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New species of *Tuberculatus* Mordvilko, 1894 (*Homoptera, Aphididae*), with a key to species and some critical notes

I. Abstract.

A new subgeneric classification of *Tuberculatus* Mordvilko, 1894 is proposed with the following subgenera: *Tuberculatus* Mordv., type species *Aphis querceus* Kltb., 1843; *Acanthocallis* Matsumura, 1917; type species *Acanthocallis quercicola* Matsumura, 1917, of which *Arakawana* Matsumura, 1917, type species *Arakawana stigmata* Matsumura, 1917 is made a synonym; *Tuberculoides* van der Goot, 1915, type species *Aphis quercus* Kltb., 1843 (= *Aphis annulata* Htg., 1841); *Orientuberculoides* subgen. nov., type species *Myzocallis yokoyamai* Takahashi, 1923; *Camelaphis* subgen. nov., type species *Tuberculatus cornutus* Richards, 1969. The following new species and subspecies are described: *T.* (*Tuberculoides*) *africanus* spec. nov., from *Quercus canariensis* (*mirbeckii*), Algeria; *T.* (*Tuberculoides*) *albosiphonatus* spec. nov., from *Quercus infectoria,* Iraq; *T.* (*Orientuberculoides*) *higuchii* spec. nov., from *Quercus mongolica grosseserrata,* Japan, with a subspecies *breviunguis* subspec. nov., from *Quercus mongolica grosseserrata* and *Q. serrata,* Japan; *T.* (*Camelaphis*) *maculipennis* spec. nov., from *Quercus infectoria* and perhaps *Q. calliprinos,* Turkey and Lebanon; *T.* (*Tuberculoides*) *maximus* spec. nov., from *Quercus persica* and *Q. macranthera,* Turkey and Iran; *T.* (*Tuberculoides*) *moerickei* spec. nov., from *Quercus infectoria,* Turkey, Lebanon and Iran, with a subspecies *galatensis* subspec. nov., from perhaps *Quercus pedunculata,* Turkey; *T.* (*Camelaphis*) *pallescens* spec. nov., from *Quercus sp.,* Turkey, Lebanon; *T.* (*Orientuberculoides*) *paranaracola* spec. nov., from *Quercus mongolica* and Moericke traps, Japan, Korea, with a subspecies *hemitrichus* subspec. nov., from Moericke traps, Korea; *T.* (*Orientuberculoides*) *paiki* spec. nov., from *Quercus dentata,* Korea; and *T.* (*Orientuberculoides*) *capitatus* (Essig

& Kuwana) subspec. *intermedius* subspec. nov. from Moericke traps, Korea. *Myzocallis naracola* Matsumura, 1919 is made a synonym of *T. (Orientuberculoides) kashiwae* (Matsumura, 1917); *Tuberculatus tuberculatus* Richards, 1968 of *Tuberculoides fangi* Tseng & Tao, 1938, transferred to *Tuberculatus (Orientuberculoides)*; *Tuberculoides elegans* Blanchard, 1939, of *T. (Tuberculatus) querceus* (Kltb., 1843); *Myzocallis querciplatensis* Blanchard, 1926, of *T. (Tuberculoides) annulatus* (Htg., 1841); *Tuberculoides grodsinskyi* Blanchard, 1939, of *Hoplocallis picta* (Ferrari, 1871). *Tuberculatus multituberculatus* Mordvilko, 1929, and *Tuberculatus flavus* Mordvilko, 1929 are considered nomina nuda. The species known to the author have been keyed. The species *T. spiculatus* Richards, 1971; *T. kunugi* Shinji, 1924 (description not seen), *T. naganoe* Shinji, 1941; and *T. fulviabdominalis* Shinji, 1941 could not be obtained, and it is not clear in which subgenus they belong. *Myzocallis (Neomyzocallis) tuberculatus* Richards, 1965 is transferred to *Tuberculatus,* which makes *Tuberculatus tuberculatus* Richards, 1968 a junior homonym. *T. (Orientuberculoides) konaracola* (Shinji, 1941) is redescribed. See also Addenda, p. 81.

II. Introduction.

After the very well illustrated revisions of the world's species by Richards (1968), and of the Japanese species by Higuchi (1969), another paper on *Tuberculatus* might seem superfluous. Besides, Richards (1969) made a new key, covering *Tuberculoides* van der Goot, and a new *Tuberculatus*.

However, there are a number of species in the Palaearctic Region that apparently escaped notice, one Pacific American species not mentioned by Richards was refound, and I was not quite satisfied with the classification by Richards (1968, 1969).

In the present paper only one species is left in *Tuberculatus* sensu stricto. The type species, *T. querceus* (Kltb.), stands apart from all others by having only a single pair of, partly fused, spinal processes on the body, and by its dense wax-cover in life.

Pacificallis Richards is retained as a subgenus. Richards uses a fleck on the bases of the tibiae as a discriminant, and such a fleck does not occur in any known Palaearctic species. The other character of *Pacificallis* used by Richards, the presence of only 5 instead of 6 ventral hairs on the first tarsal joints, is helpful, but it also occurs in some Palaearctic species without tibial fleck.

Tuberculoides van der Goot, which Richards keys as a genus, is retained in this paper as a subgenus. RICHARDS (1968, p. 362; 1969, key) separates this from *Tuberculatus* by the spinal hairs on embryos, nymphs and adults standing on VII farther apart than those on other tergites. Apart from the fact that this is also the case in several species placed by Richards in *Tuberculatus* (cfr. RICHARDS, 1969, figs. 16, 17), the spinal hairs on tergite VII in *Tuberculoides eggleri* Börner, which Richards places in *Tuberculatus,* stand perhaps even farther apart than they do in the type species of *Tuberculoides, T. annulatus* (Htg.) (cfr. QUEDNAU, 1954 fig. 36). However, it is possible on other, rather futile, characters to maintain *Tuberculoides* as a group, as long as *Tuberculatus* sensu stricto has only one species in it. It then appears that *Tuberculoides* is originally restricted to Europe, the Mediterranean areas of Africa and Asia, and adjacent states like Iraq and Iran. It is clear that the present occurrence of the type species in North and South America, South Africa, Australia and New Zealand is the result of introduction with its host tree, *Quercus robur.* Two more *Tuberculoides* that are to be described by others live within the territory of the subgenus as that is now known.

Tuberculoides, as understood here, holds the following species: *annulatus* (Htg.), *borealis* Krzywiec, *neglectus* Krzywiec, *eggleri* Börner, *africanus* spec. nov., *moerickei* spec. nov., *albosiphonatus* spec. nov., *maximus* spec. nov. The morphological characters of the subgenus can be extracted from the key to alate viviparous females.

In Eastern Asia one finds the counterpart of *Tuberculoides,* but always with long and usually knobbed hairs on the front, and with only one exception with spinal processes on the pronotum, though never with spinal processes on the mesonotum. I have given this group of species subgeneric status and propose the name *Orientuberculoides* subgen. nov., type species *Myzocallis yokoyamai* Takahashi, 1923. This now holds *yokoyamai* (Tak.), *kashiwae* (Mats.) and its synonym *naracola* (Mats.), *capitatus* (Essig & Kuwana), *fangi* (Tseng & Tao), *konaracola* (Shinji), *paranaracola* spec. nov., *higuchii* spec. nov., and *paiki* spec. nov. The chaetotaxy of the embryos shows the same variation as in *Tuberculoides,* for one finds species in which the embryos have very short, hardly visible, spinal hairs on the anterior 6 abdominal tergites besides species with all spinal hairs long in embryos.

From India to Japan there occurs another group of species, differing from *Tuberculoides* and *Orientuberculoides* by having a darkly pigmented mesonotum, and mostly very fine and thin hairs on the antennae. The

embryos usually have fine and almost wavy dorsal hairs. The fore wings show considerable pigmentation of the pterostigma. Typically the hairs on the front are as long as those on antennal segment III. For this group the name *Acanthocallis* Matsumura, 1917, type species *Acanthocallis quercicola* Matsumura, 1917, is available as a subgeneric name, and this has page priority over *Arakawana* Matsumura, 1917, type species *Arakawana stigmata* Matsumura, 1917, which I consider a synonym of *Acanthocallis*. The following species belong here: *quercicola* Mats., *stigmatus* (Mats.), *pilosus* (Tak.), *japonicus* Higuchi, *indicus* L.K. Ghosh (*fulviabdominalis* Shinji of Higuchi [1969]). Also *Tuberculatus orientalis* Richards, 1968 would come here, but, if the description is correct, it differs from all other known Palaerctic *Tuberculatus* by having spinal processes on the mesonotum, but none on the pronotum. However, also in *T. capitatus* (Essig & Kuwana) RICHARDS (1968) describes spinal processes on the meso- and metanotum, but they are certainly not present in the holotype, and in paratypes (cotypes) of the latter species that I could examine. See Addenda, p. 81.

This leaves a small group of three species from the Near East, of which only *T. cornutus* Richards was described, while *T. maculipennis* and *T. pallescens* are described in this paper as new species. *T. cornutus* and *T. maculipennis* are closely related, with their very large marginal processes, pigmented mesonotum, and strongly ornamented pterostigma. They resemble members of the Oriental subgenus *Acanthocallis,* also in that the secondary rhinaria are conspicuously ciliate. They differ from *Tuberculoides* because the alatoid nymphs have long hairs on antennal segment III. Both these species could be placed in *Acanthocallis,* but the frontal hairs in alatae are about twice as long as the hairs on ant. segment III. After some hesitation I decided to place them in a separate subgenus, *Camelaphis* subgen. nov., type species *Tuberculatus cornutus* Richards, 1969, mainly because then I have some place for *T.* (*Camelaphis*) *pallescens* spec. nov. The latter aphid in many respects agrees with *Tuberculoides* as understood here, but the alatoid nymphs have long hairs on antennal segment III, and alatae have long frontal hairs. The more distal secondary rhinaria show very distinct ciliae which I have not seen in any *Tuberculoides,* though a scanning microscope might perhaps reveal them.

RICHARDS (1968, 1969), HIGUCHI (1969) and PAIK (1972) have published beautiful drawings of many *Tuberculatus* species, and the reader is referred to their papers for illustrations.

Some described species are not especially mentioned in the key. *Tuberculatus orientalis* Richards and *T. tuberculatus* Richards, 1968 were asked for, but I could not in time obtain the types from Berkeley, California. See Addenda, p. 81.

MORDVILKO (1929) on page 40 of his Food Plant Catalogue briefly mentions two new *Tuberculatus, T. multituberculatus* nov. spec. and *T. flavus* nov. spec. from the Ussuri Province, North of Korea, but these should be considered nomina nuda.

BLANCHARD (1939) described *Tuberculoides elegans* and *T. grodsinskyi* as new species from Argentine and in 1926 *T. querciplatensis.*

The latter, according to material received from Prof. Bahamondes, is *T. annulatus* (Htg.), *T. elegans* is *T. querceus* (Kltb.) from *Quercus robur,* and *T. grodsinskyi* can without difficulty be recognized as *Hoplocallis picta* (Ferr.) from *Quercus ilex,* from which host plant Blanchard's specimens came.

Some of Shinji's species, such as *kunugii, naganoe* and *fulviabdominalis* had to be neglected. Original material does not seem to exist, and I could not satisfactorily identify available material with any of Shinji's descriptions in Japanese, or with his illustrations. I could not quite agree with HIGUCHI (1969) who applied the name *T. fulviabdominalis* Shinji to what in this paper is called *T. indicus* L.K. Ghosh.

Tuberculatus spiculatus Richards, 1971 has also not been keyed. Only one alata is known besides numerous nymphs. Richards states that the species resembles *T. pallidus* (Davidson), but that embryos and alatoid nymphs have spinules on the long dorsal hairs, and that it has the last rostral segment longer than the second joint of the hind tarsi. According to Richards' measurements it also has a shorter processus terminalis than even the fundatrix of *T. pallidus.* Dr. Richards in private correspondence informed me that the alate has 5 ventral hairs on the first tarsal joints, and that there is no dark spot at the bases of the tibiae, characters not mentioned in the original description. I do not know in which subgenus of *Tuberculatus T. spiculatus* Richards should be placed. Like Richards states, dorsal hairs with spinules are not known from any other *Tuberculatus,* but they are a generic character of *Hoplocallis* Pintera.

Tuberculatus tuberculatus (Richards, 1965 nec 1968) could not be placed in one of the subgenera I used, and not keyed because material was not seen until the manuscript was finished. It is briefly discussed on p. 78.

In a few places of the key one has to study the chaetotaxy of embryos (or first instar larvae). The technique is to find first a siphunculus, on abdominal tergite V, and to count segments from there. Fortunately the longer spinal hairs are always clearly visible in embryos in the abdomen of cleared *Tuberculatus*. But unfortunately all embryos have been removed from some very important type material.

Type material of all the species and subspecies described as new in this paper is in the author's collection. Paratypes have been given to some colleagues who allowed me to describe species from their material.

III. KEY TO ALATE VIVIPAROUS FEMALES.

1 (2) Abdomen with one large, black, bifid, spinal process on abdomen, not with additional smaller or pale spinal processes on other segments. In life covered with wax from which the tip of the process emerges. On *Quercus robur* and *Q. petraea*. Subgen. *Tuberculatus* Mordv. European species. Only one species:

T. querceus (Kltb.)

2 (1) Abdomen always with more than one pair of spinal processes, and such pairs frequently also present on pronotum.

3 (20) Fore and middle tibiae at their very bases with a bilateral blackish to pitch black, rather sharply terminated, fleck; rest of tibiae pale to dark. First tarsal joints with 5 hairs ventrally, 2 dorsally. Western North American species. Subgen. *Pacificallis* Richards.

4 (5) Basal vein (Cu_2) in fore wings with a mottled brown border which in the middle is about 0.060-0.070 mm across. Abdomen with 3-4 pairs of spinal processes, those on tergites III and IV less than half as tall as those on tergites I and II. Tibiae, especially hind ones, with a brown longitudinal stripe as dark as the bordering of the basal vein. Embryos with marginal hairs of abd. segments I-IV duplicated On *Quercus agrifolia* and *Q. kelloggi*, overwintering as eggs, especially on the latter. Pacific North America.

T. maureri (Swain)

5 (4) Basal vein (Cu_2) in fore wings mostly thicker and darker than other veins but not bordered, border half-way vein not more than 0.035 mm across. Embryos with marginal hairs in single pairs.

6 (7) Head between the eyes with more than 5 hairs in a row, usually with 6-13 hairs in irregular arrangement. Pronotum with one pair of posterior spinal processes. On *Quercus lobata,* producing sexuales. Pacific North America.

T. californicus (Baker)

7 (6) Head between the eyes with 4 hairs, or antennal segment VI only 2/3 - 3/4 of width of head across the eyes and pronotum with two pairs of spinal processes.

8 (11) Pronotum with only posterior pair of spinal processes present.

9 (10) Last rostral segment 0.13-0.15 mm long, second tarsal joints of hind legs about 0.11-0.12 mm long. In embryos marginal hair on abd. segment I (count from siphunculi) about 0.070-0.075 mm long. Spinal processes on abd. tergites I-II equal in length; mostly no processes on tergites III-VII. Ant. segment III with 1-3 rhinaria close to its base, with many hairs as long as its basal width. On *Pasania densiflora.* California.

T. pasaniae (Davids.)

10 (9) Last rostral segment up to 0.11 mm long, second tarsal joints of hind legs about 0.11-0.12 mm. In embryos the shortened marginal hairs of abd. segment I 0.040-0.050 mm long. Spinal processes on abd. tergites I-II about equal in length, those on tergite III just visible as little hills. Basal vein (Cu_2) in fore wings faintly and narrowly bordered (in the middle 0.020 mm wide). Ant. segment III with 2-8 rhinaria over at least basal 1/3 part, with hairs mostly shorter than its basal width. On *Quercus garryana.* California to British Columbia.

T. columbiae Richards

11 (8) Pronotum with two more or less distinct pairs of spinal processes.

12 (13) Ant. segment III with 7-14 (PALMER, 1952; and my paratypes of *tonkawa* Hottes; RICHARDS, 1968 mentions 4-10 in Utah material, Palmer 6-11) rhinaria covering more than 3/5 of the segment; part or parts bearing rhinaria conspicuously darker than basal portion of segment IV. Abd. tergites I-IV with spinal processes of about equal length, tergite V, etc. with much smaller processes. Last rostral segment acute with almost straight sides. On *Quercus gambelli, Q. gunnisoni.* Utah, Colorado (*Myzocallis tonkawa* Hottes).

T. kiowanicus (Hottes)

13 (12) Ant. segment III with 2-7 rhinaria, mostly not on darker pigmented areas of the segment. Spinal processes of abd. ter-

gites I and II about twice as tall as those on more posterior tergites.

14 (15) Processus terminalis measured from distal rim of primary (not accessory!) rhinarium as long as, to shorter than base of ant. segment VI; the whole segment VI much shorter than width of head including the eyes. Vertex between the eyes frequently with more than 4 hairs. Frontal hairs and the 2 more dorsal hairs thick, conspicuously knobbed, 1½ or more times basal diameter of ant. segment III; the latter with 1-3 rhinaria quite near base. On *Quercus douglasi.* California. (fundatrices of)

T. quercifolii (Davids.)

15 (14) Processus terminalis, even in fundatrices having 1-3 rhinaria on ant. segment III, slightly longer than basal part of segment VI. Vertex between eyes with 4 hairs. Frontal hairs not longer than basal diameter of ant. segment III, subacute or faintly knobbed, rather thin.

16 (17) Processus terminalis only just longer than base of segment VI (34:38), segment VI only just longer than segment V. Frontal and dorsal hairs on head thin, thinner from base to apex. Ant. segment III with 2 rhinaria near base. On *Quercus dumosa.* California. (fundatrix of)

T. pallidus (Davids.)

17 (16) Processus terminalis at least 1/4 longer than base of ant. segment VI. Ant. segment III with more than 2 rhinaria.

18 (19) Last rostral segment about 0.13 mm long, frequently with 2 pairs of lateral hairs on basal half, besides a variable number of ventral hairs. Hairs on front and vertex faintly but distinctly capitate. On *Quercus douglasi,* perhaps also *Q. tomentella?.* California.

T. quercifolii (Davids.)

19 (18) Last rostral segment 0.095-0.110 mm long, with one pair of lateral hairs on basal half, besides some ventral hairs. Frontal hairs and those on vertex gradually thinner from base to apex, more or less blunt but not knobbed. On *Quercus dumosa.* California.

T. pallidus (Davids.)

20 (3) Fore and middle tibiae never at their very bases with a short dark to blackish fleck, frequently pale with a longitudinal brown stripe; hind tibiae sometimes quite black. First tarsal joints mostly with 6, rarely 5 or 7, ventral hairs, besides 2

dorsal ones. Species from Europe and Asia, sometimes introduced into other continents.

