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## *Tischeria* Leafminers (Lepidoptera, Tischeriidae) on Deciduous Oaks from Japan

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**Abstract** Three Japanese species of *Tischeria* (Lepidoptera, Tischeriidae) on deciduous oaks are described. Of these, *T. naraensis* SATO is new to science and *T. decidua* WOCKE is newly recorded from Japan. The female of *T. quercifolia* KUROKO, hitherto unknown, is also described.

**Key words:** Japan; Lepidoptera; new species; *Tischeria*; *Quercus*.

The genus *Tischeria* ZELLER is the only component of the family Tischeriidae (Lepidoptera), and about 80 species have been described almost over the world. Taxonomic studies of this group, however, have not much progressed in Japan; only four species have been recorded (KUROKO, 1982). In Japan, *T. quercifolia* KUROKO alone is known to be associated with deciduous oaks (Fagaceae, *Quercus*), which are major host plants of *Tischeria* leafminers in Euro-Russia and North America (BRAUN, 1972; HERING, 1926; KOZLOV, 1986; TOLL, 1959). In the present paper, I add two *Quercus*-mining species to the Japanese fauna of the genus. One of them is new to science. The female of *T. quercifolia*, hitherto unknown, is also described.

The specimens used in this paper were collected by me unless otherwise mentioned. The type specimens of the new species described here are deposited in the Entomological Institute, Faculty of Agriculture, Hokkaido University, Japan.

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### Key to the Japanese Species of *Tischeria* Associated with *Quercus* on the Basis of Male Genitalia

1. Tegumen rather long, narrowed on basal 1/3, then nearly parallel-sided on apical 2/3; socii cylindrical; forks of biforked aedeagus set with a sclerotized flap on apical half. .... *T. quercifolia* KUROKO

- Tegumen trapeziform; socii tapering; forks of biforked aedeagus without flap on apical half. .... 2
- 2. Valva gradually narrowed to apex; forks of aedeagus twisted; cephalic side of tegumen 1.6 times as wide as the caudal side; socii triangular with acute angles. .... *T. naraensis* SATO, sp. nov.
- Valva parallel-sided on basal half, then strongly narrowed to apex; forks of aedeagus not twisted; cephalic side of tegumen about 2.7 times as wide as the caudal side; socii suddenly narrowed at basal 1/5, then elongated to acute apices. .... *T. decidua* WOCKE

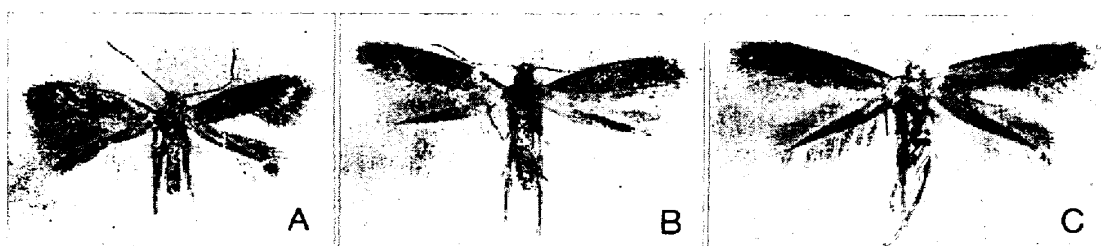


Fig. 1. *Tischeria* spp. — A, *T. naraensis* SATO, sp. nov. [♂ paratype, 92.41–42]; B, *T. decidua* WOCKE (♂) [89.36–16–1]; C, *T. quercifolia* KUROKO (♀) [89.48–6].

