INSECTA MATSUMURANA

NEW SERIES 6: 1–33 JULY, 1975

COCCOIDEA COLLECTED BY THE HOKKAIDO UNIVERSITY EXPEDITION TO NEPAL HIMALAYA, 1968 (HOMOPTERA)

Scientific Results of Hokkaidô University Expeditions to the Himalaya, Entomology No. 18

By SADAO TAKAGI

Abstract

TAKAGI, S. 1975. Coccoidea collected by the Hokkaidô University Expedition to Nepal Himalaya, 1968 (Homoptera). *Ins. matsum. n. s.* 6: 1–33, 1 tab., 13 figs.

Twenty-two species of Coccoidea belonging to 14 genera in three families are recorded from Nepal. Five species are described as new to science: *Platylecanium nepalense* from an Anacardiaceous tree, *Quadraspidiotus cotoneastri* from *Cotoneaster* sp., *Lepidosaphes piniroxburghii* from *Pinus roxburghii*, *Fiorinia kumatai* from *Citrus aurantium*, and *Fiorinia himalaica* from *Rhododendron arboreum*. *Coccus formicarii* (Green) is redescribed. The 2nd instar male of *Pseudaulacaspis takahashii* (Ferris) is described. *Lepidosaphes tubulorum* Ferris, *Pseudaulacaspis takahashii*, *Pseudaulacaspis sasakawai* Takagi, *Pseudaulacaspis cockerelli* (Cooley), and *Fiorinia turpiniae* Takahashi are noteworthy discoveries. A preliminary faunistic analysis is made.

Author's address. Entomological Institute, Faculty of Agriculture, Hokkaidô University, Sapporo, 060 Japan.

Contents

Introduction

This paper is the result of my study on a small collection of Coccoidea brought from Central Nepal by the Hokkaidô University Expedition to Nepal Himalaya, 1968. Some species of this collection were collected by Dr. T. Kumata, another one by Dr. T. Matsumura, and the others were found on pressed specimens of plants collected and prepared by Dr. Kumata. A total of 22 species belonging to 14 genera in three families are enumerated in the following pages. Of them, five species are described as new; seven other species are represented by poor or scanty material, or only by larval instars, so that they could not be determined during this study. The main part of the collection will be deposited at the Entomological Institute, Hokkaidô University, Sapporo.

The Coccoidea of the Himalaya have been little known. This region is of special interest to me, for in general it is closely related with Japan in floral and faunal constitutions. A faunistic analysis is given at the conclusion of this paper, though it is nothing more than a preliminary trial to approach the fascinating *terra incognita*.

Some notorious scale insect pests of *Citrus* have been found in the present collection. They may have been introduced by the agency of man as in many other countries where they occur. In this connection it is noteworthy that a new scale insect has been found feeding on *Citrus* in Nepal. Undoubtedly there must occur in this region many native Coccoidea which are potential pests of various useful plants. Such insects will be annoying to future systematized cultures of plants in the Himalaya. It is also quite possible that this region will contribute to giving new pests to other parts of the world.

Enumeration of the Coccoidea collected

Family Margarodidae

1. *Drosicha* sp.

Fifty-three specimens, Ghasa (2090 m), on *Butea* (?), 9–v; 1 specimen, Godavari (1450 m), on *Quercus* sp., 20–iv; 1 specimen, Kathmandu (1340 m), on rose, 17–v.

Out of the 53 specimens collected at Ghasa one has imperfectly 5-segmented antennae, of which the 4th and 5th segments are partly fused together; other 40 specimens have 6-segmented antennae, and the remaining 12 specimens 7-segmented antennae. They may belong to the 1st, 2nd and 3rd larval instars, respectively. The two specimens from Godavari and Kathmandu, both with 6-segmented antennae, may belong to the 2nd instar. It is possible that the present material contains more than one species. The Kathmandu specimen differs from the Ghasa specimens by the antennae more or less elongate in some segments and constricted in the terminal segment.

Family Coccidae

2. *Pulvinaria* sp.

Ten adult females, Khurumsang (2500 m), on *Symplocos ramosissima*, 8–vi. All in poor condition.

This species is characterized by the presence of a longitudinal row of sparse conical setae along the dorsal midline and by the ventral tubular ducts largely confined to the abdomen.

3. *Takahashia* sp.

Seventeen adult females and two larvae, Godavari (1450 m), on *Morus* sp., 25–iii. Most of the adult females are full-grown, so that excellent slides could not be prepared. The other females are teneral with fragments of the larval skin adhering to the body.

A comparison has been made between the present specimens and three adult females of *Takahashia japonica* Cockerell collected in Japan, the latter being part of the specimens studied by De Lotto (1968). The present form is very close to *T. japonica*, and may be identical with the latter. I have, however, some doubt about their identity. The anal plates are irregularly indented on the mesal margin in all the Nepalese specimens, whereas they are smooth in the three Japanese specimens of *T. japonica*. The indentation of the anal plates is also found in other coccids. *Pulvinaria maxima* Green is such a species, and may be referable to *Macropulvinaria* Hodgson. In *Takahashia* as well as in *Macropulvinaria* (if with *P. maxima* included) the indentation of the anal plates is merely a specific character, but may be a good specific character. In comparison with the Japanese specimens the Nepalese specimens have rather indistinct spiracular setae, which are little stouter, though somewhat shorter, than other marginal setae. This difference may be too subtle to adopt as a supposed specific character.

4. *Eulecanium* sp.

One adult female and two larvae, Tukucha (2600 m), on *Cotoneaster* sp., 6–v. The adult female is in very poor condition.

This species is very similar to "*Lecanium*" *kunmingi* Ferris, which was described from Yunnan, China. It disagrees with Ferris' (1950) description of that species in the marginal setae: these setae are long-hairy on the head and anal lobes, but are mostly spinous on the intermediate margin, being scarcely distinguishable from the spiracular setae in size and shape. In other characters it appears very close to *kunmingi*, although a detailed examination is difficult owing to the poor condition of the specimen.

The name *Lecanium* is admittedly suppressed as a synonym of *Coccus*, and another name, *Eulecanium*, is available for the broad group of coccids which has long been known as *Lecanium*. Our knowledge concerning this large group may not be sufficient to establish a generally acceptable splitting. For the time being this species should be retained in *Eulecanium* in substitution for *Lecanium* auct.

5. *Coccus formicarii* (Green)

Lecanium formicarii Green (1896), Ind. Mus. Notes 4: 9 [Ceylon; on tea-plant; in nests of *Crematogaster*]. *Saissetia formicarii*: Fernald (1903), Catalogue p. 202. *Lecanium formicarii*: Green (1904), Coccidae of Ceylon 3: 190 [Ceylon; on tea and other plants and

always in the nest of *Crematogaster dohrni*]. *Saissetia formicarii*: Takahashi (1929), Dept. Agr. Gov. Res. Inst. Formosa Rept. 40: 58 [Taiwan; on more than 40 species of plants; very common throughout the lowlands and always in the nest of *Crematogaster rogenhoferi*]. *Lecanium formicarii*: Ferris (1936), Microent. 1: 14 [=*Lecanium globulosum* Maskell (1897) from Hongkong]. *Lecanium formicarii*: Green (1937), Ceylon J. Sci. B. 20: 300 [Ceylon and India]. *Lecanium formicarii*: Takahashi (1942), Gov. Res. Inst. Taiwan Rept. 81: 19 [Thailand]. *Lecanium formicarii*: Takahashi (1950), Ins. matsum. 17: 71 [Riouw Is. (near Singapore)].

Fifty-four adult females, with some larvae, Balaju (1400 m), on *Prunus* sp., in an aerial ant-nest, 22–iv.

Dr. D.J. Williams compared several specimens from the present collection with the type-series of *Coccus formicarii* and informed me that the identification is right. I have examined also some specimens collected in Taiwan in an aerial ant-nest. The following description is based on the Nepalese specimens and mainly on 20 immature adult females, which are flat and about 1.3 to 1.8 mm long on slide.

Body oval in outline, grows convex dorsally; dorsal derm slightly sclerotized at maturity, with small pale spots mostly associated with minute pores; ventral derm membraneous, spiculate along anal cleft to around genital opening.

Antennae usually 7-segmented, with the 2nd, 3rd, 4th and 7th segments elongate and subequal in length, and with the 5th and 6th usually about half as long as one of the elongate segments; rarely 6-segmented. Tibia longer than tarsus, in hind legs about 1.2 to 1.5 times as long as tarsus; tibio-tarsal articulation without articulatory sclerosis in all legs; claws without denticle. Anal plates together roughly quadrate, each with four small apical setae; two fringe setae; two ventral subapical setae.

Spiracular setae straight, blunt apically; usually three and the median longest; the laterals varying in relative length, often only a little shorter than or subequal to the median, at times surpassing the latter, at times much shortened; rarely two or four spiracular setae. Marginal setae hair-like, simple, usually longer than or subequal to the median spiracular setae, 12 to 19 between anterior and posterior spiracular depressions. Submarginal ventral setae short, less numerous than marginal setae, four to nine between anterior and posterior spiracular depressions. Similar ventral setae mainly in median region, and in a broad submarginal region. Dorsal setae similar to marginal setae, scattered over body, those in median region tending to be shorter and less hair-like than those in outer region.

Spiracular disc pores in partly irregularly double or triple rows, 16 to 34 for anterior spiracle, 21 to 44 for posterior spiracle. Multilocular disc pores restricted to around genital opening, often a few on the preceding segment. Ventral tubular ducts numerous on thorax between middle coxae, less densely strewn around mouth-parts; a cluster of ducts between hind coxa and posterior spiracle; several ducts just laterally to middle and hind coxae each. Ventral minute pores numerous in a broad submarginal zone, sparse in inner region; these pores are elliptical, with a broad duct. Dorsum with about 30 to 40 (at times as many as 47) round pores medianly, anteriorly to anal plates; similar, but smaller pores sparsely scattered over dorsum. Minute dorsal pores practically evenly strewn over dorsum; these pores are elliptical, with a cruciate structure within the rim, and with a slender duct. Submarginal dorsal tubercles absent.

I have little doubt that this species is congeneric with *Coccus hesperidum* L.,

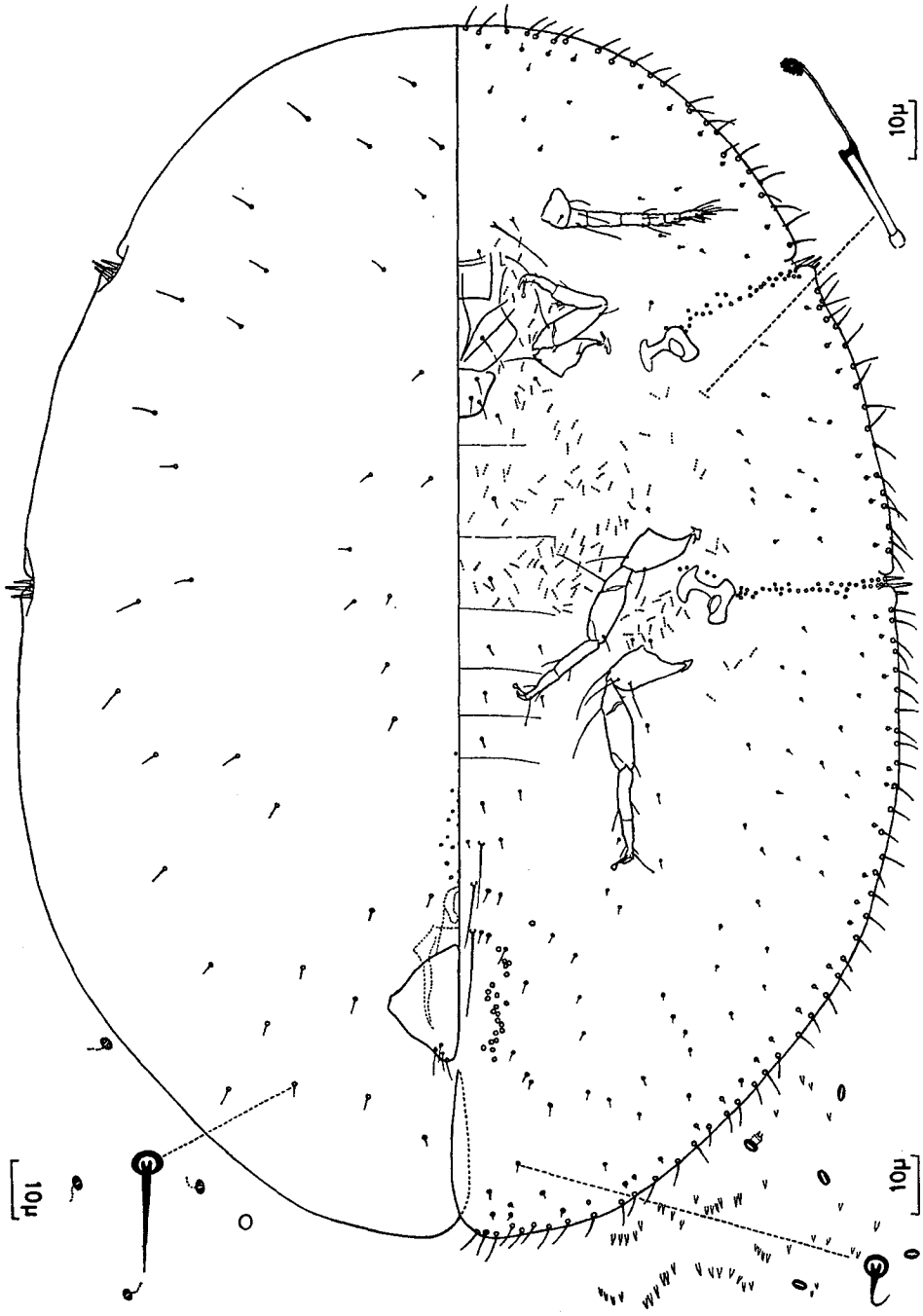


Fig. 1. *Coccus formicarii*, adult female. Balaju, on *Prunus* sp.

