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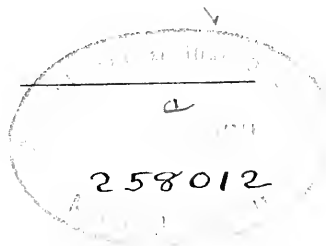
BY

E. ERNEST GREEN, F.E.S.

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PART V.

*WITH SEVENTY-FOUR PLATES.*



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## CHAPTER VIII.

## SUB-FAMILY ERIOCOCCINÆ.

I HAVE treated this group (usually included with the *Dactylopiinæ*) as a separate family, as they appear to form a natural assemblage with distinct characters; though they are undoubtedly nearly allied to the other 'Mealy Bugs' comprised in the genera *Pseudococcus*, *Phenacoccus*, *Ripersia*, &c.

The character that is most noticeable in members of this family is the presence of conspicuous prominent (often densely chitinous, anal lobes. This character connects them also with certain members of the *Asterolecaniinæ* (e.g., *Cerococcus*). The genera *Kermes* and *Fonscolombia*, the adult females of which are without any trace of anal lobes, must be regarded as exceptions, but the early larvæ of these genera suggest their relationship to the Eriococcine group. Maskell (*Trans. N.Z.* 1883, p. 128) proposed the name *Hemicoccinæ* for a sub-family to contain the genera *Kermes* and *Asterolecanium*, in the belief that the species of these genera combined the characters of the *Lecaniinæ* (in the adult stage) with those of the *Dactylopiinæ* (in the larval stages). But recent study has shown that this idea was founded upon a misconception of the characters of the insects in question. *Pseudopulvinaria* of Atkinson (syn. *Lefroyia*, Green) is another genus that does not appear, at first sight, to conform with the characters of the *Eriococcinæ*, and this also was originally referred to the *Hemicoccinæ*. But, as I have shown in my description and figures of *Lefroyia castaniæ* (= *Pseudopulvinaria sikkimensis*), this difference is more apparent than real. The anal lobes are strongly developed in the larva; but, during subsequent growth, they become distorted and retracted within an anal pit.

The remaining genera (*Eriococcus*, *Rhizococcus* and *Gossyparia*) have all the typical characters of the family, differing from each other merely in the nature of the secretory covering. The antennæ are comparatively short, never exceeding seven joints, the last of which is not elongated as in *Pseudococcus* and its allies. The body is usually armed with conspicuous dermal spines, except in the genera *Kermes* and *Pseudopulvinaria*. The tarsus is propor-

tionately long, seldom less than and often exceeding the length of the tibia. This character is somewhat exceptional amongst Coccidæ. The anal orifice (except in *Kermes*) is surrounded by a setiferous ring.

The larvae are usually rather narrow and taper behind: the body terminating in prominent lobes, each bearing a stout seta and two or three slender spines. There are similar slender spines on the dorsum—usually in transverse series across each segment.

*Eriococcus* is the only genus represented in Ceylon.

#### SYNOPSIS OF GENERA.

- A. Adult female without prominent anal lobes.
  - a.* Anal orifice without setiferous ring..... (KERMES).
  - b.* Anal orifice with setiferous ring ..... (FONSCOLOMBIA).
- B. Adult female with prominent (often densely chitinous) anal lobes: anal orifice surrounded by a setiferous ring.
  - a.* Adult female naked ..... (RHIZOCOCCUS).
  - b.* Adult female more or less clothed with secretory matter.
    - a*<sup>1</sup>. Anal lobes prominent, exerted.
    - a*<sup>2</sup>. Mature female completely enclosed in a felted ovisac.
      - ERIOCOCCUS.
    - b*<sup>2</sup>. Mature female with felted secretion on the sides only.
      - (GOSSYPARIA).
  - b*<sup>1</sup>. Anal lobes distorted and retracted within an anal pit ..... (PSEUDOPULVINARIA).



Genus ERIOCOCCUS, *Targioni-Tozzetti.*

*Eriococcus*, Targ., Catalogue, p. 33 (1869).

*Acanthococcus*, Sign., *Ann. Soc. Fr.* (5), Vol. V. p. 34 (1875).

*Uhleria*, Cooke, *Treat. Ins. Inj. Fruit & For. Trees*, Cal. p. 41 (1881).

Adult female completely enclosed in a felted ovisac. Posterior extremity of body with prominent (often densely chitinous) lobes. Derm usually with conspicuous tubular spines, which may be either sharply pointed or truncate. Antennæ normally with either six or seven joints. Tarsus frequently as long as or longer than tibia.

The genus, of which nearly one hundred species have been recognised, is widely distributed throughout both temperate and tropical regions. They have a wide range of food plants, including both Dicotyledons and Monocotyledons.

Seven species have been found in Ceylon, and may be distinguished by the following characters :—

A. Spines chiefly confined to the margin, forming a more or less continuous fringe.

(a) Tarsus equal to tibia. Spines acute..... *araucarie.*

(b) Tarsus markedly longer than tibia. Spines truncate *nueræ.*

B. Spines distributed over the dorsum.

(a) Spines numerous ; more or less evenly distributed over the whole area ; on Bamboos.

(a<sup>1</sup>) Ovisac transversely flattened ; broad in front, tapering rapidly behind ..... *bambusæ.*

(b<sup>1</sup>) Ovisac laterally compressed ; curved longitudinally into the shape of a horse-shoe ..... *transversus.*

(b) Spines comparatively few ; arranged in more or less definite longitudinal series.

(a<sup>1</sup>) Tarsus approximately equal to tibia ; spines long and sharply pointed ..... *tenuis.*

(b<sup>1</sup>) Tarsus markedly longer than tibia ; spines shorter, bluntly pointed.

(a<sup>2</sup>) Interstitial spines between the longitudinal series..... *rhodomirti.*

(b<sup>2</sup>) No interstitial spines ..... *osbeckiæ.*

ERIOCOCCUS ARAUCARIÆ, *Maskell.*

(PLATE CXXXIII.)

*Eriococcus araucariae*, Mask., *N.Z. Trans.*, Vol. XI. p. 218 (1878).*Rhizococcus araucariae*, Comst., *Rep. U.S. Dep. Ag.*, 1880, p. 339 (1881).*Uhleria araucariae*, Cooke, *Treat. Ins. Inj. Fruit & For. Trees, Cal.*, p. 41 (1881).

Ovisac of adult female (*figs.* 1, 2) white; ovoid; convex; of close textures but rather brittle. Length 2.50 to 2.75 mm. Breadth 1.50 mm.

Puparium of male (*fig.* 3) similar to, but smaller and proportionately narrower than that of the female. Dimensions 1.50 by 0.50 mm.

Adult female, before the construction of the ovisac (*fig.* 10), oblong oval; olivaceous brown, paler at the margin, with a series of darker diffused spots on the dorso-lateral area. Segments distinct. In fresh examples, in all stages, there is a marginal fringe of glassy processes which are cylindrical till near the apex where they abruptly taper to a point, the resulting form being strongly suggestive of a cricket stump (see *fig.* 6). These processes are supported by stout chitinous spines. Antenna (*fig.* 8) seven-jointed, the first reduced to a narrow ring, the third always the longest, the seventh comparatively slender. Occasionally the fourth is slightly longer than the second, and in one instance the second, fourth, and seventh were found to be equal. Limbs well developed; the tarsus equal in length to the tibia (*fig.* 17). Claw (*fig.* 18) strongly falcate, with a minute denticle near the apex. Tarsal digitules strongly dilated at apex, unguis digitules moderately dilated. Spines confined to the margin, where they form a more or less continuous fringe, though tending to separate into groups of two or three on the abdominal segments (*fig.* 11). There are numerous minute circular pores scattered irregularly over the derm. Anal lobes (*fig.* 12) approximately cylindrical at the base, obliquely tapering at apex where they terminate in the usual caudal setæ: two spines at base and one near apex of each lobe. Anal ring with 8 stout setæ.

After oviposition the insect shrivels into a shapeless mass which lies at the anterior extremity of the ovisac, the vacated space being packed with orange-yellow eggs (*fig.* 2).

Length 1.50 to 2.25 mm. Breadth 1.0 to 1.50 mm. Average dimensions of twenty examples 1.95 by 1.11 mm.

Nymph similar in structure to adult, but narrowed posteriorly.

Adult male (*fig.* 13) rather stout; thorax broad and square, much wider than the head; mesonotum not very prominent. Colour dull fulvous, evenly marbled with reddish brown; limbs and abdomen paler; a large brownish spot at base of genital sheath. Wings ample, iridescent. Head (*fig.* 14) broadly rounded at posterior angles. Rudimentary eyes minute but prominent, lateral. Ocelli four, large and prominent, blackish; two on upper and two on under surface of head. Antennæ ten-jointed, third longest; finely setose, the apical six joints bearing a few longer knobbed hairs (*fig.* 16).

Penultimate segment of abdomen roundly dilated on each side, with two long white cottony filaments, each of which is supported by a pair of strong setæ springing from a grandular pocket. Length approximately 1 mm.

This insect is a troublesome pest of *Araucaria excelsa* and allied species in Ceylon. It occurs in enormous numbers on the foliage, rendering the trees unsightly by reason of the abundant growth of sooty fungus that invariably accompanies the insect. The species is probably an introduction from New Zealand. It was first noticed on young *Araucaria* trees in the Botanical Gardens at Peradeniya and Hakgala, and is now to be found in private gardens throughout the hill districts.

Occurs also in New Zealand, the Sandwich Islands, South Africa, and in Southern California. It has now been recorded from the Indian Continent.

ERIOCOCCUS NUERÆ, *nov.*

(PLATE CXXXIV.)

Ovisac of female white, slightly tinged with ochreous. Irregularly oval, conforming to the shape of the crevices of the bark in which it rests; thin and brittle. Length averaging 2.5 mm.

Adult female turbinate, tapering behind (*fig. 1*). Antenna (*fig. 2*) seven-jointed; second, third, and seventh approximately equal, longest; fourth, fifth, and sixth approximately equal, shortest. Legs (*fig. 3*) comparatively slender; tarsus markedly longer than tibia; claw with minute denticule near extremity; digitules slender, minutely knobbed at extremity. Anal lobes (*fig. 4*) strongly chitinous, well developed; each with three longish truncate spines and one or more slender setæ. Caudal setæ stout, approximately twice the length of the anal lobes. Anal ring with eight stout setæ which extend almost to the extremity of the anal lobes. Margin with a broken series of moderately slender but conspicuous truncate spines: the series more or less continuous on the anterior margin, but broken into groups of three or four on the thorax, and of from two to four on the abdominal segments (see *fig. 1*): a pair of similar but rather smaller spines on the median dorsal area of the penultimate segment, and a single median spine immediately above the base of the anal lobes (see *fig. 4*). Disc of dorsum with numerous minute and inconspicuous hair-like spines, arranged in tranverse series across the abdomen, intermingled with minute circular ceriferous pores. Length 2.25 mm.

Young larva with conspicuous marginal truncate spines, disposed as in the adult.

On the bark of an undetermined forest tree. Nuera Eliya. March, 1898.

ERIOCOCCUS BAMBUSÆ, *nov.*

(PLATE CXXXV.)

Ovisac of female (*figs.* 2, 3) white, ochreous white, or greyish white, broad in front, tapering rapidly behind, transversely flattened; longitudinally curved across the angle formed by the base of the leaf with the stem of the plant, the insects being disposed—singly—in the axils of the leaves (see *fig.* 1). In fresh examples there is an irregular marginal fringe of fibrous filaments. The under parts are very thin and fragile, so that when the ovisac is detached the insect and eggs are exposed to view (*fig.* 3). Breadth across the middle 2.50 mm. The longitudinal curvature prevents accurate measurement of the length.

Adult female (*fig.* 4) curved in correspondence with its position on the plant. Dorsum narrower than venter, and covered with numerous stout pointed spines which are distributed without any apparent order, except that there is a tendency towards a transverse arrangement on the abdominal segments. The marginal spines are rather longer, stouter and more crowded, and tend to separate into groups towards the posterior extremity. Antenna (*fig.* 6) seven-jointed; second and third usually longest and equal; 4th usually shorter than seventh, but occasionally equal to it. Limbs with tarsus and tibia of equal length (*fig.* 7). Claw with an almost imperceptible denticle on inner edge near apex. Digitules very slender, with a minute knob at apex. Anal lobes (*fig.* 5) well developed; rather strongly chitinized; cylindrical at base, obliquely tapering at apex, with the usual spines and apical setæ. Anal ring with eight stout setæ. Owing to the peculiar form of the insect it is difficult to obtain the exact dimensions. The dorsum is longer, while at the same time it is narrower than the venter, so that—under compression—the body becomes more or less distorted. The length (making no allowance for the curvature) is found to vary between 2.0 and 2.75 mm., the average length of ten examples being 2.25 mm. Measurements of breadth are still more unsatisfactory: an average of the same ten examples gives a transverse diameter of 1.35 mm.

Adult male with long and conspicuous caudal filaments, one on each side of penultimate segment (*fig.* 8). Head and thorax brown, abdomen pinkish purple. Wings hyaline, colourless, slightly mealy. Antennæ with many longish knobbed hairs. When boiled in potash the whole insect (including the wings) assumes a bright crimson colour. Length (from frons to extremity of genital sheath) 1.25 mm. Expanse of wings 2.50 mm.

Newly hatched larva (*fig.* 9) elongate, narrow, tapering behind. There is a marginal series of stout spines, and a series of four similar spines across the middle of the thorax. Length 0.45 mm.

In the axils of the leaves of Bamboo. Yatiyantota, March: Udagama, October.

Allied to *E. onukii*, Kuwana, from which it differs in the form of the female ovisac, in the size and arrangement of the dorsal spines, and in the antennal formula. In *onukii* there are definite longitudinal series of conspicuously enlarged spines, and in that species the second antennal joint is markedly shorter than the third. The ovisac of *onukii* is laterally compressed.



ERIOCOCCUS TRANSVERSUS, *nov.*

(PLATE CXXXVI.)

Female ovisac (*figs.* 2, 3, 4) ochreous white; strongly laterally compressed, and curved into the shape of a horse-shoe, with transverse ridges corresponding to the segments of the body of the insect, those on the thoracic area produced into strong conical prominences. Transverse diameter across the dorsum, 1.25 mm.; across the side of the ovisac, 2.50 mm.

Adult female (*fig.* 5) olivaceous brown, darker beneath, curved into a loop, so that the anterior and posterior extremities become approximated. There is a well-marked fold following the curve of the body. Dorsum (*fig.* 6) closely set with small sharply pointed spines which are arranged in more or less definite transverse bands, the bands being narrower and more conspicuous on the abdominal area: the spines rather larger on the marginal area (*fig.* 7). Antenna (*fig.* 9) seven-jointed; the second, third, and seventh (and occasionally the fourth) approximately equal. Limbs well developed, tarsus markedly longer than tibia (*fig.* 8); claw with a minute (scarcely perceptible) denticle on inner margin near the apex. Anal ring with eight stout setae. Anal lobes cylindrical at base, obliquely conical at apex, with the usual spines and terminal setae. Length (under compression) averaging 2.0 mm.

Young larva (*fig.* 10) with marginal, dorso-lateral, and median series of strong spines: the marginal series consisting of forty-four, the dorso-laterals with seven spines on each side, and the median series with twelve pairs.

The insects are disposed transversely across the axils of the leaves of *Arundinaria* sp. (? *debilis*); Maskeliya district, at an altitude of 6500 feet; August, 1902.

Allied to *bambusæ*, but differing markedly in the form of the ovisac (compare *plate* CXXXVI. *fig.* 4, and *plate* CXXXV. *fig.* 2). Superficially resembling, in form and habit, the Japanese species *onukii*.

The habit of lying transversely across the axils of leaves or the angles of branches is common to the following species: *aceris* (Sign.), *tripartitus* (Full.), *elegans* (Full.), *onukii* (Kuw.), *bambusæ* (Green), and *transversus* (Green).

ERIOCOCCUS TENUIS, *nov.*

(PLATE CXXXVII.)