21 (36) Frontal hairs in alatae mostly very small and shorter than basal diameter of ant. segment III. Longest hair on ant. segment III much shorter than basal diameter of the segment. Thorax pale, with at most two longitudinal brown stripes pleurally on anterior half of pronotum. Always 3, sometimes 4, rarely a small 5th pair of spinal processes on abdomen present, but none on thorax. Longest hairs on ant. segment III in alatoid nymphs shorter than basal diameter of that segment. Fore wings with pale veins; the pale stigma at base with an oblique longitudinal brown fleck to near anterior margin of wing, rarely with its posterior or distal margin narrowly bordered with brown and then little dark triangles at the end of the veins. European, Mediterranean or Near Eastern species, sometimes introduced into other continents. Subgen. *Tuberculoides* van der Goot.

22 (27) Besides abd. tergites I-III also tergite IV with a pair of spinal processes which may be much smaller than those on tergite III, but apparently never absent.

23 (24) Spinal hairs in embryos about as long as the long marginal hairs on the same tergites. On *Quercus pubescens, Q. petraea, Q. cerris,* rarely, possibly only strays, on *Q. pyrenaica* and *Q. suber.* Central and Southern Europe.

T. eggleri Börner

24 (23) In embryos at least on abd. tergites II-III spinal hairs at most only 1/2 as long as marginal hairs on the same segments.

25 (26) Spinal hairs in embryos about 0.005-0.008 mm long on tergites I-VI, thin, blunt. Marginal hairs on these segments about 0.015-0.045 mm long, on tergite I reaching to half-way the base of the following marginal hair; on more posterior tergites, e.g. on III, reaching to the base of the following hair. On *Quercus robur, Q. petraea, Q. pseudoturneri, Q. cerris,* (perhaps accidentally) also on *Q. grosseserrata* (Kew Gardens). Poland; Sweden; England; Netherlands; Italy.

T. borealis Krzywiec

26 (25) Spinal hairs in embryos distinctly knobbed, on abd. tergite I about 0.006-0.010 mm, but more caudad gradually lengthening via about 0.016-0.039 to about 0.040-0.065 mm on tergite V, and suddenly much thicker and longer, 0.026-0.075 mm, on tergite VI. Marginal hairs on these segments 0.026-0.075 mm, already on tergite I reaching to the base of the following hair,

and on III and IV reaching the base of the second following hair. On *Quercus canariensis*. Algeria.

T. africanus spec. nov.

27 (22) Only abd. tergites I-III with spinal processes.

28 (29) Veins of wings ending in dark triangular spots. Cauda infuscated. In embryos spinal hairs an abdomen all very long, crossed, except on tergite I. On *Quercus sp.*. Iran; Turkey.

T. maximus spec. nov.

29 (28) Veins of wings not ending in conspicuous dark triangular spots. Cauda not noticeably darkened. In embryos spinal hairs at least on abd. segments I-V extremely short, often less than 0.005 mm long, in strong contrast to those on tergites VII or VIII.

30 (31) Marginal hairs in embryos on abd. tergites II-V as short as the spinal ones on these segments, not more than 0.008-0.013 mm long; only the hairs on tergite VIII, rarely VII, much longer and knobbed. Processus terminalis in adults hardly longer than basal part of ant. segment VI; ant. segment III not with a pigmented part near 1/3 from base. On *Quercus robur, Q. petraea,* rarely on other *Q. sp.* (*Q. pubescens; Q. grosseserrata*: Kew Gardens, England, Wageningen, Netherlands). Europe; introduced into other continents.

T. annulatus (Htg.)

31 (30) Marginal hairs in embryos on abd. tergites II-V always considerably longer than spinal hairs on these segments, and at least both tergites VII and VIII with long knobbed hairs. Ant. segments III pale with blackish apex, but in some cases also with more or less distinct pigmented part near the middle or at 1/3 of their length from base.

32 (33) Siphunculi almost completely pale, only at the rim and apparently on the anterior inner side pigmented. Processus terminalis in summer specimens just shorter than basal part of ant. segment VI. Ant. segment III at about 1/3-2/5 of its length from base more or less distinctly infuscated. Last rostral segment only about 2/3 of second joint of hind tarsi, with one pair of lateral hairs and one ventral pair besides the 3 subapical pairs. In embryos marginal hairs on abd. tergites II-V thin, not or hardly knobbed, short, about half as long as distance to following hair; frontal hairs thick but not knobbed. On *Quercus sp.*. Kurdistan (Iraq).

T. albosiphonatus spec. nov.

33 (32) Siphunculi distinctly dark, at least on anterior surface, on distal 1/3 part or more. Processus terminalis in fundatrices about as long as base of ant. segment VI, but in summer specimens often longer. Ant. segment III with or without pigmentation somewhere on basal half. Last rostral segment 3/4 or more of second joints of hind tarsi, rarely with only one pair of lateral hairs besides the 3 subapical pairs. In embryos marginal hairs on abd. tergites II-V at least 0.0025 mm thick, distinctly knobbed, at least on segments IV or V reaching to the base of the following hair; frontal hairs thick and knobbed.

34 (35) In fundatrices processus terminalis 1 1/5 times, in later generations 1 1/3 times as long as basal part of ant. segment VI. Siphunculi roundabout blackish on distal 1/3 (fundatrices) - 2/3 part, distinctly longer than last rostral segment. Ant. segment III only at apex blackish brown, not vaguely infuscated near the most distal rhinaria. In embryos marginal hairs on abd. segments II-IV only just reaching to base of following hair. On *Quercus petraea,* rarely *Q. robur.* Central and Western Europe.

T. neglectus Krzywiec

35 (34) Processus terminalis at most 1 1/8 times as long as basal part of ant. segment VI. Siphunculi either roundabout blackish at tip, or only on anterior half, shorter than last rostral segment. Ant. segment III often infuscated near the most distal rhinaria. In embryos marginal hairs on abd. segments II-IV all or most reaching to far past base of following hair. On *Quercus infectoria.* Turkey; Lebanon; Iraq.

T. moerickei spec. nov. *sensu latiore*

36 (21) Frontal hairs in alatae almost always twice or more times as long as basal diameter of ant. segment III. Longest hair on ant. segment III often longer than basal diameter of the segment. Thorax pale or dark. Two to several pairs of spinal processes present on abdomen, and in Oriental species often also on thorax. Longest hairs on ant. segment III in alatoid nymphs often much longer than basal diameter of the segment. Fore wings variably pigmented, or with pale veins. Near Eastern or Oriental species.

37 (54) Thorax pale, but not at the same time secondary rhinaria markedly ciliate or veins of wings ending in marked blackish triangles. Mesonotum always without spinal processes. Pterostigma either pale, or with the posterior vein very narrowly bordered, and/or with a rather irregular brownish fleck near base. Media largely pale. No triangular dark flecks at ends of veins. Hairs on ant. segment III in alatoid nymphs rather as

in adult alatae, often longer than basal diameter of the segment. Oriental species. Subgen. *Orientuberculoides* subgen. nov.

38 (53) Pronotum with spinal processes, i.e., at least the posterior pair(s) of spinal hairs on shorter or longer processes. Spinal processes on abd. tergite III much longer than their basal width.

39 (50) Pronotum only with a posterior pair of sometimes very small spinal processes. Hairs on ant. segment III not darkly pigmented.

40 (41) Front with 3 pairs of long hairs, i.e., all hairs between each lateral ocellus and the median ocellus of similar length, markedly knobbed. On various *Quercus spp.*. Formosa; Japan; Korea.

T. querciformosanus (Tak.)

41 (40) Front with only 2 pairs of long, knobbed hairs, i.e., between each lateral ocellus and the two frontal pairs of hairs one much shorter hair.

42 (43) Spinal processes on abd. tergite III completely black, often on a joint blackish sclerite; also on tergite IV sometimes blackish, very small, processes, but the processes on tergites I and II pale. Siphunculi with distal half black. Embryos with all spinal hairs long. In traps. Korea.

T. konaracola (Shinji)

43 (42) Spinal processes on abd. tergite III pale, at most with brownish apex; no dark processes on tergite IV. Embryos with short or long spinal hairs.

44 (45) Embryos with all spinal hairs on abd. tergites II-VI to half as long as the marginal hairs on the same segments, often seemingly absent on these tergites. In traps, Korea; on *Quercus mongolica*. Japan.

T. paranaracola spec. nov. *sensu latiore*

45 (44) Embryos on abd. tergites II-VI with long spinal hairs, comparable with the marginal hairs on the same segment.

46 (47) Hairs on inner side of ant. segment III (opposite the rhinaria) not placed on any sort of elevation of the segment, so that the inner profile shows a smooth curve. Longest hair on ant. segment III thin and hardly or not knobbed, up to just over half as long as basal diameter of the segment. The 3-6 rhinaria confined to basal 1/3-1/2 part of ant. segment III. On *Quercus mongolica grosseserrata, Q. serrata.* Japan; Korea.

T. higuchii spec. nov. *sensu latiore*

47 (46) Hairs on inner side of ant. segment III placed on distinctly incrassate parts of the segment, so that the inner profile of the segment shows small hills indicating the presence of a hair. Longest hairs on ant. segment III stiff, rather thick and knobbed, 3/4-1 1/5 times as long as, to much longer than, basal diameter of the segment. Rhinaria covering 1/3-9/10 part of ant. segment III.

48 (49) Longest hairs on ant. segment III about 4/5-1 1/5 times as long as basal diameter of the segment, adpressed or bent towards the segment. The 4-10 rhinaria mostly covering more than half, often 9/10 of ant. segment III, only in midsummer specimens restricted to basal 1/3 part and only 2-4 in number. Cu_2 and also Cu_1 of fore wings over their whole length much darker and thicker than media. On *Quercus mongolica grosse-serrata, Q. serrata,* according to Higuchi (1969) in Japan; in trap, Korea.

T. yokoyamai (Takahashi)

49 (48) Longest hairs on ant. segment III about 1 3/8-1 2/3 times as long as the thick basal diameter of the segment, at about 80° to the segment, straight and strongly knobbed. Rhinaria 4-7 in number, restricted to basal half of segment. Cu_2, Cu_1 and media in fore wings all about equally thick and dark, browned or slightly bordered only over a short distance from base. On *Quercus dentata.* Korea.

T. paiki spec. nov.

50 (39) Pronotum with both an anterior and a posterior pair of spinal processes. One to three of the longest hairs on ant. segment III in contrast to the others on that segment often markedly pigmented, on dark sockets, with usually also the segment pigmented around the sockets; these hairs knobbed. Often similar dark hairs on segments I and II and on the front. Group of *T. capitatus.*

51 (52) Spinal hairs on abd. tergites II-VI in embryos very thickly knobbed, the knobs 2½-3½ times as thick as the part below. Front, antennal segments I-III and thoracic nota in adults with strongly knobbed hairs. Dorsal hairs on basal half of hind tibiae with hardly blunt, or slightly capitate apices, rather stiff, about 1-1 1/3 times as long as local diameter of tibiae. Veins in fore wings rather thick but clear-cut. On *Quercus serrata, Q. variabilis* and *Q. acutissima.* Japan; China; Korea.

T. capitatus (Essig & Kuwana) *sensu latiore*

52 (51) Spinal hairs on abd. tergites II-VI in embryos blunt or slightly knobbed, the knobs elongate oval instead of transverse, 1 1/10-

1½ times as thick as the very thin part below, 0.070-0.100 mm long. Front and thoracic nota in adults with acute or partly with blunt hairs, ant. segment III with 1-3 of the dark hairs blunt, the pale hairs acute, or all hairs acute. All hairs on tibiae thin, wavy, with very fine apices, up to twice as long as local diameter of tibia. In fore wings basal vein (Cu_2), cubitus (Cu_1) and the unbranched part of media with distinct brownish borders. On *Quercus acutissima, Q. sp.* and in traps. China; Korea; Japan. (*T. tuberculatus* Richards).

T. fangi (Tseng & Tao)

53 (38) Pronotum without spinal processes. (If spinal processes on abd. tergites I and II are 2½-3½ times as long as their halfway width, go back to 45[44]). Spinal processes on abd. tergites I-III low, pale or with the 3rd pair slightly pigmented, mostly hardly longer than their basal width. Spinal hairs on abd. tergites I-V in embryos only about 1/5-1/3 as long as marginal hairs on corresponding segments. On *Quercus serrata, Q. mongolica grosseserrata, Q. dentata.* Japan; Korea. (*T. naracola* Matsumura, 1919 nec Shinji, 1941).

T. kashiwae (Mats.)

54 (37) Mesonotum usually dark, but if pale, then ant. segment III with conspicuous brown areas around the secondary, ciliate, rhinaria at mid-length; and all veins in fore wings ending in conspicuous dark triangles. Near-Eastern or Oriental species.

55 (60) Thorax pale or dark. Longest hair on ant. segment II twice or more times as long as longest hair on ant. segment III. Secondary rhinaria ciliate. Thorax without spinal processes. Pterostigma either largely dark at both ends with a colourless area from margin of wing to posterior border of stigma, or with a narrow brown border and a darker oblique basal stripe. Near-Eastern species. Subgen. *Camelaphis* subgen. nov.

56 (57) Fore wings with one very large irregular dark blotch consisting of the fused, very wide, brown, borders along all veins from sector radii to basal vein (Cu_2). Abdomen with 4 pairs of long spinal processes, and several pale short ones. On *Quercus infectoria.* Lebanon; Turkey; Iraq.

T. maculipennis spec. nov.

57 (56) Fore wings not maculated. Abdomen with two dark, or three largely pale pairs of spinal processes, with or without dark lateral processes.

58 (59) Mesonotum dark. Abdomen with very large dark marginal processes as long as the dark siphunculi, and with two spinal

pairs of dark processes on tergites II and III. On *Quercus sp.*. Turkey.

T. cornutus Richards

59 (58) Mesonotum pale. Abdomen without dark marginal processes, and with spinal pairs of largely pale processes on abd. tergites I-III, those on I being small. On *Quercus infectoria.* Lebanon; Turkey.

T. pallescens spec. nov.

60 (55) At least mesonotum dark. Longest hair on ant. segment II about as long as longest hair on ant. segment III. Secondary rhinaria ciliate or not. Thorax with or without spinal processes. Pterostigma always with a crescent-shaped, very thick, dark border along posterior margin, the rest pale. Spinal processes on abd. tergite I. Oriental species. Subgen. *Acanthocallis* Matsumura.

61 (66) Pronotum with an anterior and a posterior pair of spinal processes, mesonotum on posterior half with a pair of spinal processes.

62 (63) Not only on pterostigma long hairs, but most of surface of fore wings distad of Cu_2 with many scattered hairs. All veins in fore wings evenly broadly bordered over their whole length. Posterior part of vertex with 8-15 hairs (Richards, 1968 draws 6 hairs). Ant. segment III with some 16-28 very long, fine erect hairs of which some 10-16 point towards inner side. Embryos with dorsal hairs of some 0.080-0.110 mm long, with very fine apices. On various *Quercus spp.*. Japan; Korea. (*Myzocallis macrotuberculata* Essig & Kuwana).

T. quercicola (Mats.)

63 (62) On posterior margin of pterostigma long hairs but none on disc of fore wings. Veins in fore wings only at their bases faintly bordered. Posterior part of vertex with 4 hairs. Ant. segment III with some 7-13 hairs of which about half point inwards. Embryos with capitate or blunt dorsal hairs.

Complex of **T. japonicus** Higuchi.

64 (65) Embryos with strongly knobbed dorsal hairs, the knob to 3 times as wide as the thinnest part more basad. Dorsal hairs on femora and basal half of hind tibiae distinctly capitate, stiff. Frontal hairs capitate, their knobs about as long as wide, fully twice as thick as the thinnest part basad. Metanotum with two small, pale processes that are very strongly constricted at base. Siphunculi blackish with pale apical part, seemingly without spinules near apex. On *Quercus dentata.* Japan; Korea. In traps, Korea.

T. japonicus Higuchi

65 (64) Embryos with the apices of the dorsal hairs blunt, or knobbed to about 2 times the width of thinnest part more basad. Dorsal hairs on femora with very acute apices, on basal half of hind tibiae very fine, or stiff, acute, blunt, or a few just perceptibly capitate. Frontal hairs acute or with rounded apices, sometimes faintly capitate, but then the knob very elongate and ill defined. If metanotum has processes, these very small, not longer than their basal width. Siphunculi rather evenly pigmented, or if distad pale, then with distinct spinules. On various *Quercus spp.* India; Korea; Japan.

T. indicus L.K. Ghosh

66 (61) Neither pronotum nor mesonotum with spinal processes.

67 (68) Veins in fore wings with very broad, brown borders. Hind tibiae pale with brown base, middle and hind femora mottled brown with a distally sharply bordered pale band at distal 2/3 part. Ant. segment III with 12-24 rhinaria over most of its length, and some 13-21 fine, acute hairs of greatly varying length on inner side. On *Quercus phillyreoides, Q. sp.*. Formosa; Japan. (According to Tao, 1971, *Nippocallis lewi* Tao is synonym).

T. pilosus (Tak.)

68 (67) Veins in fore wings thin and not at all bordered. Pterostigma with thick blackish, crescent-shaped band on caudal side, which band does not touch anterior margin of wings. Hind legs, in sharp contrast to other legs, evenly black. Ant. segment III with 3-8 rhinaria on basal ½-¾ part, and 4-7 nearly all very long hairs on inner side. On various *Quercus spp.*. Japan; Korea; China. (*T. orientalis* Richards).

T. stigmatus (Mats.)

IV. Descriptions of the species

Tuberculatus africanus spec. nov.

Alate viviparous female.