the type-species of *Coccus* (=*Lecanium*). Among members of *Coccus* this species is rather peculiarly characterized by having numerous tubular ducts, which are, however, restricted to the head and thorax and to the medio-submedian region.

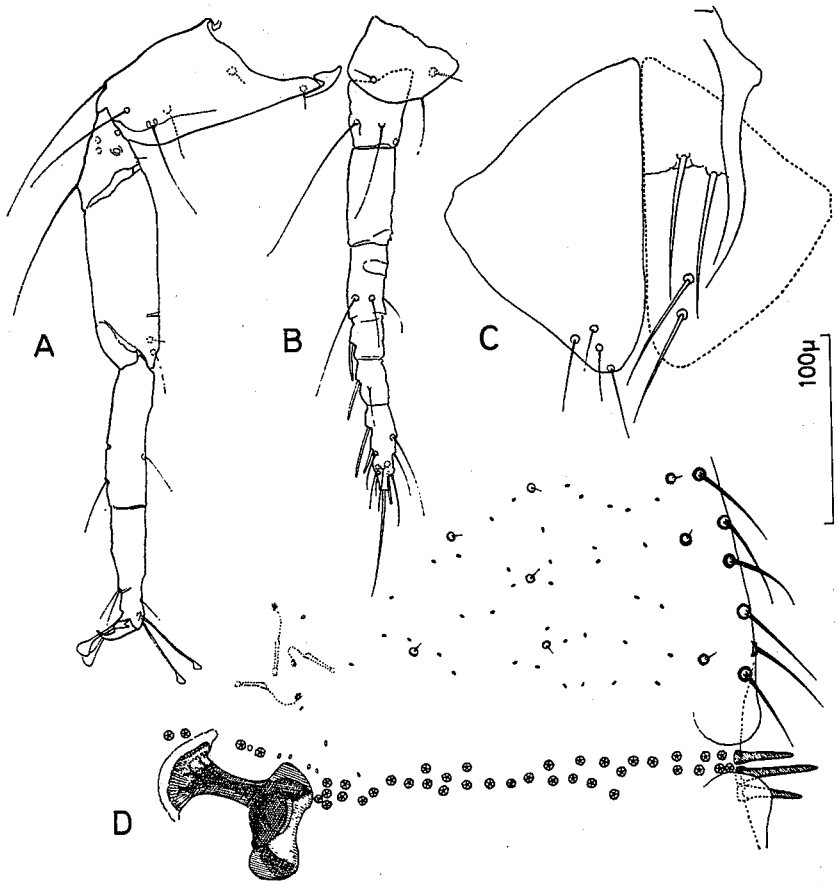


Fig. 2. *Coccus formicarii*, adult female: A, hind leg; B, antenna; C, anal lobes; D, posterior spiracle. Balaju, on *Prunus* sp.

6. *Platylecanium nepalense* n. sp.

Fifteen adult females (one the holotype), Balaju (1400 m), on the leaves of an undetermined Anacardiaceous tree, 22–iv.

The specimens are about 4.6–5.8 mm in length and more or less longer than wide (1.2–1.8 times as long as wide). They are asymmetrical in various degrees, many of them with either the left or right margin straight or nearly so, at times even slightly concave, and the opposite side rounded out; the eye-spots and antennae show corresponding asymmetry in position, the mouth-parts are set more or less aside, and the distance between the spiracle and spiracular cleft is shorter on the reduced side (more remarkably so for the anterior pair of spiracles).

Flat; dorsal derm somewhat sclerotized, with irregular pale spots strewn in submarginal zone, and with faint areolations just inside the spot zone; finely granulated along posterolateral margin of anal plate. Dorsal setae mostly hooked, in 20 or so rows on one side; the rows run perpendicular to the body margin (this pattern is disturbed on the reduced side) and are innerly connected to form some

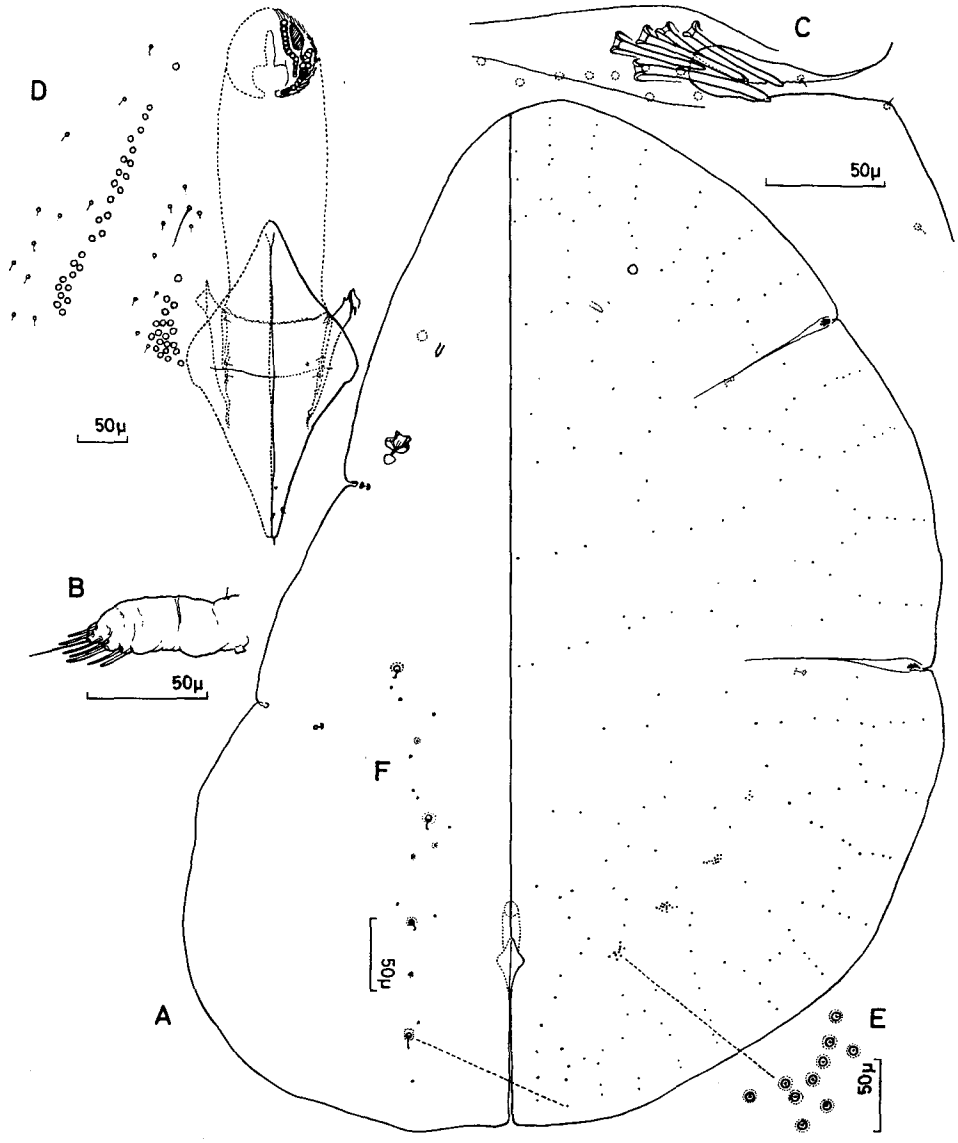


Fig. 3. *Platylecanium nepalense*, adult female: A, body; B, antenna; C, posterior spiracular cleft; D, anal-genital complex; E, "cribriform plate"; F, row of dorsal setae. Balaju, on an Anacardiaceous tree.

transverse rows across the body; minute pale points scattered along with the setal rows. Small sclerotized tubercles in four small groups on each side, forming "cribriform plates"; these groups are arranged in an arc, the posteriormost group is situated laterally to and distant from the anal plates; these tubercles are about as large as the bases of neighbouring dorsal setae, but without a seta, 1–12 (absent in one case; mean six) in the anteriormost group, 10–19 (15) in the next, 12–21 (16) in the penultimate, and 10–24 (15) in the posteriormost. Eyes about 35–40 micra

in diameter. Spiracular clefts distinct, leading to a well-marked dorsal channel of derm; spiracular setae 4–7 in each spiracular cleft. Anal plates forming together a rhombus, each plate 3.1–3.8 times as long as wide, the posterolateral margin 1.2–1.5 times as long as the anterolateral; setae of anal plates are small and not easily seen, but it seems that each plate is provided with one apical and three subapical setae; internal process of anal plate with two setae where it contacts the opening of the anal tube, and with two other setae. Anal ring approximately circular, with about 20 cellular pores on each lateral half; anal ring setae altogether six, somewhat swollen just before base. Anal cleft 2.1–2.5 times as long as anal plates. Body margin smooth, with small setae sparsely arranged just within margin on ventral surface. Antennae situated (on ventrum) posteriorly to level of (dorsal) eyes, about 60–80 micra long, with a rudimentary basal segment; an apical seta slender, and about 5–7 subapical setae shorter and mostly fleshy. Quinquelocular spiracular disc pores in irregularly single rows, 39 and 40 in maximum number for anterior and posterior spiracles, respectively, but on the reduced side of body more or less fewer than on the opposite side in accordance with the reduced distance between the spiracle and spiracular cleft, nine and 19 in minimum number for anterior and posterior spiracles, respectively. Multilocular perivulvar disc pores in two oblique series on each side; the anterolateral series is a long row largely irregularly double, composed of 22–33 (mean 28) disc pores; the posteromesal series is a rather coherent group composed of 15–23 (mean 19) disc pores; an irregularly double row of small setae is associated with each series of perivulvar disc pores; a long seta, about 40 micra long, anteriorly to the posteromesal series of disc pores and in the anterior end of the setal row. Legs absent.

The degrees of asymmetry are considerably variable in the specimens. As an approximation to this variation a simple index is adopted:

$$\text{Symmetry index} = 2 \times \frac{d_1}{d_1 + d_2} \qquad d_1 \leqq d_2$$

Here, d_1 is the distance between two positions in transverse relation on the reduced side, and d_2 is the corresponding distance on the opposite side. The maximal value, one, shows complete symmetry and lower values are proportionate to degrees of asymmetry. So far as measured by the distance between the mouth-parts and anterior spiracular setae (Table 1, Index I) and by that between the anterior spiracle and corresponding spiracular setae (Index II) the variation is quite large. The values for the distance between the posterior spiracle and corresponding spiracular setae (Index III) show a much narrower variation, and are larger than six in all the specimens measured; only one specimen shows such a value for Index I and two specimens for Index II. The values of Index III are slightly surpassed by those of Index II only in two specimens (Specimen 3 and 4), which show conspicuously large values for Index I and II. In general the indexical values are lowest concerning the position of the mouth-parts.