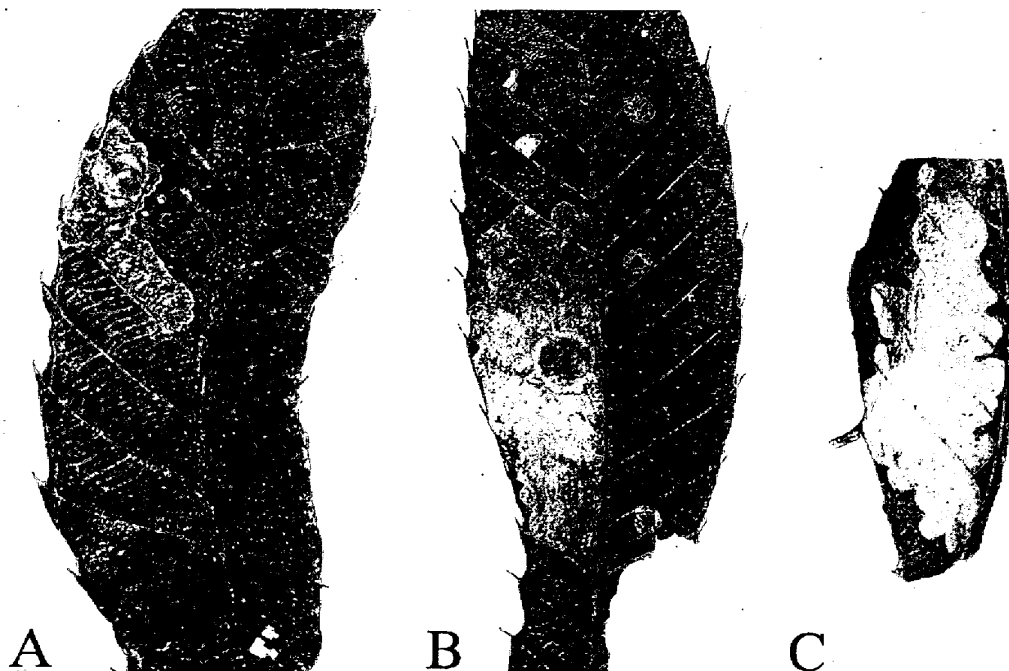


Fig. 2. Leafmines of *Tischeria* on *Quercus* leaves. — A, *T. naraensis* SATO, sp. nov., leafmine on *Q. acutissima*; B, *T. decidua* WOCKE, leafmine on *Q. acutissima*; C, *T. quercifolia* KUROKO, leafmine with an exuviae protruding from the circular cocoon nidus on *Q. acutissima*.