Ovisac of adult female pure white, elongate oval, moderately convex, closely felted. Freshly constructed examples show traces of transverse segmentation. Length 2.50 to 3 mm. Breadth 1 to 1.50 mm. Puparium of male similar but much smaller. Length about 1.25 mm. Adult female, before gestation (*figs.* 2, 3), elongate and narrow, tapering behind, of a very pale greenish yellow colour. Older females proportionately broader. Spines of

median size arranged on the dorsum as shown at *fig. 4*, disposed in median, subdorsal, and marginal series, with a few smaller hair-like interstitial spines. The median series is double, consisting of paired spines; the subdorsal series is irregular, and compound on the thoracic area; the marginal series somewhat irregular and more crowded at the anterior extremity. There are numerous small circular pores distributed over the surface of the body. Antenna seven-jointed, third or fourth longest (*figs. 6, 7*). The following variations of antennal formula have been observed: 4, 3, 7, 2, 5, 6; 4, (3, 7), 2, (5, 6); 4, 3, 7, 2, 6, 5; 4, 3, 2, 7, 6, 5; 5, 4, 7, 2, (5, 6); 3, 4, 7, (2, 5), 6; 3, (4, 7), 2, (5, 6) (The first joint being irregular in form, and usually distorted by pressure, is not included in the formulæ). Limbs well developed, moderately large; tarsus slightly longer than tibia (*fig. 8*); claw strongly curved, simple; ungual, and tarsal digitules normal. Anal lobes prominent, usually obliquely truncate, with a stout seta at apex of each, two stout spines on the inner side, and one at the base of the outer side (*fig. 5*). Anal ring with eight stout longish setæ.

Adult male (*fig. 9*) purplish brown, pruinose, except on apodema and scutellum, which remain smooth and polished. Apodema dark brown. Ocelli four, the upper pair small and widely separate, the pair on the under surface large and contiguous. Rudimentary eyes minute, lateral. Antenna ten-jointed, each joint (except the first) bearing several slender knobbed hairs. Caudal filaments opaque white, as long as the body of the insect. Length 1 mm.

On the under surface of the leaves of a species of grass; the females usually clustered near the base of the leaf, the male puparia more widely scattered (*fig. 1*). Pundaluoya, Peradeniya, Kaduganawa, Kotmali.

The insect may possibly be equivalent to *E. graminis* of Maskell (from China and Japan), but the published description of that species is inadequate, and I have been unable to obtain actual specimens for comparison. If Maskell's figures are correct, the marginal spines of *graminis* are proportionately much larger than those of *tenuis*. *E. pallidus*, with which Maskell compares his species, differs widely from *tenuis*.

### ERIOCOCCUS RHODOMYRTI, *nov.*

(PLATE CXXXVIII.)

Ovisac of female white (*fig. 5*), sometimes slightly ochreous; oblong oval, length approximately twice the breadth; moderately convex. Length 2.50 mm.

Male puparium (*fig. 4*) similar in character, but smaller. Length 1.25 to 1.50 mm.

Adult female of normal form. Principal dorsal spines of medium size; bluntly pointed; disposed in median, subdorsal, and marginal series (*fig. 8*); the median series double; an irregular series interposed on the thoracic area between the subdorsal and marginal series; marginal series rather irregular. There are numerous smaller interstitial spines and a few small circular ceriferous pores. Antenna (*fig. 9*) rather short and stout; seven-jointed, the formula

usually constant: (3, 4, 7), 2, (5, 6). Legs well developed; tarsus markedly longer than tibia (*fig.* 11); claw (*fig.* 3) with a distinct denticle on the inner side, near the apex; unguis digitules very delicate and inconspicuous. Anal lobes prominent; tapering to apex which is evenly rounded (*figs.* 6, 7), with three stout spines; caudal setæ one and a half to twice the length of the lobes. Anal ring (*fig.* 6) with 6 stout setæ, and a similar seta, close to but distinct from the ring, on each side of it. Length from 1.25 to 2.0 mm.; averaging 1.75 mm.

Adult male not observed.

Young larva (*fig.* 2) pale yellow; eyes black.

On under surface of leaves of *Rhodomyrtus roseus*. Nuera Eliya; Maskeliya; Badulla. At altitudes of over 6000 feet.

A single example, found on *Rhodomyrtus* on the isolated Namunakuli hill (Uva District), differs from the type in having longer and proportionately more slender antennæ and limbs (*figs.* 10, 12). The tarsus, in this form, is approximately equal to the tibia. In other characters this example is inseparable from the type.

#### ERIOCOCCUS OSBECKIÆ, *nov.*

(PLATE CXXXIX.)

Ovisac of female creamy white; oblong oval, length approximately twice the breadth; moderately convex. Length averaging 2 mm.

Puparium of male much smaller. Length 1 mm.

Adult female similar in form and general characters to *E. rhodomyrti*, but differing in the absence or reduction of the smaller interstitial spines found on that species. Consequently the longitudinal series of large spines are very clearly defined (*fig.* 1). The marginal series of spines is more regular and less crowded. Antenna (*fig.* 3) seven-jointed, third longest or equal to seventh, fifth and sixth always shortest and subequal. Legs with tarsus markedly longer than tibia (*fig.* 4); the claw (*fig.* 5) strongly falcate and with a small denticle near the apex. Anal lobes (*fig.* 2), slightly larger than those of *rhodomyrti*. Anal ring with six stout setæ. A similar seta at the base of each lobe often impinges upon the anal ring. Length 1.50 to 1.75 mm. Average of thirteen examples 1.55. Breadth 0.75 to 1.0, average 0.90 mm.

On leaves of *Osbeckia* sp. Namunakuli (over 6000 feet), Badulla. February.

The habit, appearance and general characters of this insect closely resemble those of *E. rhodomyrti*, which also occurs in the same locality. There is, however, a constant difference observable in the character of the dorsal spines, as described above. *Osbeckiæ* is rather a smaller insect.

## CHAPTER IX.

## SUB-FAMILY DACTYLOPIINÆ.

THIS rather unwieldy group is at present made to include a large number of genera for which it is difficult to assign any single common character. The elongate terminal joint of the antenna—in the adult female—separates most of them from the *Eriococcinæ*; but the ‘Cochineal’ insects are an exception to this rule. The general character of a setiferous anal ring (which is by no means confined to the *Dactylopiinæ*) is absent in the genera *Dactylopius*, *Apiococcus* and *Halimococcus*. They agree chiefly in the negative character of the absence of any specialised anal lobes such as are found in the typical Eriococcine genera; but there is an exception (*Geococcus*) even to this character.

The sub-family includes insects with and without limbs and antennæ, together with others of an intermediate condition. The nature of the secretionary covering varies from a rigid horny test (in *Apiococcus*, *Halimococcus*, and *Porococcus*), or a tough felted test (as in *Pseudoripersia* and *Erioides*), through various degrees of loose coverings of tomentose or mealy secretion to a condition of practical nakedness. The mealy covering is the most general and has acquired for the family the popular term of ‘Mealy Bugs.’

Of the twenty-eight genera specified in the following synopsis, eleven only have been recorded from the Island of Ceylon. Those not yet found in Ceylon are indicated by brackets ( ). It is probable that several of them, especially the root-infesting species, may occur in the Island and only await discovery.

## SYNOPSIS OF GENERA.

- A. Anal ring without setæ.
- a. Limbs and antennæ present: insects thickly covered with mealy secretion ..... DACTYLOPIUS
  - b. Limbs and antennæ wanting: insects enclosed in a horny test.
    - a<sup>1</sup>. Derm with conical spines ..... (APIOCOCCUS).
    - b<sup>1</sup>. Derm without spines..... HALIMOCOCCUS.



- B. Anal ring with four setæ : anterior and mid limbs wanting.
- a.* Posterior limbs developed ..... (CAPULINIA).
- b.* Posterior limbs rudimentary ..... (CRYPTOCOCCUS).
- C. Anal ring with six setæ.
- a.* Limbs and antennæ present.
- a*<sup>1</sup>. Antennæ five-jointed ..... (RHIZOECUS).
- b*<sup>1</sup>. Antennæ six or seven-jointed.
- a*<sup>2</sup>. Adult female enclosed in horny test: limbs normal ..... (POROCOCCUS).
- b*<sup>2</sup>. Adult female enclosed in leathery test: legs thick and swollen ..... (PSEUDORIPERSIA).
- c*<sup>2</sup>. Adult female naked, or enclosed in fragile waxy test, or in mealy secretion.
- a*<sup>3</sup>. Female with prominent chitinous anal lobes  
GEOCOCCUS.
- b*<sup>3</sup>. Female without chitinous anal lobes.
- a*<sup>4</sup>. Antennæ with bases widely separated (RIPERSIA).
- b*<sup>4</sup>. Antennæ with bases approximated  
(RIPERSIELLA).
- c*<sup>4</sup>. Limbs and antennæ relatively minute  
PSEUDANTONINA.
- c*<sup>1</sup>. Antennæ seven or eight-jointed.
- a*<sup>2</sup>. Insects ovoviviparous: no ovisac.
- a*<sup>3</sup>. Terminal joint of antenna short (GYMNOCOCCUS).
- b*<sup>3</sup>. Terminal joint of antenna elongated ... PEDRONIA.
- b*<sup>2</sup>. Insects oviparous: eggs enclosed in a more or less definite ovisac.
- a*<sup>3</sup>. Adult female completely enclosed in ovisac.
- a*<sup>4</sup>. Anal setæ comparatively short..... (ERIUM).
- b*<sup>4</sup>. Anal setæ very long..... (ERIOIDES).
- b*<sup>3</sup>. Adult female exposed at anterior extremity of ovisac.
- a*<sup>4</sup>. Margin with spiniferous tubercles TYLOCOCCUS.
- b*<sup>4</sup>. Margin without conspicuous tubercles  
PSEUDOCOCCUS.
- d*<sup>1</sup>. Antenna nine-jointed.
- a*<sup>2</sup>. Adult female with compact waxy dorsal processes  
(CEROPUTO).
- b*<sup>2</sup>. Adult female without compact waxy dorsal processes ..... PHENACOCCUS.
- b.* Limbs and antennæ rudimentary or obsolete.
- a*<sup>1</sup>. Larva with three-jointed antennæ . ..... (KUWANINA).
- b*<sup>1</sup>. Larva with six-jointed antennæ ..... ANTONINA.

- D. Anal ring with eight setæ ..... (PUTO).
- E. Anal ring with more than eight setæ.
  - a. Limbs and antennæ wanting ..... (KERMICUS).
  - b. Limbs and antennæ present.
    - a<sup>1</sup>. Adult female enclosed in compact test ... (TRABUTINA).
    - b<sup>1</sup>. Adult female naked.
      - a<sup>2</sup>. Antenna of adult female three-jointed  
(MICROCOCCUS).
      - b<sup>2</sup>. Antenna of adult female six to eight-jointed  
LACHNODIUS.

Genus DACTYLOPIUS, *Costa.*

*Dactylopius*, Costa, *Fauna del Regno di Napoli*, Vol. VI. p. 15, 1856.

Sorely against my inclination, I have resigned myself to the adoption of the above name for the 'Cochineal Insects,' in place of the more widely accepted name of *Coccus*. It is hard to part company with old friends, and ever since I commenced the study of the Coccidæ I have been accustomed to regard the name of *Coccus cacti* as that of the type of the whole family. Now, alas, both the generic and the specific name of the typical Cochineal insect have to be abandoned, and that insect must be referred to as *Dactylopius coccus*. As noted by Prof. Newstead (*Monograph of the British Coccidæ*, Vol. II. p. 256), Prof. Cockerell has made it quite clear that *Dactylopius coccus* is the first available name of the commercial Cochineal Insect.

Species of this genus are distinguished from most other 'mealy bugs' by the presence, in their bodies, of a rich crimson dye which exudes from the fresh insects when they are crushed, or may be extracted from the dried insects by boiling. They have no setiferous anal ring. The derm is characterised by the presence of irregular clusters of circular ceriferous pores and truncate spines, the latter being particularly numerous and conspicuous on the wild forms, but sparse and small on the cultivated species. The antennae are comparatively short and tapering; they are normally seven-jointed, but the joints are often confused, and some of them are usually reduced to narrow rings. The female insects secrete a considerable quantity of white mealy or tomentose matter. The males undergo their transformations in an elongated felted or tomentose sac. In some species both alate and apterous forms of the male are produced.

The several species are restricted to plants of the genus *Opuntia*. One species only (*D. indicus*) occurs in Ceylon.

For a description of the various forms and their claim to specific rank, the reader may refer to my paper 'On the Cultivated and Wild Forms of Cochineal Insects' (*Journ. Econ. Biol.*, Vol. VII. Pt. 3, p. 79, Sept. 1912). Alluding to the wild forms, I have there remarked that 'it must be confessed that a careful study of them reveals no sharp characters by which they may be defined. I am inclined to regard all these wild forms as comparatively recent derivations of *tomentosus*, differing but slightly in the proportions of the limbs and the shape of the truncate spines. The Indian and African forms were almost certainly introduced from the Neotropical regions of America, and may have become differentiated under the altered conditions. *Coccus cacti* (*Dactylopius coccus*), on the other hand, has characters so distinct as to make it probable that its segregation dates from a much earlier period.'

The cultivation of the Cochineal Insect was a thriving and profitable industry until it was ruined by the discovery of aniline dyes. A certain amount of genuine Cochineal is still employed for dyeing special goods, also as a colouring matter for culinary and medicinal purposes.

DACTYLOPIUS INDICUS, *Green (The Wild Cochineal Insect).*

(PLATE CXL.)

*Coccus indicus*, Green, *Mem. Dep. Ag. Ind.*, 1908, Vol. II. p. 28.*Coccus cacti* var. *ceylonicus*, Green (*nom. nud.*), *Ind. Mus. Notes*, 1896, Vol. IV. 1, p. 7.

Adult female subglobular; circular or broadly oval in outline. Colour purplish red to brownish red (*fig.* 16); covered dorsally with a mass of white mealy tomentum (*fig.* 9). Eyes moderately prominent, weakly chitinous. Antenna (*fig.* 12) short, tapering gradually to the extremity; seven-jointed (rarely six-jointed through the confluence of the third and fourth joints); all the joints broad and short, much broader than long, with the exception of the seventh, in which the length approximately equals the breadth; some stout curved hairs on the seventh joint, and one on the side of each of the fifth and sixth joints. Legs small, moderately stout (*fig.* 11); tibia and tarsus together shorter than the femur (with trochanter); tarsus longer than tibia; claw sharply pointed; digitules slender, very slightly dilated at extremity, the tarsals longer than the unguals. Derm with numerous circular pores and truncate spines, the former occurring singly or in small clusters of three or four pores. The truncate spines are very numerous and conspicuous, even under a comparatively low magnification; they are short and stout, cylindrical and parallel-sided, with broadly expanded bases which are usually as broad as—and sometimes broader than—the total length of the spine (*fig.* 13). In macerated preparations of the insect, when the segments of the body are extended, the spines appear to be disposed in broad segmental bands (*fig.* 10). Length of Ceylon examples ranging from 1.75 to 4.0 mm. Indian examples average slightly larger.

Adult male (*figs.* 1) dull crimson, with opaque white wings and extremely long white caudal filaments. The head is pointed in front and angled at the sides, and bears six prominent black ocelli, of which two are on the upper surface, two on the under surface, the remaining pair forming the lateral angles of the head (see *figs.* 1 and 2.) Antennæ (*figs.* 7 and 8) ten-jointed; length of joints rather variable, third and fourth longest, subsequent joints decreasing to the ninth, which is the shortest; tenth equal to the seventh, but sometimes as long as fourth; joints four to ten, each with one or two long slender knobbed hairs; two or three stout curved spines near the extremity of the tenth joint. Genital sheath short and stout.

Male puparium (*fig.* 5) cylindrical, elongate, open at posterior extremity.

Young larva (*fig.* 14) dull crimson; with many long white hair-like filaments, more particularly towards the posterior extremity.

On 'Prickly Pear' (*Opuntia monacantha*). Occurring sporadically at Hambantota, Tangalla, Jaffna, and probably all round the coast wherever this particular *Opuntia* survives. Occurs also in India.