In describing *Platylecanium asymmetricum*, Morrison (1921) states as follows: "The conspicuously asymmetrical character .... is quite probably due to the method of attachment of the insect close to one of the deep, but narrow, riblike veins of the host leaf, ..." This method of attachment on the host leaf and the fixed insertion of the stylet, combined with the immovability of the insect, may be responsible for the asymmetry of the present species, too. The structural

Table 1. Symmetry index in *Platylecanium nepalense*.

Specimen number	Reduced side	Symmetry index		
		I	II	III
1	L	0.18	0.00	0.64
2	R	0.22	0.38	0.63
3	L	0.70	0.86	0.83
4	L	0.58	0.70	0.67
5	L	0.22	0.45	0.75
6	R	0.31	0.50	0.67
7	R	0.19	0.47	0.74
8	R	0.21	0.50	0.61
9	L	0.21	0.48	—
10	R	0.47	0.55	0.67
11	R	0.27	—	—
12	R	0.20	0.22	0.62
13	R	—	—	—
14	L	—	—	—
15	L	—	—	—

Reduced side — L: left; R: right.
Symmetry index — I: distance between mouth-parts and anterior spiracular setae; II: distance between anterior spiracle and corresponding spiracular setae; III: distance between posterior spiracle and corresponding spiracular setae.

asymmetry is then an ethological as well as morphological character of these species.

I have read the descriptions of ten described species of *Platylecanium*, none of which exactly agrees with the present species. This species may be different from *P. citri* Takahashi, which has three spiracular setae in each cleft.

The so-called "cribriform plates" are definitely dorsal in the genus (Morrison 1920), and have been described as composed of "pores" for most species. I have carefully examined the "cribriform plates" of the present species and found that they are groups of sclerotized small tubercles. These tubercles are similar to the setal base, but apparently without a seta.

The genus *Platylecanium* is here accepted only provisionally, because resemblance between species of *Paralecanium* and *Platylecanium* is at times remarkable (for example, see Green 1914, p. 234). These genera coincide in geographic distribution, both being largely Oriental.

Family Diaspididae

7. *Leucaspis* sp.

One 2nd instar larva (possibly female), and three 1st instar exuvial casts, Larjung (2550 m), on the needles of *Pinus roxburghii*, 7–v.

The 2nd instar is similar to that of *Leucaspis coniferarum* Hall and Williams from Pakistan, among the *Pinus*-feeding *Leucaspis*-species, by having few dorsal macroducts.

8. *Aspidiotus* sp.

One adult female with its 2nd instar exuvial cast, Kathmandu (1340 m), on the branch of *Schima wallichii*, 22–iv.

The adult female may be referable to *Aspidiotus spinosus* Comstock, but shows the following characters.

1. Each median lobe lacks a distinctly marked and strongly sclerotized region extending from its base into the pygidium.
2. The 2nd lobes are only half as long as neighbouring plates and more or less conical in outline.
3. The 3rd lobes are similar in size and shape to the 2nd lobes and a little less sclerotized than the latter.
4. The anal opening is elongate, being twice as long as wide, and removed from the bases of the median lobes by about twice its length.
5. The perivulvar disc pores are in five groups, 10 in the median group, 11 in each anterolateral group, and four or six in the posterolateral group.

After Ferris (1941) and Balachowsky (1948) the 2nd and 3rd lobes are variable in *A. spinosus*. Though such variations as stated by them are unknown to me, it may be better to avoid discussion concerning these features. The other mentioned characters of the present specimen are assumed to be out of the normal variations of *A. spinosus*, and on this basis I am inclined to the opinion that the present adult female represents another species.

9. *Aonidiella aurantii* (Maskell)

Twelve adult females with exuvial casts, Biratanti (1150 m), on *Citrus aurantium*, 29–iv.

This species is a well-known pest of *Citrus* and other plants in warm parts of the world.

10. *Aonidiella citrina* (Coquillet)

Eight adult females with exuvial casts, Kathmandu (1340 m), on garden orange, 14–iv.

This species has been recorded from warm parts of the world as a feeder of *Citrus* and other plants.

11. *Quadraspidiotus cotoneastri* n. sp.

Seven adult females (one the holotype), Tukucha (2600 m), on the branches of *Cotoneaster* sp., 6–v.

The adult female is broadly pyriform, being a little longer than wide, with a broad pygidium. Derm membraneous in prepygidial region. Pygidium with three pairs of lobes. Median lobes robust, separated from each other by a narrow space. Second lobes smaller than the median, yet well developed, with a notch on the sloping outer margin. Third lobes a small, well-sclerotized, pointed process. A pair of paraphyses between median and 2nd lobes, about as long as median lobe;

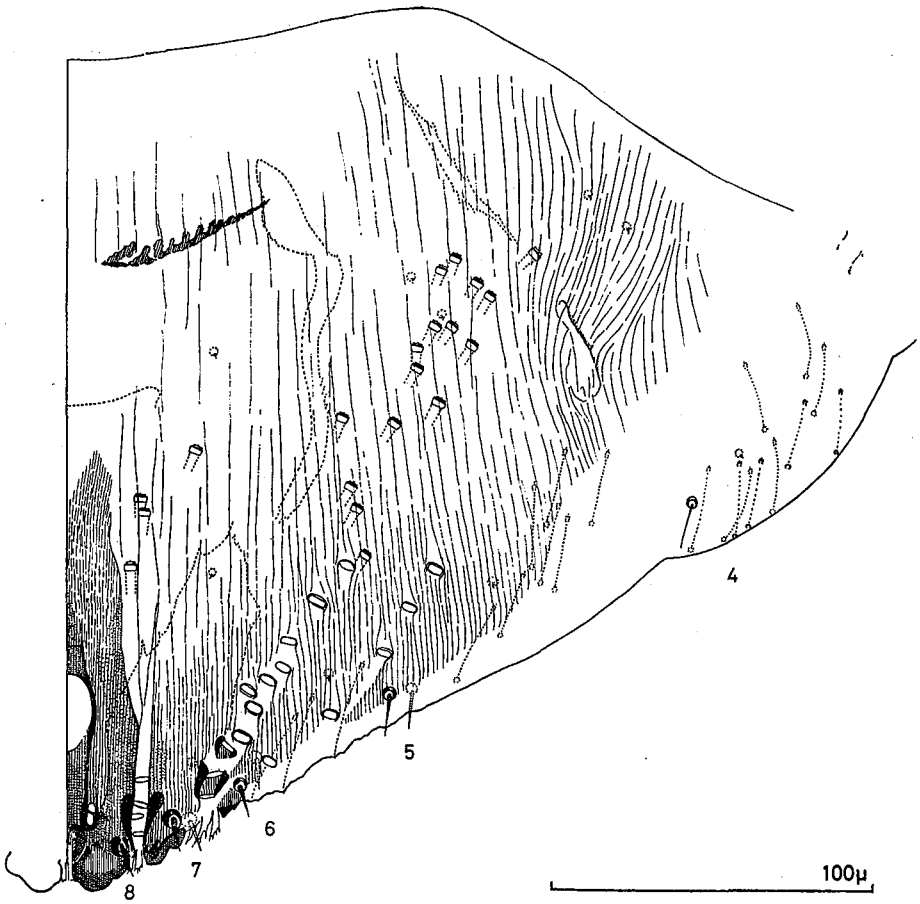


Fig. 4. *Quadraspidiotus cotoneastri*, adult female: pygidium. Tukucha, on *Cotoneaster* sp.

another pair just mesally to 3rd lobe, much smaller. Plates present in interlobar spaces, short and fimbriate. Dorsal macroducts much elongate; three or four in a short row originating between median and 2nd lobes; 5–11 in an oblique row originating between 2nd and 3rd lobes (between abd. vi and vii), the anterior end of this row not attaining laterobasal sclerosis of pygidium; one present or absent near margin laterally to 3rd lobe; 4–6 in an oblique row between abd. v and vi. Prepygidial region, involving mesothorax to abd. ii, usually with a few much shorter macroducts marginally. Microducts scattered ventrally on or near margin on pygidium; abd. iii and iv with microducts both dorsally and ventrally near margin; prepygidial region with a few submedian microducts dorsally and ventrally; abd. ii and preceding segments with much shorter microducts scattered dorsally along margin as far as level of antennae. Antennae with a rather short seta. Anal opening rather large, elliptical, more or less longer than median lobes, removed from bases of median lobes by a distance usually as long as its longitudinal diameter. Perivulvar disc pores absent.

The present specimens are seemingly full-grown, with the median and 2nd lobes

appearing more or less worn away apically. In the figure presented here slight modifications are made to the median and 2nd lobes on the supposition that these lobes are originally well convex apically.

The validity of *Quadraspidiotus* as a good genus is open to question (Takagi 1974). The new species is only provisionally placed in *Quadraspidiotus*, although it is a typical form of the genus as defined by authors except for its anal opening too large in relative size.

This species is similar to various species of *Quadraspidiotus* in varying degrees. I have failed, however, to find any described species particularly similar to it. It may be distinguished from other species by the combination of the following characters: presence of distinct 3rd lobes; absence of perivulvar disc pores; a comparatively large anal opening; absence of submarginal dorsal macroducts on the 5th abdominal segment as well as on the preceding segments; and a comparatively short row of macroducts between the 6th and 7th abdominal segments. By the size of the anal opening this species is rather intermediate between the typical *Quadraspidiotus* and *Hemiberlesia* (s. str.). *Quadraspidiotus centrafricanus* Balachowsky and Ferrero also has an enlarged anal opening set close to the pygidial apex.

12. *Hemiberlesia rapax* Comstock

One adult female and its 2nd instar exuvial cast, Kathmandu (1340 m), host undetermined, 5–vii.

This species is widely distributed in warm countries of the world, feeding on various plants.

13. *Lepidosaphes piniroxburghii* n. sp.

Six adult females (one the holotype), Larjung (2550 m), on the needles of *Pinus roxburghii*, 7–v.

The body of the adult female is rather narrow (about 2.4 times as long as wide in the holotype) and fusiform, with a distinct constriction between the meso- and metathorax, and with the free postsomatic segments moderately lobed out laterally. Derm membraneous except for a broad median dorsal area and other small areas of pygidium. Pygidium rounded on free margin. Median lobes about as long as wide, separated from each other by a space as wide as or narrower than one of them, rounded, with a faint subbasal notch on each side. Second lobes with the inner lobule about half as wide as median lobe, rounded, the rounded margin somewhat slanting outwards; the outer lobule similar in shape but smaller. Basal paraphyses present on median lobes and both lobules of 2nd lobes. Third lobes merged within pygidial margin, yet represented by a well-demarcated, sclerotized process. A pair of marginal gland spines in each interlobar space, short; a pair of longer gland spines laterally to 3rd lobe (on abd. vi), and a pair of similar gland spines towards base of pygidium (on abd. v). Conical or tubercular submarginal gland spines one or two on mesothorax (lacking on one side in one specimen), 3–8 on metathorax, 4–8 on abd. i, and 6–9 on abd. ii; abd. iii with 1–3 conical submarginal gland spines and 3–5 elongate, practically marginal ones, total 5–7; abd. iv with 2–5 elongate

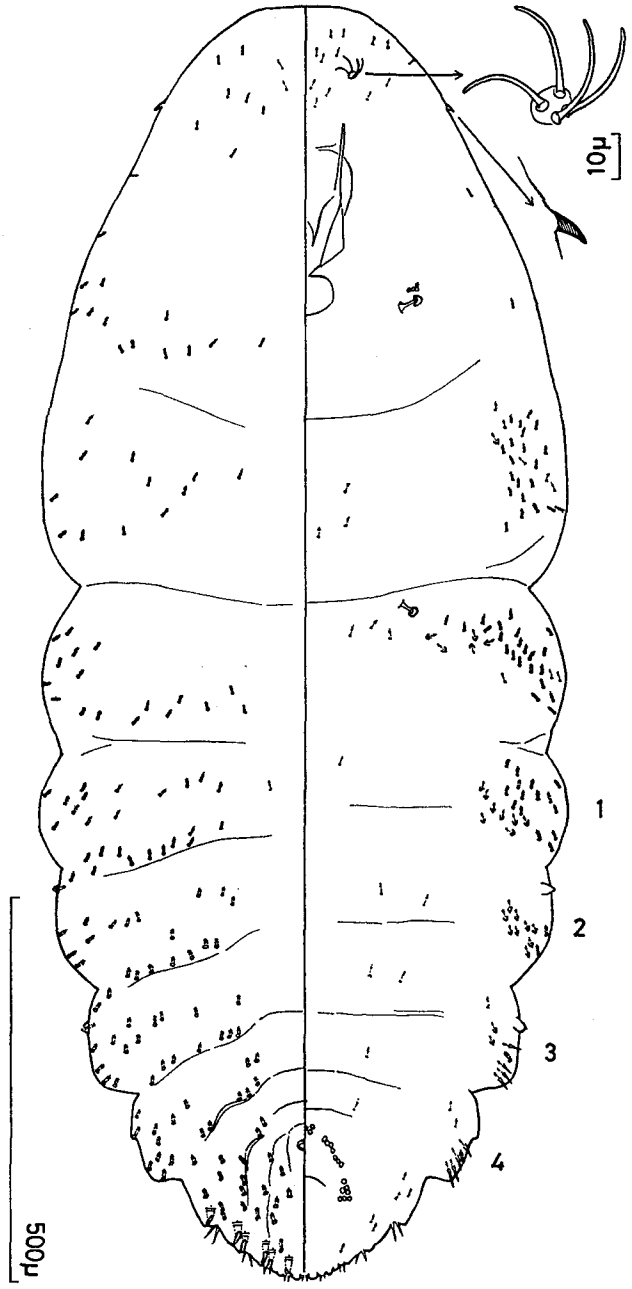


Fig. 5. *Lepidosaphes piniroxburghii*, adult female. Larjung, on *Pinus roxburghii*.

gland spines at apex of lateral lobe.