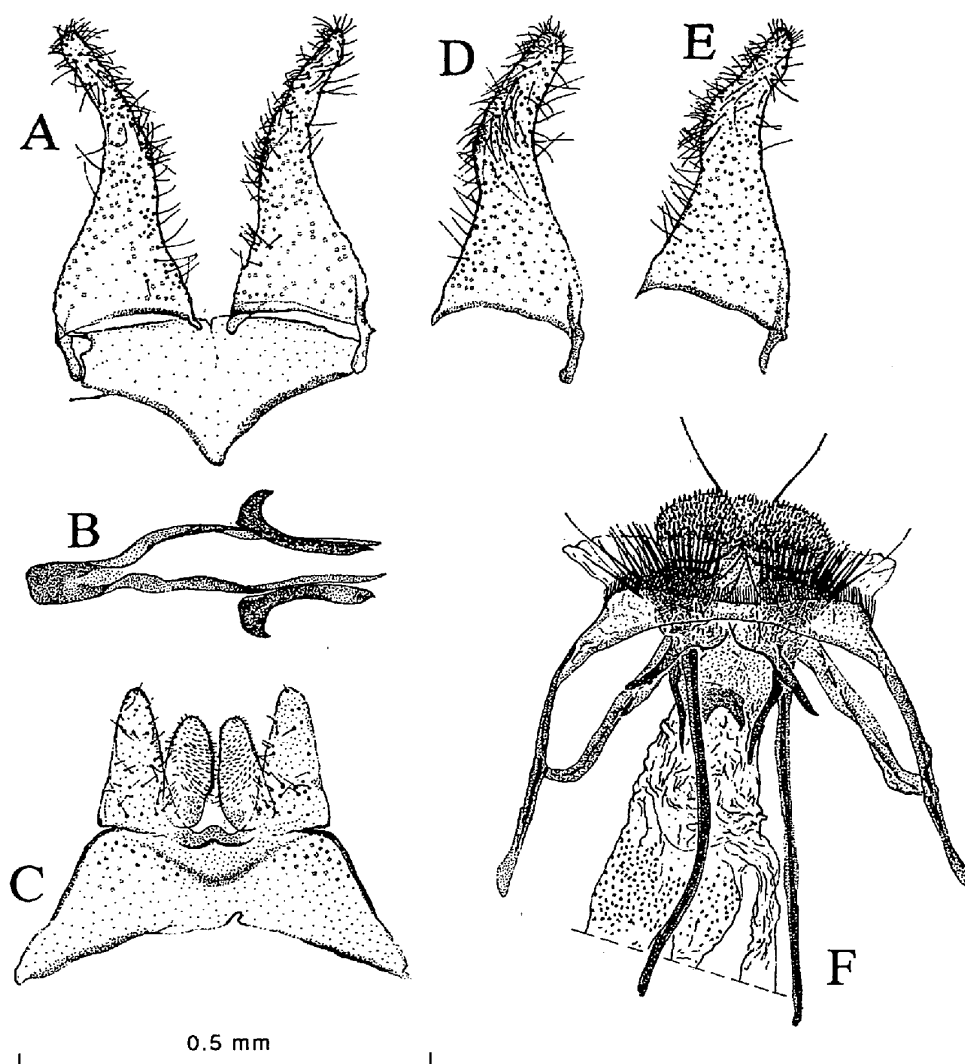


Fig. 3. *Tischeria naraensis* SATO, sp. nov. — A–C, Parts of male genitalia (A, valva and vinculum in dorsal view; B, anellus and aedeagus in dorsal view; C, tegumen with socii in ventral view) [holotype, 89.27–14]; D–E, left valva [paratypes, 89.34–20 and 89.27–19, respectively]; F, female genitalia in ventral view [89.33–21–1].

*Tischeria naraensis* SATO, sp. nov.

(Figs. 1 A, 2 A, 3)

♂, ♀. Expanse of wings: 5.4–8.1 mm.

Face pale ochereous; tuft of head pale ochereous, dusted with dark fuscous scales outwardly. Antennae pale ochereous, becoming darker toward apex; underside blackish fuscous in male; antennal shaft in male with long cilia, in female with short cilia in apical half. Thorax ochereous. Fore wings and cilia ochereous; dark fuscous scales densely speckled on costal area and apical 1/4. Hind wings and cilia dark

grey. Fore and middle legs pale ochereous, shaded with blackish fuscous outwardly; hind legs pale ochereous, with blackish fuscous tinge.

Male genitalia (Fig. 3A–E): Vinculum tapering from basal 1/3 to an obtuse apex. Valva gradually narrowed and upcurved to a blunt apex; costal margin strongly incurved from basal 1/5 to apex; ventral margin slightly concave in basal half, with rather dense slender setae in apical half; apical half of the surface sparsely covered with slender setae. Anellus forming a pair of well-sclerotized hooks; the angle of the throat obtuse; the arm short and broad, with an acute bill. Aedeagus biforked, the forks slender, somewhat twisted, with acute tips; the base rectangular. Tegumen trapeziform, the cephalic side 1.6 times as wide as the caudal side; socii sparsely setose, triangular with acute angles, widely separated; sclerotized margin between the socii slightly convex.

Female genitalia (Fig. 3 F): Ovipositor bilobed; posterior lobes (or ovipositor lobes) densely clothed with short stout setae; lateral lobes (a second pair of lobes which are lateral and anterior to the ovipositor lobes) covered with long slender and long thick setae. Posterior apophyses long, slender throughout; anterior apophyses slightly broad, the length beyond an articulation with an arm of 8th tergite about 1/3 of the length of posterior apophyses. Prela (a term used by BRAUN, 1972, a pair of rods arising cephalad from ventral membrane between terminalia and 8th sternite, the bases broad and weakly sclerotized, the distal slender portion strongly sclerotized) small and short, the base densely spinose. Ostium bursae large, the lateral edge strongly and slenderly sclerotized. Ductus bursae very short, sparsely scobinated with granules.

Leafmine (Fig. 2 A): Small, irregular in shape, varying in colour from dark yellow to blackish fuscous, with waved light-and-dark pattern. Circular nidus (to which the larva retreats when alarmed or not feeding, and within which the larva pupates) very slight at first, becoming more pronounced because of silken lining. Frass ejected from the mine.