In my paper on 'Cultivated and Wild Forms of Cochineal Insects' (*Journ. Econ. Biol.*, Sept. 1912), the host plant of *Dactylopius (Coccus) indicus* in Ceylon was wrongly determined as *Opuntia dillenica*. Burkill has shown that

*dillenæ* is exempt from attack in India, and Tryon found the same condition in Ceylon (*vide Report of the Prickly Pear Travelling Commission, Queensland, 1914*).

Plants that are thickly infested by the insect have an unhealthy appearance that is noticeable from a considerable distance. It appears indeed, from Tryon's researches, that '*O. monacantha* was formerly abundant in India and Ceylon, but has been practically exterminated there by the action of a wild Cochineal Insect (*Coccus indicus*).' Its place has now been occupied (in Ceylon) by the immune species *Opuntia dillenæ*.

A similar action has been observed in South Africa, where Lounsbury remarks—in his Annual Report for 1915-16—that 'the Indian Cochineal Insect is eradicating with astonishing rapidity the Monacantha prickly pear, especially in Natal.' A small colony of *D. indicus* was taken to South Africa in 1913 by the Queensland Prickly Pear Commission, and—according to the Report—'already nothing but a few dried stumps remain where there were formerly veritable walls of this plant.' It is remarkable that the African Cochineal Insect (*D. confusus-capensis*), though so closely allied to *D. indicus*, has infested the same species of prickly pear in South Africa for nearly a hundred years without any injurious effect. This idiosyncrasy of the Indian insect makes it a very valuable ally in the extermination of *Opuntia monacantha* in countries where that noxious weed has overrun what would otherwise be useful pasture land.

The origin of the wild Cochineal Insect, in India and Ceylon, is obscure. Burkill (*Record of the Botanical Society of India, Vol. IV. No. 6, 1911*) quotes evidence to show that the insect was introduced into India in 1795, and Tryon (*Queensland Agricultural Journ., Vol. XXV. Part 4, Oct. 1910*) gives Brazil as the source of this introduction. There were apparently subsequent introductions in 1821 and somewhere about 1840, and again in 1883—when the Government of Madras imported the insect from Algiers. Some of these introductions were undoubtedly of the cultivated Cochineal, though others are definitely described as 'Wild' or 'Sylvestre' Cochineal. But whatever its source, the fact remains that the form now found in India and Ceylon differs markedly from any of the species or forms now existent in other countries, with the possible exception of *Dactylopius argentinus*, from Argentina—the only species that I have been unable to examine.

#### Genus HALIMOCOCCUS, Ckll.

*Halimococcus*, Ckll., *The Entomologist*, Vol. XXXV. p. 15, 1902.

(PLATE CXXI.)

Cockerell defines the genus (*loc. cit.*) as follows: 'A Dactylopiine Coccid enclosed in a horny sac shaped like that of *Solenococcus* (*Cerococcus*), without legs or antennæ in the adult. Larva with no rows of dorsal spines, no hairs on anal ring, and no caudal tubercles, but four long caudal bristles as in

*Phænicococcus*. Closely related to *Phænicococcus*, but distinguished by the form of the sac, which exactly imitates that of *Solenococcus*.'

To this it may be added that the sac (or puparium) of *Halimococcus* has an operculate aperture at the posterior extremity, in which particular it differs from that of *Cerococcus*, and that the adult female is without a setiferous anal ring. The operculum has the appearance of being tightly closed and immovable, but I have seen a single individual in which it was half open, hinged on the anterior rim of the aperture. It forms the only possible exit for the young larvæ.

The insects appear to be ovoviviparous. The male is unknown in any stage. Nor has the nymphal stage of the female been determined.

The type species (*H. lampas*, Ckll.) occurs on palms in Natal. At least one other species (at present undescribed) affects a species of *Calamus* in Java.

#### HALIMOCOCCUS BORASSI, *nov.*

Mature insect completely enclosed in a hard rigid puparium of a deep reddish brown colour. This case is of a narrow oval form, strongly convex above, flattened along the point of detachment below, rounded in front, tapering and elevated behind (see *fig. 4*), where it terminates above in a broadly oval aperture closed by an operculum, which is of a brighter reddish colour. The surface is minutely roughened, and bears indistinct traces of transverse corrugation. The nymphal skin—of a pale stramineous colour—at first remains attached to the puparium, and appears to be split longitudinally along the median ventral line, the two halves of the ventral area opening outwards (see *fig. 3*). This covering is subsequently shed, or becomes detached. In many individuals an irregular covering of white waxy secretion conceals the sides of the puparium, leaving the median dorsal area exposed (*fig. 2*). Length 0·6 to 0·7 mm.

Adult female (*fig. 5*) relatively of the same form as the puparium, which it completely fills. Colour very pale yellow or creamy white, the derm so thin and delicate that it is extremely difficult to extract the insect without rupturing it, when it collapses into a shapeless film. The only noticeable feature on the fresh insect is the rostral apparatus, which is rather strongly developed, and shows as a brownish patch on the under surface. After maceration (*fig. 6*) there can be distinguished, in addition, a pair of rudimentary antennæ represented by minute irregular tubercles (*fig. 7*) and the four thoracic spiracles. There is no vestige of limbs. The anal segment (*fig. 8*) is somewhat pygidiiform, the dorsal area covered by a sharply defined chitinous plate, which is approximately of the same form as the operculum of the puparium. The minute anal orifice is in the centre of this plate, which also carries from eight to ten circular pores. The outer margin is entire without either prominences or incisions. On the ventral surface is another chitinous plate covering the genital aperture. Length of extended female 0·5 mm.

Newly hatched larva very pale yellow. Margin with a series of short setæ

or hair-like spines, those at the posterior extremity longer and stouter. Young larvæ have been observed within the puparia of the adult females.

I have been unable to recognise the nymphal stage of the female (except in the form of the nymphal skin attached to the puparium of the adult). Nor have any stages of the male been observed. But, mingled with the adult insects, are numerous small ochreous or stramineous examples (*fig. 9*) which I take to be fully grown larvæ. These are of an elongate form, and have well-developed limbs and six-jointed antennæ. The posterior extremity (*fig. 10*)—even at this early stage—shows a well-defined operculoid plate with six setæ on its outer margin, but there is no indication of this structure on the newly hatched larvæ. The length of these supposed fully grown larvæ is 0.33 mm.

The insects are crowded in sheltered angles at the base of the fronds of the Palmyra Palm (*Borassus flabelliformis*), Royal Botanic Gardens, Peradeniya.

#### Genus GEOCOCCUS, *Green.*

*Geococcus*, *Green, Ent. Mo. Mag.*, Vol. XXXVIII, p. 262 (1902).

The original diagnosis of the genus was as follows: 'Insects subterranean forming a more or less complete sac. Limbs present: antennæ close together, as in *Ripersia*; six-jointed, terminal joint large. Body terminating in a pair of chitinous anal lobes, as in *Eriococcus*. Derm with trilocular pores. Anal ring setiferous. Young larva with a pair of stout chitinous spines.' It should be added that the spines of the larva are situated at the posterior extremity, and are evidently the precursors of the large stout processes found on the anal lobes of the nymph and adult insects.

As this is at present a monospecific genus it would be unwise to add other peculiar characters that might eventually prove to be of specific value only.

The single known species appears to be intermediate between the *Eriococcine* and *Pseudococcine* groups. The antennal characters suggest its affinity to *Rhizoecus* and *Ripersia*.

At present recognised from Ceylon and the Hawaiian Islands only.

#### GEOCOCCUS RADICUM, *Green.*

*Geococcus radicum*, *Green, Ent. Mo. Mag.*, Vol. XXXVIII, p. 262 (1902).

Puparium of female (*figs. 1, 2, 3*) white, irregularly circular or oval, brittle, coarsely pulverulent externally, smooth inside. Longer diameter 2.0 to 2.50 mm. The insect lies loose within the puparium (*fig. 3*), in the hinder part of which the eggs are deposited.

Adult female (*fig. 4*) very pale yellow, caudal lobes dark brown, broadest

across the middle, tapering at both extremities, terminating posteriorly in a pair of stout conical lobes. Segments well defined with, in the living insect, a well-marked ventro-lateral longitudinal sulca on each side. Antennæ placed closed together on the extreme anterior margin; six-jointed (*fig. 6*), short and stout, terminal joint longest, about as long as the previous three joints together; each joint with several longish stout hairs, in addition to which there are four conspicuous stout curved club-shaped spines, three of them being situated on the terminal and one on the subterminal joint. Rostrum close to anterior margin; mentum biarticulate, basal joint shortest. Limbs fully developed, comparatively small but stout; femur and trochanter together approximately equal in length to the tibia, tarsus and claw; tibia and tarsus of equal length, with a longish stout curved spine on the inner margin of each; claw comparatively long and slender; unguis digitules represented by a pair of short simple hairs; no tarsal digitules. Spiracles minute and inconspicuous. Caudal lobes (*fig. 7*) broad, rather densely chitinous, the extremity of each bearing a very large and stout bluntly pointed spine. Anal aperture surrounded by six stout spiniform setæ, the median pair longer and stouter than the others. Terminal abdominal segments conspicuously hairy, especially on and at the base of the caudal lobes where many of the hairs are whip-like in form. The hairs on the rest of the body are smaller and less conspicuous. There is a pair of well-defined oval cicatrices on the dorsum of the abdomen, situated apparently at the junction of the penultimate and antepenultimate segments. The derm bears numerous glandular pores of several forms. The simplest form (*fig. 8*) is circular, with a chitinous rim and a nebulous inner ring. But the most conspicuous dermal character is the presence of numerous large compound spinnerets (*fig. 9*), each of which contains three large circular pores bound together by a subtriangular chitinous rim. On the median line of the venter (situated apparently on the metathoracic and first two abdominal segments) are three subcircular chitinous organs (*fig. 10*) analogous to (if not homologous with) the cribriform plates of *Cerococcus* and *Lecaniodiaspis*. Total length 1 to 2 mm.

Nymphal female (*fig. 14*) elongate-ovate. Antenna (*fig. 15*) and limbs as in the adult. Caudal lobes (*fig. 16*) proportionately more prominent, with the terminal spine longer, more sharply pointed and falcate, the curve taking an upward direction. Between the lobes, situated dorsally, is a pair of similar but smaller falcate spines. Another pair of falcate spines is found on the dorsum immediately behind the antennæ. Both compound and simple pores occur on the derm, but the former (*fig. 17*) are much smaller than in the adult, and the individual pores are ovate instead of circular. Three cribriform organs are found on the venter; of these, the anterior one (situate between the bases of the third pair of legs) is less than half the size of the other two which are placed respectively on the first and second abdominal segments. These organs are more conspicuous and more highly developed in the nymph than in the adult. They contain numerous irregularly polygonal cells (see *fig. 18*). The dorsal abdominal cicatrices are contracted and inconspicuous. Length 1.75 to 2.25 mm.

Young larva (*fig. 11*) elongate. Antenna (*fig. 12*) five-jointed, with four club-shaped spines as in the nymph and adult insects. Caudal lobes scarcely prominent, each bearing a conspicuous upwardly curved spine (*fig. 15*). There are no falcate spines on the dorsum. Dorsal cicatrices well defined,



the two pairs being situated near the anterior and posterior extremities respectively. Anal aperture surrounded by six stout setæ. Length approximately 0.50 mm.

Eggs (*fig.* 3) white.

Habitat: In the soil, attached to roots of grasses and other plants, under stones; and in the thin layer of soil and dwarf herbage covering rocks; Pundaluoya and Kandy.

Occurs also in the Hawaiian Islands, where it has been observed by Mr. J. Kotinsky.

#### Genus PSEUDANTONINA, *nov.*

Species resembling *Antonina* in habit and form, but possessing limbs. Type, *bambusæ*.

It will be inadvisable to fix the characters of the genus too closely, pending the discovery of other species. The characters of the single species for which the new genus has been erected appear to be intermediate between those of *Antonina* and *Ripersia*.

#### PSEUDANTONINA BAMBUSÆ, *nov.*

(PLATE CXLIII.)

Adult female (*fig.* 1) naked or sparsely covered with loose white secretion; irregularly elongate oval, evenly rounded at either extremity; flattened by compression from its position between the stem and the enfolding stipules. Antennæ marginal, very small; usually five-jointed (*fig.* 2), occasionally with six (*fig.* 3), and sometimes with only three joints (*fig.* 4); intersegmental divisions feeble and frequently indistinct. Limbs very small and weak, though the normal number of joints are developed and even well formed (*fig.* 5); claw long and slender, curved at the tip; tarsal digitules long and slender, minutely knobbed; unguis digitules rather shorter. The median and posterior legs appear to spring from a crowded patch of minute pores, but these pores are actually on the dorsum, immediately above the insertion of the limbs (see *fig.* 5). Rostrum situated close to the anterior extremity; mentum broad and short. Spiracles rather small, opening into a short cylindrical chamber. Anal orifice (*fig.* 6) opening on to or just within the posterior margin. Anal ring incomplete, bearing six moderately long setæ. Derm with a few very small scattered spiny hairs, and circular pores of various sizes, viz., a series of comparatively large thick-rimmed pores (*fig.* 2) on the anterior margin, extending downwards on each side to the level of the anterior spiracles (see *fig.* 1); some smaller pores on the marginal area of the abdomen, more crowded on the posterior segments (*fig.* 6); crowded patches of still smaller pores above the insertion

of the median and posterior limbs (*figs.* 1, 5); and some minute inconspicuous pores mingled with the others (see *fig.* 2). Dimensions varying from 2·75 by 1·25, to 4·75 by 2·0 mm.

Young larva without prominent posterior lobes, but bearing a pair of long caudal setæ. Derm with longitudinal series of comparatively large circular pores on both dorsum and venter, there being four series on the dorsum, four on the venter, and a complete marginal series. Length 0·45 mm.

Concealed beneath the imbricating stipules of a small stemmed bamboo (? *Teinostachyum attenuatum*) in the jungle above Nuera Eliya.

#### Genus PEDRONIA, *nov.*

Insects ovoviviparous. Derm with stout conical spines. Antenna six- or seven-jointed, the terminal joint elongate. Without prominent chitinous anal lobes.

Type, *strobilanthis*.

Superficially resembling *Rhizococcus*; but differing from the Eriococcine genera in the elongate terminal joint of the antennæ and the absence of the characteristic prominent anal lobes.

#### PEDRONIA STROBILANTHIS, *nov.*

(PLATE CXLIV.)

Adult female (*fig.* 1), naked; brownish red to dark purple-brown, with longitudinal series of small colourless glassy spiniform paired processes arising from stout sharply pointed conical spines arranged as in *fig.* 3. Antenna (*fig.* 5) normally seven-jointed, but in many examples the number is reduced to six, owing to a confluence of the second and third joints (*fig.* 6). Terminal joint always much the longest. Formula of normal antenna 7, (1, 2), 6, (3, 4, 5). Formula of six-jointed form 6, 3, 1, (2, 5), 4. Limbs stout; tarsus shorter than tibia (*fig.* 7); the two together scarcely longer than the femur (with trochanter); tarsal digitules slender, slightly knobbed; claw sharply pointed. I have been unable to detect any unguinal digitules. More or less definite eye spots are noticeable on the anterior margin. Posterior extremity (*fig.* 4) with broadly rounded lobes. There is a pair of stout spines (part of the marginal series) at the apex of each lobe, and a longish seta from below the apex. Anal ring with six stout setæ. The dorsal spines, in the typical form, have bases almost as broad as their length (*fig.* 9); but a form with longer and more slender spines (*fig.* 8) was observed on the isolated hill of Namunakuli. This form may be distinguished as var. *tenuispina*. Size of female insect averaging 1·0 mm. by 0·60 mm.

No ovisac is formed, the insects being ovoviviparous.

Male puparium (see *fig. 1*) pure white; narrow, about twice as long as broad; posterior extremity open. Length 1.75 mm.

Other stages not observed.

On under surface of leaves of *Strobilanthes* sp.; Pedrotalagala (7000 ft.), Nuera Eliya; March.

The variety *tenuispina* was observed only on the isolated Namunakuli Hill (Badulla District), at about the same elevation.

The plants were so thickly infested by the insect that the leaves were wilted and falling off. Some of the plants appeared to be dying from the attack. A sooty fungus accompanied the insect and smothered the foliage. The female insects are unusually active and move about with considerable rapidity.