Marginal macroducts six on each side of pygidium, single on supposed abd. iv and vii and double on v and vi. Dorsal macroducts much smaller than marginal macroducts, but not minute, nor filiform, occurring from prothorax to supposed

Fig. 6. *Lepidosaphes piniroxburghii*, adult female: pygidium. Larjung, on *Pinus roxburghii*.

abd. vii except in median region; scattered in lateral lobes of segments, but arranged in rows along posterior borders of segments and on abd. i–iv also in infrasegmental rows; abd. iv with 4–5 submedian macroducts, part of them usually separated to form an infrasegmental row; abd. v with 2–4 submedian macroducts; combined abd.

vi and vii with 6–9 macroducts, one of them being situated just anteriorly to 2nd lobe. Similar ventral macroducts numerous on lateral lobes of meso- and metathorax and abd. i. Head with many microducts scattered mostly on ventrum, and with a little larger ducts (diminished macroducts) on dorsum. Abd. ii and iii each with a robust lateral tubercle and abd. iv with a low lateral prominence, towards base, these processes somewhat sclerotized, each with a duct similar to dorsal macroducts.

Perivulvar disc pores in five groups, 1–6 medians, 5–12 anterolaterals, and 4–13 posterolaterals; 22—51 in total. Anal opening located near bottom of pygidium, anteriorly to level of genital opening. Antennae flat, each with 4–6 long curved setae, and often with one or two small setae. A sharp, strongly sclerotized spur in place of eye, directed posteriorly (in one specimen directed anteriorly on one side). Anterior spiracles each with 3–7 trilocular disc pores; posterior spiracles without disc pores. Bosses absent.

This species is undoubtedly close to *Lepidosaphes pseudotsugae* Takahashi, which occurs in Japan on *Pseudotsuga japonica* and other conifers. Their host plants belong to the Pinaceae. The adult females of the two species exhibit a common structural pattern readily perceptible as a combined effect of their agreements in the body shape, the multisetose antennae, the ocular spines, the size and arrangement of macroducts, the pygidial lobes, etc. Some negative characters, e. g. the absence of bosses, also contribute to this effect. On the other hand, the two species differ in many details as follows.

1. In *L. piniroxburghii* the head is strewn with many ducts (microducts, mostly ventral, and a little larger dorsal ducts, 37–55 in total), whereas in *L. pseudotsugae* only with a few microducts (1–9 in total).

2. In *L. piniroxburghii* the ocular spines are directed posteriorly (exceptionally directed anteriorly in one observed case); in *L. pseudotsugae* these spines are directed anteriorly.

3. In *L. piniroxburghii* the disc pores associated with the anterior spiracles are fewer than in *L. pseudotsugae*.

4. In *L. piniroxburghii* the dorsal macroducts occur as high as the prothorax (except the diminished dorsal ducts on the head), extending more or less into the submedian region on each segment. In *L. pseudotsugae* the macroducts are confined to the mesothorax and succeeding segments and absent in the submedian region on the anterior four of these segments.

5. In *L. piniroxburghii* the gland spines are present on the mesothorax and succeeding segments, whereas in *L. pseudotsugae* they are usually absent on the mesothorax and sometimes also on the metathorax and 1st abdominal segment.

6. The marginal gland spines of the pygidium occur in pairs in *L. piniroxburghii*, whereas singly on the 6th and 7th abdominal segments in *L. pseudotsugae* (although rarely in a pair on the 6th).

7. In *L. piniroxburghii* the lateral tubercles of the abdomen are only weakly sclerotized, whereas in *L. pseudotsugae* these processes are all strong spurs.

8. In *L. piniroxburghii* the perivulvar disc pores are fewer than in *L. pseudotsugae* (total 65–110 in the latter).

9. In *L. piniroxburghii* the pygidial lobes are less produced than in *L. pseudotsugae*.

Remarkable differences between the two species are concerned with the

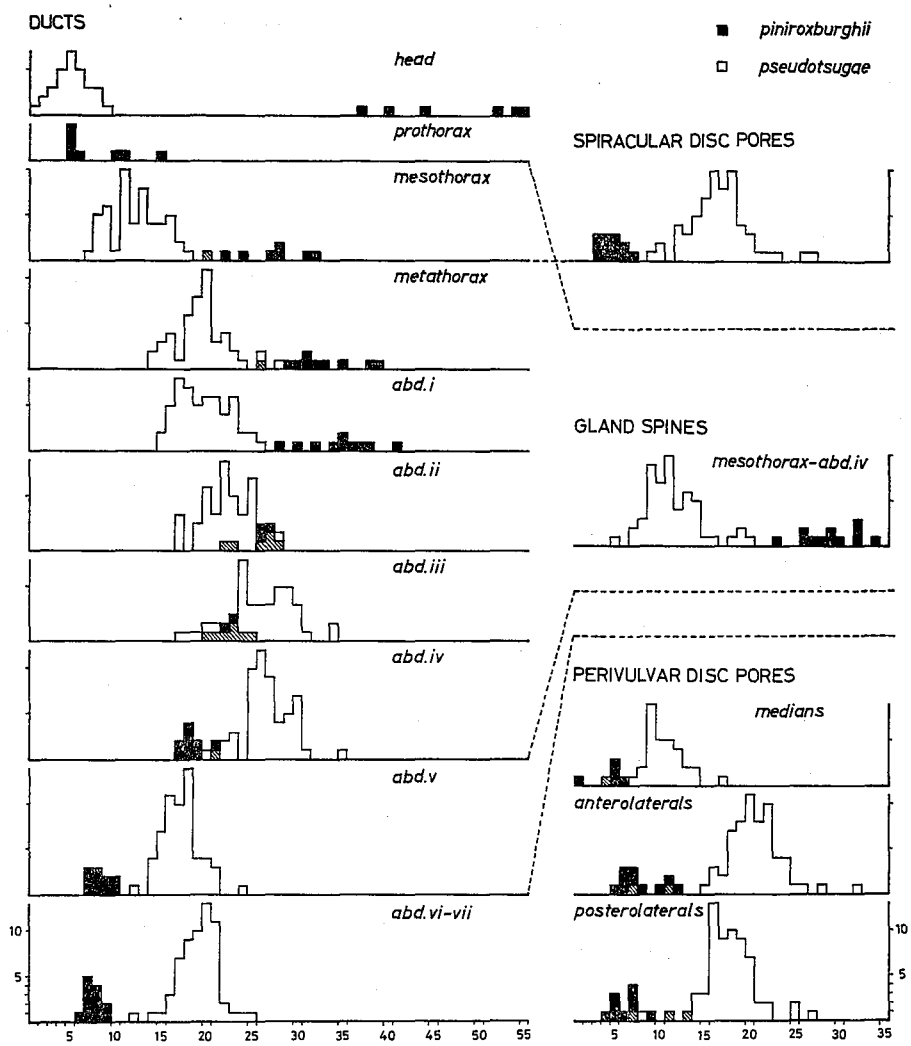


Fig. 7. 'Cross-overs' of adult female characters between *Lepidosaphes piniroxburghii* from Nepal (Larjung, on *Pinus roxburghii*) and *Lepidosaphes pseudotsugae* from Japan (Ôdai-ga-hara, on *Pseudotsuga japonica*). Number of all ducts on head (on both dorsal and ventral surfaces); number of macroducts on one side (on both dorsal and ventral surfaces) of thoracic and abdominal segments; number of disc pores associated with each anterior spiracle; number of prepygidial gland spines on one side of body; number of perivulvar disc pores in one group. Black: *L. piniroxburghii*; white: *L. pseudotsugae*; hatched: overlap of the two.

abundance of wax-secretory organs. In this regard *L. pseudotsugae* appears to be comparatively reductive, lacking gland spines and dorsal ducts in some anterior parts of the body. However, the differences are complicated. The gland spines are indeed fewer in *L. pseudotsugae*, but the spiracular and perivulvar disc pores are fewer in *L. piniroxburghii*. On the segments anterior to the 2nd abdominal segment the ducts are fewer in *L. pseudotsugae*, but on the posterior segments they

are fewer in *L. piniroxburghii*. These 'cross-overs' of characters, summarized in Fig. 7, suggest that these two species, which are undoubtedly closely related to each other, have different evolutionary passes rather than any direct phylogenetic relationship.

In his trial to divide *Lepidosaphes* into smaller genera Borchsenius (1963) proposed *Pinomytilus* for *L. pseudotsugae* and later (1964) added to it another species, *P. pinifolii* Borchsenius, which occurs in Korea on the needles of *Pinus*. As mentioned by Williams (1971) these species resemble each other rather remotely. He emphasized the presence of mesothoracic gland spines in the Korean species and their absence in the type-species of *Pinomytilus*, suggesting that these species are not congeneric. *L. piniroxburghii* has mesothoracic gland spines, yet it is close to *L. pseudotsugae*. I have found among the type-series of *L. pseudotsugae* one specimen in which a single gland spine occurs on one side of the mesothorax; this variation was already described by Takahashi (1957) in the original description. The presence or absence of mesothoracic gland spines is at most a specific character in this case. Further, I have doubt that other characters supposed to be of generic value in connection with the splitting of *Lepidosaphes* are worthy of serious consideration. *Pinomytilus*, as here understood, is a species-group of the genus *Lepidosaphes*, and comprises *L. pseudotsugae* from Japan and *L. piniroxburghii* from Nepal, and possibly also *L. pinifolii* from Korea. It is an East Asian group of conifer-feeders.

14. *Lepidosaphes beckii* (Newman)

Many specimens, Kathmandu (1340 m), on the leaves of garden orange, 14–iv.

This species is widely distributed in the world. Its authentic host plants, however, belong to the originally Asian genus *Citrus*, and its relatives are centred in East Asia. The native locality of this notorious pest may be within the overlapped natural distributions of *Citrus* and the related scale insects.

15. *Lepidosaphes tubulorum* Ferris

Lepidosaphes tubulorum Ferris (1921), Bull. ent. Res. 22: 216 ["Type from *Sapium sebiferum*, Taihoku, Formosa. Also from *Salix warburgi* at the same place, and from *Ilex crenata*, willow and currant in Japan"]. *Lepidosaphes tubulorum*: Kuwana (1925), Imp. Plant Quar. Serv. Japan Tech. Bull. 2: 30 [Japan, on *Diospyros*, *Pyrus* and many other plants]. *Lepidosaphes tubulorum*: Ferris (1953), Microent. 18: 61 [Kunming, China, on *Salix* and *Hedwigia*]. *Paralepidosaphes ussuriensis* Borchsenius (1962), Ent. Obozr. 41: 866 [Maritime Province, on *Malus*, *Populus*, *Syringa*, *Betula*, and *Ulmus*]. *Paralepidosaphes spinulata* Borchsenius (1964), Ent. Obozr. 43: 157 [Korea, on *Ficus*].