*Specimens examined.* 10 ♂♂ & 8 ♀♀. Holotype: ♂, Nara, Nara, 26/vii/1989, ex *Quercus acutissima* [specimen code 89.27–14]. Paratypes: 2 ♂♂ & 1 ♀, Nara, Nara, 22/vii–4/ix/1987, ex *Q. acutissima*; 3 ♂♂ & 4 ♀♀, ditto, 12/iv–25/viii/1989, ex *Q. acutissima*; 1 ♂, ditto, 21/viii/1992, ex *Q. acutissima*; 3 ♂♂ & 3 ♀♀, ditto, 4–24/viii/1992, ex *Q. variabilis*.

*Distribution.* Japan (Honshu).

*Host plants.* *Quercus acutissima* CARRUTHERS and *Q. variabilis* BLUME (Fagaceae).

*Remarks.* It is difficult to distinguish this new species from the other two species, *T. decidua* and *T. quercifolia*, by wing and body colour. These three species are, however, very easily discriminated from each other by the male genitalia as mentioned in the key. On the other hand, it is very difficult to discriminate the three species by the female genitalia. The relative length and breadth of anterior apophyses and the sclerotization of ostium bursae may help to discriminate them; in *T. naraensis*, the relative length of anterior apophyses beyond an articulation with an

