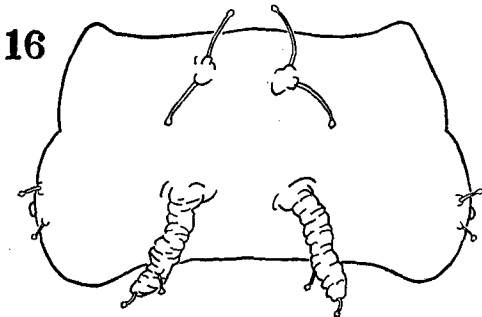
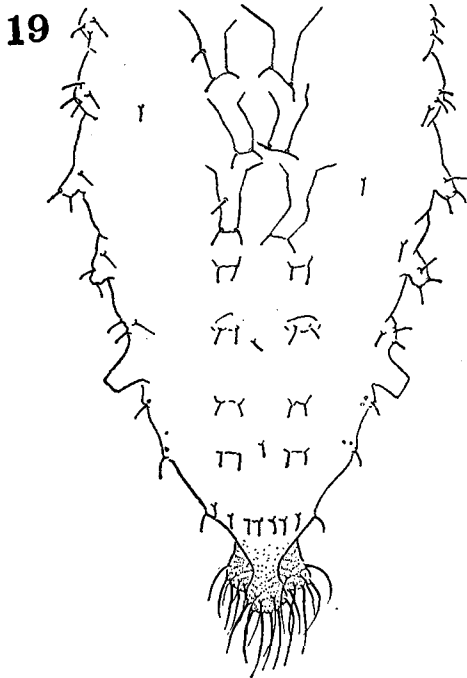
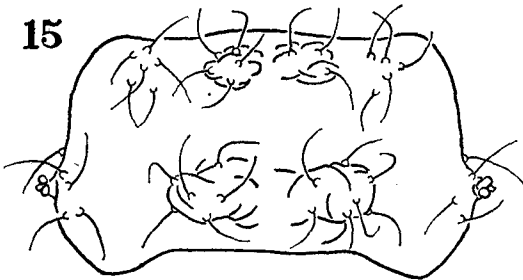
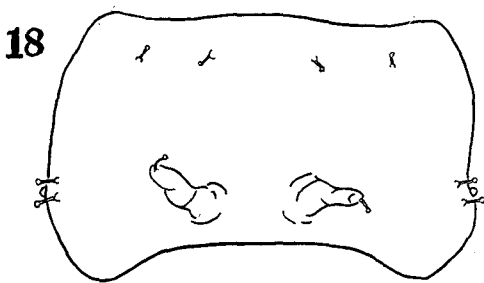
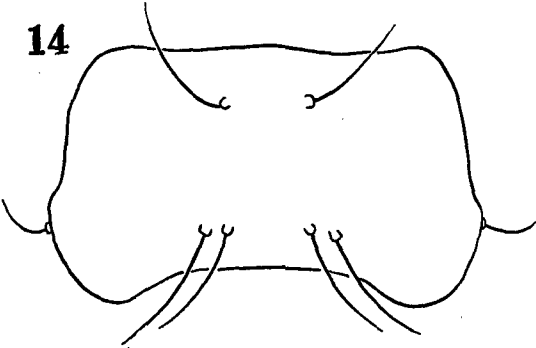
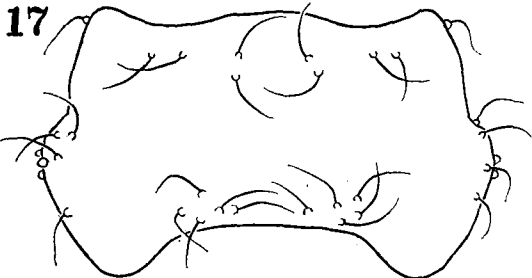
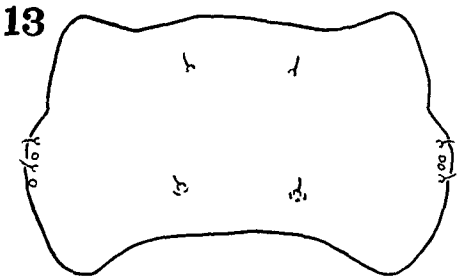
Plate III. Pronotum (figs. 13-18) and abdomen (fig. 19). 13, *Tuberculatus kashiwae*; 14, *T. pilosus*; 15, *T. quercicola*; 16, *T. querciformosanus*; 17, *T. stigmatus*; 18, *T. yokoyamai*; 19, *T. capitatus*.