One adult female in poor condition and its 2nd instar exuvial cast, Kathmandu (1340 m), on the branch of *Schima wallichii*, 22–iv.

As previously stated (Takagi 1960), the presence or absence of small conical processes on the head and the development of lateral tubercles on the metathorax are not associated with other particular characters, so that these characters may be involved within the variation of *L. tubulorum*. In Japan the form with well-

developed cephalic processes and metathoracic tubercles is prevailing. This form is identical with *Paralepidosaphes ussuriensis*, so far as compared with specimens of the latter mounted from the type-material collected on *Syringa amurensis*. If my interpretation concerning the specific status of *L. tubulorum* is right, *P. ussuriensis* is a synonym of the former. The specific difference between *Paralepidosaphes spinulata* and *P. ussuriensis* given by Borchsenius seems to be not fully convincing. Since I have not yet examined any specimens from Taiwan, the type-locality of *L. tubulorum*, my interpretation remains only tentative. The specimen from Nepal belongs to the *ussuriensis*-form, having well-developed cephalic processes and sclerotized metathoracic tubercles.

16. *Lepidosaphes* sp.

Five adult females and several 2nd instar exuvial casts, Kathmandu (1340 m), on the bark of *Wendlandia coriacea*, 22–iv. Three adult females and several 2nd instar exuvial casts, Kathmandu, on *Caryopteris odorata*, 22–iv. Female scale highly convex dorsally, whitish, growing brown (based on material from *Wendlandia*).

This species seems to be an unnamed species. It is not named here, since the available specimens are not good in condition.

This species resembles *L. tubulorum*, but differs from the latter mainly by the lateral tubercles of the abdomen not sclerotized into spurs. By the same reason it is certainly not *L. yamahoi* Takahashi (=*L. cycadicola* var. *yamahoi*), nor *L. coreana* Borchsenius (=*Paralepidosaphes coreana*).

This species lacks conical processes on the head. At maturity, however, the head is strewn with minute cuticular granules. Antenna with two setae, of which one is larger than the other. Anterior spiracle with five or six trilocular disc pores in a group, at times with another disc pore isolated anteromesally. Metathorax without gland spines. Abdominal lateral tubercles not always seen in the specimens, but seemingly present between abd. i and ii, ii and iii, and iii and iv, and membraneous. Pygidium and dorsal ducts practically as in *L. tubulorum*.

17. *Pseudaulacaspis takahashii* (Ferris)

Phenacaspis takahashii Ferris (1955), Microent. 20: 52 [Taiwan, host undetermined].
Pseudaulacaspis takahashii: Takagi (1970), Ins. matsum. 33: 50 [Taiwan, on *Diospyros discolor*].

Fifty-five adult female, with exuvial casts, and 11 2nd instar males, Kathmandu (1340 m), on the branches of *Schima wallichii*, 22–iv.

This species was originally described from Tai-pei and later from Ken-ting, both these localities being found under the subtropical climate of the lowland of Taiwan. In a comparison of the adult females from Kathmandu with those from Ken-ting (40 adult females collected on the branches of *Diospyros discolor*; part of them were studied in my previous work, l.c.) the following differences are found.

1. The Kathmandu specimens lack dorsal macroducts on the metathorax, whereas the Ken-ting specimens have 1–9 dorsal macroducts in the posterolateral corner of the segment.

2. The Kathmandu specimens are often with disc pores associated with one or both posterior spiracles, whereas the Ken-ting specimens without them.

3. The Kathmandu specimens are more variable in the total numbers of dorsal macroducts, perivulvar disc pores, and gland spines.

We should take note of that the comparison is based only on a single colony from each locality. As to the spiracular disc pores, Ferris (l. c.) states that his specimens from Tai-pei have "a small group of accompanying disc pores" at each posterior spiracle. Then, the presence or absence of these pores is at most a local or colonial character in Taiwan. Furthermore, the Kathmandu specimens are variable concerning this character.

In either colony the numbers of the abdominal dorsal macroducts, perivulvar disc pores and gland spines show a tendency to vary together. In scatter diagrams constructed for these numbers the Ken-ting specimens approximately fall within the Kathmandu specimens, and the regression lines fitted to the diagrams run closely between the colonies (Fig. 8). In reality, it is impossible to distinguish individual Ken-ting specimens from the Kathmandu specimens on the basis of these numbers.

In the Ken-ting specimens the number of dorsal macroducts on the metathorax seems to have some correlation with that on the 1st abdominal segment of the same side ($r=0.47$, $n=40$). On the other hand, the Kathmandu specimens always lack metathoracic dorsal macroducts in spite of the fact that the dorsal macroducts of the 1st abdominal segment are often quite numerous. This difference may indicate that a divergence of some kind takes place between the Nepalese and Taiwanese forms, although further materials are necessary to support this assumption.

The numbers of the disc pores, dorsal macroducts and gland spines in the Kathmandu specimens are as follows:

1. Disc pores accompanying the posterior spiracles. These pores, if present, are one to eight in number for each spiracle. Of the examined specimens 22 (40%) have disc pores at both posterior spiracles, other 22 (40%) at one of them, and the remain (20%) at neither. The largest number for one individual is 15 (seven for one of the posterior spiracles, and eight for the other).

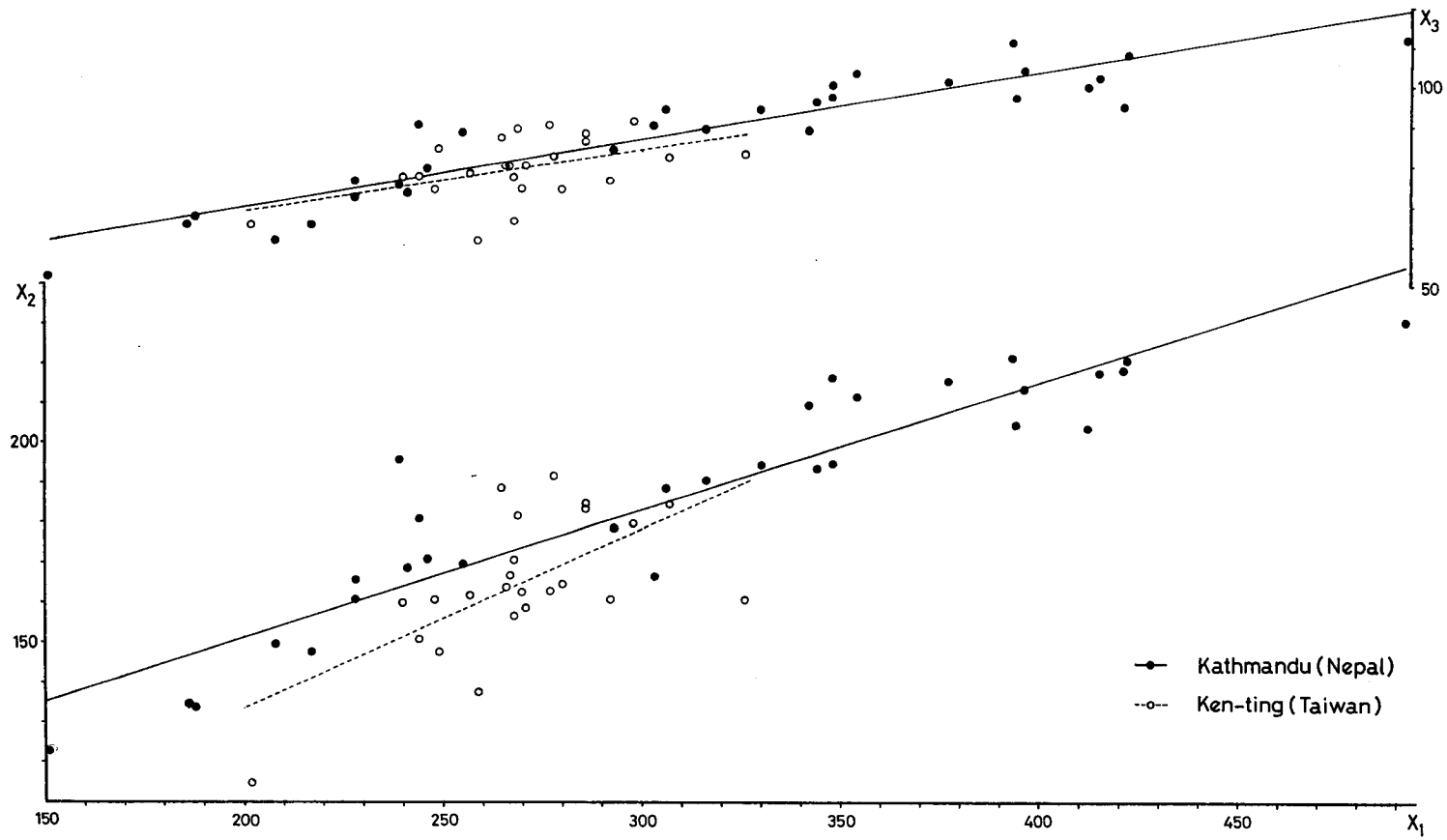
2. Perivulvar disc pores. In the specimens plotted in Fig. 8: 16–35 medians, 26–55 anterolaterals, and 26–55 posterolaterals.

3. Dorsal macroducts. In the plotted specimens the submedian macroducts are as follows: 7–22 on abd. ii, 6–19 on iii, 6–18 on iv, 6–15 on v, and 0–5 on vi; and the submarginal macroducts: 7–49 on abd. i, 13–48 on ii, 11–34 on iii, 7–27 on iv, and 7–19 on v.

In addition, the pygidium is provided with seven marginal macroducts on each side.

4. Gland spines. In the plotted specimens: 4–16 on metathorax, 3–17 on abd. i, 5–14 on ii, 4–14 on iii, 3–9 on iv, 1–5 on v, and one on each of vi–viii.

Fig. 8. *Pseudaulacaspis takahashii*, adult females. Scatter diagram between number of dorsal macroducts on abdomen (X_1) and number of perivulvar disc pores (X_2), and between X_1 and number of gland spines on metathorax to 5th abdominal segment (X_3). Black: specimens from Nepal (Kathmandu, on *Schima wallichii*); white: specimens from Taiwan (Ken-ting, on *Diospyros discolor*). (The Ken-ting specimens include teneral individuals so that the data may include some small miscounts owing to crowded macroducts in those individuals.)


X3
100
50
X2
200
150
150
200
250
300
350
400
450
X1
Kathmandu (Nepal)
Ken-ting (Taiwan)