Although the character and arrangement of the spines is suggestive of the *Eriococcinae*, the abdominal extremity has not the highly chitinous and modified lobes characteristic of that family; and the terminal joint of the antenna is more like that found in *Pseudococcus* and its allies.

#### ERIOIDES, *gen. nov.*

Adult female enclosed in a tough felted case, with an opening at the posterior extremity. Terminal segments of abdomen with dense groups of spines on the dorsum. Antenna seven-jointed; terminal joint elongate. Limbs well developed. Anal ring with six very long curling setae, much longer than those of the caudal lobes.

Type, *cuneiformis*.

#### SYNOPSIS OF SPECIES.

- A. Adult female enclosed in a cuneiform case: on surface of leaves *cuneiformis*.  
 B. Adult female enclosed in an irregular case: in crevices of bark *rimulae*.

#### ERIOIDES CUNEIFORMIS, *nov.*

(PLATE CXLV.)

Puparium (or ovisac) of adult female (*fig. 4*) white externally, often discoloured by a deposit of black fungus, pale buff within. Broad behind, tapering to a fine point at anterior extremity; indented at posterior extremity, where there is an aperture through which the waxy abdominal processes of the insect project; irregularly wrinkled transversely. Closely felted and tough. Length 3.0 to 3.50 mm. Breadth across broadest part about 2.0 mm.

Adult female at first olivaceous (*fig. 7*); changing with age to slaty purple (*fig. 5*). At first approximately parallel-sided, the cephalic extremity only narrowed (*fig. 7*); later, shrivelling in front and becoming gradually contracted

until it assumes the form shown in *figs.* 5 and 6; lateral margins slightly recurved. Abdominal segments with a median dorsal series of stout white waxy processes, directed backwards; posterior margin with seven longer and stouter processes, also directed backwards. Antenna (*fig.* 9) with seven joints, the division between the third and fourth often indistinct; seventh much the longest. Limbs (*fig.* 10) stout; tarsus slightly shorter than tibia; digitules very fine and delicate, often missing, tarsals with a minute apical knob, unguis weakly dilated at extremity. Derm with groups of stout pointed spines on positions corresponding with the waxy processes displayed by the living insect, viz., a dorsal series of small groups on the last six or seven segments of the abdomen, and large groups on the marginal areas of the posterior segments. These groups become larger and more crowded as they approach the posterior extremity until—on the last two segments—they become almost confluent (*fig.* 8). There are numerous small circular ceriferous pores on the dorsum, and some larger pores on the venter. Anal ring large and conspicuous, bearing six very long whip-like setæ, and outlined by a double chain of cells. Caudal setæ about one-third the length of those of the anal ring. Length of insect 2·0 to 2·75 mm.

On the upper surface of the leaves (and occasionally on the slender branches) of *Eugenia oligantha*; also on a species of *Calophyllum*. Nuera Eliya. The puparia are almost invariably situated at the base of the leaf, in the groove above the midrib.

I have been unable to obtain the male of this species, or to recognise the male puparia.

#### ERIOIDES RIMULÆ, *nov.*

(PLATE CXLVI.)

Adult female enclosed in a stout, closely felted sac, which is whitish externally, but buff-coloured internally. The sac is open at the hinder extremity, revealing the terminal segments of the insect, from which project two longish curling flattened white filaments (*figs.* 9, 10). In its earlier stage of construction the sac is often vase-shaped and disposed in an erect position, the anterior parts sunk in a crevice of the bark (*fig.* 9). Later, it usually assumes a procumbent position and is of a more irregular form (*fig.* 10). Length of fully developed sac about 2·75 mm.

Adult female at first yellow (*fig.* 6), becoming dull purplish later. Form oval, tapering somewhat behind and (in life) constricted at the anterior extremity. Cephalo-thorax and base of abdomen naked; terminal five or six segments of abdomen covered dorsally with white mealy secretion and (in older examples) with stout marginal waxy processes directed backwards. Derm with numerous minute pores; the dorsum of the terminal segments almost completely covered with large chitinous plates crowded with stout spines (*fig.* 11). On the anal segment these spines are longer, and taper evenly to a sharp point; the spines on the preceding segments are of the peculiar shape shown at *fig.* 12, sharply constricted at the base, above which they are broadly napiform. There is a moderately long, stout, caudal seta on each side of the anal

segment. Anal ring large and conspicuous, with a double undulating chain of cells encircling six extremely long whip-like setæ fully twice the length of the caudal setæ. Antenna (*fig. 13*) with seven joints, of which the seventh is the longest; the remaining joints subequal in length, though the third is usually slightly longer and the sixth slightly shorter than the others. Limbs robust (*fig. 8*); tarsus equal to or slightly longer than the tibia; claw stout and falcate; unguis digitules very short, tarsal digitules moderately long. Length of mature insect 1.50 to 2.0 mm.

Adult male (*fig. 3*) apterous, but with small wing pads. Pale yellow; with a pair of longish curling white caudal filaments. Antenna (*fig. 5*) ten-jointed, with from one to six fine knobbed hairs on each of the last six joints. Genital sheath short and stout. Length 0.75 mm.

Young larva (*fig. 2*) pale yellow, slightly dusted with white powdery secretion.

In crevices of the bark of *Phyllanthus* sp. and *Euonymus* sp.; Nuera Eliya and Bandarawella. Also on the stems of *Loranthus longiflorus*—principally around the nodes and in the axils of the leaves; Hewaheta.

Genus TYLOCOCCLUS, *Newstead.*

*Tylococcus*, Newst., *Ent. Mo. Mag.*, Vol. XXXIII. p. 165 (1897).

Newstead erected this genus to contain a single species (*T. madagascariensis*) characterised by a series of prominent, spiniferous marginal tubercles; with the other characters as in *Pseudococcus*.

Brain ('The Coccidæ of South Africa,' *Trans. R. Soc. S. Africa*, Vol. II., Nov. 1915, p. 65) assigns my *Phenacoccus insolitus* to this genus. I am not, however, in agreement with that author, with regard to the systematic position of *insolitus*, and prefer to retain it in the genus *Phenacoccus*. The type of Newstead's genus has eight-jointed antennæ and constructs no ovisac. The two new species that I am now describing, though without such well-defined tubercles, are—I believe—congeneric with *madagascariensis*. They agree with that insect in the possession of eight-jointed antennæ, in producing no ovisac, and in the fact that they occur only in shelters constructed by ants.

SYNOPSIS OF CEYLON SPECIES.

- A. Marginal tubercles rounded and prominent; limbs small and very stout ..... *formicarii.*
- B. Marginal tubercles reduced or obsolescent; limbs larger and, proportionately, less stout ..... *simplior.*

TYLOCOCCLUS FORMICARII, *nov.*

(PLATE CXLVII.)

Adult female subcircular; strongly convex above; transversely wrinkled. Thinly dusted with white meal; body brownish where exposed. A thick tufted fringe of white cottony secretion proceeding from beneath, and partly overlapping the margin, raises the insect from its support. No ovisac. After treatment with potash, the margin is seen to be strongly produced into prominent lobes, of which there are seventeen on each side, each with a dense cluster of long, slender, sharply-pointed spines and spiniform setæ (see *figs.* 2, 5). Before compression there are deep incisions between the segments, but these are partially obliterated after compression (*fig.* 1). Antenna (*fig.* 2) eight-jointed. In some examples the third and fourth or fourth and fifth joints are more or less confluent, suggesting a reversion to a seven-jointed form. And there is occasionally a partial division of the eighth joint which, if complete, would result in a nine-jointed form. In the normal eight-jointed antenna, the eighth is more than twice as long as the second, which is the next longest; fourth and fifth shortest, equal. Eye well defined, but scarcely prominent (*fig.* 2). Legs comparatively small, but robust (see *figs.* 1, 3); tibia, tarsus and claw together shorter than femur (plus trochanter); femur very broad; tibia scarcely longer than broad; tarsus as long as the tibia; claw (see *fig.* 4) large and stout, more than half as long as the tarsus; tarsal digitules simple, unguis digitules slightly dilated at extremity. Anal ring with six comparatively short stout setæ. Anal orifice surrounded and partly obscured by a loose cluster of stout hairs. Derm with numerous short stout hairs and minute circular pores. Some larger pores surrounding the genital orifice, on the venter. Caudal setæ approximately two and a half times as long as the anal setæ. Anterior and posterior glandular foveæ conspicuous; the posterior pair very large and with stout tumescent lips (see *fig.* 1). Length 1·85 to 2·0 mm. Breadth 1·75 to 1·85 mm.

Larva ovate. Margin without prominent lobes, but with a marginal series of moderately stout curved setæ. Antenna six-jointed. Limbs rather stout; tarsus longer than tibia. Claw stout and falcate. Length 0·45 mm.

Early nymph with a close covering of white meal. There are still no marginal prominences, but there are clusters of stout setæ on the marginal area of each segment. Antenna six-jointed, the second joint elongated. Length 0·65 mm.

From nests of *Cremastogaster*, on *Grewia columnaria*. Maha Illuppalama.

TYLOCOCCLUS SIMPLICIOR, *nov.*

(PLATE CXLVIII.)

Adult female coated above with rather dense white meal. Margin with a close fringe of white tassels which tend to coalesce. Broadly oval; rather strongly convex above. Margin of body, on each side, with a series of seventeen more or less prominent ceriferous tracts, which become rather broken and diffuse at the cephalic extremity. Each tract bears a group of from five to eight stout, sharply acuminate spines and many strong setæ (see *figs.* 6, 7). Antenna (*fig.* 2) rather short, eight-jointed; eighth as long as or longer than the preceding two joints together; first joint basally constricted; fourth shortest. A conspicuous eye spot is noticeable shortly beyond the base of the antenna, on each side (see *fig.* 6 *b*). Limbs robust but comparatively short (*fig.* 3); femur and trochanter together longer than tibia, tarsus, and claw together; tarsus approximately two-thirds the length of tibia; claw stout, falcate; tarsal digitules slender, simple; unguis slender, slightly dilated at extremity. Anterior glandular foveæ rather small and inconspicuous; posterior foveæ large and well defined. Anal ring with six comparatively short setæ. Anal lobes (see *fig.* 7) rounded, prominent; the caudal setæ stout, nearly three times the length of those on the anal ring. Between the anal lobes is a pair of stout setæ equalling in size those of the anal ring. Derm with scattered minute circular pores which are more concentrated on the marginal area and on the ceriferous tracts (see *figs.* 6, 7). Length 2 to 2.5 mm.

On undetermined plant. Maha Illuppalama, N.C.P. Attended by ants (*Ecophylla smaragdina*). Clearly allied to *T. formicarii*, from which it differs in the obsolescent marginal lobes, in the larger limbs, and in the smaller number of spines on the ceriferous tracts.

Genus PSEUDOCOCCLUS, *Westwood.*

*Pseudococcus*, Westw., *Synop. Gen. Br. Ins.*, p. 118 (1839).

*Dactylopius*, Targ., *Mem. Soc. Ent. Ital.* (1867).

*Boisduvallia*, Sign., *Ann. Soc. Ent. Fr.* (5), Vol. V. p. 338 (1875).

*Oudablis*, Sign., *Bul. Soc. Ent. Fr.* (6), Vol. I, p. clvii. (1881).

Westwood proposed this name to cover the 'mealy bugs,' and specified *adonidum* (now generally known as *longispinus*) as the type of the genus. Signoret, in 1875, restricted the name to those species having nine-jointed antennæ and relegated the others (with eight or fewer joints) to the genus *Dactylopius*, by which name they were generally recognised until the publication of Mrs. Fernald's *Catalogue of the Coccidæ of the World*, in which many sweeping changes in generic names were propounded. The name *Dactylopius* having now been allotted to the 'Cochineal Insects,' Westwood's name takes

its place for those species having antennæ with eight or fewer joints, while the species with nine-jointed antennæ are referred to *Phenacoccus*.

The dividing line between *Pseudococcus* and *Phenacoccus* in the one direction and *Ripersia* (with six to seven-jointed antennæ) in the other direction, is not very satisfactory and can be accepted only as a more or less convenient method of breaking up a cumbersome group. There are certain species of *Pseudococcus* in which a partial division of the terminal joint may occur which—if complete—would relegate the species to *Phenacoccus*. On the other hand, there are species of *Phenacoccus* in which the separation of the eighth and ninth joints is but weakly defined. Again, there are species of *Pseudococcus* in which the number of antennal joints is reduced by more or less complete fusion to seven or even six, thus bringing them within the definition of the genus *Ripersia*.

The genus is universally distributed, representatives being found in every known country. Approximately 150 species have been described, of which twelve are now recorded from Ceylon.

For a first subdivision of the species, the position and arrangement of the dermal spines will be found a convenient character. They are associated with ceriferous pores, usually in well-defined groups in positions corresponding with the waxy tassels that are commonly found on the living insects. These groups of spines and pores have been termed ceriferous tracts or cerarii. They are usually confined to the marginal area of the body and may form a complete marginal series (e.g., *citri*, *longispinus*, &c.), or be confined to the posterior segment only—as in *virgatus*—or they may be found on two or more of the terminal segments of the abdomen. *Ps. scrobicularum* is an exception, having the spines placed in transverse series across the abdominal segments; in this and in the character of the anal ring *scrobicularum* approaches the species for which I have erected the new genus *Erioides*. The relative lengths of the caudal setæ and those of the anal ring and the size of the spiracles are useful characters. The antennal formula, though useful in some cases, is not altogether reliable, so much depends upon the condition of the specimen and of the preparation; and, in many species, the relative dimensions of the antennal joints themselves are variable. The length of the tarsus in relation to the tibia is a more reliable character.

A character that appears to be common (though not confined) to the species of *Pseudococcus* is the presence of two pairs of large oval glandular cicatrices (foveæ, or osteoles) which are situated on the dorsum—one pair near the anterior extremity and the other near the posterior extremity of the body. They are concerned in the secretion of a fluid—probably of an offensive nature—which is exuded when the insect is irritated.

#### SYNOPSIS OF CEYLON SPECIES.

- A. Ceriferous tracts on terminal segment only.
- (a) Limbs long and slender ..... *virgatus*.
  - (b) Limbs short and stout ..... *kandyensis*.
- B. Ceriferous tracts on terminal and penultimate segments only. Body elongate.
- (a) Limbs and other organs proportionately small ..... *pulverarius*.
  - (b) Limbs, &c., proportionately large ..... *pulverarius-bambusæ*.
- C. Spines in conspicuous transverse bands across abdomen ... *scrobicularum*.



- D. A more or less complete marginal series of ceriferous tracts.
- (a) Tarsus of mid leg approximately half length of tibia.
    - (a<sup>1</sup>) Anal lobes with two spines only.
    - (a<sup>2</sup>) Caudal setæ much longer than those on anal ring. Spines on terminal segments short. Marginal tassels short ..... *citri.*
    - (b<sup>2</sup>) Caudal setæ scarcely longer than those on anal ring. Marginal tassels long ..... *citriculus.*
    - (b<sup>1</sup>) Anal lobes with from four to six spines ..... *monticola.*
  - (b) Tarsus of mid leg exceeding half length of tibia.
    - (a<sup>1</sup>) Ceriferous tracts indefinite; dorsal osteoles inconspicuous ..... *filamentosus var. corymbatus.*
    - (b<sup>1</sup>) Ceriferous tracts well defined; dorsal osteoles large and conspicuous.
      - (a<sup>2</sup>) Eighteen pairs of ceriferous tracts; all with spines of approximately equal size ..... *lilacinus.*
      - (b<sup>2</sup>) Seventeen pairs of ceriferous tracts; posterior spines enlarged ..... *bromeliæ.*
  - (c) Tarsus of mid leg less than half length of tibia.
    - (a<sup>1</sup>) A single elongated seta on anal lobes.
    - (a<sup>2</sup>) Tibia of hind limb without translucent pores ..... *longispinus.*
    - (b<sup>2</sup>) Tibia of hind limb with conspicuous translucent pores.
      - (a<sup>3</sup>) Hind tibia markedly dilated; translucent pores crowded ..... *maritimus.*
      - (b<sup>3</sup>) Hind tibia not dilated; translucent pores scattered..... *comstocki.*
    - (b<sup>1</sup>) Several elongated setæ on anal lobes; marginal fringe of tassel short ..... *debregasiae.*

PSEUDOCOCCUS VIRGATUS? *Ckll.*

(PLATE CXLIX.)