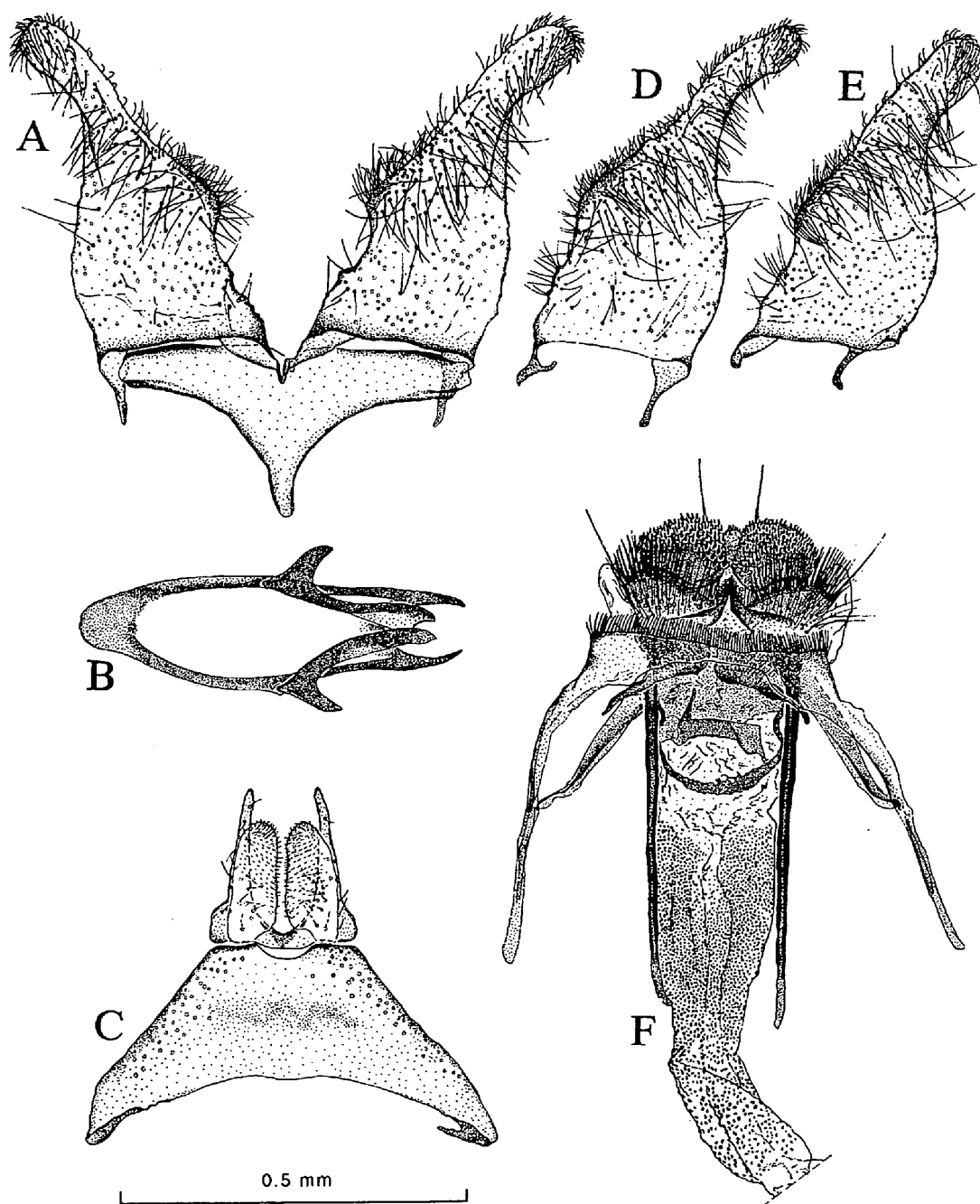


Fig. 4. *Tischeria decidua* WOCKE. — A–C, Parts of male genitalia (A, valva and vinculum in dorsal view; B, anellus and aedeagus in dorsal view; C, tegumen with socii in ventral view) [TERAMOTO-2]; D–E, left valva [89.29–2 and 91.74–19, respectively]; F, female genitalia in ventral view [KUMATA-50].

arm of 8th tergite is shorter and the lateral margin of ostium bursae is strongly and narrowly sclerotized.

*Tischeria naraensis* is similar to the European *Quercus*-mining species *T. dodonea* STAINTON in male genital structure, especially in the shape of valva. The new species is, however, easily distinguished from the latter by the twisted forks of the aedeagus, the triangular socii with sparse setae, and the ratio of 1.6 between the caudal and the cephalic width of the tegumen.

Although the leafmine of *T. naraensis* varies in colour, it is never whitish in a monotone. This enables us to distinguish the leafmine of this species from that of *T. quercifolia*. Moreover, the leafmine of *T. naraensis* is easily discriminated from that of *T. decidua* by the thinner and nondeciduous cocoon nidus.

### *Tischeria decidua* WOCKE

(Figs. 1 B, 2 B, 4)

*Tischeria decidua* WOCKE, 1876, Z. Ent. Breslau, (N.F.), 7, 41–43.

♂, ♀. Expanse of wings: 7.3–10.0 mm.

Face ochereous; tuft of head ochereous to orange ochereous. Antennae ochereous, darkening toward apex; underside blackish fuscous in male; antennal shaft in male with long cilia, in female with short cilia on apical half. Thorax ochereous to orange ochereous. Fore wings and cilia ochereous to orange ochereous; costal margin and apical 1/4 usually sprinkled with brownish ochereous scales. Hind wings and cilia dark grey. Fore and middle legs pale ochereous, with blackish fuscous shading outwardly; hind legs ochereous, somewhat mixed with blackish fuscous in spurs and tarsi.

Male genitalia (Figs. 4 A–E): Vinculum tapering from basal 1/3 to a long pointed apex. Valva parallel-sided on basal half, then strongly narrowed and upcurved to a round apex; costal margin strongly incurved on apical 3/5; ventral margin shallowly concave from basal 1/5 to 2/5, densely setose in the middle; apical half of the surface covered with long slender setae. Anellus forming a pair of well-sclerotized hooks; the throat acutely angled; the crown pointed; the arm moderate in length, with an acute bill. Aedeagus biforked, the forks slender with acute tips; apical margin of membrane between the forks somewhat sclerotized; the base semielliptical. Tegumen trapeziform, the cephalic side about 2.7 times as wide as the caudal side; socii sparsely setose, suddenly narrowed at basal 1/5, then elongated to acute apices, apart from tegumen.

Female genitalia (Fig. 4 F): Ovipositor bilobed; ovipositor lobes clothed with short stout setae; lateral lobes covered with long slender and long thick setae. Posterior apophyses slender throughout; anterior apophyses slender, the length beyond an articulation with an arm of 8th tergite about 2/5 of the length of posterior apophyses. Prela small and short, the base densely spinose. Ostium bursae large, the margin, especially lateral, well sclerotized. Ductus bursae short, densely scobinated with granules.