Colour in life not known. Body in mounted specimens 2.05-2.55 mm long, pale with yellowish head and thorax. Dorsal hairs rather thin, nearly acute, stiff; spinal hairs on abd. tergite III about 0.022 mm long, and those on tergite VII similar, but the 8 hairs on tergite VIII up to 0.060 mm long, the lateral ones with fine apices. Spinal processes on abd. tergites I-IV all pale without darker apices, about 0.070, 0.074, 0.105, 0.074 mm long, respectively, all blunt and apparently

not scabous; those on tergites II and III more slender than the thickly conical ones on tergites I and IV; each process with one hair on top. Marginal processes on abd. tergites III and IV distad spinulosely imbricated, about 2/3 times as high as the spinal ones on tergite I, the others much lower. Front protruding in the middle, with a distinct little process half as tall as its basal width above the median ocellus. Frontal hairs beside this process acute, 0.025 mm long, the higher pair on small semiglobular processes, bluntish and only 0.016 mm long. Antennae rather thin, 9/10 of, to nearly as long as body; segments I and II distally brown; segment VI brown slightly basad and distad of the rhinaria; flagellum spinulose from base; segment III with 4-8 rhinaria on the slightly incrassate basal 1/3 - 4/9 part; processus terminalis 1 1/10 - 1 1/3 times as long as base of segment VI; longest hairs on ant. segment III 1/3 of basal diameter of segment. Rostrum short, reaching to midway first and second coxae; last segment with convex sides, blunt, with 2 lateral pairs of hairs and 3-5 ventral ones besides the 3 subapical pairs, about 0.110 mm long, shorter than second joints of hind tarsi (0.125 mm). Thorax pale, but two anterior pleural stripes vaguely indicated. Wings with veins thin, pale, but Cu_2, Cu_1 and sector radii basad thicker and much browner; stigma pale with a variable oblique brown basal fleck; veins not ending in dark triangles. Legs pale; femora at 3/4 of their length dorsally and ventrally slightly infuscated; tibiae with very vague brownish stripe from base; first tarsal joints ventrally mostly with 6, sometimes 5 hairs, dorsally with 2 hairs; second tarsal joints brown. Siphunculi tapering, 4/5 of last rostral segment, pale with distal 1/5 - 1/4 part on anterior face brown. Cauda faintly brownish; knob 1 1/3 - 1 1/2 times as wide as long, with some 15-17 hairs.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	2.19	2.12	0.72	0.42	0.39	0.20 + 0.23	6 & 6	0.09	0.14
2.	2.53	2.33	0.83	0.48	0.40	0.21 + 0.26	6 & 8	0.10	0.16
3.	2.44	2.25	0.79	0.47	0.40	0.19 + 0.25	5 & 5	0.10	0.15
4.	2.05	1.96	0.63	0.43	0.35	0.18 + 0.23	4 & 4	0.10	0.14
5.	2.36	2.19	0.77	0.45	0.39	0.20 + 0.23	4 & 6	0.10	0.15
6.	2.32	2.14	0.71	0.44	0.39	0.20 + 0.25	5 & 5	0.10	0.14
7.	2.38	2.26	0.75	0.47	0.39	0.22 + 0.25	6 & 7	0.10	0.14
8.	2.47	2.34	0.83	0.53	0.39	0.20 + 0.25	5 & 7	0.10	0.15

(1-8, from *Quercus canariensis* (*mirbecki*), Alger, Algeria, 17-IV-'64, leg. Pasquier: Remaudière no. A 1271).

Larvae.

In embryos spinal hairs on abd. tergites I-VIII irregularly increasing in length as follows: 0.006; 0.011-0.026; 0.011-0.039; 0.015-0.043; 0.016-0.043; 0.065-0.080; 0.074-0.080; 0.045-0.060 mm. Marginal hairs on tergites I-VII: 0.022-0.035; 0.060-0.067; 0.067-0.076; 0.069; 0.069-0.074; 0.067-0.070; 0.039-0.043 mm. On about tergite III or IV the marginal hairs reach the base of the second following hair, and the spinal hairs suddenly get much longer on tergite VI.

Last instar alatoid nymphs with the lower frontal hairs thick, 0.088 mm, blunt, the pair above 0.140 mm, slightly knobbed, the next higher pair 0.122 mm, the hairs on vertex about 0.085-0.095 mm. On abdomen spinal hairs thick and knobbed, increasing in length from 0.100 mm on tergite I to 0.150 mm on tergite VI; shorter pleural hairs of, e.g., 0.050 mm irregularly present on anterior abd. tergites. Hairs on ant. segment III as in alatae very short.

Discussion. *T. africanus* is so similar to *T. borealis* Krzywiec that specimens without embryos, or samples without old nymphs cannot with certainty be identified. But in embryos of *T. borealis* all the spinal hairs on abd. tergites I-VI are of about the same length, 0.002-0.006 mm, the marginal hairs on these tergites much shorter than in *africanus*: 0.014-0.016; 0.026-0.039; 0.030-0.046; 0.030-0.050; 0.046-0.060; 0.046-0.060 mm long. The greatest difference is in last instar alatoid nymphs. In *T. borealis* these larvae show all the spinal hairs on abd. tergites I-VI very short and at first glance absent, but two pairs of frontal hairs and all the marginal hairs are long, thick and knobbed. In alatoid nymphs of *T. africanus,* of which two specimens were submitted, the spinal hairs and those on vertex are all about as long as the marginal hairs. *T. eggleri* can easily be separated from *T. borealis* and *T. africanus* when embryos are available, but the alatoid nymphs of *T. eggleri* are very similar to those of *T. africanus.*

Dr. G. Remaudière, who submitted the measured material, kindly allowed me to include it in this paper.

Types. Holotype: Alate viviparous female (no. 5 of measurements), from *Quercus mirbeckii* (= *Q. canariensis*), Agric. Inst. of Algeria, Alger or Algiers, Algeria, 17-IV-'64, leg. R. Pasquier, collection no. Remaudière A 1271. Paratypes: alate viviparous females and nymphs with collecting data as for holotype, mostly in the collection of Dr. G. Remaudière, Paris.

Tuberculatus albosiphonatus spec. nov.

Alate viviparous female.

Colour in life not known. Body in mounted specimens about 1.15-1.65 mm long, pale. Dorsal hairs thin, nearly acute, on abdominal tergite III about 0.008-0.012 mm long, the 6-8 on tergite VIII about 0.016 (lateral ones) to 0.020 (middle pair) mm long. Spinal processes on abdominal tergites I-III pale but those on tergite III with brownish distal part; those on tergite I about 0.040 mm long, much more slender than the equally long, very thickly conical pair on tergite II; processes on tergite III about as long as their basal width, about 0.080 mm, conical with slightly concave sides, blunt, faintly rough; lateral processes on tergites II and III about as large as spinal processes on tergites I and II, lateral processes on tergites I and IV very low, like the others scabrous. Front protruding in the middle but not with a distinct tubercle above the ocellus; lower frontal hairs about 0.022-0.035 mm long, acute, not stiff, the more dorsal pairs stiff, bluntish, 0.013-0.017 mm long, placed on conspicuous semiglobular processes about as tall as the hairs on top. Antennae thin, 3/4 of, to nearly length of body; segments I and II apically brownish; flagellum pale with the apical parts of III-V, and distal half of base of VI blackish; flagellum conspicuously spinulose from base; segment III with 1-4 round rhinaria on basal 1/5 - 1/3 part, near the most distal one more or less vaguely brownish pigmented but paler brown than the apical parts of segments I and II; hairs on segment III thin, less than half basal diameter of the segment; processus terminalis shorter than basal part of segment VI. Rostrum short, reaching just past anterior margin of mesosternum; apical segment short and blunt, with convex sides, 2/3 of the length of second joint of hind tarsi, with one lateral and one dorsal pair of hairs besides the 3 subapical pairs. Thorax pale, apparently even without the usual brown pleural stripes on pronotum. Wings with extremely thin, colourless veins; stigma pale, at base with a conspicuous brown spot, distally very faintly tinted; Cu_2 and sector radii slightly pigmented at their bases. Legs pale with femora dorsally and ventrally infuscated at 3/4 of their length; articulating part of hind tibiae dark brown; tarsi brown; first joint with 6-7 ventral hairs and 2 dorsal ones. Siphunculi slightly tapering, nearly as long as their basal width,

about half as long as second joints of hind tarsi, nearly smooth, flangeless, not pigmented or only on the inner side of the rim. Cauda pale, with the knob just wider than long, with 14-16 hairs.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	1.21	1.19	0.35	0.23	0.22	0.15 + 0.13	2 & 2	0.04	0.11
2.	1.43	1.23	0.38	0.26	0.23	0.13 + 0.11	3 & ?	0.04	0.12
3.	1.15	1.07	0.30	0.21	0.20	0.13 + 0.12	3 & 3	0.04	0.11
4.	1.47	1.28	0.37	0.26	0.23	0.14 + 0.13	2 & 3	0.05	0.12
5.	1.30	1.16	0.36	0.22	0.22	0.13 + 0.12	2 & 2	0.04	0.12
6.	1.57	1.25	0.40	0.25	0.22	0.14 + 0.13	2 & 3	0.04	0.14
7.	1.72	1.35	0.43	0.28	0.26	0.15 + 0.13	3 & 4	0.04	0.14
8.	1.38	1.24	0.37	0.26	0.23	0.14 + 0.13	2 & 2	0.04	0.12
9.	1.62	1.20	0.37	0.23	0.23	0.14 + 0.12	2 & 3	0.04	0.11

(1-8, from *Quercus sp.*, Salahuddin near Shaqlawah (Kurdistan), Iraq, 10-VIII-1968, leg. P. Stary no. 12037 B; 9, from *Quercus sp.*, Sulaymaniyah (Kurdistan), Iraq, 24-IX-'66, leg. Matthur, no. C.I.E. A. 1371).

Larvae.

In embryos marginal hairs stiff, faintly knobbed, on segments I to VII 0.006; 0.008; 0.009; 0.010; 0.013; 0.015; 0.035 mm long, therefore on tergites II-V about half as long as the distance to the nearest hair. Spinal hairs on tergites I-VII about 0.002-0.004 mm long, mostly hardly visible when erect, blunt. Lower frontal hairs (one pair) thick but not at all knobbed, about 0.040 mm long.

Older and alatoid nymphs frontally with one upper pair of 0.060-0.070 mm long, tapering, blunt hairs on semiglobular processes, and one lower pair of similar, 0.060 mm long hairs, not on processes. Ant. segments I and II each with a faintly knobbed hair of about 0.016 mm, but flagellum with hairs as in alate. Marginally on abdomen on each segment stiff hairs, not knobbed, increasing in length from 0.030 on segment I to 0.052 on segment VI, to 0.085 on segment VII, mostly with in addition 1-2 shorter hairs; however, spinal hairs seemingly absent on tergites I-VI, only 0.004-0.008 mm long. Siphunculi with indistinct, thick brownish flange. Articulating part of hind tibiae conspicuously brown.

Discussion. Dr. P. Stary collected a sample from an unidentified *Quercus* in Iraq. A slide received for identification contained no embryos, and therefore identification was impossible. Dr. J. Holman then

sent me the unmounted parts of the sample. This was cleared once more and mounted. When several slides had been made, embryos were examined. Two kinds were found, both with very short spinal hairs, but differing in the length of the marginal hairs, long in one, short as in *T. albosiphonatus* in the other. Only then it was noticed that two extremely alike *Tuberculatus* were present in the sample, in about equal numbers, both with usually a brownish spot at basal 1/4 of ant. segment III, the same pigmentation of wings, and the same size of body. But one had the siphunculi darkened on distal half, and a longer and more acute last rostral segment with more hairs. Sorting on pigmentation of siphunculi caused no errors. The larvae were identified by their last rostral segments. The species with the pigmented siphunculi in alatae is thought to be *T. moerickei.*

One specimen was submitted for identification by Dr. Eastop, British Museum (Nat. Hist.), London. The locality on the label was Solaimaniya, but this probably is what the Times Atlas has as Sulaymaniyah in Kurdistan. On a label the colour in life is mentioned as light green. The interrelation antennae: body differs from the others because the body is much extended through a different mounting technique.

In structure of embryos this species resembles *T. neglectus* Krzywiec and *T. borealis* Krzywiec. In both marginal hairs are longer, markedly knobbed, and on thick bases. Adult *borealis* differ by having four pairs of spinal processes and longer last rostral segment, adult *neglectus* by their much longer, markedly pigmented siphunculi and longer processus terminalis. Though both have a brownish spot in the pterostigma, it differs little in pigmentation from the distal margin of the stigma, whereas in *T. albosiphonatus* this spot is sharply bordered dark brown, the rest nearly colourless.

Types. Holotype: alate viviparous female (no. 4 of measurements), from *Quercus sp.,* Salahuddin near Shaqlawah (Kurdistan), Iraq, 10-VII-1968, leg. P. Stary no. 12037 B. Paratypes: alate viviparous females and some larvae, with collecting data as for holotype. These paratypes partly in the collection of Dr. J. Holman, Prague; one alate viviparous female from *Quercus sp.,* Solaimaniya, 24-IX-'66, leg. Matthur, in British Museum (Nat. Hist.), London; one alate viviparous female in a slide with one alate of *T. moerickei* n. sp., from *Quercus infectoria,* Germik, Iraq, 12-V-'71, leg. UNDP/FAO IR 38.

Tuberculatus borealis Krzywiec, 1971

This species, originally described from *Quercus robur* and *Q. petraea,* appears to infest a few other species of *Quercus* as well. Dr. V.F. Eastop collected it from *Q. grosseserrata* in Kew Gardens, England. Dr. R. van den Bosch found it together with *Tuberculatus eggleri* on *Q. cerris* near Rome. In the Netherlands I found large numbers on *Q. pseudoturneri* in the Zoological Gardens « Blijdorp » at Rotterdam. The species is rather variable. Though it should have spinal processes on abd. tergites I-IV in alatae, the pair of processes on tergite IV is often very small and apparently sometimes completely absent, but not in fundatrices. The embryos constantly show very short spinal hairs, 0.002-0.006 mm long, on abd. tergites I-VI, but the length of the marginal hairs on tergites I-V shows great variation, though not among embryos within the same mother. In some embryos the marginal hairs on abd. tergite II are only 2/7 as long as the distance to the following hair, in others they are nearly as long as that distance. Sometimes marginal hairs on tergites IV and V are shorter than those on tergites II and III. There is no correlation between the length of the marginal hairs on tergites I-IV in embryos and the development of the spinal processes on abd. tergite IV in their mother.

Siphunculi in alatae are very often completely pale and only few specimens were seen in which the apices of the siphunculi were more or less pigmented.

By the colour of the siphunculi and the chaetotaxy of the embryos it is always possible to distinguish alatae with spinal processes only on abd. segments I-III from *Tuberculatus annulatus* (Htg.) and *T. alhosiphonatus* spec. nov. The latter species also differs by having the processus terminalis just shorter than the basal part of ant. segment VI, whereas in *T. borealis* the processus terminalis is always just longer than the base of ant. segment VI.

Differences from *Tuberculatus africanus* spec. nov. are mentioned in the discussion of that species.

Tuberculatus capitatus (Essig & Kuwana, 1918)

The original desciption mentions that two pairs of large, dorsal, finger-like tubercles bearing spines occur on the pronotum, three long pairs on the abdomen, but: « mesothorax with many small tubercles

supporting each such a spine ». This would seem to mean that the mesonotum has no spinal processes. Also HIGUCHI (1969), after studying cotypes, according to his acknowledgements from the California Academy of Sciences collection, keys and describes *capitatus* as having no spinal processes on the mesonotum.

However, RICHARDS (1968) in his description of *capitatus* states: « meso- and meta-notum each with a pair of finger-like tubercles ». This is of more than usual importance because Richards selected a lectotype from the cotypes.

Dr. P. H. Arnaud kindly sent me a cleared slide from the collections of the California Academy of Sciences labelled left: « (Kunugi) / *Quercus* / *serrata* Thunb. / Tokyo, Japan / May 26, 1913 / S.I. Kuwana », and right: « 63 / *Myzocallis* / *capitata* / Essig & Kuw. / cotypes » in black ink, « Holotype » in red ink, and « Essig » printed in blue. There are two alatae and two alatoid nymphs in the slide. In the alatae there is no trace of spinal processes on the mesonotum, and the thick hairs on the mesonotum are placed singly on small tubercles, as described by ESSIG & KUWANA (1918).

From the Essig collection in the Entomology Division of the University of California, Berkeley I could borrow a number of cotypes among which alatae remounted by Dr. Richards (« rem't Richards '67 »). None had a processus on the mesonotum.

I do not know whether perhaps an other specimen labelled « lectotype » exists in which spinal processes are present of the kind described by Richards. Such a lectotype with finger-like processes on the mesonotum would not agree with the original description. I was informed by the Scientific Assistant of the International Commission on Zoological Nomenclature that a lectotype which does not agree with the original description could only be set aside by the Commission using its plenary powers.

PAIK (1965) records this species from Korea from *Quercus acutissima* and *Q. variabilis*. Some samples from *Q. acutissima* used for his book are available, and they key to *Tuberculatus fangi* (Tseng & Tao) which was also received from Korean Moericke traps. However, figure 37 in Paik's book relates to *T. capitatus*.

One trapped alata from Korea clearly belongs to *T. capitatus,* but it differs from all other material that I have examined. I make this the type of a subspecies which can be distinguished as follows:

1 (2) Spinal hairs on abd. tergites II-VI in embryos 0.030-0.060 mm long, not or hardly crossed. Ant. segment III with 2-6 rhinaria over less than basal half, its longest hairs to nearly twice as long as basal diameter of the segment. Dorsal hairs on basal half of hind tibiae stiff, subacute, blunt or with faintly incrassate apices. Certainly on *Quercus variabilis* and *Q. serrata,* probably also on other *Quercus spp.* Korea; Japan; ? China.

T. **capitatus** (Essig & Kuwana) sensu stricto

2 (1) Spinal hairs on abd. tergites II-VI in embryos 0.050-0.085 mm long, markedly crossed. Ant. segments III with 5-7 rhinaria covering slightly more than basal half, its longest hairs to 2 2/3 times basal diameter of the segment. Dorsal hairs on hind tibiae distinctly capitate over nearly whole length of hind tibia. In trap. Korea.

T. **capitatus** subspec. **intermedius** subspec. nov.

A detailed description is not given because it would merely repeat those given by RICHARDS (1968) and HIGUCHI (1969).

T y p e s. Holotype of *Tuberculatus capitatus* subspec. *intermedius* subspec. nov.: Alate viviparous female, from Moericke trap, Suwon, 1-10-VI-'67, leg. W.H. Paik.

Tuberculatus eggleri Börner, 1950

Börner described the aphid as *Tuberculoides eggleri* from *Quercus lanuginosa* (*pubescens*). A considerable number of samples from this host is available. Other samples came from *Quercus petraea, Q. cerris, Q. suber* (one specimen), and allegedly from *Q. tozza* and *Q. pedunculata?* (*robur*).

Some specimens from *Quercus aegilops* collected in Turkey distinctly show small spinal processes on abd. tergite V, and small hair-bearing elevations spinally on tergites VI and VII. Besides, the posterior spinal hairs on the pronotum stand on semiglobular elevations. It is possible that another taxon is involved but the material is too small for a decision. Slightly less marked spinal processes on tergite V are also present in two specimens of a rather large sample of fundatrices from *Quercus pubescens* from Cavtat, Yougoslavia.

The embryos in the available material show some variation in the length and thickness of the spinal hairs. In some these hairs on abd. tergite I are half as long and slightly more than half as thick as those

on tergite II, but in other samples the spinal hairs on tergite I are almost as thick as those in tergite II, though hardly more than half as long. The absolute length of all spinal and marginal hairs also varies somewhat between samples, but the differences cannot be associated with special host plants or special regions.

Tuberculatus fangi (Tseng & Tao, 1938)

Specimens of a *Tuberculatus* closely agreeing with the original description are available from *Quercus acutissima,* Korea, and from traps from Korea. A few specimens from Tokyo, Japan, were also examined.