*Dactylopius virgatus*, Cockerell, *The Entom.*, Vol. XXVI. p. 178 (1893).

*Dactylopius ceriferus*, Newstead, *Ind. Mus. Notes*, Vol. III. No. 5, p. 24 (1895).

*Dactylopius tatini*, Green, *Ind. Mus. Notes*, Vol. IV. No. 1, p. 7 (1896).

*Pseudococcus marchalli*, Vayssière, *Bul. Soc. Ent. Fr.*, Vol. XVII. p. 366 (1912).

*Pseudococcus bicaudatus*, Keuchenius, *Medel. v. h. Bessekisch Proefstation, Djemba*, No. 16, p. 63 (1915).

Adult female (figs. 2, 3, 4, 5) at first dull orange, afterwards purplish, paler beneath. In each stage, after a change of skin, the insect is yellowish, gradually assuming the darker tint before the next moult. (Newstead describes *D. ceriferus* as being olivaceous beneath and paler above.) Dorsum powdered with

white mealy secretion which, in older examples—when oviposition is commencing, conceals the colour of the insect except at definite paired patches on the thorax and post-abdomen, where the derm remains visible (*fig. 4*). This pattern is very characteristic of the species. Posterior extremity with a conspicuous pair of stout, tapering, waxy tassels, as long as half the length of the body; the rest of the body with numerous long, fine, straight, glassy filaments (*fig. 2*). These glassy filaments are extremely fragile, falling off and becoming entangled with the accumulations of secretion that surround the insects; they are constantly reproduced. The female, during oviposition, rests upon a pad of silky white filaments, and wisps of the same material surround its body. Antenna (*fig. 6*), eight-jointed, terminal joint longest; third next longest. Eyes small, slightly prominent. Legs well developed; femur moderately stout, tibia and tarsus slender (see *fig. 7*); tarsus approximately one-third length of tibia. Claw stout; tarsal digitules slender, with minute terminal knob; unguals moderately dilated towards the extremity (*fig. 8*). Spiracles (*figs. 14, 15*) rather large, especially the posterior pair. Anal ring with six longish stout setae. Caudal lobes rounded, rather prominent, each with a pair of stout, sharply pointed spines, surrounded by a group of small ceriferous pores; caudal setae stout, relatively short, but longer than those of the anal ring, springing from the ventral face of the lobe (*fig. 9*). A group of slightly larger ceriferous pores surrounds the genital orifice. On each side of the penultimate segment is a scattered series of from six to nine conspicuous oval or circular pores communicating with short, stout tubular ducts (*fig. 10*), and there are small series of from one to three on the marginal area of all the other segments; similar ducts are distributed over the frons, and a pair of ducts opens on to the dorsum near the centre of each of the three segments preceding the penultimate. Derm with numerous very minute trilocular pores, intermingled with some short, fine hairs. Length of fully developed female 3 to 3.5 mm. Breadth 1.5 to 2 mm.

Adult male (*fig. 11*) dull brown, darkest on thorax. Body powdered with short white filaments. Head broad. Ocelli black: two on upper surface (*fig. 12*), separated by more than their own diameter: two on under surface (*fig. 13*), contiguous; rudimentary eyes minute, lateral. Wings ample, hyaline and iridescent, covered with minute hairs, which are arranged in an irregular network. Extremity of abdomen with a pair of long, straight, white filaments, which are as long as the body of the insect. Genital sheath short and stout. Length 1 mm.

Puparium of male cylindrical, white, woolly.

Eggs pale yellow; hatching very soon after extrusion. No definite ovisac. Young larva very pale yellow.

Nymph similar to adult, but smaller. Antenna, seven-jointed. Limbs proportionately shorter and stouter.

Widely distributed throughout the island, on various plants: on *Talinum*, *Calliandra*, *Castilleja elastica*, *Sagittaria*, and *Thunbergia* (Kandy district); on *Asparagus* and *Lilium* sp. (Colombo); on *Croton* (Putlam); and on Tomato plants (Trincomali). Received also from the Maldives Islands, on *Portulaca*. Recorded from India, Jamaica, Sandwich Islands, Mauritius, Mexico, Texas, Java, Nigeria, Zanzibar.

This species can be readily distinguished by the single pair of stout waxy caudal appendages, and by the fine glassy filaments. The pattern formed by

the bare spots on the dorsum is also characteristic. I know of no other species that possesses the conspicuous tubular ducts which, in this insect, take the place of the usual ceriferous tracts. *Rhipersia filicicola*, of Newstead, produces somewhat similar glassy filaments, but that insect is distinguished by its six-jointed antennæ.

PSEUDOCOCCUS KANDYENSIS, *nov.*

(PLATE CL.)

Adult female oblong oval, tumescent; median dorsal area elevated, more particularly on the thorax. Colour, dark slaty grey or dull purplish grey; closely powdered with white mealy secretion. Anal orifice encircled by a pair of opaque white curved waxy plates, and with a pair of short white divergent flattened filaments from the aperture itself. The early adult insect rests on a pad of tangled pale golden silky filaments which extend beyond the margins of the body (*fig.* 1). Later, the insect is partially concealed beneath a covering of loose woolly secretion. Limbs and antennæ rather small. Antenna (*fig.* 3) eight-jointed; eighth considerably the longest; second next longest; remainder sub-equal, the fourth usually the shortest. Legs (*fig.* 4), stout; tibio-tarsal section shorter than femur and trochanter; tarsus short, approximately one-third length of tibia; claw short and stout, unguis digitules slightly dilated, tarsal digitules simple (see *fig.* 5). Spiracles (*figs.* 8, 9), small and slender. Derm with scattered minute circular pores and short inconspicuous hairs; the marginal area with some larger and more conspicuous broad-rimmed pores communicating with short stout ducts (*fig.* 6). Anal lobes small and sub-conical (see *fig.* 7); each with two longish slender sharply pointed spines, several longish hairs, and a stout seta of approximately the same length as the setæ of the anal ring. There are no spines on any other parts of the body. When boiled in potash the insect exudes a pale pink stain. Length averaging 2.5 mm.

Apparently ovoviviparous. No ovisacs or ova observed, but numerous newly emerged larvæ.

On a small wiry grass, on edge of jungle. Kandy.

PSEUDOCOCCUS PULVERARIUS, *Newst.*

(PLATE CLI. 1-6).

*Rhipersia pulverarius*, Newstead, *Ent. Mo. Mag.*, Vol. XXVIII. p. 145 (1892).  
*Dactylopius pulverarius*, Newstead, *Mon. Brit. Cocc.*, Vol. II. p. 174 (1903).

Adult female (*fig.* 2), very elongate, the length being from three to four times greater than the breadth. Colour, pale pink to purplish brown; more or less completely covered with white powdery secretion. Antennæ and limbs small. The antenna is said by Newstead to contain either six, seven, or eight joints, of which the last is considered to be the normal number. In examples from Ceylon the smaller numbers (six and seven) appear to be more usual (*figs.* 3, 4), the terminal joint is by far the longest, exceeding the united lengths of the two

preceding joints. Limbs small; tibia and tarsus together approximately equal to the femoral joint (*fig.* 5), the tarsus slightly shorter than the tibia; unguis digitules very slightly dilated. Anal segment (*fig.* 5), with a longish caudal seta and two stout sharply pointed spines on each side; some longish hairs are distributed over both dorsum and venter in the neighbourhood of the anal ring. In some examples there is a smaller pair of pointed spines and a longish hair on the lateral margins of the penultimate segment. Remaining segments of the body without spines or ceriferous tracts. Anal ring comparatively large; with six stout setae that are only slightly shorter than the caudal setae. Derm with numerous circular ceriferous pores which are more crowded towards the margins of the body and on the posterior segments. They are of two sizes, some very minute pores being interspersed amongst others of a comparatively large size (see *fig.* 6). The posterior dorsal glandular foveae are small and inconspicuous; anterior foveae absent or obsolescent. Length 3 to 4 mm. Breadth 1 to 1.50 mm.

On grasses; concealed between the stem and the enveloping bases of the leaves (*fig.* 1). Pundaluoya.

The insect constructs no definite ovisac, but surrounds itself with a considerable quantity of pulverulent wax, amongst which the eggs are deposited.

The species has, hitherto, been recorded from Great Britain only, but has probably a very much wider distribution. The insect is so well concealed, and is itself so inconspicuous, that it may be very easily overlooked.

In examples from Ceylon both the limbs and antennae are distinctly smaller than in typical British examples, and the tibiae are relatively shorter.

PSEUDOCOCCUS PULVERARIUS, *subsp.* BAMBUSÆ, *nov.*

(PLATE CLI. 7-10.)

Adult female differing from the typical insect occurring on grasses in the considerably larger size of all the parts of the body (compare *figs.* 4, 5 and 8, 9).

Antenna (*fig.* 8) eight-jointed, the divisions between the second and third and between the seventh and eighth joints somewhat weakly defined; eighth comparatively short, only slightly longer than second; third shortest.

Legs (*fig.* 9) stout. Anal ring (*fig.* 10) with a loose chain of large cells, and six longish setae. There are, usually, paired spines on the terminal, the penultimate and, occasionally, on the antepenultimate segment also. Hairs, pores, and other dermal characters as in the type. Length 3.50 to 4.75 mm. Breadth 1.75 to 2.0 mm.

Concealed between the stipules and stems of a species of Bamboo: Pundaluoya.

The adult female surrounds itself with a considerable quantity of powdery white secretion.

Comparison of the relative proportions of the limbs shows that those of the form on Bamboo are from one-quarter to one-third larger than those of the form on grasses.

## PSEUDOCOCCUS SCROBICULARUM (Green).

(PLATE CLII.)

*Dactylopius scrobicularum*, Green, *Ind. Mus. Notes*, Vol. IV. No. 1, p. 8 (1896).

Adult female (figs. 2, 3) dark purplish slate colour; dorsum of thoracic segments dusted lightly with white mealy secretion; dorsum of abdomen entirely concealed by series of blunt white waxy processes which may be more or less distinct, or may coalesce to form irregular transverse ridges on each segment. The processes are produced into a coarse fringe on the margin. A pair of longish diverging curved strap-shaped processes (with incurved edges) projects from the region of the anal orifice. The venter of the insect is quite naked. Body broadest across the middle, narrowing to a blunt point in front and behind. Segments tumescent, very distinct on the under surface. Antenna (fig. 5) eight-jointed; eighth longest, as long as the previous three together; several stout hairs on each joint. Limbs moderately stout; tarsus about two-thirds the length of the tibia (fig. 7); digitules slender, knobbed. Anal lobes rounded, rather prominent; each with a longish stout seta on the hinder margin. Anal ring (see fig. 6) with six long curling setæ, which are as long as or longer than those of the anal lobes. Derm with numerous larger circular pores and smaller trilocular pores, and with transverse dorsal series of conical spines across the abdominal segments (see fig. 6). There are no spines on the thoracic segments. Length 1.75 to 2.25 mm. Breadth 1.0 to 1.25 mm.

The insects are concealed within small pits (scrobiculæ) at the bases of the veins on the under surface of leaves of *Elæocarpus amoenus* (fig. 1). Pundaluoya. Their presence can be detected by white waxy tufts which project from the apertures of the scrobiculæ. The juices of the living insect are of a rich beet-red colour; but, after boiling in potash, the tissues assume a bottle-green tint.

The character of the anal ring and the dermal armature suggest affinity to *Erioides cuneiformis* and *E. rimulæ*.

## PSEUDOCOCCUS CITRI, Risso.

(PLATE CLIII.)

*Dorthezia citri*, Risso, *Essai, Hist. Nat. des Orangers* (1813).*Pseudococcus adonidum*, Nietn., *Enemies of the Coffee Tree* (1861) (not *adonidum*, Geoff.).*Lecanium phyllococcus*, Ashm., *Can. Ent.*, Vol. XI, p. 160 (1879).*Dactylopius brevispinus*, Targ., *Anal. di Agr.* p. 137 (1881).*Dactylopius destructor*, Comst., *Rep. U.S. Dep. Ag.*, 1880, p. 342 (1881).*Dactylopius citri*, Sign., *Bull. Soc. Ent. Fr.* (6), Vol. IV., p. cl. (1884).

Adult female (figs. 2, 3) yellowish, pinkish-yellow, purplish, brownish or greyish-yellow above; usually yellowish beneath. The colour on the dorsum is

almost completely concealed by a close covering of white mealy powder ; there is, usually, however, a median and sometimes a lateral stripe partially free from the secretion, revealing the true colour of the insect. The venter is only thinly dusted with mealy powder. There is a complete marginal series of thirty-four short, stout, white, waxy tassels, subequal in length, though rather stouter on the abdominal segments. Between the last pair of tassels is a pair of small ligulate processes of a denser and smoother wax, proceeding from the anal orifice. Form broadly oval ; convex above, flattish below, with the segments more or less tumescent. Antenna (*fig.* 7) eight-jointed ; eighth considerably longer than any of the others ; second and third elongate, approximately equal ; the fourth and seventh subequal. Limbs (*fig.* 6) comparatively slender ; tarsus approximately half the length of the tibia ; the tibia and tarsus together approximately equal to femur and trochanter. Foot with slender digitules ; the apices of the tarsals minutely knobbed, those of the unguals slightly dilated. Margin of body with a series of ceriferous tracts in positions corresponding with the waxy tassels. Each tract bears a pair of sharply pointed spines (see *fig.* 4), two or three hairs and a scattered group of minute circular pores which are of the same size as those on the rest of the derm. It is noticeable that there are thirty-six of these tracts, though the number of apparent marginal tassels is thirty-four only. Two of the tracts are situated close together on the frons, and probably give rise to a single compound tassel. There are the usual larger circular pores on the venter, extending across the genital area. Posterior extremity (*fig.* 4) with slightly prominent anal lobes, each surmounted by a stout caudal seta. Anal ring with six setae, which are slightly more than half the length of the caudal setae. Length of Ceylon examples averaging 2.6 mm., ranging from 1.75 to 4 mm.

Adult male (*fig.* 10) dull brown, thinly powdered with white meal, except the median sternal plate on the thorax, which is smoothed and polished. Caudal filaments white, approximately as long as the body. Wings greyish, highly iridescent. Antenna (*fig.* 13) ten-jointed, hairy ; second joint dilated ; third and tenth longest ; a pair of fine knobbed hairs at apex of tenth (see *fig.* 14). Ocelli prominent, black : two on upper and two on under surface of head (see *figs.* 10 and 11). Rudimentary eyes minute, black, lateral. Limbs slender : tarsus about one-third the length of the tibia ; claw long and slender. Length 0.75 mm. Both apterous and micropterous forms of the male are occasionally produced.

Young larva pinkish yellow, thickly dusted with white meal. Eggs honey yellow.

On Coffee, Cacao, Citrus, Cinchona, Anona, Loranthus, Ipomea and numerous other plants. Widely distributed throughout the Island. A cosmopolitan species, and a common greenhouse pest in Europe.

Living examples of this species are readily distinguishable from *Ps. longispinus* (which occurs in similar situations) by the shorter and stouter fringe of waxy tassels. But dried examples (which have usually lost their appendages) are not so easily separated. The following microscopical points may be relied upon.

*Ps. citri* : Thirty-six marginal ceriferous tracts ; spines on all the tracts of equal diameter ; caudal setae much longer than those of the anal ring ; tarsus approximately half the length of the tibia.

*Ps. longispinus* : Thirty-four marginal ceriferous tracts ; spines of the ter-

minal and penultimate tracts conspicuously larger and stouter than those on the remaining tracts; caudal setæ scarcely longer than those of the anal ring; tarsus approximately one-third length of tibia.

Risso's original description of *Dorthisia citri*, in his *Histoire Naturelle des Orangers* (pp. 252-3), gives very meagre details of the character of the insect. We have, therefore, to rely principally upon circumstantial evidence in fixing the particular species to which that author was referring. The nature of this evidence may be gathered from the following translation of the paragraphs relating to *D. citri*.