Leafmine (Fig. 2 B): Large, irregular in shape, varying in colour from brown

to blackish fuscous. Circular nidus darker, distinct even in the early mine, outlined by a dense ring of silk at prepupal stage, swollen like a thick disc on the leaf surface, then falling off the leaf on the ground. Frass ejected from a small hole on the nidus, although HERING (1926) mentioned that larvae of this species did not eject frass from mines.

*Specimens examined.* 36 ♂♂ & 26 ♀♀. 2 ♂♂, Tomakomai, Hokkaido, em. 29/v-4/vi/1970, ex *Quercus dentata*, T. KUMATA leg.; 2 ♂♂, Mt. Apoi, Hokkaido, 6-21/v/1975, ex *Q. mongolica*, T. KUMATA leg.; 1 ♀, Todai, Nagano, em. 4/v/1976, ex *Q. serrata*, T. KUMATA leg.; 2 ♂♂ & 1 ♀, Nagoya, Aichi, 12/vi/1967, ex *Q. acutissima*, T. KUMATA leg.; 1 ♂ & 1 ♀, Azai, Shiga, 9/viii/1987, ex *Q. acutissima*, N. TERAMOTO leg.; 1 ♂ & 1 ♀, ditto, 7/xi/1991, ex *Q. serrata*; 1 ♂, ditto, 7/xi/1991, ex *Q. variabilis*; 7 ♂♂ & 6 ♀♀, Nara, Nara, 17/vii-25/viii/1989, ex *Q. acutissima*; 1 ♂, ditto, 14/x/1992, ex *Q. serrata*; 14 ♂♂ & 13 ♀♀, Kamitsushima, Tsushima, em. 3-9/vi/1980, ex *Q. acutissima*, T. KUMATA leg.; 4 ♂♂ & 2 ♀♀, Mine, Tsushima, em. 3-9/vi/1980, ex *Q. serrata*, T. KUMATA leg.; 1 ♂ labelled "Silesia, Staudinger, 751." & 1 ♀ "Silesia, Staudinger" (both are deposited in Zoological Museum, Helsinki).

*Distribution.* Japan (Hokkaido, Honshu and Tsushima), Europe, and Russia.

*Host plants.* *Quercus acutissima* CARRUTHERS, *Q. variabilis* BLUME, *Q. dentata* THUNBERG, *Q. mongolica* FISCHER and *Q. serrata* MURRAY in Japan; *Quercus* spp. and *Castanea sativa* MILLER in Europe (HERING, 1926); *Q. mongolica* in Russia (KOZLOV, 1986). Belonging to Fagaceae.

*Remarks.* *Tischeria decidua* is new to the fauna of Japan.

As mentioned in *T. naraensis*, the male of *T. decidua* is easily distinguishable from the other species by the genital characters, whereas the female is not. The long, slender anterior apophyses and the U-shaped sclerotized margin of the ostium bursae may aid in discriminating the female of this species.

The leafmine of *T. decidua* is easily separated from those of the other species by the thick and deciduous disc-like cocoon nidus.

In Shiga, Japan, occasional outbreaks of this species have occurred in plantations of *Q. acutissima* and *Q. variabilis*, which were made for cultivating wild silk moths, *Antheraea yamamai* (GUÉRIN-MÉNEVILLE), Saturniidae. At that time, more than ten leafmines were found in a single leaf.

### *Tischeria quercifolia* KUROKO

(Figs. 1 C, 2 C, 5)

*Tischeria quercifolia* KUROKO, 1982, Moths of Japan, 1: 59, 2: pls. 216 (7) and 26 (1-2).

♂, ♀. Expanse of wings: 7.5-11.1 mm.