From the careful description by RICHARDS (1968) it would seem that his *Tuberculatus tuberculatus* of 1968 is identical with *T. fangi* (Tseng & Tao). I therefore consider *Tuberculatus tuberculatus* Richards, 1968 a synonym of *Tuberculoides fangi* Tseng & Tao, 1938, transferred to *Tuberculatus.*

Dr. F.W. Quednau drew my attention to the description of *T. fangi.* Tao (1964) lists *T. fangi* as a synonym of *quercicola* Mats. but the original descriptions do not agree. Re *quercicola* vide p. 35.

Tuberculatus fulviabdominalis (Shinji, 1941)

Shinji under this name draws a *Tuberculatus* with 11 or 12 hairs on the inner side of antennal segment III, with both the hind femora and hind tibiae dark or black, with 3 pairs of dark spinal processes on the abdomen of which the 3rd are very thick and with a thick, crescent-shaped band on the caudal side of the pterostigma. His measurements show that the processus terminalis is 1,2 times as long as the basal part of ant. segment VI.

These data do not agree with the material from Japan and Korea that keys to *T. fulviabdominalis* with the keys in HIGUCHI (1969). For in those aphids the hind tibiae are only dark near base, the processes on abd. tergite I are always pale, even if those on II and III are black, while ant. segment III has only 3-5 hairs on inner side, of which 3-4 are very long. Only *T. pilosus* Tak. has the hairs on antennal segment III rather like Shinji's figure on p. 369. But that has broadly banded veins in the wings, and a pale portion at about 3/5 of the length of the femora, though the pigmentation of the stigma agrees.

As no material was seen that agrees with all characters of Shinji's *fulviabdominalis,* the name is not used in the key. Specimens wholly

agreeing with HIGUCHI'S (1969) key and description are to be found under the name *T. indicus* L.K. Ghosh.

Tuberculatus higuchii spec. nov. sensu latiore

Alate viviparous female.

Colour in life not known. Body in mounted specimens 1.85-2.10 mm, or 2.50-2.70 mm (subspecies) long, pigmentless with faintly yellowish head and thorax, the latter with brown pleural stripes, and with slightly brown apices to the pair of spinal processes on abd. tergite III. Dorsal hairs more or less knobbed, the longest spinal hairs on mesonotum 0.055-0.065 mm, or 0.025-0.035 mm (subspecies) long. Pronotum only with a posterior pair of spinal processes, much longer than their basal width, or as long as their basal width (subspecies); mesonotum without spinal processes; abdomen with three pairs of spinal processes on tergites I-III, and rarely a very low pair on tergite IV; processes on tergite I about 0.125-0.150 mm long, those on tergite II the same length, those on tergite III mostly shorter; pale but those on tergite III more or less distinctly with infuscated apex; slender and tapering with one apical hair, or thicker and more blunt with two subapical hairs and usually an additional hair more basad (subspecies). Median frontal tubercle hardly developed. Frontal hairs on large sockets and these on processes to 0.017 mm high; antenniferous tubercles well developed, as high as the foundation of a frontal hair; frontal hairs about 0.100-0.110 mm long, less capitate than with dilated apices. Antennae pale with distal 2/9 part, or 1/10 part (subspecies), of segments III, the tips of IV-V and the part around the rhinaria on VI blackish brown, shorter than body; segment III with 2-6 elevated rhinaria in a row on basal 1/3 - 1/2 part, with 2-4 hardly capitate, rather thin inconspicuous hairs in the available material at most up to a little over half as long as basal diameter of the segment, and not placed on a suddenly thickened part of the segment; therefore inner profile of the segment evenly curved or straight; processus terminalis about 1 1/2, or 1 1/20-1 1/5 (subspecies) times as long as basal part of segment VI. Rostrum short, reaching to a little past anterior margin of mesosternum; apical segment rather acute with slightly convex sides, as long as second joint of hind tarsi, with 4-6 long hairs besides the 3 subapical pairs. Fore wings with thin, pale brown, not bordered veins, and very pale brownish stigma. Femora pale; tibiae much darker, evenly pale brown,

dorsally with blunt or hardly capitate hairs 1/2 - 3/4 times as long as local diameter of tibia; first tarsal joints with 5, exceptionally on a leg 6, ventral hairs and 2 dorsal ones. Siphunculi rather long and slender, longer than last rostral segment, with rather well developed flange, colourless with distal 1/5 - 1/2 dark brown, somewhat ringed near apex and there on the underside slightly spinulose. Cauda pale, with the knob slightly wider than long, with about 12-14 hairs.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	2.05	1.87	0.55	0.38	0.32	0.20 + 0.29	5 & 5	0.12	0.13
2.	?	1.68	0.48	0.31	0.30	0.19 + 0.28	4 & 5	0.11	?
3.	1.87	1.83	0.52	0.36	0.33	0.20 + 0.30	3 & 4	0.10	0.13
4.	2.48	2.34	0.75	0.47	0.41	0.25 + 0.30	4 & 5	0.12	0.16
5.	2.61	2.42	0.73	0.51	0.43	0.28 + 0.32	4 & 6	0.12	0.16
6.	2.68	?	?	?	?	?	?	0.13	0.18
7.	2.58	2.40	0.79	0.46	0.45	0.26 + 0.28	4 & 5	0.12	0.18
8.	2.57	?	0.93	0.44	0.44	0.24 ?	3 & 5	0.12	0.18

(1-3, from *Quercus mongolica grosseserrata*, Mt. Yatsugatake, Japan, 29-VII-1967, leg. H. Higuchi no. a 284; 4-5, from *Quercus sp.*, Ônuma, Japan, 17-VI-1967, leg. H. Higuchi no. a 35; 6-7, from *Quercus mongolica*, Ônuma, Japan, 16-VI-1967, leg. H. Higuchi no. a 13; 8, from *Quercus serrata*, Mt. Iwawaki, 28-VI-1959, leg. R. Takahashi. Nos. 1-3 are *T. higuchii* sensu stricto, nos. 4-8 are *T. higuchii* subsp. *breviunguis*).

Larvae.

Embryos with long, thick, strongly knobbed spinal and marginal hairs. Marginal hairs on abd. tergites I-VII 0.042; 0.060; 0.071; 0.80; 0.074; 0.075; 0.038 mm long. Spinal hairs on these tergites 0.025-0.042; 0.025-0.042; 0.035-0.042 0.050-0.067; 0.071-0.076; 0.088-0.097 mm long, the variation in length of spinal hairs partly because they stood at an angle to the horizontal. All measurements relate to embryos in the holotype of *T. higuchii* sensu stricto.

Discussion. It looks as if the complications in the *yokoyamai* group of *Tuberculatus* to which this species belongs are comparable to those in the Western Palaearctic subgenus *Tuberculoides* van der Goot. The available material of *T. higuchii* can be divided as follows:

1 (2) Spinal processes on abd. tergites I-III slender, rather pointed, bearing one hair, on the top. Processus terminalis about 1 1/2 times as long as basal part of ant. segment VI. Longest spinal hairs on meso-

notum about 0.055-0.065 mm long, their knob nearly twice as thick as thinnest part more basad. On *Quercus mongolica grosseserrata.* Japan. Korea.

T. higuchii nov. spec. sensu stricto

2 (1) Spinal processes on abd. tergites I-III thicker and more blunt, with 2 hairs on or near the top and motly one hair more basad. Processus terminalis 1-1 1/5 times as long as basal part of ant. segment VI. Longest spinal hairs on mesonotum 0.025-0.035 mm, slightly capitate. On *Quercus mongolica* and *Q. serrata.* Japan.

T. higuchii subsp. **breviunguis** subsp. nov.

Only of the main species the embryos could be examined, for apparently they had been removed from the others.

The present species and subspecies evidently have been confused with *T. yokoyamai* Tak. Dr. Takahashi sent one slide, from *Quercus serrata,* identified as *T. yokoyamai,* but this contained one *T. kashiwae* Mats. and one *T. higuchii* subsp. *breviunguis* subspec. nov. Both the main species and the subspecies were clearly used for the description of *T. yokoyamai* by HIGUCHI (1969) according to some slides which Dr. H. Higuchi kindly sent at my request. One unidentified slide of the latter collection held one *T. kashiwae* and one *T. higuchii* subsp. *breviunguis.* The sample from Ônuma, mentioned by HIGUCHI (1969, p. 121) consisted of the subspecies *breviunguis* and it shows a shorter processus terminalis than mentioned by HIGUCHI (1969). On the other hand the 3 examined specimens from Mt. Yatsugatake show only one hair on the spinal abdominal processes.

The short processus terminalis in the subspecies might suggest that the specimens are fundatrices of the main species, or of one of the other members of the group mentioned on p. 23. However, the dates of collecting, 16-VI, 17-VI and 28-VI make this very improbable.

With the available literature *T. higuchii,* like several other species, keys to *T. yokoyamai.* It seems likely that further work on this group of species, of which I have not nearly enough material, will reveal more taxa. Besides *T. kashiwae* Mats., which differs by the absence of spinal processes on the pronotum, but which certainly is very closely related, we now know also *T. yokoyamai* (Tak.), *T. konaracola* Shinji, *T. paranaracola* sp. nov., *T. paiki* sp. nov., *T. higuchii* sp. nov., and *T. querciformosanus* Tak. which belong in this species-complex. With the key to species it should not be particularly difficult to identify these species.

Some remarks concerning the nomenclature are to be found in the discussion on *T. paranaracola* on p. 76.

The present species is named for Dr. H. Higuchi who provided nearly all the material, and who by his 1969 paper, comments, and specimens of other Japanese species, gave invaluable help.

Types. Holotype of *T. higuchii* spec. nov. sensu stricto: alate viviparous female (no. 1 of measurements), from *Quercus mongolica grosseserrata,* Mt. Yatsugatake (Yamanashi Pref.), Japan, 29-VII-'67, leg. H. Higuchi no. a 284. Paratypes of the main species: two alatae and alatoid nymphs with data as for holotype.

Holotype of *breviunguis* subspec. nov.: alate viviparous female (no. 4 of measurements) from *Quercus sp.,* Ônuma (Hokkaido), 17-VI-'67, leg. H. Higuchi no. a 35 (in slide with *T. kashiwae* Mats.). Paratypes: three alatae from *Quercus mongolica* (*grosseserrata* according to Higuchi, 1969), Ônuma, (Hokkaido), 16-VI-'67, leg. H. Higuchi no. a 13; one alate from *Quercus serrata,* Mt. Iwawaki (Osaka), 28-VI-'59, leg. R. Takahashi (in slide with *T. kashiwae* Mats.).

Tuberculatus indicus L. K. Ghosh, 1972

This name is here introduced for the species which HIGUCHI (1969) described as *Tuberculatus fulviabdominalis* Shinji, 1941. As stated on pp. 35-36, the species is very nearly related to *T. japonicus* Higuchi but differs as mentioned in the key.

Material is available from India, Korea, and Japan. As one might expect over such a large range, the species varies in some respects, notably in the structure of the hairs. One extreme is a sample collected by Dr. R. van den Bosch on Mt. Kongo near Osaka, Japan, on 29-V-'64. All the hairs on ant. segment III have very acute apices, and all the hairs on the femora and tibiae are wavy with extremely fine apices. the embryos have long, but distinctly knobbed dorsal hairs, with the hairs just widen a little towards the apex. Alatoid last instar nymphs have the dorsal hairs with widened apices, like the antennal hairs, but femoral and tibial hairs as in alatae. The other extreme is the type specimen from Assam, India. The hairs on ant. segment III have very faintly knobbed apices, some dorsal hairs on the tips of the femora and the bases of the tibiae are blunt and very faintly knobbed, and the embryos have long, but distinctly knobbed dorsal hairs, with the

knob balloon-shaped and twice as thick as the thinnest part of the shaft of the hair, which is thin. That looks like subspecies.

However, material from *Quercus alienus* and *Q. acutissima,* as well as from traps from various localities in Korea bridges the gap between the mentioned Japanese and Indian material if all specimens are considered.

In only two other respects does the large Indian type specimen differ from the many available Japanese and Korean specimens. Antennal segments III have 7 and 10 rhinaria over about the whole length of the segment, while my Japanese and Korean specimens show 3-7, mostly 5 or 4 rhinaria on basal 7/10 of the segment, just as HIGUCHI (1969) mentions for his *fulviabdominalis*. Besides, its siphunculi seem to be pale, while in the other specimens they are somewhat darkened, either only on basal half, or completely. These differences still seem too small to create subspecies for the Korean and Japanese specimens.

Tuberculatus kashiwae (Matsumura, 1917)

The species has been recognized by a recent author (HIGUCHI, 1969), and it can easily be recognized by the pale colour and the absence of spinal processes on the thorax. Sometimes specimens have been misidentified as *kashiwae,* vide p. 77 sub *paranaracola* spec. nov..

Myzocallis naracola Matsumura, 1919 is used for an aphid in SHINJI'S (1941) Japanese book on aphids. But the name seems to have been applied wrongly. Matsumura does not mention spinal processes for his aphid. This became understandable when I could examine specimens identified by Matsumura as *naracola* without further data, mounted in a slide which Dr. Higuchi most kindly allowed me to examine. The specimens are in very poor condition, but in one without abdomen I could find the right-side posterior spinal hair on the pronotum, which is not placed on a process or tubercle. This, combined with the very low spinal processes on the abdomen, and the structure and chaetotaxy of what is left of the antennae, makes it possible to identify *naracola* with *kashiwae* as described and illustrated by HIGUCHI (1969).

Consequently *Myzocallis naracola* Matsumura, 1919 is made a synonym of *Myzocallis kashiwae* Matsumura, 1917, transferred to *Tuberculatus.*

Tuberculatus konaracola (Shinji, 1941) (fig. 13, p. 58)

Alate viviparous female.

Colour in life not known. In mounted specimens head and body pallid, except a pair of pleuro-marginal light brown stripes on pronotum, blackish brown spinal processes placed on an equally dark sclerite on abd. tergite III, and the black distal 3/5 - 1/2 part of the pale siphunculi. On pronotum one pair (0.035-0.074 mm long) of pale spinal processes, on abd. tergite (fig. 13) I a pale pair (0.135-0.140 mm long), on tergite II a pale pair (0.115?-0.120 mm long), on tergite III two completely blackish ones (0.130-0.160 mm long), and on tergite IV a low pair with dark apical part (0.030 mm long). Frontal tubercles surpassing the median frontal process. Frontal hairs stout, 0.100 mm long, 4-4½ times basal diameter of ant. segment III, knobbed (knob 1 1/2-2 1/4 times as thick as part below), their stout sockets on processes as long as wide; hairs on vertex slightly knobbed, 0.022-0.028 mm long. Antennae shorter than body, pale; segment I on outer side infuscated, segments III-V with apicad longer blackish brown apices, segment VI with pale base and processus terminalis; flagellum from distal 1/3 part of segment III apicad gradually more distinctly imbricated, with dispersed inconspicuous spinules on the imbrications; segment III with 4-7 round, apparently not-ciliate rhinaria in a row over 1/2 - 3/4 of its length, and on inner side with 3-4 thick, capitate hairs, each on an elevated part of the segment, and at an angle of 45 - 60°; longest of these hairs 0.030-0.037 mm long, 1 1/6-1 7/10 times basal diameter of the segment. Last rostral segment 0.104-0.110 mm long, about as long as second joint of hind tarsi, with 6 long, fine hairs besides the 3 subapical pairs. Wings with normal venation, media and sector radii almost colourless in comparison to the dark brown, narrowly bordered Cu_1 and basal vein (Cu_2). Fore femora mottled brownish, other femora paler; tibiae all much darker than femora, fore tibiae rather dark brown, middle and hind tibiae with brown, apicad narrower and paler longitudinal stripes; first tarsal joints with 6 ventral and 2 dorsal hairs. Siphunculi as long as second joint of hind tarsi, pale with distal half blackish, rather slender, tapering, on the dark part with transverse rows of spinules, with hardly indicated flange. Cauda pale, with the knob probably wider than long.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	2.38	2.08	0.64	0.35	0.37	0.20 + 0.36	4 & 5	0.12	0.14
2.	2.78	2.22	0.66	0.46	0.36	0.19 + 0.38	7 & 7	0.13	0.14

(from yellow traps, Suwon, Korea, leg. W.H. Paik; no. 1, 11-X-'66; no. 2, 17-X-'67).

Larvae.

Embryos inside alate no. 2. All dorsal hairs long and markedly knobbed. Spinal hairs on abd. tergite I: 0.028; on II: 0.060; on III: 0.060; on IV: 0.060; on V: 0.065; on VI: 0.080; on VII: 0.080; on VIII: 0.060 mm long.