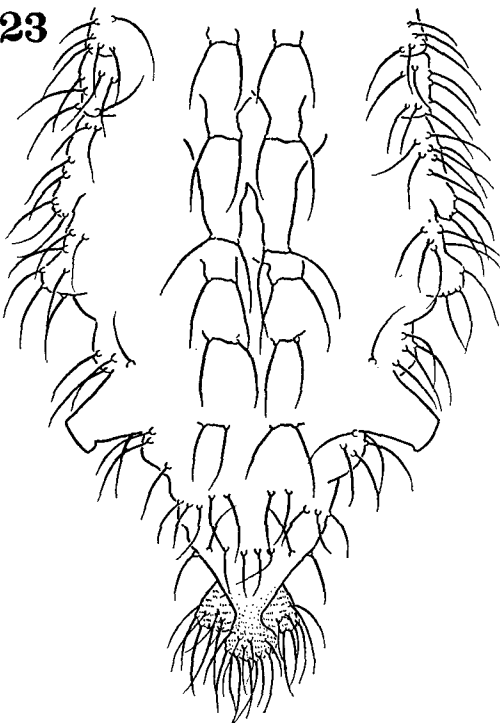
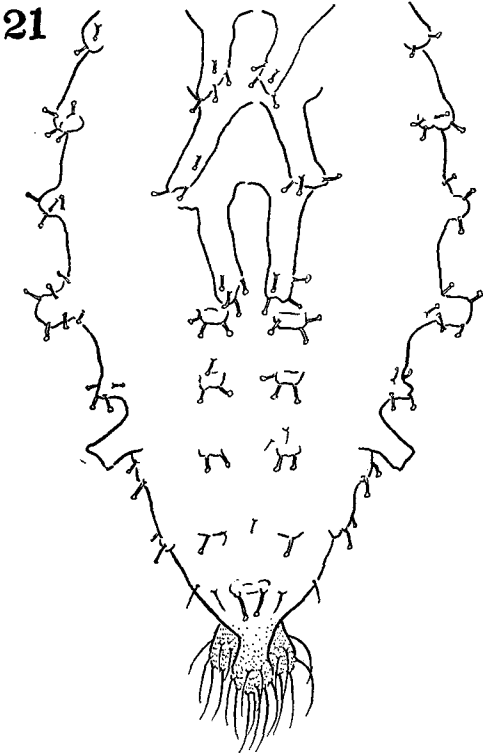
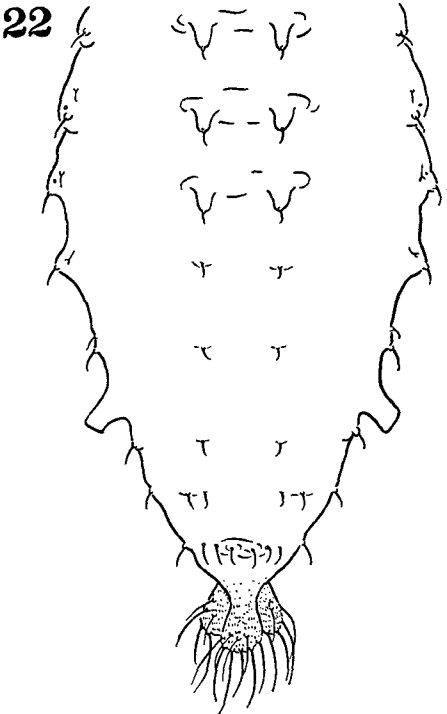
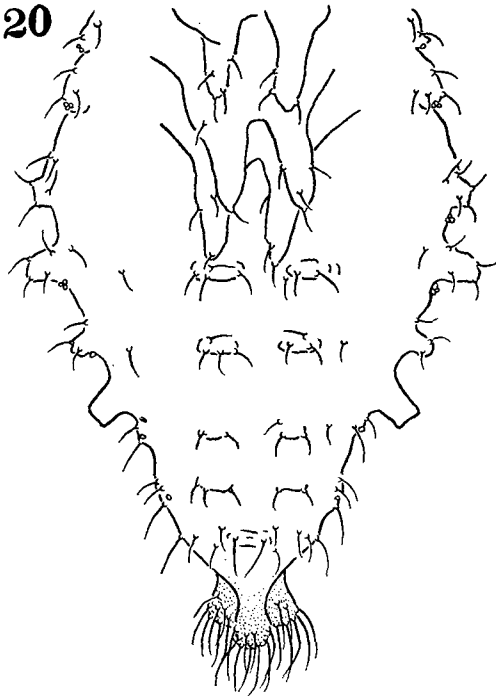
Plate IV. Abdomen. Fig. 20, *Tuberculatus fulviabdominalis*; 21, *T. japonicus*; 22, *T. kashiwae*; 23, *T. pilosus*.