'The greatest scourge of the Orange tree, and especially of the Lemon, is a kind of scale-insect, which one of us has placed—for the time being—in the genus established by M. Bosc under the name of "dorthisies" (*Dorthisia citri*). . . . This hemipteron has the body oblong oval, convex above, slightly swollen below, of an ashy-grey colour, passing to pale yellowish, covered with a cottony white powder, with some appendages on the sides; the posterior limbs longer than the anterior. The male differs from the female in having two long transparent wings, with two silky filaments which project beyond the body; they are not common; the female, on the contrary, covers itself with white cottony matter, which she spreads over the leaves, flowers and fruits, and in time she covers with it the ends of the branches. It is in the midst of this down that she lays 150 to 400 yellowish eggs.

#### PSEUDOCOCCUS CITRICULUS, *nov.*

(PLATE CLIV.)

Adult female (*fig. 1*) obovate, broadest across the abdominal region; depressed. Dorsum closely covered with white meal which—in some examples—is thickened on the median and lateral areas of the abdomen. Margin with a complete fringe of thirty-four longish white mealy tassels which are shorter in front and increase gradually in length towards the posterior extremity, the terminal pair considerably longer—usually twice the length of any of the others. A pair of ligulate waxy processes from the anal orifice. Antenna (*fig. 2, 3*) eight-jointed, slender; the third usually the longest, markedly longer than the eighth (*fig. 2*), but sometimes rather shorter (*fig. 1*); fourth to seventh approximately, equal, shortest; occasionally there are traces of an imperfect division of the eighth (see *fig. 2*). Limbs slender (*fig. 4*); tarsus approximately half the length of the tibia; unguinal digitules slightly dilated; tarsal digitules slender, minutely knobbed at extremity. Anterior and posterior foveæ well-marked. Marginal ceriferous tracts well defined; ceriferous spines sharply pointed, three spines on each of the first, second, third, and sixth tracts, two on each of the remaining tracts, those on the terminal and penultimate tracts distinctly larger than the others; each tract with a cluster of circular pores and from two to four slender setæ (see *figs. 3, 6, 7*). Caudal setæ comparatively short. Anal ring with six

setæ, each rather more than three-quarters the length of the caudal setæ. Derm evenly distributed with numerous minute pores; a transverse series of larger ring-shaped pores on the venter, across the genital region. Length 1·5 to 2·25 mm.

Male puparium unusually elongate; white. Length 2·5 to 4·0 mm. Breadth 1·0 mm.

On under surface of leaves of *Citrus aurantii*. Royal Botanic Gardens. October 1910.

A smaller and more delicate insect than *P. citri*, with a more definite and conspicuous fringe of waxy processes. Superficially resembling *Phenacoccus mangiferae*, but differing completely in structural characters.

#### PSEUDOCOCCUS MONTICOLA, *nov.*

(PLATE CLV.)

Adult female (*fig. 2*) elongate, narrowed in front. Body closely covered with white granular secretion, with a marginal fringe of stout waxy appendages which are moderately long at the anterior extremity, very short on the thorax, and thence gradually increasing in size to the posterior extremity. There is also an ill-defined median ridge of secretory matter. In many examples the marginal fringe is imperfect, persisting on the posterior segments only. Colour of denuded insect pale olivaceous green. After treatment with potash a somewhat irregular sublateral series of glandular pits is noticeable (see *fig. 3*). These pits have a broadly thickened rim and a translucent area containing two or more superimposed layers of large polygonal cells (*fig. 4*). Antenna (*fig. 7*) eight-jointed; antennal formula: 8, (1, 2), (3, 7), (4, 5, 6). Limbs moderately stout, conspicuously hairy; tarsus less than half the length of the tibia; unguis moderately dilated towards the extremity, tarsal digitules slender. Spiracles (*figs. 9, 10*) rather large. Apex of mentum (*fig. 5*) with a group of stout curved setæ, of which one on each side is considerably longer than the others and has a lateral direction. Including those on the anal lobes, and a supplementary pair on the frons, there are eighteen ceriferous tracts on each side of the body. Spines stout and sharply pointed; 2-3 on first and second tracts, 5-7 on the third, 2 on each of fourth to sixteenth, 3-5 on the seventeenth, and 4-6 on the eighteenth (anal) tract. Other (rather smaller) spines are scattered sparsely over the dorsum and collected into groups of two to three on the median area of each abdominal segment. Anal lobes (see *fig. 8*) prominent and rounded, each with a longish stout seta. Anal ring with six stout setæ which are only slightly shorter than those on the anal lobes. Anterior and posterior dorsal foveæ small and inconspicuous. Length 3 to 3·5 mm.

On foliage of a dwarf bamboo, locally known as 'Elephant Grass,' on patnas above Maskeliya, and at Patipola, at an elevation of about 6000 feet.

The insects occur singly, near the tips of the leaves, on the upper surface, resting with the head directed towards the apex of the leaf (see *fig. 1*). No ovisacs were observed.



PSEUDOCOCCUS FILAMENTOSUS, *Ckll.*, var. CORYMBATUS, *nov.*

(PLATE CLVI.)

Adult female, before oviposition (*fig. 2*), with longitudinal series of stout white cottony tufts covering the dorsum, arranged in six series on the thorax and five on the abdomen. A pair of divergent flattened waxy filaments projects from the posterior extremity. In older examples the tufted appearance of the secretion is lost. Each insect secretes a dense white ovisac, inconspicuously striated both longitudinally and transversely. The resulting mass is subglobular, the insect itself—with its body tilted vertically—forming the anterior quarter. Colour of insect (and of the eggs and young larvæ) dull purplish. In boiling potash the insect assumes a dull bottle-green tint, while the liquid is stained an inky colour. Form broadly oval, the anal segment slightly projecting. Limbs relatively small (see *fig. 3*). Antenna (*fig. 4*), seven-jointed; seventh much the longest; second next longest, but only half the length of seventh; third, fourth, fifth and sixth approximately equal, shortest. Legs small but robust (*fig. 5*); tarsus approximately three-fourths the length of the tibia; tibia and tarsus together slightly shorter than femur and trochanter. Ungual digitules slightly dilated, very thin and delicate; tarsals rather stouter, with minute knob at extremity. Both sets of digitules are often missing—especially on the anterior limbs. Spiracles conspicuous; the posterior spiracle markedly larger than the anterior (see *figs. 8, 9*). Anal ring with six comparatively short setæ. Anal lobes small but moderately prominent; each with a stout seta (about one and a half times as long as those of the anal ring) and two small, stout spines. Venter with scattered short setæ. Margin of body with single, rather slender (often curved) spines, at intervals on the thoracic area (*fig. 6*), and small groups (of two or three spines) on the abdominal segments, representing the usual ceriferous tracts. Some similar spines are distributed sparsely, but more or less symmetrically, over the dorsum, especially on the frons (see *figs. 10, 11*). On each side of the body is an irregular series of smaller and larger pits containing oval translucent areoles (*fig. 7*). Derm with numerous small pores of two sizes. Length 1.75 to 3.0 mm.

Clustered on terminal branches of *Breynia patens*, where the ovisacs have the appearance of white berries (see *fig. 1*); also occasionally on tea, *Thespesia populnea*, *Casalpinia* sp., *Desmodium* sp., and on a Malvaceous plant. Examples on *Casalpinia* were attended by ants which had constructed fibrous shelters over them. The berry-like arrangement of the ovisacs is not so noticeable in examples on plants other than *Breynia*. The species occurs also in India, on various plants, e.g., *Gossypium*, *Artocarpus integrifolia*, *Thespesia* and *Casuarina*; also on stored potatoes. These Indian examples were at first wrongly identified as *Ps. nipæ*, and recorded as such in the *Mem. Dep. Ag. Ind.*, Ent. Ser., Vol. II., No. 2, p. 23.

I distinguish this species, very doubtfully, from typical *filamentosus* on account of the compact berry-like form of the ovisac. All the structural characters of the two insects appear to be identical.

The characters of both *filamentosus* and var. *corymbatus* suggest that they might, with some justice, be allocated to the genus *Erium*.

PSEUDOCOCCUS LILACINUS, *Ckll.*

(PLATE CLVII.)

*Pseudococcus lilacinus*, Cockerell, *Pr. Dav. Ac. Sci.*, Vol. X. p. 128 (1905).*Dactylopius crotonis*, Green, *Tropic Agric.*, Vol. XXIV. p. 44 (1905)." " " *Journ. Econ. Biol.*, Vol. VI. Pt. 2, p. 35 (May, 1911).

Adult female (*figs.* 1, 2, 3) broadly ovoid, strongly convex above. Colour brownish red, disguised by a more or less complete covering of white mealy secretion, which is more densely disposed on circular patches (ten to twelve) on the thorax, and in transverse bands on the abdomen. In the early adult (*fig.* 2) these whiter areas stand out conspicuously against the darker ground colour, but in older individuals the colour may be obscured by a more general covering of secretion. Margin with a complete series of thirty-six short, stout, bluntly pointed waxy tassels, subequal in length, those on the anterior half of the body often more or less confluent. Antenna (*figs.* 5, 6, 7) eight-jointed; the eighth longest, often with a median clearer area (see *fig.* 7) suggestive of a suppressed division; seventh usually somewhat expanded apically; fourth to seventh may be approximately equal, or the sixth and seventh may be slightly longer than the other two. Legs (*fig.* 8) well developed, robust; claw (see *fig.* 9) stout and falcate, approximately half the length of the tarsus; digitules slender, the tarsals minutely knobbed, the unguals slightly dilated at extremity. Tarsus more than half the length of the tibia. Spiracles markedly unequal in size, the posterior being fully twice the size of the anterior pair (compare *figs.* 10, 11). The ceriferous tracts (eighteen on each side) are situated on more or less prominent tubercles which become obscured under compression except towards the posterior extremity (see *figs.* 4, 12, 13), but may be observed to advantage in parasitised examples when they stand out conspicuously. The anterior two tracts, on each side, are situated close together, on the frons. Each ceriferous tract bears two (occasionally three) stout, sharply pointed spines, all approximately of equal size, and a scattered group of subtriangular trilocular pores, with a pair of longish setæ near the base of the tubercle (see *fig.* 12). Posterior extremity (*fig.* 13) with rounded anal lobes. Anal ring with six stout setæ which are approximately half the length of the stouter caudal setæ. Two pairs of longish slender setæ spring from the space between the anal lobes. Derm with scattered minute ceriferous pores which are of the same size and structure as those on the ceriferous tracts, being trilocular and subtriangular (*fig.* 14). Some larger circular pores on the venter surrounding the genital orifice. Glandular foveæ well developed; the posterior pair particularly conspicuous. Length (under compression) 2 to 2.75 mm.; average of thirty examples 2.33 mm. Breadth 1.75 to 2.25 mm.; average 1.96 mm.

On *Codiaeum*, *Castilloa*, *Erythrina*, *Theobroma cacao*, *Terminalia*, etc. Pundaluoya, Peradeniya, Kandy, Gammaduwa, Colombo.

The insects are massed upon the young shoots of the plants. They construct no definite ovisac, and do not secrete much waxy matter, so that each individual in the mass is easily distinguishable. They are very frequently preyed upon by the carnivorous larvæ of a Lycænid butterfly (*Spalgis epius*), and are parasitised by a small Dipteron which pupates within the body of its host.

PSEUDOCOCCUS BROMELIÆ, Bouché.

(TEXT FIGURE 1.)

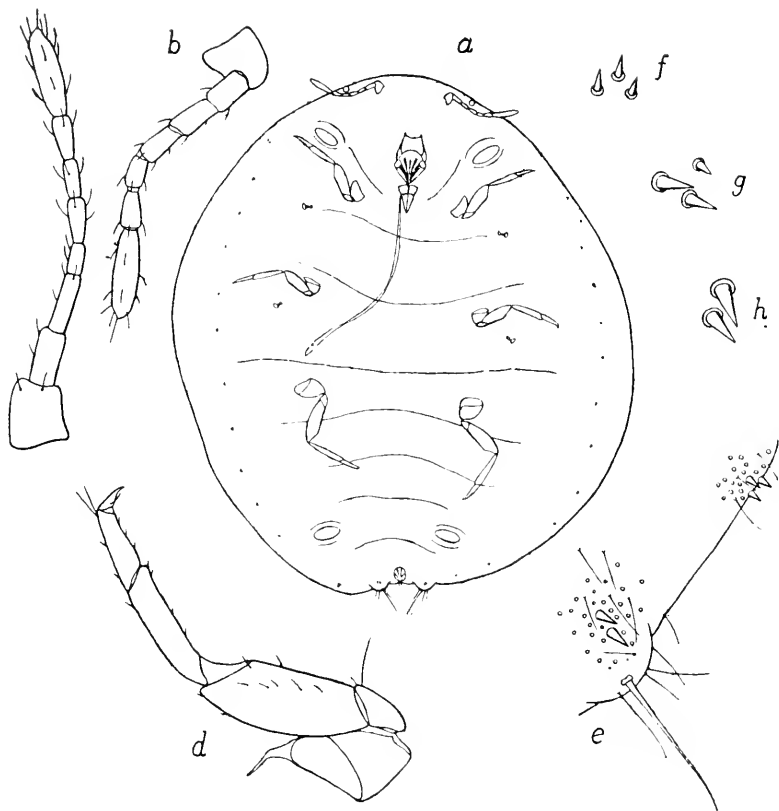
*Lecanium bromeliæ*, Bouché, *Schadl. Gart. Ins.*, p. 49 (1833).

*Dactylopius bromeliæ*, Signoret, *Ann. Soc. Ent. Fr.* (5), Vol. V., p. 310 (1875).

*Pseudococcus bromeliæ*, Fernald, *Cat. Cocc. of the World*, p. 98 (1903).

Adult female very pale, olivaceous, or greyish, or obscurely yellowish, with a close but not very dense covering of white powdery secretion; margin with short, subconical waxy tassels, most of which may be missing in old examples. Body rather broadly ovate (see *fig. 1, a*); convex and tumescent above, flattish beneath; limbs and antennæ relatively small. Antennæ (*fig. 3, b, c*) either seven or eight-jointed; terminal joint always the longest, and markedly stouter than the preceding joints; the penultimate and (in the eight-jointed form) the fifth widened distally, the remaining joints subcylindrical. Legs (*fig. 1, d*) moderately stout; tibia shorter than femur, and approximately three times the length of the tarsus; tarsal and ungual digitules very slender and inconspicuous. Anterior and posterior dorsal osteoles very large and conspicuous, with tumescent labiæ. Anal lobes rounded, small and inconspicuous (*fig. 1, a, c*). Ceriferous tracts seventeen on each side, each with from two to four (rarely five) small but stout conical spines, three or four slender setæ, and an irregular group of small ceriferous pores. Examination of a series of sixteen examples shows that there are—almost invariably—three spines on each of the three first tracts; usually two only on the fourth tract; the fifth tract has two or three in almost equal frequency; sixth tract usually with three; seventh to ninth tracts usually with two only; tenth to sixteenth usually with three; seventeenth (anal lobe) tract invariably with two only. The spines on the posterior tracts are slightly but distinctly enlarged, those on the anal lobe being the largest (see *fig. 1, f, g, h*). Anal setæ comparatively short, approximately equal to the diameter of the anal ring. Caudal setæ about twice as long as those of the anal ring. Length averaging 2 to 3 mm.; breadth 1.5 to 2 mm.

On rhizomes of *Canna* and on roots of *Impatiens* sp.; Peradeniya. Recorded, as a pest of pine-apple plants, from the tropical regions of both Hemispheres. In Ceylon the species appears to prefer the roots of various plants, and has not been observed on pine-apples. The insect determined by Maskell as *bromeliæ*, from India, was more probably *lilacinus*.



## EXPLANATION OF TEXT FIGURE 1.

## PSEUDOCOCCUS BROMELLÆ.

- a.* Adult female, optical section,  $\times 30$ .  
*b.* Antenna, seven-jointed form,  $\times 130$ .  
*c.* " eight-jointed form,  $\times 130$ .  
*d.* Mid leg,  $\times 130$ .  
*e.* Anal lobe and ceriferous tracts of posterior segments,  $\times 220$ .  
*f.* Cerarial spines of first tract,  $\times 450$ .  
*g.* " " sixteenth tract,  $\times 450$ .  
*h.* " " seventeenth tract,  $\times 450$ .