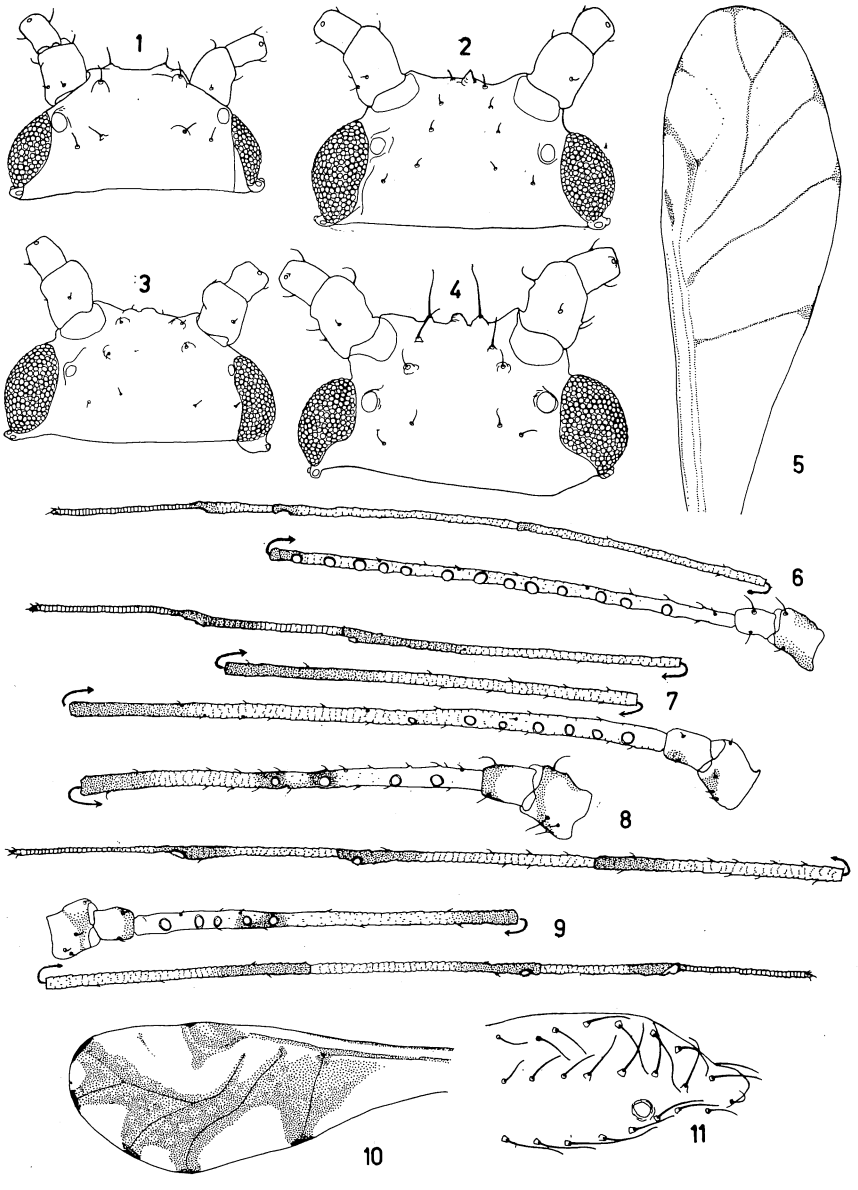
Discussion. If one applies the very practical keys to the alate females of *Tuberculatus* of Japan by HIGUCHI (1969, 1972), it appears that six distinct taxa in my collection all run to *T. yokoyamai.* Some of these are discussed on p. 77. The present species differs by its conspicuous black third pair of spinal processes on tergite III. Dr. H. Higuchi wrote to me that such a species had not yet been refound in Japan. Dr. W.H. Paik kindly sent me a translation of the (Japanese) description of *Tuberculoides konaracola* Shinji, 1941. Shinji writes that the third pair of dorsal processes on abdomen is dark or black in contrast to the pale ones on tergites I and II, and that the siphunculi have the colour of the body. In the latter respect the description differs markedly from my material. But Dr. H. Higuchi to whom I sent one of the specimens, wrote that in the key to species in SHINJI (1941) the siphunculi are stated to have dark distal halves. It seems, therefore, probable that what I describe here is really Shinji's species. But his description also states that the tibiae have blackish tips. One of the conspicuous features of *konaracola* is that the tibiae are very much darker than the femora, but paler towards the tips. Shinji writes that ant. segment III has 5-6 small rhinaria, but his fig. 140 shows 4 large ones. He does not mention processes on the pronotum though they are very distinct. According to HIGUCHI (1972) Shinji mentions *Quercus serrata* as host of his species. He left no material. Therefore a neotype has been chosen.

Types. Neoholotype: alate viviparous female (measurements no. 2), from yellow Moericke trap, Suwon, Korea, 17-X-'67, leg. W.H. Paik. Neoparatype: like neoholotype but trapped 11-X-'66.

Tuberculatus maculipennis spec. nov. (figs. 1, 6, 10, 12; pp. 54, 58)

Alate viviparous female.

Colour in life « greyish with pale appendages. Greyish appearance comes from waxy dusting. Highly tuberculate on abdomen. Tubercles are dark. Wings are strongly pictured » (Dr. R. van den Bosch). Body in mounted specimens about 1.75-2.00 mm long, with dark brown clouded head and prothorax, blackish brown mesothorax; abdomen (fig. 12) with anterior spinal, pleural and marginal processes blackish brown, posterior ones pale; brownish siphunculi, and pale cauda. Dorsal hairs rather numerous, rather thin but stiff, blunt with faintly incrassate apex, of various lengths, from about 0.030-0.105 mm long. Abdominal tergites I-IV with blackish brown spinal processes; on tergite I elongated mammiform, nearly smooth, about 0.065 mm long; on tergites II-IV cylindrical, about 0.035-0.045 mm thick, and about 0.075, 0.100 and 0.110 mm long, respectively, all with transverse rows of spinules on anterior surface and, like those on tergite I, all with 2 hairs of 0.016-0.025 mm long on or near top; tergites V, VI and VII with pale, spinal processes 0.050-0.025 mm in height but seemingly taller because of large sockets of one long (0.10 mm) and one mostly shorter (0.035) hair on each of them; parallel to these processes on each side a row of pleural hairs increasing from tergites I-V from 0.020-0.080 mm, even longer on tergite VI, to 0.095 mm; some of these hairs may be duplicated; between these and the marginal processes on tergites II-IV spinulose, dark brown, pleural processes about 0.035-0.050 mm high, with one hair of 0.018 (on II) - 0.045 (on IV), and more caudad paler to pale, smooth, smaller processes with hairs up to 0.080 mm on top; tergites II-IV with blackish brown marginal sclerites, each caudad gradually turning into a spinulose, thick, slightly flattened marginal process, more or less saddle-shaped; distance from anterior edge of marginal sclerite on tergite IV to tip of process about 0.140 mm, the ones on tergite II and III smaller; marginal sclerites of tergite III by a sclerotic extension linked with pleural processes; each of these marginal processes with 2 hairs of 0.035-0.055 mm on top; tergite V with half-pale, nearly smooth, dome-shaped, processes about 0.040-0.045 mm high, each with a hair of about 0.10 mm on top; caudad these marginal processes pale, smooth and smaller, with long hairs; tergite VIII with



Figs. 1-11. *T. maculipennis* spec. nov.: 1, head; 6, antenna; 10, wing. *T. maximus* spec. nov.: 2, head; 7, antenna. *T. moerickei* spec. nov.: 3, head; 9, antenna. *T. pallescens* spec. nov.: 4, head; 5, wing; 8, antenna; 11, dorsal chaetotaxy of embryo. 5 and 10, x 47; 11, x 70; others x 77.

one wide, very flat, spinal process bearing in all specimens 3 hairs 0.045-0.075 mm long, a pleural pair of small conical processes with each one hair of up to 0.105 mm, and a marginal pair each with one, rarely 2 hairs of up to 0.105 mm long; in total with 7 or in some specimens 8 hairs. Front (fig. 1) without a median process; hairs besides median ocellus to 0.065 mm long, the pair above similar, the pair higher up like the next pair and the 4 hairs between the eyes about 0.025 mm long. Antennae (fig. 6) considerably longer than body; segment I brown, the rest pale to very pale brownish with the very tips of segments III and IV much darker; segment III with 10-15 circular, equally sized, ciliate rhinaria in single file to near tip of segment; longest hairs on segment III often with just incrassate apices, to 4/5 basal diameter of segment; flagellum faintly imbricated, with disperse spinules. Rostrum not reaching middle coxae, last segment about 0.10-0.11 mm long, about 6/7 of second joint of hind tarsi, with mostly two lateral pairs of hairs and 2-4 ventral ones besides the 3 subapical pairs. Fore wings (fig. 10) with normal venation, very strongly maculated with brown in various shades, easiest described by extremely broad bands along all the veins and their branches (but not along the hardly visible sector radii), and these borders mutually fused; between the apices of the bordered veins semicircular to roughly triangular areas open to tip and hind margin of the wing quite colourless; stigma brown with a paler band and a posterior paler crescent; sector radii and unbranched part of media usually strongly curved, the former with a dark triangle at its base; also hind wings with extensive maculation in pale brown, with a large pale area between the two obliques and near tip. Fore legs with coxae (somewhat flattened) of 0.20 mm wide, 0.22 mm long, rather larger than other coxae; all coxae dark brown; fore femora slightly thicker than other femora; middle and hind legs with a brown incomplete ring around femora at 2/3 - 3/4 part of their length, tarsi with brownish apices; rest of legs pale; dorsal hairs of hind tibiae with just capitate apices, on basal half to nearly twice as long as local diameter of tibia; first tarsal joints with 7 hairs ventrally and 2 hairs dorsally. Siphunculi rather tall, smooth, slightly flanged, mostly darker brown at base than at top. Cauda pale, with knob globular or slightly wider than long, with 4-5 long hairs and 8-11 smaller hairs. Anal plate deeply incised.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	1.78	2.23	0.79	0.47	0.38	0.16 + 0.29	13 & 14	0.11	0.12
2.	1.98	2.31	0.82	0.48	0.42	0.16 + 0.29	14 & 14	0.10	0.12
3.	2.08	2.35	0.87	0.50	0.42	0.16 + 0.27	13 & 13	0.11	0.14
4.	1.99	2.26	0.83	0.45	0.43	0.15 + 0.26	13 & 13	0.11	0.13
5.	1.80	2.17	0.81	0.44	0.37	0.15 + 0.26	12 & 13	0.11	0.14
6.	1.90	2.26	0.84	0.45	0.38	0.16 + 0.28	13 & 14	0.12	0.12
7.	1.12	2.07	0.75	0.45	0.36	0.16 + 0.21	10 & 10	0.10	0.12

(1-6, from *Quercus infectoria,* Sarba, Lebanon, 20-IV-'65, leg. R. van den Bosch no. IV - 20a; 7, from *Quercus calliprinos?,* Col N. Islâhye (1100 m), Turkey, 19-XI-'65, leg. G. Remaudière no. 0-3495).

Oviparous female.

Colour in life not known. Body in mounted specimens about 1.80-2.20 mm long, oval, caudad tapering, with many slightly dark, long (0.060-0.160 mm), stiff, rather thin hairs with blunt or faintly incrassate apices, on mostly dark sockets; the spinal hairs in pairs on low paired processes which from mesonotum to abd. tergite IV are dark brown, more caudad paler to pale; also marginal and pleural hairs to abd. tergite IV on dark, elevated sclerites. Anterior part of head brownish like ant. segment I; antennae pigmented as in alatae, 3/4 - 8/9 of length of body; segment III without rhinaria, but on inner side with some 5-8 rather thin, long hairs, the longest of which may be up to 5 times basal diameter of the segment; hairs on outer side of segment III much shorter than that diameter, and longest hairs on segments IV and V thin and not longer than that diameter. Dorsal hairs on tibiae up to over twice the local diameter of the tibiae, but not on hind tibiae because these are up to twice as thick as other tibiae at their basal 1/4 part, from where they taper distad, having many pseudosensoria over most of their length; first tarsal joints with hairs as in alatae. Cauda semi-oval, not constricted. Other characters about as in alate viviparous female.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Siph.	Cau.
			III	IV	V	VI		
1.	2.15	1.70	0.56	0.32	0.30	0.15 + 0.21	0.12	0.10
2.	2.00	1.61	0.51	0.30	0.28	0.15 + 0.22	0.12	0.12
3.	1.85	1.61	0.49	0.30	0.29	0.17 + 0.23	0.10	0.10

(1-3, from *Quercus calliprinos?,* Col N. Islâhye (1100 m), Turkey, 19-XI-'65, leg. G. Remaudière no. 03495).

Alate male.

Colour in life not known. Body in mounted specimens smaller than in most alatae, with the sclerotic parts more darkly pigmented. Spinal processes on abd. tergites I-IV very much smaller than in alatae, not or hardly longer than their basal width, not much longer than the more slender ones on posterior tergites. Antennae longer than body; segments I and II as dark as anterior half of head, flagellum rather evenly brownish yellow; segment III with some 15-22 mostly strongly transversely oval, sunk rhinaria, in a partly double row along one side; segments IV and especially V with deeply sunk rhinaria, the former with 1-6, the latter with 5-6, and also basal part of segment VI with 1-3 similar secondary rhinaria. Pigmentation along veins in fore wings much less developed than in alatae, mostly consisting in disconnected small patches along the veins, and the vague bands along the separate veins not confluent. Cauda knobbed, like the genitalia brownish black. Other characters rather as in alate viviparous female.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on segments				Siph.	Cau.
			III	IV	V	VI	III	IV	V	VI		
1.	1.78	2.08	0.66	0.44	0.40	0.17 + 0.27	15 & 17	1 & 3	5 & 5	3 & 1	0.07	0.11
2.	1.63	1.87	0.66	0.38	0.32	0.15 + 0.21	22 & ?	6 & ?	6 & ?	2 & ?	0.08	0.11

(1, with the oviparae; 2, from *Quercus robur?,* Hazar Gölü (1300 m), Turkey, 15-X-'62, leg. G. Remaudière no. 0-2127).

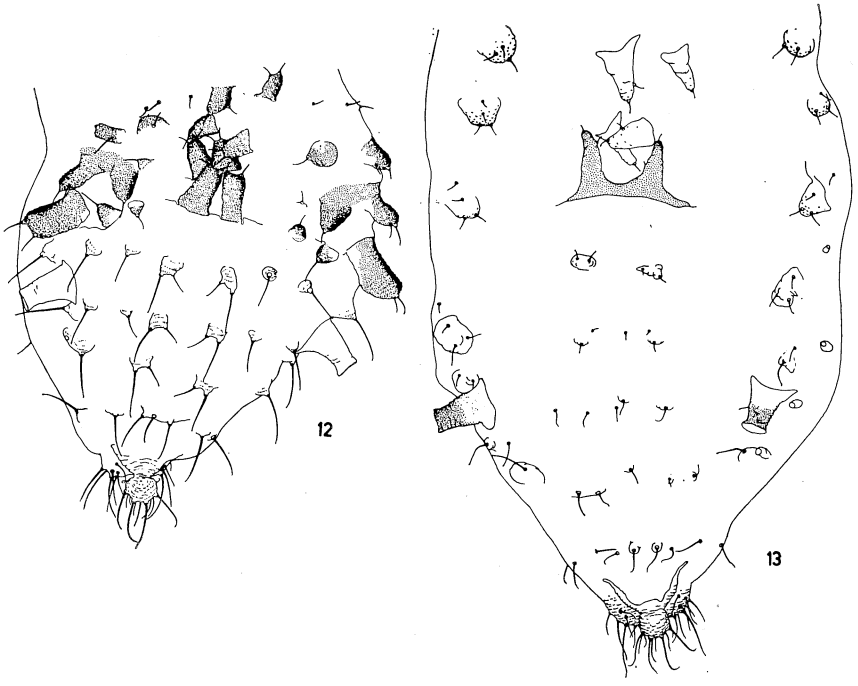
Embryos and larvae.

First instar larva with all spinal hairs long, 0.060-0.090 mm, the pair on abdominal tergite VII 1½ times as far apart as those on tergite VI, like the similar marginal hairs all dark and capitate, or rather with apices blunt and widened to about twice the thinnest part basad. Antennae of 4 segments; segment II with a pale, weakly knobbed hair of 0.055 mm, segment III with a similar thinner hair of 0.018-0.022 mm and a very thin, finely acute hair of 0.0085 mm, both near apex; segment IV with one hair of the last mentioned type. Last rostral segment 0.082 mm, with 2 lateral hairs on basal half. Flagellum and tibiae spinulose from base.

Last instar alatoid nymph with long hairs to 0.080 mm long on antennal segment III, 3 times basal diameter of segment. Abdominal

tergite IV with 12 hairs, the spinal and marginal ones in double pairs on low processes.

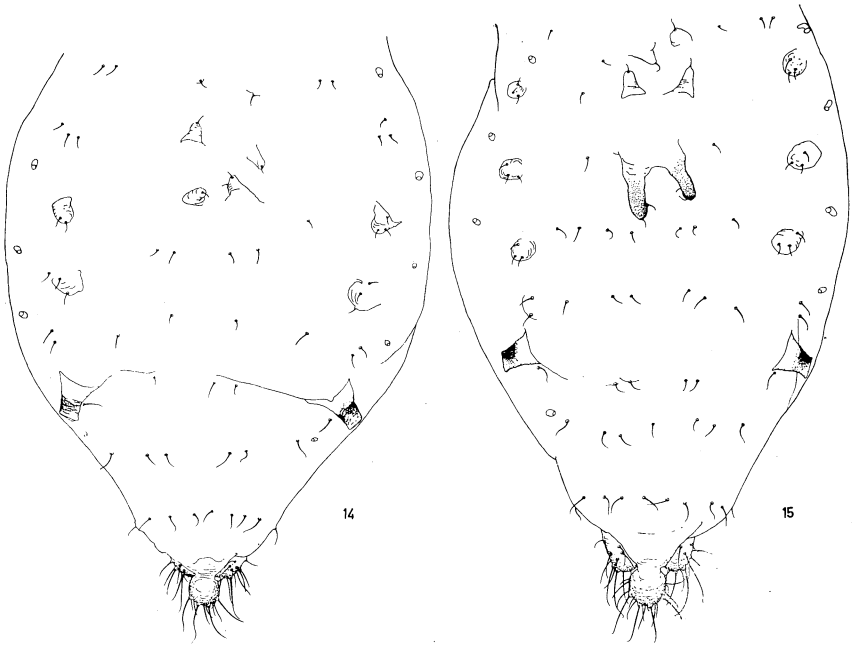
Discussion. From the occurrence of pleural processes joined by a sclerite to marginal processes, it would seem that this aphid is nearly related to *Tuberculatus cornutus* Richards from Turkey. In both



12. *T. maculipennis* spec. nov.: abdomen, x 60.
13. *T. konaracola* (Shinji): abdomen, x 60.

species old nymphs have very long hairs on antennal segment III; but adult alatae have short hairs on that segment, like all European members of this group. In the subgenus *Tuberculoides* v. d. Goot both old nymphs and adults have very short-haired IIIrd antennal segments. In the subgenus *Pacificallis* Richards antennal segment III is long-haired in old nymphs, but that group is distinct by characters indicated in the key on p. 26. The Oriental species, placed in this paper in the subgenus *Acanthocallis* Mats., excell by thoracic spinal processes, or they have long antennal hairs in adults.

The first specimens I received from Dr. R. van den Bosch, Berkeley, California, who had the host plant identified by a Beirut specialist. Later Dr. G. Remaudière sent me a number of specimens from Turkey, and kindly gave me permission to use also those for description. Among the latter material were the sexuales here described. Unfortunately the Turkish oaks from which the material was taken could not be identified with certainty.



14. *T. maximus* spec. nov.: abdomen, x 43.
15. *T. pallescens* spec. nov.: abdomen, x 44.

T y p e s. Holotype: alate viviparous female (measurements no. 1), from *Quercus infectoria,* Sarba, 20 km N. of Beirut, Lebanon, 20-IV-'65, leg. R. van den Bosch no. IV-20a. Paratypes: alate viviparous females and larvae with data as for holotype; alate viviparous female, oviparous female, male and larvae, from *Quercus calliprinos?,* Col N. Islâhye (1100 m), Turkey, 19-XI-'65, leg. G. Remaudière no. 0-3495; male, from *Quercus robur?,* Hazar Gölü (1300 m), Turkey, 15-X-'62, leg. G. Remaudière no. 0-2127; alate viviparous females, from *Quercus sp.,* Felahieh (Kayseri), Turkey, 22-VI-'66, leg. G. Remaudière no. 0-3730.

Tuberculatus maximus spec. nov. (figs. 2, 7, 14; pp. 54, 59)

Alate viviparous female.