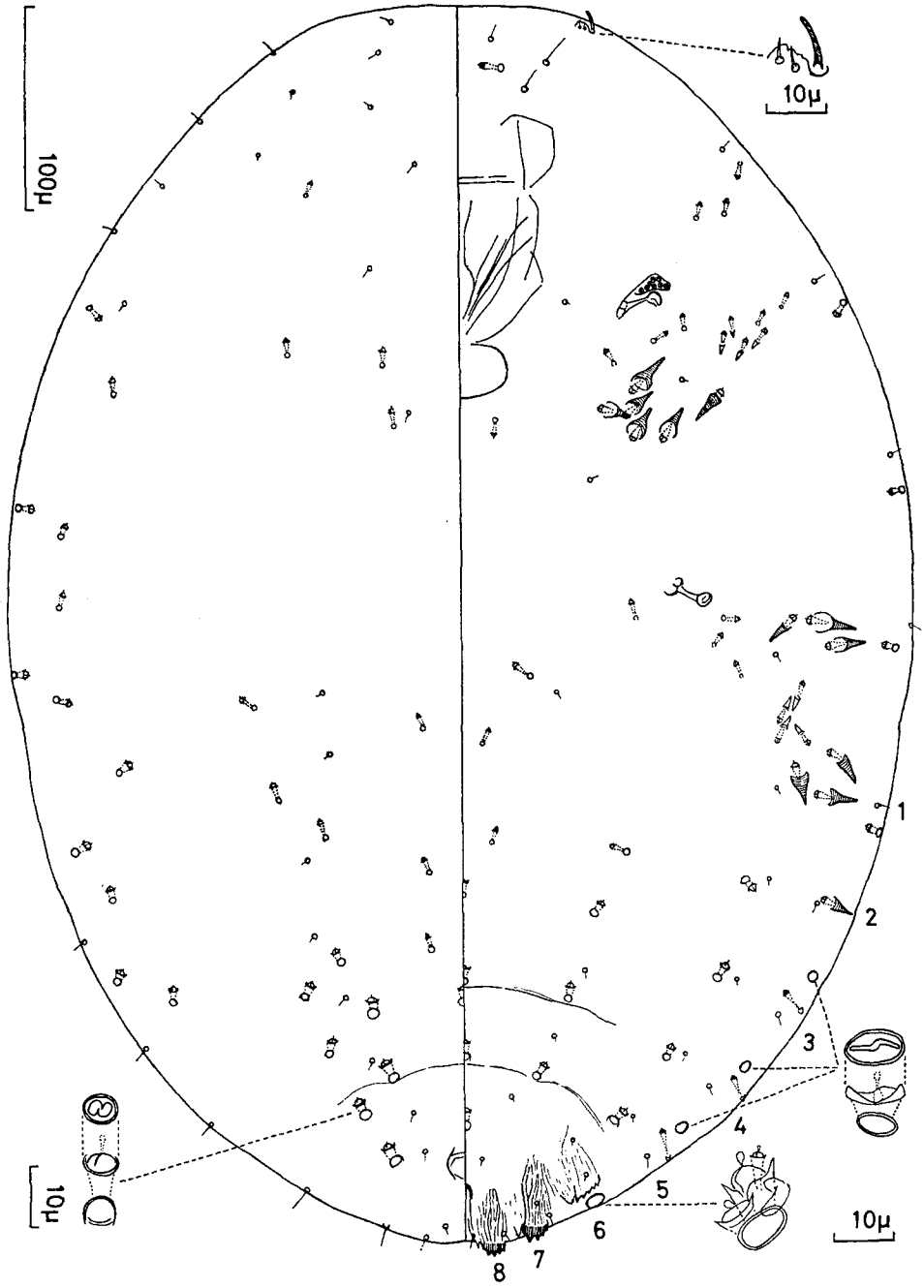


Fig. 9. *Pseudaulacaspis takahashii*, 2nd instar male. Kathmandu, on *Schima wallichii*.

I have not found any distinct difference in the 2nd instar males between the Kathmandu and Ken-ting forms. The 2nd instar male is provided with three pairs of broad serrate processes or lobes on the pygidium; mesalmost lobes separated

from each other by a good space. Each lobe is accompanied by a spine just mesally, but this spine lacks microduct. The dorsal and ventral tubular ducts show a geminate pore structure at the inner end, but the median partition of this structure is incomplete. The main dorsal duct system on the abdomen is a double submedian longitudinal series; the ventral system is composed of median, submedian and submarginal longitudinal series all single. Larger, more or less compressed ducts form a marginal series of "cup-like ducts" (Boratýnski 1953), three on supposed abd. iii–v. Three similar ducts (and another slender duct ?) opened in a common pore on supposed abd. vi ("communal ducts" of Tippins 1970). Strong gland spines clustered as follows: 4–6 posteriorly to anterior spiracle, 1–3 laterally to posterior spiracle, 2–4 on supposed abd. i submarginally, and one or two on abd. ii near margin. Some small gland spines lateroposteriorly to anterior and posterior spiracles each, and a much reduced one on abd. iii–v each marginally. Anterior spiracle with 6–10 trilocular disc pores.

Dr. D. J. Williams has kindly compared some adult females from the present material with *Pseudaulacaspis grandilobis* (Green) (=*Diaspis grandilobis*). After him the former differs from the latter by a less squat body, by lacking numerous large dorsal ducts on the median areas of the head and thorax, and by lacking numerous pores around the 2nd spiracles.

18. *Pseudaulacaspis sasakawai* Takagi

Pseudaulacaspis sasakawai Takagi (1970), Ins. matsum. 33: 75 [Taiwan, on *Stauntonia keitaoensis* and *Symplocos arisanensis*].

Over 60 adult females were mounted and examined from material collected at Lete (2440 m), on the leaves of *Hedera nepalensis*, 5–v.

This species was originally described from specimens collected at an altitude of about 2300 m in Taiwan. The locality of the present material from Nepal corresponds in altitude to the original locality, both belonging to the lower conifer zone.

In the total numbers of the dorsal macroducts and perivulvar disc pores the type-series shows wide ranges in spite of a small number of the available specimens. The Nepalese form is represented by a coherent group of individuals concerning these characters, but otherwise can not be distinguished from the type-series. Since the type-series is limited in good specimens, further comparison has not been attempted.

The numbers of the dorsal macroducts, perivulvar disc pores and gland spines are as follows.

1. Submedian macroducts: 2–6 on abd. ii, 4–8 on iii, 3–8 on iv, 2–5 on v, and two or three on vi (except in one specimen, in which only one duct is present on one side of abd. vi).

2. Submarginal macroducts: 5–13 on abd. ii, 6–13 on iii, 3–8 on iv, 3–7 on v, and 1–3 on vi (absent in one case).

3. Perivulvar disc pores: 5–13 medians, 13–29 anterolaterals, and 22–38 posterolaterals.

4. Gland spines: 0–2 on mesothorax, 1–5 on metathorax, 2–6 on abd. i, 5–10 on ii, 4–10 on iii, 3–7 on iv, 1–4 on v, one (or exceptionally two) on vi (laterally to

3rd lobe), and one on each of the succeeding two segments.

This species is very close to *Pseudaulacaspis cockerelli* (Cooley), from which it is distinguished by having a constant submarginal series of macroducts on the supposed 6th abdominal segment. The present specimens hold to this pattern. The only observed exception seems not normal, lacking macroducts not only in the submarginal series but also in the submedian series on the 6th abdominal segment on one and the same side.

This species may be close to "*Chionaspis*" *strobilanthi* Green occurring in Ceylon. The description of the latter is too brief, yet does not exactly coincide with the former.

19. *Pseudaulacaspis cockerelli* (Cooley)

One adult female, Khurumsang (2500 m), on *Symplocos ramosissima*, 8–vi.

The present specimen may be rightly identified with *P. cockerelli*, agreeing closely with Ferris' (1955) description. The body is fusiform and broadest across the metathorax. Marginal gland spines: three or four on base of pygidium (on abd. iv), two belonging to v, and one to each of the succeeding three segments. Short submarginal gland spines: absent or one present on mesothorax, three on metathorax, four or five on abd. i, eight or nine on ii, and six or seven on iii. Submedian macroducts: two or six on abd. ii, four on iii, four on iv, three or four on v, and one or two on vi. Submarginal macroducts: eight or nine on abd. ii, eight or nine (including one opened in marginal prominence) on iii, five or six on iv, and six or seven on v. Perivulvar disc pores: nine medians, 20 or 24 anterolaterals, and 27 or 28 posterolaterals. Anterior spiracles each with a crescentic group of disc pores a little more numerous than 10. Antennal tubercles separated from each other by a distance about three times as long as one of them.

The limits of this species were once removed to receive a variety of forms, which grade in body shape, dorsal macroducts, perivulvar disc pores, gland spines, etc. (Takagi 1970). This interpretation, adopted by me owing to the absence of distinct gaps among varying forms, includes so diverse extremes within the limits of a single species that it may be open to criticism. This problem is, however, beyond the scope of the present study.

20. *Fiorinia kumatai* n. sp.

Five adult females (one the holotype) and eight exuvial casts of the 2nd instar female, Biratanti (1150 m), on the underside of the leaves of *Citrus aurantium*, 29–iv.

The adult female is broadest about the metathorax and the base of abdomen, with the head margin broadly convex, and with the pygidium rather narrow. Derm membraneous except for pygidium, which is weakly sclerotized in a broad median region dorsally and in a broad marginal region ventrally. Median lobes almost wholly sunken into an apical incision of pygidium, rather small, divergent, serrate, without a distinct zygosis connecting their bases. Second lobes absent. Marginal gland spines absent on pygidium. Marginal macroducts reduced in size,

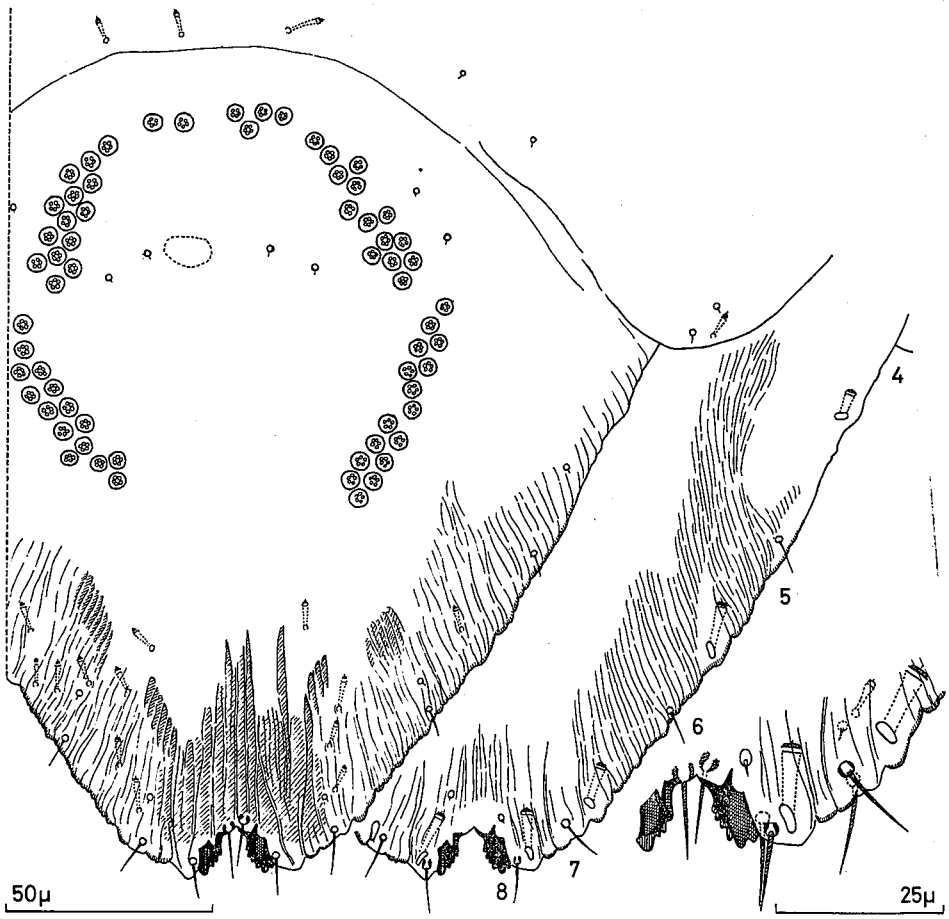


Fig. 10. *Fiorinia kumatai*, adult female: pygidium. Biratanti, on *Citrus aurantium*.

but larger than ventral microducts, four on each side of pygidium all single. Perivulvar disc pores in five groups, 59–69 in total, the median group in a single transverse row and often connected with anterolateral groups. Meso- and metathorax and abd. i with conical gland spines on lateral margin, 11–18, 9–13, and 3–6 respectively; abd. ii occasionally with one larger gland spine on lateral margin. Ventral microducts 15–29 between anterior spiracles around labium; 10–16 between posterior spiracles; 2–4 (usually three) in median region on each of supposed abd. i–iv; one and one or two on margin on abd. iii and iv respectively; some in submarginal region of pygidium. Antennae on head margin, irregularly conical or truncated, each with a strong seta. Interantennal tubercle absent or represented by a small process. Anterior spiracles each with 2–5 (usually two or three) disc pores.

The exuvial cast of the 2nd instar female is pale yellow, not strongly sclerotized, and translucent; oblong, a little more than twice as long as wide. The pygidium is quite membraneous, so that its marginal structure is not well preserved

in the examined casts. Median lobes sunken into pygidium, divergent. Second lobes well developed in two lobules, the inner lobule with a pair of long slender basal scleroses. Marginal gland spines single and well developed at least on abd. ii–iv. Five single marginal macroducts on each side, belonging to abd. iii–vii.

This species is similar to certain described species in lacking lateral lobes and marginal gland spines on the pygidium and in having much reduced marginal macroducts, but exactly agrees with none of them. It may be related to *Fiorinia gelonii* Green, *F. saprosmae* Green, *F. similis* Green and other early described species, but recent descriptions of them are not available for detailed comparisons.