Face, tuft of head, antennae and thorax whitish ochereous; underside of antennae blackish fuscous in male; antennal shaft in male with long cilia, in female with short cilia on apical half. Fore wings ochereous or pale ochereous, the colour becoming more intense on the apical half and costal area, not dusted with brown or fus-

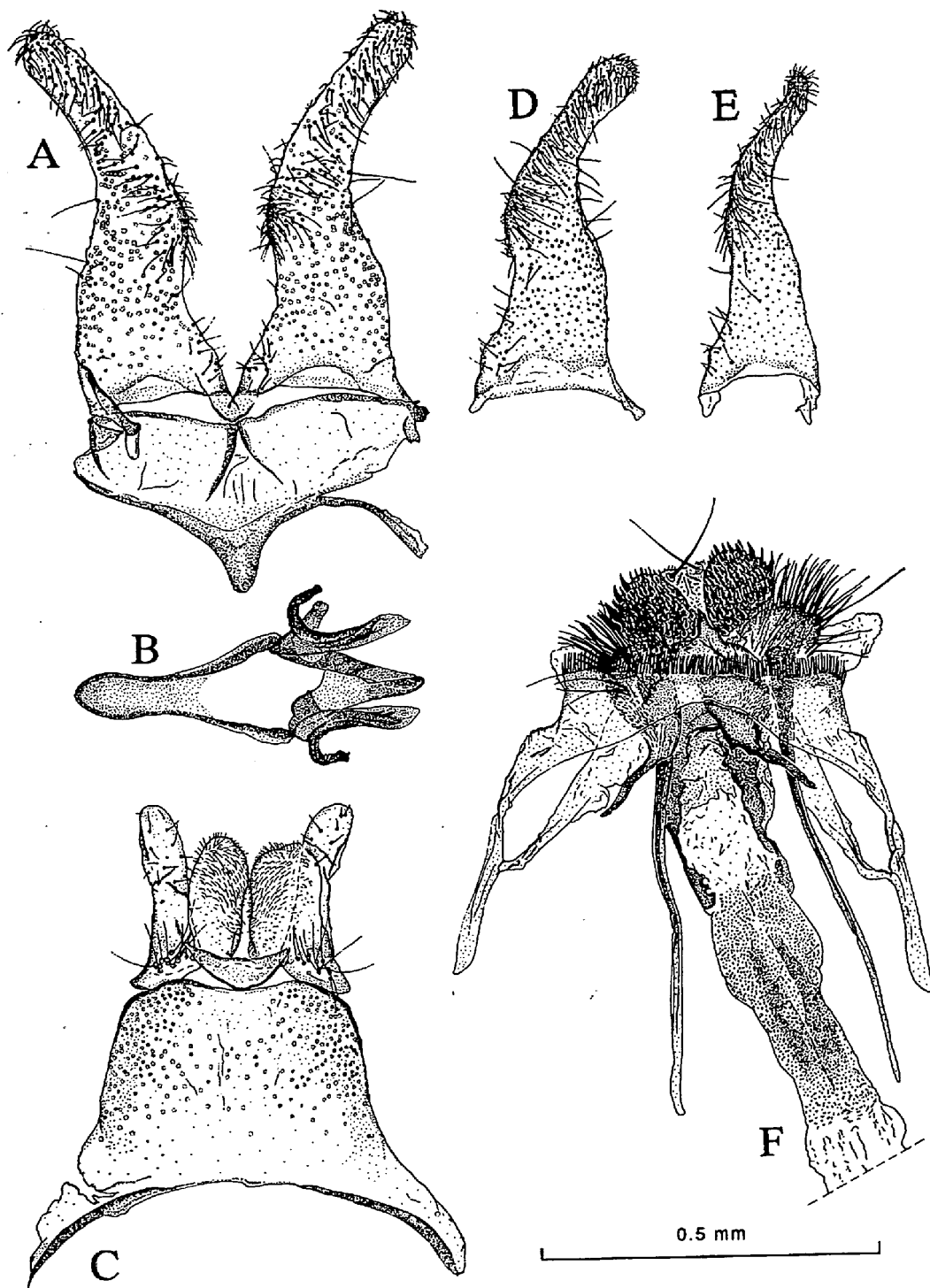


Fig. 5. *Tischeria quercifolia* KUROKO. — A-C, Parts of male genitalia (A, valva and vinculum in dorsal view; B, anellus and aedeagus in dorsal view; C, tegumen with socii in ventral view) [84.63]; D-E, left valva [KUMATA-11 and 84.162, respectively]; F, female genitalia in ventral view [KUMATA-9].



cous; cilia pale ochereous. Hind wings and cilia grey. Fore and mid legs shaded with blackish fuscous outwardly; hind legs pale ochereous with blackish fuscous spurs.