Colour in life not known, but certainly pale. Body in mounted specimens about 2.00-3.15 mm long, pale, with the head and thorax faintly yellowish. Dorsal hairs scarce, rather stiff, on abdominal tergite III about 0.020-0.030 mm long, thin, with slightly knobbed or blunt apex, but the 8-10 hairs in tergite VIII acute and about 0.070 mm long. Spinal hairs on tergite VI usually in single pairs, those on tergite VII in double or single pairs. Pale spinal processes present on abdominal terigtes II and III (fig. 14), but apparently very flat or absent on tergite I; those on tergite II somewhat further apart than those on tergite III, about 0.025-0.045 mm high, volcano-shaped, very blunt, with a hair on top and often one halfway; those on tergite III 0.055-0.085 mm high, similarly shaped. Median frontal process (fig. 2) small or not developed. Antennae (fig. 7) about 1 - 1 1/5 times as long as body, with segments I and II faintly smoky, segments II-V thin, either quite pale or on basal half of III vaguely brownish, always with extensive, not sharply bordered, blackish brown apical parts, segment VI pale with the part near the rhinaria brown; segment III from base gradually more distinctly spinulosely imbricated, on basal 1/3 - 2/3 with 3-11 rather widely spaced, nearly round rhinaria on a very slightly thickened part; primary rhinarium on segment V round, rather small, that on segment VI elongate, larger; processus terminalis about as long as or slightly longer than basal part of segment VI; hairs on segment III at 45°, about 1/3 - 1/2 diameter of thick base of segment. Rostrum not reaching middle coxae; last segment about 1 1/10 times second joint of hind tarsi, rather acute, with 8-10 hairs besides the 3 subapical pairs. Wings with normal venation, veins pale, thin, with the bases of basal vein (Cu_2), cubitus (Cu_1) and sector radii thickened and brown, very small brown spots at the apices of cubitus (Cu_1), branches of media, and sector radii, and with an oblique brown basal line on, and a narrow evenly brown, border caudally along the pale stigma. Legs with the femora pale with faintly smoky parts near apex; tibiae, especially the hind ones, much darker, with a longitudinal brown band, with darker apices; hind tibiae with the dorsal hairs on basal half 1/2 - 1 times local diameter of tibia, knobbed, the other hairs acute; distal half

spinulose; first tarsal joints with 2 dorsal hairs and 6 ventral hairs. Siphunculi rather long, about 6/7 of second joint of hind tarsi, tapering, quite smooth, colourless with distal 1/3 - 3/4 part strongly contrasting blackish brown, with very small flange. Cauda strongly knobbed, the knob slightly dusky to brown, just wider than long, rounded, with about 13-16 hairs of varying lengths. Subanal plate bilobed.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	2.89	3.14	1.09	0.74	0.60	0.29 + 0.28	6 & 7	0.13	0.17
2.	2.71	2.62	0.91	0.56	0.51	0.24 + 0.22	5 & 5	0.12	0.15
3.	2.69	2.64	0.93	0.56	0.52	0.23 + 0.23	5 & 6	0.12	0.17
4.	2.89	2.83	1.03	0.64	0.50	0.26 + 0.23	5 & 6	0.12	0.17
5.	2.70	2.80	0.94	0.63	0.56	0.26 + 0.26	6 & 6	0.13	0.16
6.	3.11	3.13	1.13	0.70	0.58	0.27 + 0.26	7 & ?	0.13	0.18
7.	2.70	2.66	0.93	0.62	0.49	0.21 + 0.25	11 & 11	0.11	0.16
8.	2.76	2.75	0.95	0.60	0.48	0.23 + 0.32	7 & 9	0.11	0.16
9.	2.92	?	0.96	0.64	0.52	0.22 + ?	9 & 10	0.11	0.17
10.	2.30	2.66	0.88	0.60	0.49	0.25 + 0.29	6 & 8	0.11	0.15
11.	2.06	2.39	0.72	0.53	0.48	0.26 + 0.26	5 & 5	0.10	0.16

(1-5, from *Quercus sp.*, Karaj-Chaloos Highway, Iran, 6-VI-'60, leg. R. van den Bosch no. IR 114; 6-7, from *Quercus sp.*, Kara Göl (1500 m), Turkey, 9-VI-'65, leg. G. Remaudière no. 0-3553; 8-9, from *Quercus sp.*, Tatvan (1720 m), Turkey, 9-X-'62, leg. G. Remaudière no. 0-1959; 10, from *Quercus sp.*, Ilgar Daglari (1100 m), Turkey, 24-VI-'66, leg. G. Remaudière no. 0-3794 b; 11, from *Quercus persica*, Karaj, Iran, 1-V-'66, leg. G. Remaudière no. i-2641 a).

Oviparous female.

Colour in life not known. Mounted specimens about 2.50-3.00 mm long, with segments caudad the siphunculi elongated and tapering. From pronotum to abd. tergite VI very irregular paired spinal sclerites present which are mostly fragmentary and hardly pigmented on more anterior tergites but mostly cloudy brown and fused to a spinal patch on tergites III-V. Dorsal hairs not much pigmented, stiff, spinally 0.085-0.150 mm long, with slightly knobbed apices, mostly four hairs to each pair of spinal sclerites on abd. tergites III-V, with 1-2 pairs of pleural hairs and 3 pairs of marginal hairs all on stout bases. Head pale to brownish. Frontal hairs about 0.150 mm long, those on vertex about 0.100-0.110 mm. Antennae much shorter than body, pale, with segments I and II slightly smoky, the very tip of segments III and the apices of segments IV and V blackish brown; segment III without

rhinaria, on inner side with some rather stiff, faintly knobbed hairs the longest of which are up to 7/8 of basal diameter of the segment; hairs on more distal segments shorter and thinner. Legs uniformly pale; hind tibiae near base swollen to 1 1/3 - 1 1/2 times the thickness of the middle tibiae, with many pseudosensoria over about 3/5 of their length; dorsal tibial hairs slightly capitate, to 0.075 mm long on the hind tibiae; chaetotaxy of tarsi as in alatae. Siphunculi brownish with pale base, smooth, with flange. Cauda rounded, small.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Siph.	Cau.
			III	IV	V	VI		
1.	2.80	2.02	0.56	0.43	0.39	0.22 + 0.25	0.13	0.10
2.	2.76	2.00	0.57	0.43	0.39	0.20 + 0.23	0.13	0.10
3.	2.81	2.05	0.57	0.45	0.40	0.22 + 0.23	0.13	0.09
4.	2.53	1.86	0.52	0.36	0.35	0.21 + 0.22	0.13	0.08

(1-4, from *Quercus macranthera,* Karaj, Iran, 14-XI-'62, leg. G. Remaudière no. i-1862 a).

Alate male.

Colour in life not known. Mounted specimens very different from alate viviparae. Head and thorax brown to locally blackish brown; abdomen with spinal dark brown sclerotic patches or bars from tergite I-VIII, these are narrow and very thin in the middle on tergites I-II, much wider and tending to fuse along the median line more caudad, with very low, paler elevations bearing 1-2 rather small, thin hairs each from tergites I-IV; marginally no pigmentation on abdomen. Antennae much longer than body; segments I and II pigmented like head; segments III and often IV and V, pale brownish yellow at base, gradually darker towards the blackish brown apex; segment III with some 50-70 medium sized, slightly protruding, flat-topped, round to slightly transversely oval, scattered rhinaria over whole length; IV with some 20-35 similar rhinaria, V with some 10-20, VI with some 4-8 secondary rhinaria on basal part; hairs on segment III to 0.020 mm long, thin, hardly capitate. Wings and legs as in alate females. Siphunculi black with pale base. Cauda knobbed, brown, much paler than the very strongly developed genitalia.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on segments				Siph.	Cau.
			III	IV	V	VI	III	IV	V	VI		
1.	2.04	2.77	0.80	0.64	0.59	0.28 + 0.30	53 & 59	20 & 19	11 & 12	4 & 4	0.10	0.12
2.	2.28	2.85	0.82	0.64	0.63	0.30 + 0.30	65 & 69	22 & 32	13 & 19	8 & 5	0.10	0.12

(1-2, from *Quercus macranthera,* Karaj, Iran, 14-XI-'62, leg. G. Remaudière no. i-1862 a).

Larvae.

First instar larvae and embryos with all dorsal hairs long, on strong sockets, with globose apices; on abd. tergite I: 0.023; on II: 0.056; on III: 0.065; on IV: 0.065; on V: 0.061; on VI: 0.078; on VII: 0.065 mm long. Antennae of 4 segments; segment III with 2 blunt hairs of 0.009 mm near apex.

Last instar nymphs (sample i-2641 with alata no. 11). Tergum without pigmentation or sclerotisation; evenly pale. Spinally from abd. tergites I-VI with only one pair of long, knobbed hairs 0.110-0.170 mm long and in addition more mediad one pair equally thick hairs but only 0.020-0.030 mm long, absent on tergites V and VI; tergite VII with two pairs of long spinal hairs. Hairs on front about 0.130 mm long, but longest hairs on ant. segment III up to 0.015 mm. Rhinaria on III through the skin: 3-5.

Discussion. The material here described is not homogeneous, but this may be because of difference between generations. Dr. R. van den Bosch collected 5 alatae and several larvae from an unidentified *Quercus* near Karaj, Iran on 6-VI-'60. Dr. G. Remaudière collected a sample of alatae and larvae on 1-V-'66 near Karaj, Iran, from *Quercus persica.* These two viviparous Iran samples differ from other, Turkish, samples by having fewer, 3-7, rhinaria restricted to basal 1/3 - 4/9 of the pale ant. segment III, by longer dorsal hairs on the hind tibiae, 3/4 - 1 time diameter of the tibiae, but shorter hairs, to 1/3 basal diameter of the segment, on ant. segment III; the front has only a just indicated median process or none at all. They might be fundatrices. In the Turkish samples there are 6-11 rhinaria over 1/2 - 3/4 part of ant. segment III, and this part is distinctly brownish. The dorsal hairs on the hind tibiae are shorter, 1/2 - 3/5 of tibial diameter, but hairs on ant. segment III are longer, to 1/2 basal diameter of the segment; the front has a small but distinct median process. The embryos in all samples are indistinguishable.

The sexuales are with some reluctance described as *T. maximus,* because they were not associated with viviparous morphs that could aid in the identification. They came from another species of *Quercus* than the typical viviparae from Karaj, Iran.

The pigmentation at the ends of the veins of the fore wing make it rather simple to separate *T. maximus* from the closely related *T. annulatus* group. The presence of only 2-3 pairs of spinal processes on abdomen separates it from the much smaller *T. eggleri* which agrees in the uniformly long spinal hairs of its embryos.

Types. Holotype: alate viviparous female (measurements no. 3), from *Quercus sp.,* at 8 km from summit tunnel of Karaj-Chaloos Highway, Iran, 6-VI-'60, leg. R. van den Bosch no. IR 114. Paratypes: alatae with collecting data as for holotype; alatae and alatoid nymphs, from *Quercus persica,* Karaj, Iran, 1-V-'66, leg. G. Remaudière no. i-2641a; sexuales, from *Quercus macranthera,* Karaj, Iran, 14-XI-'62, leg. G. Remaudière no. i-1862a; alatae, from *Quercus* sp., Kara Göl (1500 m), Turkey, 9-VI-'65, leg. G. Remaudière no. 0-3553; alatae, from *Quercus sp.,* Tatvan (1720 m), Turkey, 9-X-'62, leg. G. Remaudière no. 0-1959; alatae, from Ilgaz Daglari (1100 m), Turkey, 24-VI-'66, leg. G. Remaudière no. 0-3794b.

Tuberculatus moerickei spec. nov. (figs. 3, 9; p. 54)

Alate viviparous female.

Colour in life pale yellow (Moericke). Body in mounted specimens collected in spring or late autumn 2.00-2.60 mm long, in summer specimens only 1.30-1.60 mm long, pale, with head and thorax faintly yellowish. Dorsal hairs short, the spinal ones on abd. tergite III blunt to rather acute, 0.008-0.013 mm long, the 6-10 hairs on tergite VIII 0.025-0.035 mm long, blunt or acute. Quite pale or very faintly pigmented spinal processes, each with a single hair on top, present on abd. tergites I, II and III, rather variable in shape, distally mostly cylindrical with rounded top, basally strongly tapering; the ones on tergite III up to 4/5 of length of last rostral segment; those on tergite II mostly slightly shorter, and those on tergite I in spring specimens from half as long as those on III to nearly as long. Median frontal process over the ocellus (fig. 3) only about 0.008 mm high, 0.025 mm wide at base. Antennae (fig. 9) in spring and autumn specimens slightly shorter than body, in summer sometimes a little longer than body; segments I and II distally brownish,

segment III in mature specimens brownish near the most distal rhinaria, i.e., at basal 1/4 - 4/9 part, basad more gradually pale than distad, at apex brown to blackish brown like segments IV-V and the middle portion of VI; remainder quite pale; flagellum with spinules from near base of segment III; spring and autumn specimens with 5-7 rather evenly spaced, round rhinaria on basal half, summer specimens with 2-5 similar rhinaria on an often distinctly incrassate part on basal 1/4 - 3/7 part; processus terminalis subequal to base of VI in spring and autumn, slightly longer than base of VI in summer; hairs on segment III thin, inconspicuous, rather adpressed, 2/7 - 1/2 of basal diameter of segment. Last rostral segment rather acute with conspicuously convex sides, in spring and autumn 0.100-0.115 mm long, in summer 0.085-0.100 mm long, longer than siphunculi, nearly as long as second joints of hind tarsi, with 6-8 hairs besides the 3 subapical pairs. Wings with pale veins with the base of Cu_2, Cu_1 and sector radii slightly brown; stigma pale with a markedly brown oblique spot near base and faint pigmentation distad of origin of sector radii. Legs rather evenly pale with the femora at distal 3/4 part dorsally and ventrally more or less brownish, the tibiae with an indistinct longitudinal brownish stripe from base; dorsal hairs on basal half of hind tibiae slightly adpressed, blunt or faintly capitate in spring, more acute in summer forms; first tarsal joints ventrally with 6 hairs, dorsally with 2 hairs. Siphunculi rather slender, tapering, often slightly curved caudad, pale, with distal 1/3 - 1/2 part especially on anterior surface, very much less on posterior side, dark to blackish, smooth, flangeless, in spring about 2/3 times, to in summer 5/6 times, last rostral segment. Cauda with thick nearly globular, often slightly pigmented knob, with about 12-14 hairs.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	2.59	2.13	0.75	0.42	0.38	0.21 + 0.22	6 & 7	0.10	0.13
2.	2.11	1.89	0.61	0.42	0.32	0.20 + 0.20	5 & 6	0.09	0.13
3.	2.28	2.14	0.69	0.47	0.40	0.22 + 0.21	5 & 5	0.08	0.13
4.	2.42	2.13	0.69	0.46	0.39	0.22 + 0.21	5 & 6	0.09	0.13
5.	2.19	2.11	0.68	0.45	0.42	0.21 + 0.21	6 & 6	0.09	0.14
6.	2.07	1.90	0.56	0.38	0.38	0.21 + 0.21	5 & 6	0.09	0.14
7.	1.43	1.55	0.44	0.31	0.30	0.18 + 0.20	4 & 4	0.06	0.12
8.	1.51	1.46	0.44	0.29	0.27	0.17 + 0.18	3 & 5	0.05	0.13

(1-5, from *Quercus infectoria,* Aïn Zhalta (900 m), Lebanon, 22-IV-'66, leg. V. Moericke no. 236; 6, from *Quercus robur?,* N. Pertek, Turkey, 1-X-'62, leg. G. Remaudière no. 0-2124 a; 7-8, from *Quercus sp.,* Salahuddin near Shaqlawah, Iraq, 10-VI-'68, leg. P. Stary).

Larvae.

In first instars and embryos in spring all marginal hairs except those on tergite VII thick and knobbed, from 0.035 on abd. tergite I to 0.075 mm on tergite VI; in summer alatae on tergites I to VII: 0.024; 0.043; 0.059; 0.057; 0.052; 0.054; 0.22 mm long; from tergite II reaching past the base of the following hair. Spinal hairs very different, often seemingly absent, distinctly knobbed with very thin base, in spring forms on tergites I-V: 0.016 mm, on VI 0.013 mm, on VII 0.070 mm and on VIII 0.052 mm, i.e., suddenly stout and long on tergite VII; in summer forms these hairs from tergite I-VI only 0.004-0.006 mm long, then suddenly 0.080 mm long on tergite VII. In these measurements the sockets were not included.

Older alatoid nymphs in spring very variable in chaetotaxy. In some from Lebanon a complete row of single pairs of very thick spinal hairs about 0.11 mm long, with large knobs and large sockets, but then besides single outer, pleural pairs of tiny knobbed hairs of 0.0085 mm which on tergite V often only on one side pass into long hairs like the spinal ones, and marginally on tergites I-IV groups of 2-4 tall hairs on a joint, low, process, but tergites VI and VII with single marginal hairs, and double pairs of spinal hairs on joint processes. In other alatoid nymphs (from Kurdistan and some from Lebanon) all marginal hairs long as above, with in addition one shorter hair and often one minute hair like the very inconspicuous spinal and pleural hairs from tergites I-VI; spinal hairs on tergites VII and VIII always longer. Siphunculi in alatoid nymphs with a large, thick flange, totally different from those in adults.

Discussion. Professor V. Moericke collected the first specimens that I saw in Lebanon, from *Quercus infectoria.* They may well be fundatrices. A specimen collected in the autumn in Turkey by Dr. G. Remaudière agrees very well with the Lebanese material. But a number of specimens collected by Dr. P. Stary in Kurdistan (Iraq), together with *T. albosiphonatus* spec. nov., are rather different by their smaller size, and the rather longer marginal hairs of their embryos. Yet I have included them in the paratype-series because I can find no important character by which they differ from the Lebanese sample.

Mature specimens have a distinct brownish area on ant. segment III, in the Lebanese ones just below the middle of the segment, in the Kurdistan ones more towards the base of the segment. This brown zone distally ends rather suddenly past the most distal of the rhinaria, but

fades more gradually basad. The position of the brown zone is correlated with the position of the most distal rhinarium, which in the Lebanese specimens stands nearly mid-way the segment, but in Kurdistan alatae with only two rhinaria the most distal one is at about one fourth of the length of the segment. Such brown areas are also present in *T. pallescens* and *T. albosiphonatus,* all from the Near-East.

T. neglectus Krzywiec is very similar, but differs by a longer processus terminalis and longer siphunculi, also in its fundatrices. I have not seen specimens of *T. neglectus* with a brownish area somewhere on the basal part of ant. segment III.