PSEUDOCOCCUS LONGISPINUS, *Targ.*

(PLATE CLVIII.)

*Dactylopius longispinus*, Targ., *Catalogue*, p. 32 (1869)." *adonidum*, " " " " " " "  
" " Sign., *Ann. Soc. Ent. Fr.* (5), Vol. V. p. 306 (1875).  
" *longifilis*, Comst., *Rep. U.S. Dep. Ag.*, 1880, p. 341 (1881).

Adult female elongate ovate; at first dull pinkish orange; older examples greyish orange (*figs.* 2, 3). Limbs yellowish. Dorsum thinly covered with white mealy secretion, almost completely hiding the colour of the insect. Margin with a complete fringe of white tassels (seventeen on each side), which are shorter in front, and increase in length towards the posterior extremity, the terminal four being exceptionally long, sometimes exceeding the length of the body of the insect. Two short flattened filaments, together forming a tube, proceed from the anal ring, and lie between the long caudal processes. Under surface almost nude (*fig.* 3). Antenna (*fig.* 4) eight-jointed, eighth, considerably the longest; first, second, and third next longest, and approximately equal; fourth to seventh shortest, but varying in their relative lengths. Legs (*fig.* 5) rather long, the tibio-tarsal joints exceeding the length of the femur and trochanter; tarsus approximately one-third length of tibia. Claw (*fig.* 6) falcate and acutely pointed; unguis digitules moderately dilated at extremity; tarsal digitules slender, scarcely perceptibly knobbed at extremity. Margin with seventeen ceriferous tracts on each side. Cerarial spines stout, conical and sharply pointed; the first three tracts each with three (occasionally four) spines, the remainder with two spines only; those on the two last segments of the body markedly larger than the others (compare *figs.* 8*a* and 8*b*); sometimes the spines on the ante-penultimate tract also are slightly enlarged; the ceriferous tracts on the terminal and penultimate segments are defined by more densely chitinous areas. There is an isolated spine on the frons at a short distance behind each of the anterior ceriferous tracts. Cerarial pores in compact groups, especially on the terminal and penultimate tracts. Anal ring with six long stout setæ, approximately equal in length to but more slender than the caudal setæ (see *fig.* 7).

Length (of Ceylon examples) 2.5 to 3.25 mm. Elsewhere the insect is said to attain a length of 4 mm.

Adult male (*fig.* 9) dull brown, dusted with minute curling white filaments, except on the scutellum and sternal plate, which remain smooth and shining. Wings iridescent. Caudal filaments opaque white, shorter than the body. Antenna ten-jointed, clothed with short hair; terminal joint with one or more longer slender knobbed hairs projecting laterally from near the apex. Ocelli four, black; those on the lower surface larger and contiguous. Length approximately 1 mm.

Male puparium white, tubular, formed of felted woolly secretion.

Eggs pale yellowish, hatched almost immediately after extrusion. The eggs and young larvæ are covered by the body of the female, mingled with a small amount of woolly secretion. I have observed no definite ovisac.

On *Jasminum* and *Lantana* (Pundaluoya) : on cultivated ferns (Colombo) ; on *Mimosa* (Peradeniya) ; on *Gossypium* (Kurunegalla) ; and on *Albizzia* (Kegalla). An almost cosmopolitan species, but confined to glass-houses in the temperate regions.

When disturbed, the female insect discharges a drop of thick yellowish fluid from the anterior glandular foveæ.

In the synonymy I have purposely omitted early references to the name *Coccus adonidum*, about the identity of which there is considerable doubt. Cockerell points out that Linnæus's description apparently refers to some Monophlebid species. Signoret's *adonidum* is certainly identical with *longispinus* of Targioni-Tozzetti. It is not clear why Westwood's description of this species, under the name of *Pseudococcus adonidum*, in 1839, should not have priority ; but as the insect is now generally recognised as *Pseudococcus longispinus* it seems advisable to retain that name.

#### PSEUDOCOCCUS MARITIMUS, Ehrhorn.

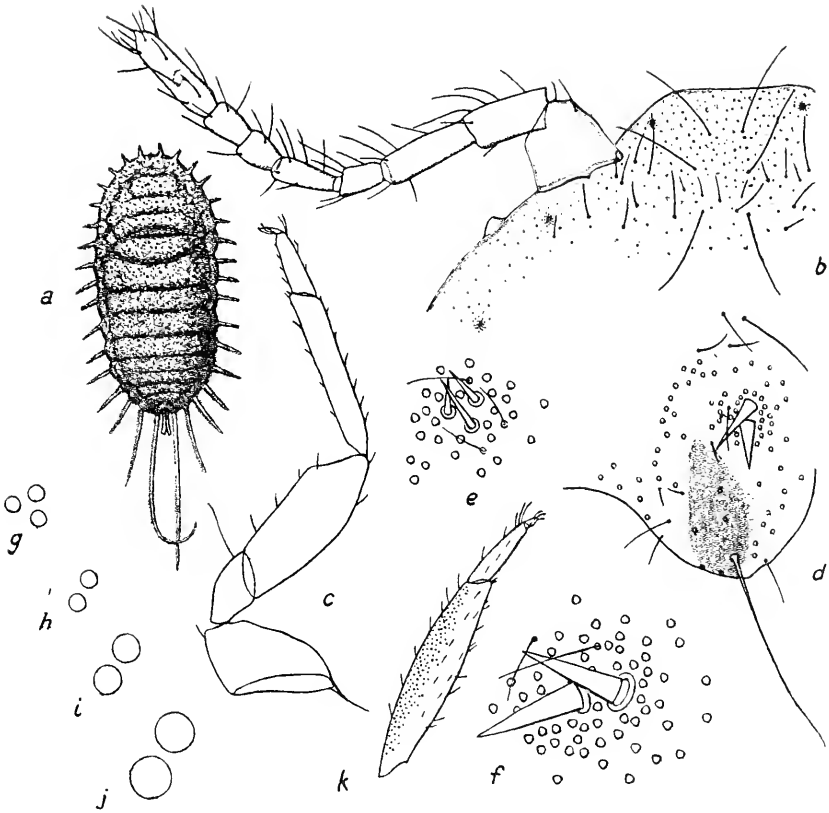
(TEXT FIGURE 2.)

*Dactylopius maritimus*, Ehrhorn, *Can. Ent.*, Vol. XXXII. p. 315 (1900).

*Pseudococcus maritimus*, Fernald, *Cat. Cocc. of the World*, p. 106 (1903.)

Adult female greyish or dull pink, the dorsum closely covered with white mealy secretion. Form long ovate, length approximately twice the breadth. Margin with seventeen equidistant, slender, straight, waxy tassels on each side, short on the anterior parts, and progressively longer towards the posterior extremity of the body, the posterior (caudal) pair of tassels twice as long as the preceding pair, and more than half the length of the actual body of the insect (see *fig. 2, a*). Antenna (*fig. 2, b*) eight-jointed ; third and eighth joints longest, subequal. Legs moderately long and slender ; tarsus approximately one third as long as the tibia ; tibiæ of hind limbs usually dilated (*fig. 2, k*), its outer area crowded with minute translucent pores ; similar but more scattered pores occur on the inner area of the femur of the same limb. There are seventeen ceriferous tracts on each side of the body ; the first three tracts having three spines apiece, the remainder with two spines only. The spines of the first fifteen tracts are small (*fig. 2, e*) and of approximately equal size ; those of the sixteenth tract are larger, while those of the seventeenth (anal lobe) tract are larger still (*fig. 2, f*). The relative sizes of these spines may be perceived by a comparison of the sockets from which they spring (see *fig. 2, g, h, i, and j*). There is a diffuse chitinous area, narrowed anteriorly, on the venter of each anal lobe (*fig. 2, d*). Caudal (anal lobe) setæ distinctly shorter and more slender than those of the anal ring. Length (exclusive of waxy appendages) 2.5 to 3 mm. ; breadth averaging 1.5 mm.

On *Passiflora* sp. and Tomato plants ; Pundaluoya. Until recently recorded from the United States of America only, but now recognised as a greenhouse pest in England. The species probably occurs throughout the tropical and subtropical regions where, owing to its similarity to *longispinus*, its identity may have been overlooked.



EXPLANATION OF TEXT FIGURE 2.

PSEUDOCOCCUS MARITIMUS.

- a. Adult female,  $\times 15$ .
- b. Antenna and frons,  $\times 130$ .
- c. Mid leg,  $\times 80$ .
- d. Anal lobe,  $\times 220$ .
- e. Ceriferous tract of frons,  $\times 450$ .
- f. Ceriferous tract of anal lobe,  $\times 450$ .
- g. Sockets of spines of tracts 1 to 3,  $\times 450$ .
- h. " " " 4 to 15, "
- i. " " " 16 "
- j. " " " 17 "
- k. Tibia and tarsus of hind limb,  $\times 80$ .

PSEUDOCOCCUS COMSTOCKI, *Kuw.*

(TEXT FIGURE 3.)

*Dactylopius comstocki*, Kuwana, *Pr. Cal. Ac. Sci.*, Vol. III., p. 52 (1902).*Pseudococcus comstocki*, Fernald, *Cat. Cocc. of the World*, p. 100 (1903).

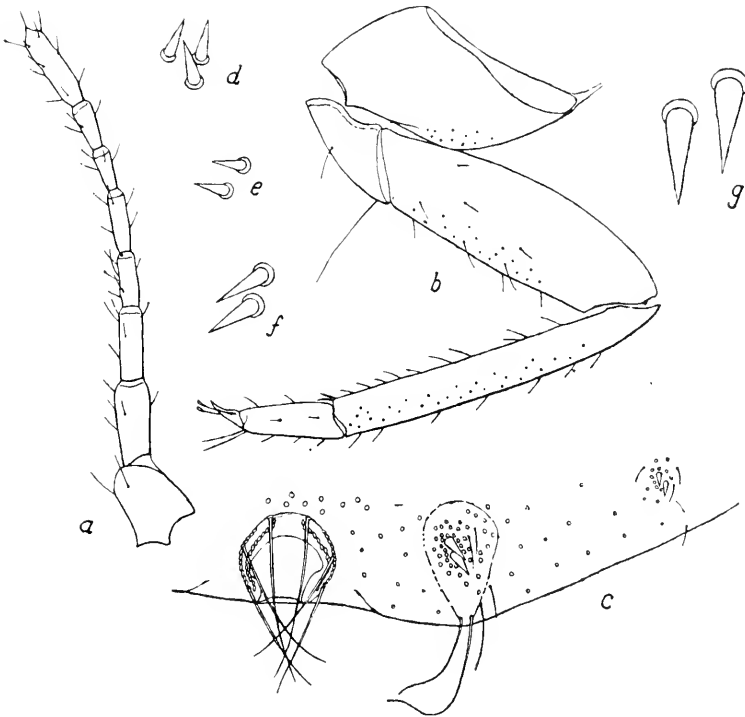
Adult female elongate ovate, dull pale purplish, closely overlaid with white mealy secretion. Margin with a series of slender waxy tassels, which gradually increase in length towards the posterior extremity of the body. There are seventeen ceriferous tracts on each side of the body, of which the first three or more (occasionally as many as seven) carry three or four spines apiece (*fig. 3, d*); the remaining tracts with 2 spines only. The spines of the seventeenth (anal lobe) tract are greatly enlarged (*fig. 3, g*), and those of the sixteenth tract are slightly enlarged (*fig. 3, f*). The seventeenth tract is surrounded by a well-defined ovate, chitinized area, narrowed posteriorly (*fig. 3, c*). The tibia of the hind limb is slender, and is fully three times the length of the tarsus. There are scattered translucent pores on the outer area of the tibia, on the inner area of the femur, and—a very few—on the outer area of the coxa. Cerarial pores rather scattered (not crowded as in *longispinus* and *maritimus*). Caudal setæ as long as or slightly longer, but more slender than those of the anal ring. Length 2.5 to 3 mm.; breadth 1.5 to 2 mm.

On *Loranthus* sp., *Trema orientalis*, and *Cinnamomum camphora*, Pundaluoya.

Superficially resembling both *longispinus* and *maritimus*; distinguishable from the former by the shorter lateral tassels, and by the absence of a circumscribed chitinous area surrounding the penultimate ceriferous tract; also by the presence of translucent pores on the hind limb. Differs from *maritimus* in the absence of a marked dilation of the tarsus of the hind limb, and the smaller number of translucent pores on the same; in the presence of a circumscribed chitinous area on the seventeenth ceriferous tract, and in the less crowded condition of the cerarial pores.

Originally described from Japan, but occurring in the West Indies and Southern States of America, and probably throughout the Indo-Asiatic Region.





EXPLANATION OF TEXT FIGURE 3.

PSEUDOCOCCUS COMSTOCKI.

- a. Antenna,  $\times 130$ .
- b. Hind leg,  $\times 130$ .
- c. Posterior extremity,  $\times 130$ .
- d. Spines of 1st ceriferous tract,  $\times 450$ .
- e. " 15th " " "
- f. " 16th " " "
- g. " 17th " " "

PSEUDOCOCCUS DEBREGEASIAE, *sp. nov.*

(PLATE CLIX.)

Adult female oblong ovate; convex above. Dorsum closely covered with greyish or white meal, sometimes ochreous—in dried examples. A marginal fringe of thirty-four short white tassels, slightly longer on the posterior segments. Antenna (*fig. 1*) eight-jointed, hairy; a stout curved spine on side of terminal joint, and a similar spine near distal end of seventh joint; eighth joint considerably longer than any of the others; third next longest, closely followed (occasionally equalled) by second; fourth to seventh shortest, subequal. Limbs (*fig. 2*), long and robust; tarsus of anterior leg half, or slightly more than half the length of tibia; tarsus of mid and posterior legs less than half the length of the tibia. Claw (*fig. 3*), stout and falcate; digitules slender, the unguis slightly dilated at extremity, the tarsals minutely knobbed. Ceriferous tracts in a series of seventeen on each side; each tract with two or more stout spines and some longish stout setæ. The spines on the anterior seven or eight tracts are more numerous and are drawn out at the apex, assuming the appearance of unusually stout setæ (see *fig. 6*). On the abdominal segments the spines are of the normal form, and are seldom more than two in number. Towards the posterior extremity (see *fig. 7*) the setæ on the ceriferous tracts are longer and more numerous, attaining their maximum size and number on the anal lobes, where they form a rather dense tuft amongst which it is difficult to isolate with certainty any specialised caudal setæ. Anal ring large, bearing six very stout setæ which are markedly larger than any of those on the anal lobes. Derm with numerous minute scattered pores and many comparatively long setæ. The anterior and posterior glandular foveæ are small and inconspicuous. Length averaging 3 mm., ranging from 2 to 3.25 mm.

On *Debregeasia velutina*; in shelters constructed by the ant *Cremastogaster dohrni*. Pundaluoya; Peradeniya.

Characterised by the unusually numerous and long setæ on the anal lobes.

Genus PHENACOCCLUS, *Cockerell*.

*Pseudococcus*, Sign. (non Westw.), *Ann. Soc. Ent. Fr.* (5), Vol. V. p. 328, 1875.  
*Phenacoccus*, Ckll., *Ent. News*, Vol. IV. p. 318, 1893.

Signoret erroneously adopted Westwood's genus, to contain those 'mealy bugs' that have nine-jointed antennæ; whereas the type of Westwood's *Pseudococcus* is *longispinus*—a species with eight-jointed antennæ. Cockerell accordingly erected the genus *Phenacoccus* to replace Signoret's (not Westwood's) *Pseudococcus*.

With the exception of this difference in the antennæ, there is no character

to distinguish the species of *Phenacoccus* from those of *Pseudococcus*, and it is doubtful if the former should rank as more than a subgenus of the latter.

Ferris makes the presence of a denticle on the claw a distinguishing character of this genus ; but there are species with nine-jointed antennæ that lack this character (*e.g.*, *glomeratus*).

SYNOPSIS OF CEYLON SPECIES.