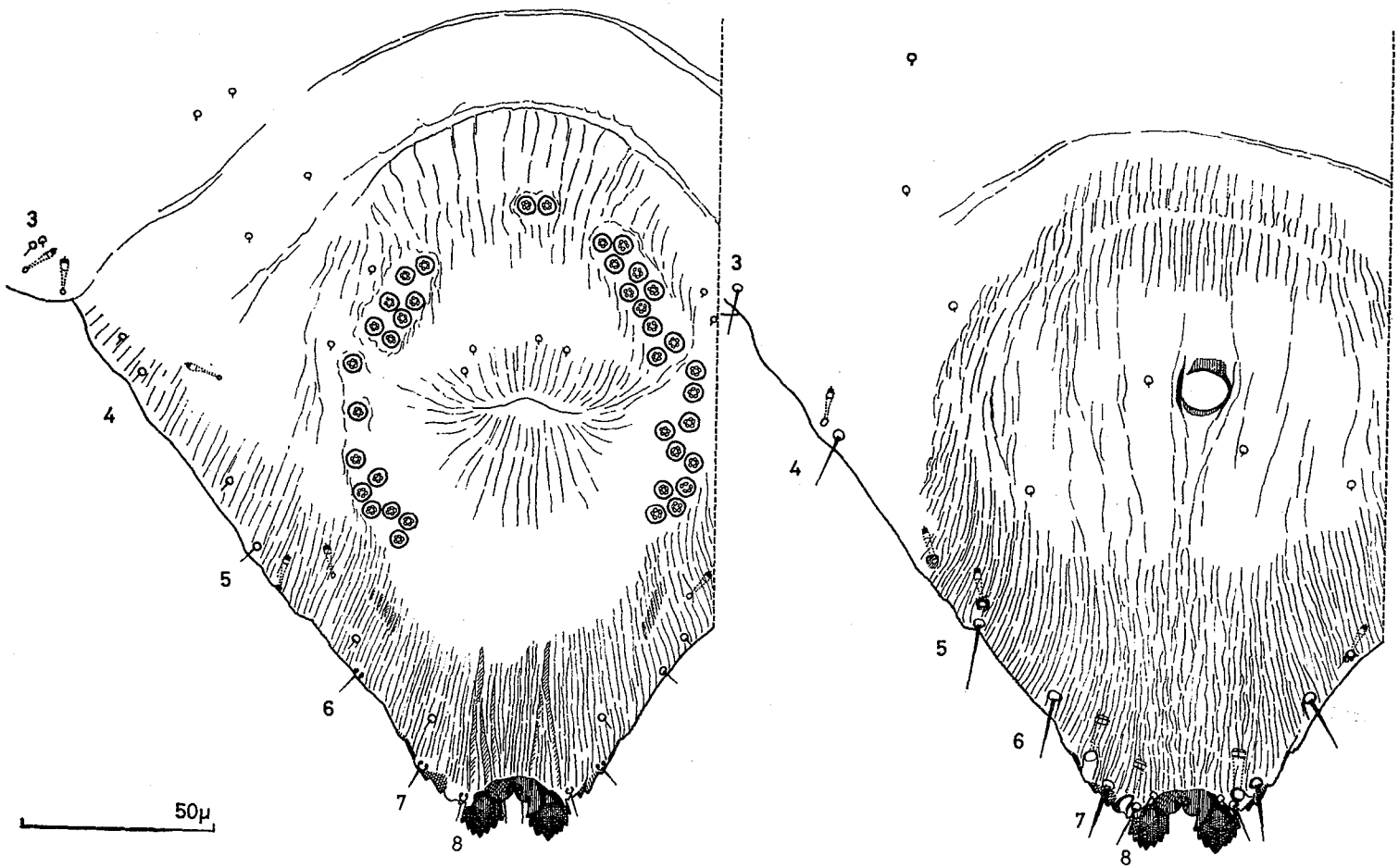
21. *Fiorinia himalaica* n. sp.

Eight adult females (one the holotype) and some female exuvial casts, Pati Bhanjyang (1840 m), on *Rhododendron arboreum*, 9–iv. Found on the underside of the leaves, in the indumentum.

The adult female is oblong, with the head margin truncate. Pygidium triangular, the free margins practically straight, forming apically a right or more or less acute angle; pygidial derm only weakly sclerotized. Median lobes well developed, wholly produced or nearly so, roughly serrate, parallel or a little divergent, separated from each other by a space somewhat narrower than one of them, connected with each other by a thick basal zygosis. Second lobes almost obsolete, at most represented by slight angular prominences. Marginal gland spines absent on pygidium. Dorsal setae on pygidial margin developed, much stronger than ventral ones. Marginal macroducts reduced in size, but much larger than microducts, 1–3 on each side as follows: one always present just laterally to median lobe (on abd. vii), one usually present just laterally to 2nd lobe (on vi), and one at times present at the preceding position (on v). Three to eight microducts scattered along pygidial margin, some of them opened on dorsal surface; one or two microducts usually present on last prepygidial segment (abd. iii) in posterolateral corner. Perivulvar disc pores in five groups, 38–60 in total; these groups are at times irregularly disrupted, but the numbers of disc pores for each group may be given as follows: 2–6 medians, 7–17 anterolaterals, and 9–14 posterolaterals. Two to seven microducts on each side of labium; 0–2 posteriorly or mesally to posterior spiracle. Small conical gland spines along prepygidial body margin, in a row segmentally interrupted or partly continuous on supposed prothorax to abd. ii (at times lacking on prothorax or abd. ii, or on both), 8–42 in total on one side. Antennae situated just within head margin, usually a low and rounded tubercle with a rather short seta. Interantennal process absent. Anterior spiracles each with 2–5 disc pores; posterior spiracles without disc pore.

Second instar exuvial cast of female not thickly sclerotized, oblong, gradually tapering caudad, with a comparatively large, rounded pygidium. Median lobes prominent, largely produced, rounded, roughly serrate, separated from each other by a good space. Second lobes much reduced, represented by a conical process as

Fig. 11. *Fiorinia himalaica*, adult female: pygidium. Pati Bhanjyang, on *Rhododendron arboreum*.


3
4
5
6
7
8
50μ
3
4
5
6
7
8

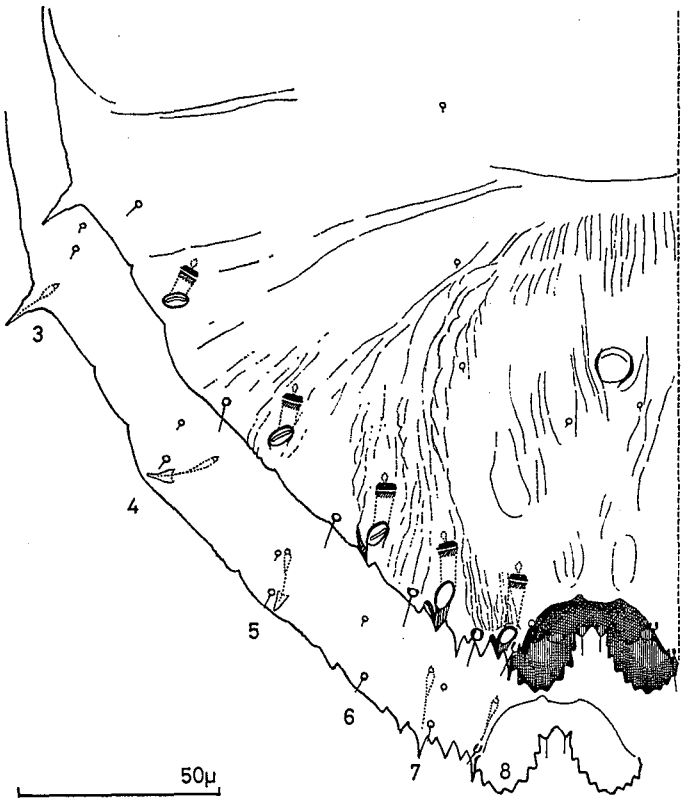


Fig. 12. *Fiorinia himalaica*, 2nd instar female: pygidium of exuvial cast. Pati Bhanjyang, on *Rhododendron arboreum*.

large as pore prominence situated just mesally, often with a smaller conical process (outer lobule) laterally. Marginal gland spines small, one just laterally to median and 2nd lobes each (on abd. vii and viii) and on supposed abd. iv and v each; abd. iii with one gland spine at times well developed, but at times reduced or even not discernible. Five marginal macroducts on each side, belonging to abd. iii–vii.

This species finds no close species among the described *Fiorinia*. It is referred to the *horii*-group on account of its enlarged median lobes and its association with a true rhododendron (see the following paper, p. 35). Among the known species of the group this species is uniquely characterized by having rudimentary 2nd lobes and by lacking gland spines on the pygidium.

22. *Fiorinia turpiniae* Takahashi

Fiorinia theae var. *turpiniae* Takahashi (1934), Dept. Agr. Gov. Res. Inst. Formosa Rpt. 63:21 [Taiwan, on *Turpinia formosana*]. *Fiorinia turpiniae*: Ferris (1950), Microent. 15: 78 [Kunming, China, on *Citrus* sp.].

Five adult females and exuvial casts, Kathmandu (1340 m), on the leaves of garden orange, 14–iv, in poor condition; 1 adult female and exuvial casts,

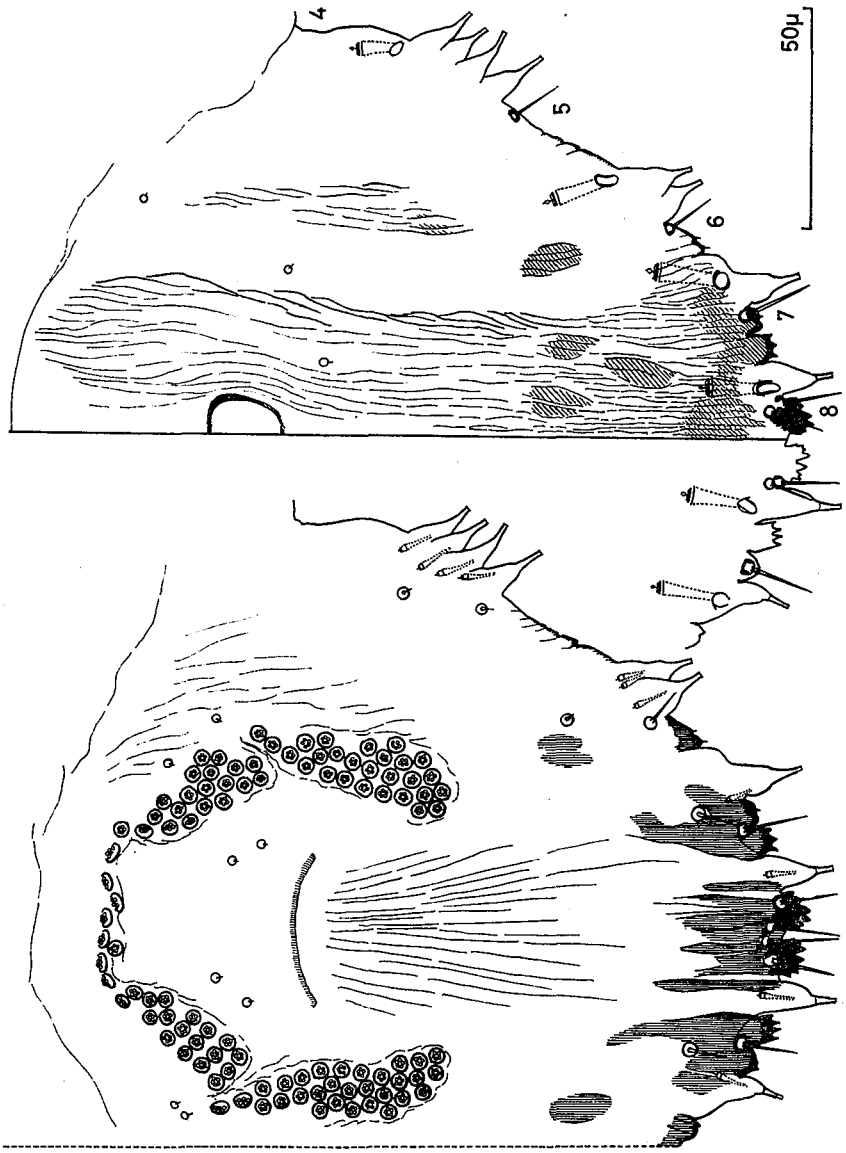


Fig. 13. *Fiorinia turpiniae*, adult female: pygidium. Biratanti, on *Citrus aurantium*.