I saw some specimens from *Quercus pedunculata* (?), Turkey, from the collection of Dr. G. Remaudière, Paris, which agree fairly well with *T. moerickei* as described above, but ant. segments III are uniformly pale to the dark brown tip, the brown spot at the base of the pterostigma is inconspicuous, the processes on abd. tergites I and II are very broadly conical, and the pair on tergite III is brownish pigmented. Only one embryo could be examined which in chaetotaxy resembles those of *moerickei,* except that on tergite VI a spinal hair is 0.020 mm long. Other spinal hairs could not be measured, and they seem to be exceedingly short. This Turkish material is not *neglectus,* under which name I received it, because of the short processus terminalis and siphunculi, though the siphunculi are distally blackish brown over about half their length. For this Turkish material I propose the name *Tuberculatus moerickei galatensis* subspec. nov.

Types. *Tuberculatus moerickei* spec. nov. sensu stricto: holotype: alate viviparous female (fundatrix?) (measurements no. 1), from *Quercus infectoria,* Aïn Zhalta (900 m), S.E. of Beirut, Lebanon, 22-IV-'66, leg. V. Moericke no. 236. Paratypes: alatae (fundatrices?) and alatoid nymphs with collecting data as for holotype; alate viviparous female, from *Quercus robur?,* Pertek, Turkey, 1-X-'62, leg. G. Remaudière no. 0-2124a; alate viviparous females, from *Quercus sp.,* Salahuddin near Shaqlawah, Kurdistan (Iraq), 10-VI-'68, leg. P. Stary no. 12037 B; one alata vivipara in a slide with one specimen of *T. albosiphonatus* sp. n., from *Quercus infectoria,* Germik, Iraq, 12-V-'71, leg. UNDP/FAO, IR 38; alate viviparous females, from *Quercus infectoria,* Baabdat, Lebanon, 23-V-'73, leg. D.H.R.L. no. 772; alate viviparous females from *Quercus infectoria,* Faitroun (1200 m), Lebanon, 2-VI-'73, leg. T.B. Larsen no. TBL 007.

Tuberculatus moerickei galatensis subspec. nov.: holotype: alate viviparous female, from *Quercus pedunculata?,* 5 km W. of Ankara, Turkey, 28-VI-'66, leg. G. Remaudière no. 3828b. Paratypes: alate viviparous females with collecting data as for holotype.

Tuberculatus paiki spec. nov.

Alate viviparous female.

Colour in life not known. Body in mounted specimens pale with only on the pronotum two thin, brown, pleural longitudinal stripes. Dorsal hairs on mesonotum very thick, up to 0.070-0.100 mm long, capitate, with rather globular knob about twice as thick as thinnest part basad; anterior spinal hairs on pronotum sometimes duplicated in fundatrix. Spinal processes all completely pale; pronotum with one posterior pair 0.030-0.075 mm long with in the fundatrices 2 hairs on top, with sometimes 1-3 near or on base, in the 2nd generation with one hair on top and sometimes a small one on basal part; mesonotum without spinal processes; abdomen with long, rather cylindrical, bluntish spinal processes on abd. tergites I-III and sometimes very small and low ones on IV; those on I to 0.150 mm long, those on II 0.120-0.180, on III 0.150-0.180, with 1-2 hairs on or near top, with 1-2 lower down and these hairs 0.026-0.040 mm long, faintly capitate. Median frontal tubercle hardly visible; upper and lower frontal hairs thick, 0.120-0.130 mm long, distinctly capitate; the pair between these and a lateral ocellus 0.030-0.045 mm long. Antennae pale, with the apices of segments III-V and the part around the rhinaria on VI blackish, shorter than body in the fundatrices, longer than body in the second generation; segment III with 4-7 rhinaria on basal 2/5 - 1/2 part; hairs on inner side of segment III stout, longest 0.045-0.060 mm long, nearly as long as longest on segment II, 1 3/8 - 1 2/3 times as long as the thick basal diameter of the segment, and about 3-4 of such stout, knobbed hairs and 1-3 shorter ones present, all placed on strong sockets on elevated parts of the segment; hairs on inner side much thinner, shorter and finely capitate; processus terminalis in presumable fundatrices 1 1/5 - 1 1/3 times base of ant. segment VI, in later specimens 1 1/2 times that base. Rostrum short, reaching a little past anterior margin of mesosternum; last segment rather acute with slightly convex sides, 1 1/10 - 1 1/5 times as long as second joint of hind tarsi, with 7-8 hairs besides the 3 subapical pairs. Wings with normal,

equally thin, veins which only near their bases are thicker and infuscated or faintly bordered; stigma evenly pale, only distal margin faintly brownish. Legs pale to yellowish, tibiae slightly darker than femora, to pale brownish; longest dorsal hairs at middle of hind tibiae 0.038-0.061 mm long, a little longer than local diameter of tibiae, with little knobs; first tarsal joints with 6 ventral and 2 dorsal hairs. Siphunculi rather tall, strongly tapering, with a fairly distinct flange, colourless with distal 1/4 - 3/7 part dusky to blackish, with some spinules on the pigmented part. Cauda strongly knobbed, the knob just wider than long, colourless, with 10-12 hairs of which 4 larger ones are not on the underside. Subanal plate deeply bilobed.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	3.15	2.68	0.91	0.54	0.47	0.26 + 0.33	6 & 6	0.13	0.18
2.	3.15	2.65	0.88	0.54	0.50	0.23 + 0.31	7 & 7	0.13	0.18
3.	?	2.43	0.70	0.49	0.43	0.26 + 0.38	6 & 6	0.12	0.14
4.	2.39	?	0.81	0.47	?	? ?	4 & 4	0.12	0.15

(1-2, probably fundatrices, from *Quercus dentata,* Seoul, Korea, 12-V-'71, leg. W.H. Paik no. 6269-A; 3-4, probably 2nd generation, from *Quercus dentata,* Suwon, Korea, 30-V-'71, leg. W.H. Paik).

Larvae.

Embryos with all dorsal hairs long, stout, on strong sockets, and more or less inverted, triangular knobs about 3 times as thick as thinnest part of shaft; spinal hairs on abd. tergites I-VIII 0.059; 0.074; 0.082; 0.078; 0.087; 0.095; 0.095; 0.060 mm long; marginal hairs on tergites I-VII 0.059; 0.087; 0.087; 0.091; 0.082; 0.082; 0.043 mm long.

Older nymphs certainly belonging to this species are not available.

Discussion. *T. paiki* spec. nov. seems to be the end of a series of very similar species with one pair of processes on the pronotum, in which the hairs on ant. segment III get longer and longer. Fortunately spring material, even probable fundatrices, of *T. yokoyamai* Takahashi are also available from the same area as *T. paiki,* and therefore one can be reasonably certain that *T. paiki* is not a long-haired subspecies of *T. yokoyamai* with different geographical distribution. Specimens intermediate in antennal hair-length between *T. paiki* and *T. yokoyamai* have not been seen. HIGUCHI (1969, p. 119) mentions for *T. quercifor-*

mosanus that the longest hairs on ant. segment III are as long as those on segments I and II. That is just about the case in *T. paiki* and one is somewhat surprised not to find 3 pairs of long knobbed hairs on the front instead of 2 pairs. In *T. yokoyamai,* HIGUCHI (1969, p. 121) writes that the longest hair on ant. segment III is shorter than the shortest on segments I and II. This is not always the case in the true *T. yokoyamai,* but certainly not so in *T. higuchii* spec. nov.

The description of *Tuberculoides naganoe* Shinji, 1941 seems to relate to a member of *Orientuberculoides* subgen. nov. The length of the hairs on ant. segment III as figured by Shinji could apply to *T. paiki.* Shinji in his key states, that in *T. naganoe* the antennae have conspicuous, mostly capitate bristles, that the finger-shaped dorsal processes are colour of the body, and that the tibiae are brown or black. But in the description of the species he writes (translation by Dr. K. Yora) that every segment of the body has one pair of dorsal finger-shaped processes, and that especially the processes on the head, thorax and abd. segments I-III are large. Because of the latter statement it is not possible to identify Shinji's *naganoe* with any of the refound Oriental species.

Tuberculatus paiki spec. nov. is named for Professor Woon Hah Paik who set me a very difficult task when he asked me for opinions on a great many, mainly trapped, Korean aphids, and to describe new ones.

Types. Holotype: alate viviparous female, probably fundatrix (no. 1 of measurements), from *Quercus dentata,* Seoul, Korea, 12-V-'71, leg. W.H. Paik no. 6269-A. Paratypes: alate viviparous female taken with holotype; alate viviparous females, *Quercus dentata,* Suwon, Korea, 30-V-'71, leg. W.H. Paik.

Tuberculatus pallescens spec. nov. (figs. 4, 5, 8, 11, 15; pp. 54, 59)

Alate viviparous female.

Colour in life bright green. Body in mounted specimens about 2.50-3.50 mm long, quite pale with the head and thorax hardly visibly tinted. Dorsal hairs stout, usually subacute, the pleural ones on abdominal tergite III about 0.035 mm long, but the 10-14 hairs on tergite VIII up to 0.117 mm long; sockets of hairs not much enlarged; sometimes some spinal and pleural hairs very thick, long, to 0.17 mm, and capitate; spinal hairs on tergites IV-VIII in double pairs. Ventral

hairs much finer than dorsal ones, about 0.065 mm long. Spinal processes (fig. 15) present on abdominal tergites I, II and III; those on tergite I about 0.025-0.045 mm high, conical with rounded apex, colourless; those on tergite II similar in shape and colour but 0.045-0.075 mm high; those on tergite III on a common base, in total about 0.180 mm high, the free parts measured from the base about 0.120 mm high, finger-shaped, blunt, rather slender, over about distal half to two-thirds blackish brown pigmented and each, like the ones on tergites I and II, with 1-2 stout hairs, one rather near, one on apex; these hairs blunt or faintly capitate, and 0.025-0.030 mm long, rarely to 0.14 mm and capitate. Marginal processes short and thick, inconspicuous, colourless. Front (fig. 4) with a conspicuous median horn of 0.025 mm above the median ocellus, flanked by hairs of 0.10-0.11 mm; higher up shorter hairs of 0.050 mm. Antennae (fig. 8) 7/10 - 9/10 of length of body; all segments pale with marked dusky to black apices, but segment III also with very conspicuous short blackish brown parts near the middle which sometimes fuse, and segment VI with the part near the rhinaria blackish; segment III with 3-5, rarely 2 or 6 round, indistinctly ciliate, rhinaria on basal half or just over; the most basal one of these rhinaria always on a colourless part, and at least two other rhinaria on pigmented parts; basal 1/3 part of segment III smooth, remainder gradually more distinctly spinulosely imbricated; hairs on segment III 0.016-0.030 mm long, bluntish of faintly capitate; primary rhinaria of segments V and VI similar in size, slightly elongated; processus terminalis subequal to basal part of last segment. Rostrum reaching to halfway the middle coxae, last segment rather blunt, about 6/7 of second joint of hind tarsi, with 8 hairs besides the 3 subapical pairs. Wings with normal venation; veins (fig. 5) as in *T. maximus* spec. nov., but also apex of basalis (Cu_2) with a larger brown fleck, the sector radii sometimes partly obsolete, the stigma on the basal side with a black oblique streak and at the caudal side from the sector radii bordered with dark brown. Femora pale with a very distinct blackish brown blotch dorsally near apex and a less distinct mark ventrally; tibiae on basal part brown, and this pigment on hind tibiae running out into a brown stripe over half the tibial length, on distal half pale with brown apex; hind tibiae spinulose on distal 3/5 part, with the dorsal hairs on basal half rather stiff, slightly capitate and about as long as local diameter of tibiae; only the ventral hairs really acute; first tarsal joints with 8 hairs, 2 of which placed dorsally. Siphunculi rather stout, about as long as second joint of hind tarsi, pale with distal 1/3 - 2/5

part blackish brown, smooth. Cauda brownish with globose, very thick knob, with about 18 hairs. Subanal plate bilobed.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	2.56	2.28	0.67	0.42	0.42	0.30 + 0.31	3 & 3	0.10	0.19
2.	3.00	2.12	0.63	0.39	0.39	0.26 + 0.28	4 & 4	0.11	0.21
3.	2.87	2.22	0.67	0.40	0.40	0.30 + 0.28	3 & 4	0.10	0.20
4.	2.95	2.28	0.71	0.44	0.42	0.28 + 0.35	3 & ?	0.11	0.20
5.	2.75	2.27	0.64	0.42	0.45	0.29 + 0.30	4 & 4	0.10	0.20
6.	2.89	2.33	0.71	0.43	0.45	0.30 + 0.28	3 & 4	0.12	0.21
7.	3.38	2.56	0.79	0.49	0.50	0.32 + 0.28	4 & 4	0.11	0.21
8.	3.26	2.65	0.85	0.51	0.51	0.32 + 0.28	6 & 6	0.12	0.21

(1-6, from *Quercus spp.*, Fouar, Lebanon, 21-V-'65, leg. R. van den Bosch no. 21a; 7, from *Q. calliprinos,* Col N. Islâhye (1100 m), Turkey, 19-XI-'65, leg. G. Remaudière no. 0-3501; 8, from *Q. sp.,* N. of Tarsus (300 m), Turkey, 22-XI-'65, leg. G. Remaudière no. 0-3512).

Oviparous female.

Colour in life not known. Body in mounted specimens about 2.30-3.50 mm long, with the part caudad the siphunculi variably extracted like an ovipositor. No distinct pigmentation or sclerotisation of integumentum present. Abd. tergites II and III with very indistinct paired spinal elevations bearing two hairs each. Dorsal hairs very long, up to 0.20 mm, pale, rather thin, on rather large sockets, blunt or sometimes faintly capitate, not numerous; abd. tergite III with 4 spinal hairs, 2 pleural hairs and 6 marginal hairs; tergite VIII with some 16 hairs of various length and apparently with acute apices. Front with small but distinct median tubercle. Antennae 2/3 - 7/8 of length of body, pale, with segments I and II distally dark smoky; segments III-V apically, and segment VI near the rhinaria brownish black; segment III largely smooth, without rhinaria, with some 11-16 rather erect hairs of which one or two may be slightly capitate and just longer, to 1 1/3 times, basal diameter of segment. Legs pallid, with brown subapical spots on femora; tibiae all pale, hind tibiae on basal one-thirds just over twice as thick as middle tibiae; dorsal tibial hairs thin, rather erect, with blunt or finely capitate apices, to 0.130 mm long; first joints as in alate viviparae. Siphunculi waisted, broadly conical, flanged, apicad brown, smooth, to 5/7 of second joints of hind tarsi. Cauda semi-oval, very hairy.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Siph.	Cau.
			III	IV	V	VI		
1.	2.99	1.92	0.51	0.35	0.35	0.26 + 0.28	0.11	0.13
2.	3.37	2.00	0.56	0.36	0.36	0.26 + 0.27	0.11	0.14
3.	2.64	2.35	0.57	0.37	0.39	0.29 + 0.27	0.10	0.14
4.	2.35	1.73	0.46	0.31	0.33	0.26 + 0.21	0.10	0.15

(1-2, from *Quercus sp.,* N. Tarsus (300 m), Turkey, 22-XI-'65, leg. G. Remaudière no. 0-3512; 3-4, from *Q. calliprinos,* Col N. Islâhye (1100 m), Turkey, 19-XI-'65, leg. G. Remaudière no. 0-3504).

Alate male.

Colour in life not known. Mounted specimen very different from alatae. Head mottled smoky to mottled blackish brown on frontal half; thorax brownish to brown; abdomen with more or less brownish to blackish brown, rectangular median sclerites of which the one on tergite III is darkest and bears two very small, dark to blackish spinal processes; most of these sclerites with only two hairs of 0.020-0.055 mm; pleural hairs erratic, marginal hairs not on pigmented sclerites. Antennae very different from those in alatae; segments I and II as dark as front; segments III-V from their pale bases gradually darker to the blackish brown apices; segment III with some 35-50 flat, roundish to transversely oval, scattered, hardly ciliate rhinaria; IV with 11-25 rather scattered rhinaria; segment V with 6-12 rhinaria more or less in a row, and VI with 0-3 secondary rhinaria on basal portion. Pigmentation of wings similar to that in alatae, but stigma darker, and strongly bordered along its whole posterior margin. Legs darker than in alatae. Siphunculi thinner and shorter than in alatae, brown with pale bases. Cauda knobbed, blackish like the very strongly developed genitalia.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on segments				Siph.	Cau.
			III	IV	V	VI	III	IV	V	VI		
1.	2.17	2.56	0.66	0.55	0.52	0.30 + 0.36	46 & 49	17 & 24	11 & 10	3 & 3	0.07	0.15
2.	2.18	2.42	0.69	0.49	0.49	0.30 + 0.28	39 & 42	16 & 19	8 & 10	1 & 2	0.06	0.17
3.	2.42	2.40	0.73	0.49	0.48	0.28 + 0.25	37 & 40	19 & 16	7 & 10	2 & 1	0.07	0.17
4.	2.32	2.26	0.65	0.44	0.45	0.28 + 0.28	42 & 43	13 & 11	6 & 7	0 & 0	0.06	0.17

(1, from *Quercus sp.,* N. Tarsus (300 m), Turkey, 22-XI-'65, leg. G. Remaudière no. 0-3512; 2-4, from *Quercus calliprinos,* Col N. Islâhye (1100 m), 19-XI-'65, leg. G. Remaudière nos. 0-3501 and 0-3504).

Larvae.

Embryos (fig. 11) and first instar larvae with all dorsal hairs very long, blunt, but not knobbed, on strong sockets; spinal hairs on abd. tergite I: 0.070; II: 0.082; III: 0.074; IV: 0.095; V: 0.127; VI: 0.135; VII: 0.135; VIII: 0.100 mm long. Antennae of 4 segments; segment III near apex with 2 stout hairs of 0.022 mm, segment IV with one similar hair near the rhinaria.

Discussion. Dr. R. van den Bosch collected a small number of alatae from the leaves of *Quercus sp.* The sample also contained a *Myzocallis.* Because the larvae could not certainly be ascribed to the species they were thrown away. The *Quercus* could not be identified.

Dr. Remaudière after examining a manuscript of the key on p. 26, provided more material from Turkey, including the sexuales. The oviparae could easily be classified, but the males look so different from the alate females that they would not have been identified as *T. pallescens* but for the chaetotaxy of the antennae and the ornamentation of the wings. Two samples were labelled *Quercus calliprinos,* one came from *Quercus robur* with a query.