Plate V. Abdomen. Fig. 24, *Tuberculatus quercicola*; 25, *T. querciformosanus*; 26, *T. stigmatus*; 27, *T. yokoyamai*.

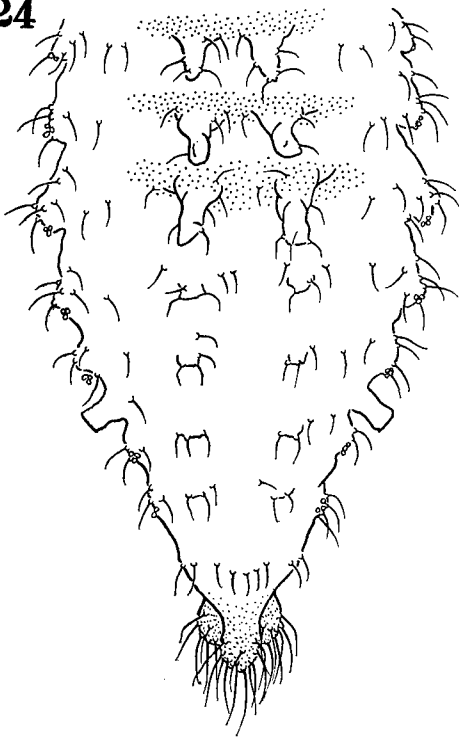




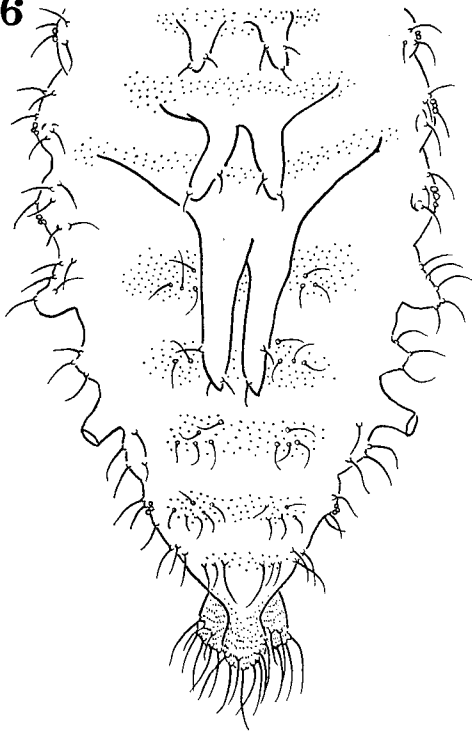




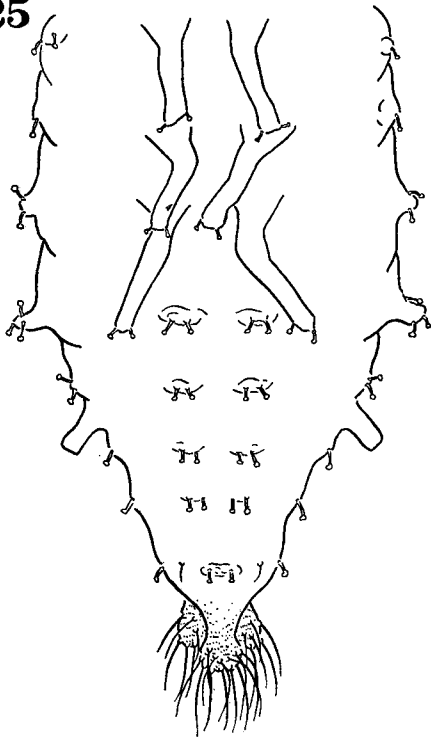
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