Male genitalia (Figs. 5 A–E): Vinculum tapering from basal  $2/5$  to a round apex. Valva gradually narrowed to a round apex; costal margin deeply incurved on apical  $2/3$ ; ventral margin shallowly incurved on basal half; apical half of the surface covered with slender setae. Anellus forming a pair of well-sclerotized hooks; the shank broad; the crown projected, with an acute tip; the arm thin and long, turned in a hairpin-shape, with a blunt bill. Aedeagus biforked, each fork consisting of two segments, the caudal segment with a sclerotized flap; the base linguiform, strongly sclerotized peripherally. Tegumen rather long, narrowed on basal  $1/3$ , then nearly parallel-sided on apical  $2/3$ , the cephalic side about 1.9 times as wide as the caudal side; socii cylindrical, set with several long setae at base, separated by a sclerotized crescent, apart from tegumen, with round apices.

Female genitalia (Fig. 5 F): Ovipositor bilobed; ovipositor lobes clothed with short stout setae; lateral lobes covered with long slender and long thick setae. Posterior apophyses slender throughout; anterior apophyses broad, slightly expanding toward tip, the length beyond an articulation with an arm of 8th tergite about  $1/4$  of that of posterior apophyses. Praela small, moderate in length, the base densely spinose. Ostium bursae large, the lateral margin sclerotized broadly and irregularly. Ductus bursae moderate in length, densely scobinated with granules.

Leafmine (Fig. 2 C): Large, irregular in shape, whitish, translucent at first. Nidus not apparent in the early mine, but becoming distinct in later stage because of silken lining, somewhat swollen. Frass ejected from a small hole near the centre of the mine.

*Specimens examined.* 12 ♂♂ & 15 ♀♀. 6 ♂♂ & 4 ♀♀, Ishikari, Hokkaido, 23/iv–16/v/1984, ex *Quercus dentata*; 2 ♀♀, Teine, Hokkaido, 9/vii/1956, ex *Q. mongolica*, T. KUMATA leg.; 1 ♂ & 1 ♀, Sapporo, Hokkaido, 30/vii/1964, ex *Q. mongolica*, T. KUMATA leg.; 1 ♀, ditto, 6/xii/1955, ex *Q. dentata*, T. KUMATA leg.; 1 ♂, Onuma, P. Oshima, Hokkaido, 18/v/1978, ex *Q. serrata*, T. KUMATA leg.; 2 ♂♂ & 3 ♀♀, Nishinasuno, Tochigi, em. 4–10/v/1976, ex *Q. serrata*, T. KUMATA leg.; 1 ♂ & 2 ♀♀, Todai, Nagano, em. 4–24/v/1976, ex *Q. serrata*, T. KUMATA leg.; 1 ♂ & 1 ♀, Hukushima, Nagano, em. 1–18/v/1976, ex *Q. serrata*, T. KUMATA leg.; 1 ♀, Azai, Shiga, 9/viii/1987, ex *Q. acutissima*, N. TERAMOTO leg.; 1 ♀, Nara, Nara, 16/xi/1989, ex *Q. acutissima*.

*Distribution.* Japan (Hokkaido, Honshu, Shikoku and Kyushu).

*Host plants.* *Quercus acutissima* CARRUTHERS, *Q. dentata* THUNBERG, *Q. mongolica* FISCHER and *Q. serrata* MURRAY (Fagaceae).

*Remarks.* The female of *T. quercifolia* has hitherto been unknown.

This species is characteristic in the whitish tuft and thorax, and in the fore wings without specks on the surface. In the female genitalia, it is separated from the

other species in that the anterior apophyses are broad and slightly expand toward tip and the lateral margin of the ostium bursae is irregularly sclerotized.

The leafmine of *T. quercifolia* is easily distinguishable from those of the other species by the whitish and monotonous colour.

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