Recognition of the alatae is very simple. The pigmentation of the ings, and of ant. segment III is highly characteristic, and so are the median frontal process and the long frontal and dorsal hairs. From the oviparae it appears that the species really belongs in the subgenus *Camelaphis.*

Types. Holotype: alate viviparous female (measurements no. 1), from *Quercus sp.* Fouar, Lebanon, 21-V-'65, leg. R. van den Bosch no 21a. Paratypes: alatae with data as for holotype; al. viv. females, oviparae and males, from *Quercus calliprinos,* Col N. Islâhye (1100 m), Turkey, 19-IX-'65, leg. G. Remaudière nos. 0-3500b, 0-3501 and 0-3504; al. viv. females, oviparae and males, from *Quercus sp.,* N. Tarsus (300 m), Turkey, 19-XI-'65, leg. G. Remaudière no. 0-3512; al. viv. females, from *Quercus robur?,* Pertek N. Elazig, Turkey, 14-X-'62, leg. G. Remaudière no. 0-2124b; alatae and some males (!), from *Quercus infectoria,* between Bchatfin and Derkoube, Lebanon, 28-V-'73, leg. D.H.R.L. no. 779; alatae, from *Quercus infectoria,* Baabdat, Lebanon, 23-V-'73, leg. D.H.R.L. no. 772; alatae from *Quercus infectoria,* Faitroun (1200 m), Lebanon, 2-VI-'73, leg. T.B. Larsen no. TBL 007.

Tuberculatus paranaracola spec. nov.

Alate viviparous female.

Colour in life not known. Body in mounted specimens completely pale or with an inconspicuous pale brown, pleuro-marginal, longitudinal stripe on pronotum. Frontal hairs on large bases on strong sockets, rather thick, capitate with the knob twice as thick as the part below, about 0.080-0.110 mm long; between these two pairs and the lateral ocelli hairs very small, 0.008-0.013 mm long, on small sockets, and the other dorsal cephalic hairs similar; hairs on pronotum similarly small, but mesonotum with much stouter knobbed hairs of 0.016-0.030 mm long; hairs on the spinal processes 0.004-0.009 mm long, marginal hairs somewhat longer, and tergite VIII with hardly capitate hairs up to 0.024 mm long; ventral hairs to 0.065 mm long, acute or faintly capitate. The two spinal processes on pronotum inconspicuous, up to 0.025 mm long and mostly wider than their length; mesonotum without processes; abdomen with the scabrous spinal processes on tergites I-III about equal in length, varying from 0.030-0.065 mm, scabrous, mammiform, bluntly conical to finger-shaped; rather distinct marginal processes on tergite IV with hairs of up to 0.025 mm long. Front with hardly indicated median process; the tubercles bearing the frontal hairs reaching past the hardly developed frontal tubercles. Antennae in fully extended specimens slightly shorter than body; segment I brownish, at the inwards protruding top with a rather thin capitate hair of up to 0.030 mm long; other segments pale, from segment III with rather gradually dark brown apices; flagellum from near base of segment III distad gradually more distinctly spinulosely imbricated; segment III with 4-8 rather large, not elevated rhinaria over at least two-thirds length of segment, and with some mostly rather adpressed, moderately thick capitate hairs of up to 0.016 mm long, up to 4/5 diameter at its thin, constricted base. Rostrum not reaching middle coxae; last segment with slightly convex sides, bluntish, about 0.085 mm long, 5/6 of second joint of hind tarsi, with 6-8 hairs besides the 3 subapical pairs. Femora pale, but all tibiae brown to dark brown, slightly paler towards apex; dorsal hairs on hind tibiae slightly capitate, on basal half to 0.025 mm long, about 2/3 of local diameter of tibia; first tarsal joints with 2 dorsal hairs and 5, less frequently 6, ventral hairs. Wings with pale stigma and media, very pale sector radii, and rather dark brown and

thick cubitus (Cu_1) and basal vein (Cu_2). Siphunculi rather thick, pale with the very apex faintly brown, truncated conical, without flange, on distal 1/3 part slightly spinulose. Cauda pale, with the knob slightly wider than long, with only 9-12 hairs of different lengths. Subanal plate pale, with two widely separate lobes.

Measurements in mm.

No.	Length body	Ant.	Antennal segments				Rhin. on III	Siph.	Cau.
			III	IV	V	VI			
1.	2.01	1.94	0.56	0.34	0.33	0.19 + 0.37	7 & 7	0.10	0.13
2.	1.70	1.69	0.47	0.30	0.27	0.17 + 0.35	4 & 6	0.09	0.13
3.	1.64	1.79	0.52	0.30	0.29	0.18 + 0.36	5 & 6	0.10	0.12
4.	2.19	1.94	0.56	0.35	0.30	0.21 + 0.36	8 & 8	0.10	0.13
5.	2.26	?	0.57	0.36	0.33	? ?	6 & 7	0.10	0.11

(1-5, from yellow Moericke trap, Suwon, Korea, 5-VI-'67, leg. W.H. Paik).

Larvae.

Embryos with very strongly capitate marginal hairs, the knob of which is about 3 times as thick as the part below; length on tergite I: 0.024; II: 0.026; III: 0.028; IV: 0.035; V: 0.037; VI: 0.035; VII: 0.039 mm long. Spinal hairs on tergite VII long: 0.060; on VIII: 0.030 mm, but on tergite VI and more anterior tergites virtually invisible, blunt, at most 0.009 mm long.

Discussion. The five specimens described above as *T. paranaracola* spec. nov. came from a few slides identified as *T. quercicola* Mats. by Prof. W.H. Paik. The slides held more specimens than these five, and though there was some variability in length of hairs on ant. segment III, the whole sample seemed homogeneous enough.

But when the embryos inside the alatae were carefully studied the picture became complicated. Every alate contained embryos of only one kind, but there were three kinds:

a. embryos with spinal hairs on abd. tergites I-VI exceedingly short: *T. paranaracola* spec. nov.

b. embryos with spinal hairs on abd. tergites I-VI about 1/3 - 1/2 as long as the corresponding marginal hairs. 3 Specimens.

c. embryos with spinal hairs on abd. tergites I-VI about as long as the corresponding marginal hairs. One specimen.

The alate female c. keys to *T. yokoyamai* (Tak.) in the key I constructed. But for alates a. and b. there was no name available.

Very short spinal hairs in embryos are also found in the Oriental *T. kashiwae* (Mats.), but in that species the pronotum has no spinal processes and the abdomen very low spinal processes as figured by HIGUCHI (1969, fig. 22). A number of Shinji's species mentioned in the Introduction remains unidentified and of none the embryos are described.

Kunugi SHINJI, 1924, was described in Japanese. Dr. H. Higuchi kindly wrote that according to the description the antennae are longer than the body; ant. segment III about as long as VI, with 4 hairs and 2 small rhinaria; segment IV about as long as V, both with 2 hairs; each thoracic segment with a pair of finger-like processes; abdomen with 3 pairs of large processes, and these processes concolorous with the body. As Dr. Higuchi comments, *kunugi* should be similar to *T. yokoyamai* (Tak.), but Shinji mentions spinal processes on all thoracic segments. Such a *Tuberculatus* has not been refound, and SHINJI (1941) does not mention his *kunugi* at all. *T. naganoe* Shinji, 1941 is excluded because of its long antennal hairs, and *T. konaracola* Shinji, 1941 has the spinal processes on abd. tergite III black.

Therefore I decided to describe the alatae of type a. and b. as a new species, with two subspecies, which key as follows:

1 (2) Embryos with spinal hairs on abd. tergites II-VI hardly visible, thin, with faintly incrassate apices, about 1/6-2/9 times as long as the marginal hairs on corresponding tergites. In traps, Korea; on *Quercus mongolica* (*grosseserrata*), Japan.

T. **paranaracola** spec. nov. sensu stricto

2 (1) Embryos with spinal hairs on abd. tergites II-VI very distinctly capitate, but only about 1/3-1/2 times as long as the marginal hairs on corresponding tergites. In traps, Korea.

T. **paranaracola hemitrichus** subspec. nov.

I found no other characters than the chaetotaxy of the embryos by which to separate *T. paranaracola* from related species.

Alatae with embryos of type a., typical *paranaracola,* have also been found in Japan. I received from the late Dr. Takahashi some slides identified by him as *Tuberculoides kashiwae,* and one of these, misidentified because it has prothoracic spinal processes, held embryos

with very short spinal hairs. These embryos have since been removed by Dr. Quednau, but a duplicate slide is in the Takahashi collection.

Since no other differences between the two subspecies could be found other than those mentioned in the key above, no detailed description is given of the adults or embryos of subspec. *hemitrichus* subspec. nov.

Types. Holotype of *Tuberculatus paranaracola* spec. nov.: alate viviparous female (measurements no. 2), from yellow Moericke trap, Suwon, Korea, 5-VI-'67, leg. W.H. Paik. Paratypes: alate viviparous females with data as for holotype; alate viviparous females, from *Quercus mongolica,* Abasiri, Hokkaido, Japan, 11-VI-'59, leg. S. Takagi (identified by Dr. R. Takahashi as *Tubercoloides kashiwae*). Holotype of *Tuberculatus paranaracola hemitrichus* subspec. nov.: alate viviparous female, from yellow Moericke trap, Suwon, Korea, 5-VI-'67, leg. W.H. Paik. Paratypes: alate viviparous females with data as for holotype.

Tuberculatus tuberculatus (Richards, 1965)

Dr. W. Quednau, Canada, recently sent me specimens of « *Myzocallis* » *tuberculatus* Richards, 1965. This species has before, as *Tuberculatus punctatellus* Fitch, been placed in *Tuberculatus* by HOTTES & FRISON (1931). I agree with Richards that this cannot be the species described as *Aphis punctatella* from *Carya* by FITCH (1856). First because Fitch states that, collectively, his *Carya* aphids differ from *Aphis tiliae* (*Eucallipterus tiliae* [L.]) by having their wings flat in repose, and a depressed body, second because the description of the pigmentation of the wings of *Aphis caryella* could not possibly apply to « *Myzocallis* » *tuberculatus* Richards. It is far from clear why RICHARDS (1965) described his species in *Myzocallis* as in that paper he recognized *Tuberculatus* as a full genus. In his key to genera the species goes to *Myzocallis* instead of *Tuberculatus* because the siphunculi are « spiculose » (1), but in his key to *Myzocallis* species complex he

(1) Spike in English has two quite different connotations, each with a different derivation. According to the Oxford Dictionary spike in the sense of ear, inflorescence of a plant, is derived from the classical Latin spica, spicus or spicum for ear. But spike in the sense of pointed piece of metal or wood is derived from the Old Norse spik for large nail. Spiculum, from which the botanical term is seemingly derived, occurs in classical Latin, but in the very definite senses of a) sting of a wasp or scorpion, b) the sharp point of an arrow or javelin, or the arrow or javelin itself, again in the sense of sting. In other words, it seems better to use the term spinulose derived from the diminutive of the Latin spina, thorn, than spiculose derived from the Latinized diminutive of an Old Norse word, spik.

gives a choice between species with « spiculose » siphunculi and others with siphunculi without spinules. Also the speculations on evolution (Richards, 1965, p. 112-145) give no clue. By his own arguments the species could just as well land in *Myzocallis* as in *Tuberculatus*. The species with its large spinal processes that occur only on the abdomen is here transferred to *Tuberculatus*. But this *Tuberculatus tuberculatus* (RICHARDS, 1965) makes *Tuberculatus tuberculatus* Richards, 1968 a junior homonym. The latter name can be replaced by *Tuberculatus fangi* (TSENG & TAO, 1938) (vide p. 45). *Tuberculatus tuberculatus* (RICHARDS, 1965) will not fit into any of the subgenera used in the present paper. It has 6 ventral hairs on the first tarsal joints, and no fleck at the bases of the tibiae. Dr. Quednau will publish on its classification.

Tuberculatus yokoyamai (Takahashi, 1923)

This was described as *Myzocallis yokoyamai* from Tokyo, Japan, apparently sent by K. Yokoyama. A slide labelled « *Tuberculoides yokoyamai* Takah., May 2, 1921, Tokyo, K. Yokoyama coll. » was received on loan from Dr. C.C. Tao. The specimens do not agree with the original description as to pigmentation. For TAKAHASHI (1923) writes that the abdomen is « provided with 3 pairs of finger-like tubercles, of which the first is green and the other two are black ». The processes are all pale in the specimens. Furthermore he writes « Fore femora almost colourless, but the middle femora pale green, slightly dusky at midlength, and the hind pair black, with the bases pale green and the apices paler ». All the legs in the specimens are rather uniformly pale with the tibiae slightly darker.

The answer to this problem may be another Takahashi slide, like the preceding one mounted in some water-soluble gummy substance. This also was received on loan from Dr. Tao whom I had asked for original specimens of *T. querciformosanus* and *T. yokoyamai*. The second slide is labelled: « *Tuberculoides querciformosanus* Takah., March 2, 1921, Taichu, K. Sawada Coll ». It contains not *querciformosanus,* but a specimen of *Tuberculatus japonicus* Higuchi.

Both slides are labelled in Takahashi's characteristic handwriting, but they must have been relabelled long after they were made, because of the name *Tuberculoides*. Both species were originally described as *Myzocallis*. Underneath the labels of both slides there were pieces of another, apparently blank, label. Both slides must have been made about the same time. I presume that an error was made in the relabelling.

In this relation it is significant that the description of the colour in the original description of *Myzocallis yokoyamai* agrees completely with the pigmentation of *Tuberculatus japonicus* Higuchi. I therefore suppose that Takahashi received a mixture of the two species. The *yokoyamai* slide also held an alate *Shinjia pteridifoliae* Shinji, 1929 which name may become a synonym when it can be decided that *Atarsos orientalis* Mordv., 1929 (p. 23 of his Food Plant Catalogue) was published before Shinji's description.

Subsequent authors apparently neglected the colour description by Takahashi. MORITSU (1953) listed *yokoyamai* as a synonym of *Tuberculatus kashiwae* Mats., giving a quite different description of the colour. HIGUCHI (1969) does not in detail refer to pigmentation of his species, but considers *T. kashiwae* of Moritsu a synonym of *yokoyamai.* Species identified by, and donated by the late Dr. Takahashi, agree with the redescription by Higuchi, but as to pigmentation not at all with the original description. In the key the original Takahashi slide of *yokoyamai* served as example. A considerable number of typical *yokoyamai* (fundatrices) were collected by Dr. R. van den Bosch in Japan.

The two *Tuberculatus* on the *yokoyamai* slide borrowed from Dr. Tao were remounted. The specimen replaced on the original slide is chosen as lectotype. This now bears an additional label: « Remounted by / D.H.R.L. / lectotype / April 8, 1972 / ».

The specimen has the following characteristics (measurements in mm): Body pale, 2.39. Head with 2 pairs of long frontal hairs on large sockets on small processes; lower pair 0.113, socket plus process 0.028, upper pair 0.087, socket plus process 0.022; more dorsal pair much thinner, 0.016. Antennae 2.17, pale, very apex of segment III dark, other segments of flagellum with more extensive dark apices; III with 8 and 9 rhinaria over 4/5 and 7/8 of segment, 3 thick knobbed hairs on inner side up to as long as basal diameter, 0.026, of segment, on elevated parts of segment; length of segments III-VI: 0.745, 0.426, 0.373, 0.180+0.319. Pronotum with 2 anterior pairs of spinal hairs 0.012, posterior pair on processes, upright, estimated 0.060 with hairs on top 0.043. Mesonotum without processes. Abdomen with spinal processes pale, on segment I 0.117, on II 0.170, on III 0.160, on IV 0.028, with 2-3 hairs of 0.020. Siphunculi tapering, apparently smooth, pale, 0.117. Cauda pale, 0.150. Legs pale; first tarsal joints ventrally with 5 hairs (one fore, one hind leg); second joint of hind tarsi 0.117. Wings with pale, thin veins; no spot in stigma.

The contents of the original slide were returned to Dr. C.C.C. Tao.

V. Acknowledgements.

Dr. F. W. Quednau kindly examined a first draft of my key, and to him I owe the remark on the curious inner row of marginal hairs in embryos of *T. maureri* Swain, and the name *T. fangi* Tseng & Tao which I had overlooked. The late Dr. R. Takahashi gave me a fairly complete collection of the species from Japan, to which Drs. R. van den Bosch and H. Higuchi added valuable material. Dr. W. H. Paik sent very important material from Korea. Drs. R. van den Bosch, V. Moericke, G. Remaudière, and P. Stary collected in Lebanon, Turkey, Iraq, Iran and made that and other material available. Drs. Krzywiec, C.C. Tao, P. Arnaud, J. Powell and H. Higuchi donated or sent on loan essential type material. Dr. V.F. Eastop sent many specimens of the British Museum (Nat. Hist.), London, and Dr. G. Ch. Shaposhnikov submitted the Oriental material of the Zoological Institute of the Acad. of Sciences of the U.S.S.R., Leningrad. The invaluable help of all these colleagues is gratefully acknowledged.

Mrs. Hielkema-Visser made the drawings in this paper.

VI. Addenda.

After the first proofs a number of slides arrived from Dr. G. Ch. Shaposhnikov, Leningrad. The original material shows that *Tuberculatus flavus* Mordvilko, 1929 (nomen nudum) was meant for *Tuberculatus kashiwae* (Mats.), while *Tuberculatus multituberculatus* Mordvilko, 1929 (nomen nudum) would have been a synonym of *T. quercicola* (Mats.). Dr. Shaposhnikov collected besides: *T. higuchii* spec. nov., *T. japonicus* Higuchi, *T. paiki* spec. nov., *T. paranaracola* spec. nov., and *T. stigmatus* (Mats.) from the Primorsk Kray (Ussuria, Vladivostok area) of the U.S.S.R., and found *T. borealis* Krzywiec on *Quercus robur* at Novosibirsk, and at several localities in the European part of the U.S.S.R.

Holotypes of *Tuberculatus orientalis* Richards, 1968 and *T. tuberculatus* Richards, 1968 were received just before page proofs came in. The type of *T. orientalis* is an overcooked, abortive specimen (pterothorax defective, wings less than half-size, abdominal processes underdeveloped) of *T.* (*Acanthocallis*) *stigmatus* (Mats.). On p. 24, first paragraph, alterations are required. Examination of the type of *T. tuberculatus* Richards, 1968 confirmed what I suggested in the second paragraph of the chapter on *Tuberculatus fangi,* p. 45.

RIASSUNTO

L'Autore propone una nuova suddivisione del genere olartico *Tuberculatus* Mordv., presentando una chiave per la determinazione delle specie ed alcune note descrittive.

Il gen. *Tuberculatus* comprende specie associate a *Quercus* spp., ad eccezione di una specie californiana che vive su piante del gen. *Pasania,* che tuttavia è strettamente correlato a *Quercus* e sovente considerato sinonimo di *Lithocarpus.*

Vengono descritti due nuovi sottogeneri ed un certo numero di nuove specie e sottospecie di *Tuberculatus* provenienti dall'area Mediterranea e dall'Estremo Oriente.

SUMMARY

In an introduction, a key to species, and a number of descriptive notes, the authors proposes a new subdivision of the holarctic aphid genus *Tuberculatus* Mordv. *Tuberculatus* is a genus associated with *Quercus* spp., with the exception of one Californian species which lives on the nearly related plant genus *Pasania,* often considered a synonym of *Lithocarpus.* Two new subgenera, and a number of new species and subspecies of *Tuberculatus* are described from the Mediterranean area and the Far East.

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