Biratanti (1150 m), on the bark of *Citrus aurantium*, 29–iv. The 2nd instar exuvial cast of the female is chestnut brown, with black medianly.

The specimens disagree with the original description as follows.

1. Anterior spiracle with two or three disc pores (in the original description: "Spiracles....with no parastigmatic pores").

2. Marginal gland spines 7–9 on one side of pygidium as follows: one between median and 2nd lobes, one between 2nd and 3rd lobes, two or three laterally to 3rd lobe, and three or four towards base of pygidium ("Gland spines....5 or 6 on each side").

3. Perivulvar disc pores more numerous: 39–46 in united median and anterolateral groups, 18–30 in each posterolateral group ("Circumgenital pores in 3 groups; the upper group with about 26 pores, ...; the lower lateral group with about 16 pores").

4. In the 2nd instar exuvial cast I can not find "a defined area on the anterior extremity".

These differences, together with the difference in host, may arouse some doubt about the present identification. As to the 1st two of these differences the present specimens agree with the description given by Ferris for specimens collected on *Citrus* in Yunnan. I provisionally follow him in identifying the *Citrus*-feeding form with *F. turpiniae.*

The following description concerning microducts should also be given.

1. About 60 microducts in a row along lateral margin of body. This row, rising on the supposed 2nd abdominal segment, extends anteriorly to the level of the mouth-parts, and is interrupted once or twice in the thoracic region.

2. Some microducts (13 in the specimen from Biratanti) scattered around labium.

3. A small group of microducts posteromesally to each posterior spiracle.

4. A submedian longitudinal row of ventral microducts through supposed abd. ii–iv on each side (six or seven in the row in the specimen from Biratanti).

This species is close to *Fiorinia theae* Green and *F. proboscidaria* Green, so far as the latter two are understood as in my previous paper (Takagi 1970). It can be easily distinguished from the latter two by having prominent gland spines. The 2nd instar females are very similar among them in the exuvial casts; in all of them each of the anterior two gland spines is borne on a marginal prominence, which is, however, not remarkable in *F. turpiniae.*

Faunistic remarks

Needless to say the 22 species here enumerated are mere fragments from the Nepalese fauna of Coccoidea. Yet, they must suggest some aspects of the faunal constitution.

The altitudes from which the present collection was brought range from 1150 to 2600 m above the sea level. According to Kitamura (1955) this altitudinal range corresponds mainly to the warm temperate zone, extending up to the lower cold temperate zone, of the floral constitution in Central Nepal. These zones in Nepal belong to Good's (1964) Sino-Japanese region, which involves Manchuria, Korea, southern Sakhalin, Japan (excluding the Ryûkyû Is.), major part of temperate China, and Tibetan-Himalayan mountains. The mountain flora of Taiwan has many plants common or closely related to the Sino-Japanese flora, whereas the lowlands of Taiwan, together with the southern foot of the Himalaya, belong to Good's Indo-Malaysian subkingdom, which covers the faunistic Oriental region and extends further to the east to include New Guinea and adjacent islets.

Among the collected species *Aonidiella aurantii, A. citrina, Hemiberlesia rapax,* and *Lepidosaphes beckii* should be excluded from consideration, because these species are widely distributed over the world through human agencies. As

to the undetermined species their genera are, except *Takahashia*, widely distributed in Asia, in Asia and Africa, in Eurasia and Africa, etc. However, "*Eulecanium* sp." is closely related to a Yunnan species, and "*Lepidosaphes* sp." belongs to Borchsenius' *Paralepidosaphes*, which is East Asian in distribution. *Takahashia* is represented by the type-species, *T. japonica*, which occurs in Japan and was recorded from Korea and China; another form (*T. wuchangensis* Tseng) was described from China, but is unknown to me.

Coccus formicarii was recorded from various localities in tropical Asia. The genus *Platylecanium* is also tropico-Oriental, with further species occurring in the northern end of Australia and New Hebrides. To this list of tropical Asian elements may be added *Pseudaulacaspis takahashii*, which occurs also in the lowlands of Taiwan and which may be close to the Ceylonese *P. grandilobis*. The relationship of *Fiorinia kumatai* to other species of the genus is unknown, but this species may be related to certain tropical species described by Green.

Lepidosaphes tubulorum is widely distributed in East Asia and the known localities except in Taiwan lie within the floristic Sino-Japanese region; it is uncertain whether any human agency is involved in its distribution. *Fiorinia turpiniae* was originally described from a mountain of Taiwan and supposed varieties of it are now known from Nepal and Yunnan. *Pseudaulacaspis sasakawai* was originally described from an altitude of about 2300 m in Taiwan and is now known from the corresponding altitude in Nepal. This species is close to *P. cockerelli*, which occurs in East Asia as north as Japan and is now found at an altitude of 2500 m in Nepal; the occurrence of *P. cockerelli* outside Asia is probably due to human agencies.

Fiorinia himalaica forms the *horii*-group together with some Japanese and montano-Taiwanese species all associated with rhododendrons. *Lepidosaphes piniroxburghii* is obviously related to *L. pseudotsugae*, which occurs in the conifer zone of Japan, and possibly to the Korean *L. pinifolii*; these species form a species-group, *Pinomytilus*, and are associated with conifers. As to *Quadraspidiotus cotoneastri*, the state of the genus *Quadraspidiotus* is not yet settled in connection with the *Hemiberlesia* problem (Takagi 1974), but the scale insects referable to this genus as interpreted by recent authors are quite scarce in the tropics.

Thus, two main distributional patterns may be distinguished concerning the Nepalese Coccoidea and their related forms. One is tropical and may be Oriental or Indo-Malaysian, and the other seem to be Sino-Japanese with substantially the same usage of the term as in phytogeography concerning spatial extent. As suggested the mountain fauna of Taiwan is related to the Sino-Japanese region.

This is possibly too simplified a generalization of the Nepalese faunal constitution, but there is, I believe, good reason for adopting phytogeographic patterns in analyzing a Coccoidea fauna. So far as the collecting sites of the present materials are concerned, the Sino-Japanese elements are found at higher as well as lower altitudes, whereas the Indo-Malaysian elements are not found in the cold temperate zone.

The species of *Pseudaulacaspis* found in Nepal are separated into Sino-Japanese and Oriental elements. Other genera seem also centred or richly represented in eastern side of Asia covering both the floristic Sino-Japanese region and faunistic Oriental region. This pattern, based on insufficient evidence from this largely unknown area, may be important to the biogeography of Coccoidea.

The southern slopes of the Himalaya, where the Sino-Japanese and Oriental regions border upon each other, are interesting in this regard.

Acknowledgements

Acknowledgement is made to Prof. T. Nakashima for his encouragement. I wish to express my appreciation for Prof. M. Yamada and all the other members of the Expedition. My thanks are especially due to Dr. T. Kumata and Dr. T. Matsumura for their efforts to collect Coccoidea during their own busy tasks. I am deeply grateful to Dr. D. J. Williams, Commonwealth Institute of Entomology, who kindly compared for me *Coccus formicarii* with the type-series and *Pseudaulacaspis takahashii* with *P. grandilobis*. Last but not least my sincere thanks should be made to Prof. T. Yamazaki, University of Tokyo, for his kindness in identifying host plants.

References

Balachowsky, A.S. 1948. Les cochenilles de France, d'Europe, du Nord de l'Afrique et du Bassin Méditerranéen. IV. 154 pp. Paris.

Boratýnski, K.L. 1953. Sexual dimorphism in the second instar of some Diaspididae (Homoptera: Coccoidea). Trans. R. ent. Soc. Lond. 104: 451–479.

Borchsenius, N.S. 1962. Descriptions of some new genera and species of Diaspididae (Homoptera, Coccoidea). Ent. Obozr. 41: 861–871.

Borchsenius, N.S. 1963. On the revision of the genus *Lepidosaphes* Shimer (Coccoidea, Homoptera, Insecta). Zool. Jur. 42: 1161–1174.

Borchsenius, N.S. 1964. New genera and species of scale insects (Homoptera, Coccoidea, Diaspididae) from Transcaucasia, Middle Asia and Eastern Asia. Ent. Obozr. 43: 152–168.

De Lotto, G. 1968. A generic diagnosis of *Takahashia* Cockerell, 1896 (Homoptera, Coccoidea). Proc. Linn. Soc. Lond. 179: 97–98.

Fernald, M.E. 1903. A catalogue of the Coccidae of the World. 360 pp. Amherst.

Ferris, G.F. 1921. Some Coccidae from Eastern Asia. Bull. ent. Res. 22: 211–220.

Ferris, G.F. 1936. Contributions to the knowledge of the Coccoidea (Homoptera). Microent. 1: 2–16.

Ferris, G.F. 1941. The genus *Aspidiotus* (Homoptera; Coccoidea; Diaspididae). Microent. 6: 33–69.

Ferris, G.F. 1950. Report upon scale insects collected in China (Homoptera: Coccoidea). Part II. Microent. 15: 69–97.

Ferris, G.F. 1953. Report upon scale insects collected in China (Homoptera: Coccoidea). Part IV. Microent. 18: 59–84.

Ferris, G.F. 1955. The genus *Phenacaspis* Cooley and Cockerell. Part I. Microent. 20: 41–82.

Good, R. 1964. The geography of the flowering plants. 3rd ed. 518 pp. London & Colchester.

Green, E.E. 1896. Catalogue of Coccidae collected in Ceylon. Ind. Mus. Notes 4: 2–10.

Green, E.E. 1904. Coccidae of Ceylon. III. pp. 171–249, pls. 61–93. London.

Green, E.E. 1914. Remarks on small collection of Coccidae from Northern Australia. Bull. ent. Res. 5: 231–234.

Green, E.E. 1937. An annotated list of the Coccidae of Ceylon, with emendations and additions to date. Ceylon J. Sci. B 20: 277–341.

Kitamura, S. 1955. Flowering plants and ferns. *In* Kihara, H. ed., Fauna and Flora of Nepal Himalaya — Scientific results of the Japanese expeditions to Nepal Himalaya 1952–1953 I: 73–290. Kyôto.

Kuwana, I. 1925. The Diaspine Coccidae of Japan. II — The genus *Lepidosaphes*. Imp. Plant Quar. Serv. Japan Tech. Bull. 2. 42 pp. 11 pls.

Morrison, H. 1920. The nondiaspine Coccidae of the Philippine Islands, with descriptions of apparently new species. Philip. J. Sci. 17: 147–200, pl. 1.

Morrison, H. 1921. Some nondiaspine Coccidae from the Malay Peninsula, with descriptions of apparently new species. Philip. J. Sc. 18: 637–677, pl. 1.

Takagi, S. 1960. A contribution to the knowledge of the Diaspidini of Japan (Homoptera: Coccoidea). Part I. Ins. matsum. 23: 67–100.

Takagi, S. 1970. Diaspididae of Taiwan based on material collected in connection with the Japan-U.S. Co-operative Science Programme, 1965 (Homoptera: Coccoidea). Part II. Ins. matsum. 33: 1–146.

Takagi, S. 1974. An approach to the *Hemiberlesia* problem (Homoptera: Coccoidea). Ins. matsum. n. s. 3: 1–33.

Takahashi, R. 1929. Observations on the Coccidae of Formosa. Part I. Dept. Agr. Gove. Res. Inst. Formosa Rtp. 40. 82+3 pp.

Takahashi, R. 1934. Observations on the Coccidae of Formosa. Part IV. Dept. Agr. Gov. Res. Inst. Formosa Rpt. 63. 71 pp.

Takahashi, R. 1942. Some injurious insects of agricultural plants and forest trees in Thailand and Indo-China. II. Coccidae. Gov. Res. Inst. Taiwan Rpt. 81. 56 pp.

Takahashi, R. 1950. Some species of Coccidae from the Riouw Islands. Part I. Ins. matsum. 17: 65–72.

Takahashi, R. 1957. Some Japanese species of Diaspididae (Coccoidea, Homoptera). Trans. Shikoku Ent. Soc. 5: 104–111.

Tippins, H.H. 1970. The second instar males of three species of *Fiorinia* (Homoptera: Diaspididae). J. Georiga ent. Soc. 5: 94–99.

Williams, D.J. 1971. Synoptic discussion of *Lepidosaphes* Shimer and its allies with a key to genera (Homoptera, Coccoidea, Diaspididae). Bull. ent. Res. 61: 7–11.