- A. Spiniferous tracts confined to the last two segments of the abdomen ; spines few..... *glomeratus*.
- B. A complete marginal series of spiniferous tracts ; spines numerous.
  - (a) Margin of living insect without waxy tassels ; dorsum with spiniferous tubercles..... *insolitus*.
  - (b) Margin with complete series of waxy tassels ; dorsum unarmed.
    - (a<sup>1</sup>) Marginal tassels comparatively short, broad and flattened ..... *iceryoides*.
    - (b<sup>1</sup>) Marginal tassels long, cylindrical.
      - (a<sup>2</sup>) Spines sharply pointed ..... *ornatus*.
      - (b<sup>2</sup>) Spines truncated.
        - (a<sup>3</sup>) Thirty spiniferous tracts ; claw, without conspicuous denticle ..... *mangiferæ*.
        - (b<sup>3</sup>) Thirty-four spiniferous tracts ; claw, with pronounced denticle ..... *spinosus*.

PHENACOCUS GLOMERATUS, *nov.*

(PLATE CLX.)

Adult female (when freed from the enveloping mass of cottony secretion) of an orange pink colour. Broadly oval. Mouth parts rather small : the mentum distinctly bi-articulate, the terminal joint longest, narrow and acutely pointed. Antenna normally nine-jointed (*figs.* 2, 3) ; occasionally the division between eighth and ninth is imperfect ; in one example a ten-jointed antenna (*fig.* 4) was observed, a small joint being interposed between the normal fourth and fifth ; second usually longest, with the ninth next longest, but the third is often approximately equal to the second ; fifth usually markedly longer and larger than fourth (*fig.* 2), but occasionally these two joints are of equal size (*fig.* 3) : eighth always shortest. Legs moderately stout ; tarsus rather less than half length of tibia. Claw stout, without any denticle ; unguis digitules slightly dilated, tarsal digitules simple (*fig.* 5). Anal ring (*fig.* 6) with six longish stout setæ, rather more than half the length of the caudal setæ. A pair of small conical spines on each anal lobe, and a single spine (occasionally two) on the lateral margin of the preceding segment ; other segments unarmed. Derm with numerous small pores and some fine hairs ; some longer and stouter hairs between the antennæ. Average length 3 mm.

Eggs bright orange pink. Other stages not observed.

Insects crowded together and enveloped in a mass of loose cottony secretion that completely conceals their form. There are no definite waxy tassels. On *Hibiscus cocculentus* and *Thespesia lampas*. Peradeniya. Larvæ of the Lycænid butterfly—*Spalgis epius*—prey upon the egg-masses.

PHENACOCOCCUS INSOLITUS, *Green*,

(PLATE CLXI.)

*Phenacoccus insolitus*, *Green, Mem. Dep. Ag. Ind.*, Vol. II. (2), p. 26 (1908).

Adult female pale yellow (*fig. 2*); often symmetrically marked with small blackish maculate patches (*fig. 3*), of which there are two on each side of the mesothorax, two on each side of the median abdominal region, and a few indefinite transverse patches on the median area. Examples on *Solanum* are more strongly marked than those on *Cajanus*. Dorsum with a very thin covering of mealy powder, scarcely obscuring the colour of the insect; and with numerous erect hair-like glassy filaments. Still older examples may assume a purplish tint, and parasitised individuals are of a reddish-brown colour. Eyes black, conspicuous. Limbs yellowish. Ovisac elongate, white, often contorted (*fig. 1*). Antenna normally nine-jointed (*figs. 6, 7*), the eighth and ninth more or less closely fused, but always with a distinct line of division; second and ninth longest and approximately equal; fourth and eighth usually shortest and equal; occasionally eight-jointed (*fig. 8*) through a fusion of the fourth and fifth. Limbs well developed; tarsus short, approximately one-third length of tibia; claw with a small denticle on inner margin at about one-third from the point (*fig. 9*); tarsal digitules simple, unguis digitules minutely knobbed at extremity. Body with a complete marginal series (sixteen on each side) of spiniferous tubercles (*fig. 4*), the spines robust and sharply pointed (*fig. 5*). Similar but rather smaller tubercles in longitudinal series on the dorsum—viz., a pair above the frons, a median series of nine commencing on the metathorax, curved lateral series of eleven on each side terminating on the fifth abdominal segment, and short submedian series of three on each side on the thorax. Derm between the tubercles with scattered minute ceriferous pores (see *fig. 5*). The spiniferous tubercles, themselves, are devoid of ceriferous pores. Anal ring with six stout setæ. Caudal setæ scarcely longer than those of the anal ring. Length 1.50 to 2.50 mm. Breadth 1 to 1.75 mm.

Adult male (*fig. 10*) greenish yellow suffused with purplish red, lightly dusted with mealy powder. Posterior extremity with four stout white waxy filaments, the inner pair longest—equalling the length of the abdomen, their extremities outwardly curved. Antenna with simple hairs. Length (without appendages) 1 mm.

On *Cajanus indicus*, *Cyclea burmanni* and *Solanum melongena* (Brinjal). Peradeniya; Colombo; Jaffna. Occurs also in India, on *Sida cordifolia*.

The insects, of both sexes, are crowded on the under surface of the leaves. On a single leaflet of *Cajanus*, scarcely an inch long, thirty-two fully developed female ovisacs were counted. Sometimes the male puparia are present in enormously preponderating numbers. The long narrow ovisac, with the female resting at its extremity, gives it a strong resemblance to a species of *Pulvinaria*.

Signoret erected a genus—*Boisduvallia*—for species having all the characters of *Dactylopius*, but ‘presenting four filaments at the extremity of the abdomen of the male.’ The two species (*lauri* and *quadricaudata*) that he designates under his new genus have eight-jointed antennæ in the female.

Attention should be drawn to an error in the original description of this species (*loc. cit.*), where it is wrongly stated that the median dorsal series of tubercles is absent on the abdominal segments.

#### PHENACOCOCCUS ICERYOIDES, Green.

(PLATE CLXII.)

*Phenacoccus iceryoides*, Green, *Mem. Dep. Ag. Ind.*, Ent. Ser., Vol. II. (2), p. 26 (1908).

*Dactylopius obtusus*, Newstead, *Mitt. Zool. Mus. Berlin*, Vol. V. (2), p. 164 (1911).

The adult female secretes a large, highly convex, but comparatively short white ovisac; the insect tilted into an erect position and resting upon the anterior part of the ovisac (*figs.* 1, 2). The ovisac itself is very delicately fluted longitudinally.

The female, before oviposition, is of an oval form (*fig.* 3), flattish or moderately convex; densely covered with white meal, which is produced into a more or less conspicuous series of prominences on the median line. After oviposition, these dorsal processes become obsolete. Margin with a complete fringe of contiguous white (or slightly brownish) waxy conical processes, which are broadly dilated and flattened on the thoracic area but subcylindrical on the abdominal area, the terminal processes slightly longer. Under parts and limbs honey-yellow. In early adult examples (*fig.* 4) the fringe is almost continuous and may have two or three pale brownish lines running through it. Eyes very prominent (see *fig.* 5). Antenna (*fig.* 6) long and slender, nine-jointed; first about as long as it is broad, third usually longest but occasionally equalled by second, remainder subequal but gradually decreasing in length to the eighth, ninth usually slightly longer; all the joints with a few slender hairs which are longer on the first and second joints. Legs rather slender; tarsus approximately half length of tibia; claw stout, a well-defined denticle on its inner edge at about one-third from the tip; tarsal digitules slender, simple; unequal digitules slightly dilated at extremity (see *fig.* 7). Margins of segments slightly protuberant, each prominence with a group of about twenty stout bluntly-pointed or truncate spines (see *figs.* 5, 8). Some looser groups of similar spines on the dorsum, in the positions occupied by the

denser agglomerations of mealy secretion. Derm with numerous minute ceriferous pores, more crowded towards the margins. Anal ring with six stout setæ. Caudal setæ slightly longer than those of the anal ring. Surrounding the anal orifice is an irregular ring of longish slender hairs, and other similar hairs occur on the cephalic area, especially between the antennæ. Smaller hairs are scattered over the surface of the derm. The usual glandular foveæ, on the cephalic and post-abdominal areas, are present though not very conspicuous. There is, on the venter of the second abdominal segment, a large transversely disposed cicatrice (*fig. 9*), the outline of which is sharply defined in well-stained preparations. In some examples the area of the cicatrice is occupied by opaque matter which renders the organ very conspicuous; but in unstained or weakly stained preparations it can be seen only with difficulty and may be easily overlooked. Length 3 to 4 mm.

Eggs and young larvæ honey-yellow.

On *Tephrosia candida* (Badulla), *Odina woodier*, *Callicarpa lanata*, *Murraya koenigii*, and *Wendlandia notoniiana* (Kandy), and on an undetermined Malvaceous plant (Peradeniya). Occurs also in India, on Mango (Calcutta), on *Boswellia* (Tanjore), and on *Capparis horrida* (Surat). Recorded by Newstead from German East Africa.

The general appearance of a collection of these insects is remarkably like that of an *Icerya*, for which it might easily be mistaken.

#### PHENACOCOCUS ORNATUS, *nov.*

(PLATE CLXIII.)

Adult female (*figs. 1, 2*) oblong oval, flattish; pinkish yellow to reddish orange. Dorsum more or less completely covered with white mealy secretion which does not, however, obliterate the divisions of the segments; margin with a series of twenty-six extremely long, slender, white waxy tassels, radiating symmetrically from the body of the insect (*fig. 2*). Antennæ and limbs long and slender. Antenna (*fig. 6*) nine-jointed; second joint considerably longer than any of the others; all the joints with a few moderately long hairs. Leg (*fig. 7*) with the tibia equal in length to the femur and trochanter; tarsus approximately one-fourth length of tibia; claw, without any denticle; unguis digitules very slightly dilated at extremity; tarsal digitules short, simple. Eye (see *fig. 4*) unusually prominent, on an elongate conical tubercle. Spiracles (*fig. 5*) trumpet-shaped. Margin of body with a complete series of twenty-six sharply defined oval chitinous plates (see *fig. 3*) each of which bears a cluster of stout conical spines and numerous small ceriferous pores (see *figs. 4* and *8*); some larger circular pores are distributed over the surface of the body. Anal ring (*fig. 8*) with six stout setæ springing from an irregular cluster of small pores. Caudal setæ equal to or slightly smaller than those of the anal ring. Length 2.50 to 3.0 mm. Breadth 0.75 to 1.25 mm. Marginal waxy processes 3.0 to 5.0 mm.

Male puparium in the form of an oblong cottony sac, open at the posterior extremity.

Adult male very pale yellow ; ocelli black ; posterior extremity with a pair of long, slender cottony filaments.

On leaves of *Jasminum* sp. (Haputale and Wellwaya), and on foliage of the tea plant (Haldummulla). The insects are crowded on the under surface of the leaves, but are disposed in such a manner that the delicate waxy fringe has sufficient room for development (see *fig.* 1).

The species is probably indigenous on wild Jasmine and has adopted the tea plant more recently. Only one instance of its occurrence on tea has been recorded ; but, in that case, two or three tea bushes on the edge of the jungle were very heavily infested. Examples from tea were much redder than those taken on Jasmine.

Recorded also from Southern India, on *Jasminum* sp.

#### PHENACOCOCCUS MANGIFERÆ, Green.

(PLATE CLXIV. 1-16.)

*Pseudococcus mangiferæ*, Green, *Ind. Mus. Notes*, Vol. IV. p. 6 (1896).

Adult female at first narrow oval (*fig.* 8) later broadly oval (*figs.* 5, 6) ; dorsum depressed. Pale honey-yellow : dorsum almost completely covered by thick white meal, except for a bare space in the middle (*fig.* 5) which, in the early adult, is frequently of a definite triangular shape (*fig.* 8). Margin with a complete fringe of stout cottony tassels, of which those at the posterior extremity are usually longer. In the early adult, the marginal tassels are longer and more slender and tend to become separated into packets of two or three. There is little or no secretion on the venter (*fig.* 6). Antenna (*fig.* 11) nine-jointed ; first joint short and stout, remaining joints long and slender, approximately equal in length, the third and ninth slightly longer. Eyes prominent (*fig.* 13). Limbs slender (*fig.* 12) ; tarsus less than half length of tibia ; tibia slightly shorter than femur and trochanter ; tarsal digitules slender, simple ; ungual digitules slightly dilated. Claw (*fig.* 16) slender and sharply pointed, without (or with the merest trace of) a denticle on its inner edge. Anterior and posterior glandular foveæ present but not conspicuous. Margin of body with a complete series of thirty clusters of truncate spines set on definite circumscribed patches (see *figs.* 10, 13, 14) which are slightly denser than the rest of the derm. There are numerous small ceriferous pores which are more crowded and conspicuous on the marginal patches. Anal ring (*fig.* 14) with six stout setæ. Caudal setæ moderately long. Length 1·5 to 2·25 mm.

Nymph (*fig.* 7) with a radiating fringe of tufts of long glassy filaments lightly matted together with loose cottony secretion.

Adult male (*fig.* 1) very pale yellow ; eyes and ocelli black ; wings hyaline. Caudal filaments exceeding the length of the body. Upper pair of ocelli widely separated ; lower pair close together (*fig.* 2). Rudimentary eyes lateral close to base of antennæ. Length rather less than 1 mm.

Male puparium (*fig.* 9) irregularly cylindrical, white ; sometimes with a few irregular lateral processes. Length 1·25 mm.

On under surface of leaves of Mango (Pundaluoya and Bandarawella). Received also from India, on Mango.

The insects are congregated in large patches, sometimes completely covering the under side of the leaves. There is not much accumulation of loose cottony matter, as the insect appears to be ovoviviparous and no ovisac is produced. The exuviae of the females and empty puparia of the males remain attached to the leaves. The species is fortunately not very common, or it would constitute a serious pest. But a bad case was observed at Bandarawella, where a single Mango tree in front of the Rest House was so heavily infested that not a single leaf had escaped attack and considerable defoliation had resulted. The presence of the insect is rendered conspicuous by a copious growth of black fungus which collects on the upper surface of the foliage. The insect is preyed upon by the larvae of a small Coccinellid beetle. These larvae themselves secrete white cottony tassels which make them almost indistinguishable from the Coccidæ upon which they are feeding.

Allied to *Phen. ornatus*, from which it may be distinguished by the larger number of marginal spiniferous patches, and by the spines being truncate.

#### PHENACOCCLUS SPINOSUS, *Robinson.*

(PLATE CLXIV. 17.)

*Phenacoccus spinosus*, Robinson, *Phil. Journ. Sci.*, Vol. XIII. Sec. D, No. 4, p. 145 (July 1918).

Adult female similar, in nearly every particular, to *Phenacoccus mangiferae*, from which it may be distinguished by the presence of thirty-four (instead of thirty) spiniferous marginal tracts. The claw (*fig. 17*) is stouter and blunter, and has a very pronounced denticle on its inner edge. The spines are truncate—as in *mangiferae*.

On *Ficus* sp., Peradeniya: and on an undetermined plant, at Trincomali. Received also from Java, on *Psidium pumilum*. Originally described from the Philippine Islands.

The difference in the form of the claw, alone, would not justify the separation of this species from *mangiferae*; but the number of definite spiniferous tracts would seem to constitute more than a varietal distinction.

#### Genus ANTONINA, *Sign.*

*Antonina*, Signoret, *Ann. Soc. Ent. Fr.* (5), Vol. V. p. 24 (1875).  
*Chetococcus*, Maskell, *N.Z. Trans.* Vol. XXX. p. 249 (1898).

Signoret diagnoses his genus as follows: 'The species for which we have created this genus is distinguished from other *Coccinae* by the absence of limbs of which one can see no trace and by the shortness of the antennæ which present but a multiarticulate stump with some stiff hairs at the extremity. Its form is elongate, cylindrical, three times longer than broad and somewhat resembling the pupa of a fly; the rostrum presents in the young stage a



biarticulate lip, but in the advanced stage we have never been able to see it in its entirety. The abdominal extremity, rugose and strongly punctate, approaches that of the *Lecaniidae* and more especially of the genus *Aclerda*, with a horny thickening, but without the caudal squamæ of the *Lecaniidae*. The anogenital ring is large, in a wide circle, finely punctate and transversely striate, with six hairs which do not project beyond the abdomen.'

Though this description really relates to a single species only (*purpurea*), it may be accepted so far as it goes, with the exception that the antennæ can scarcely be described as 'multiarticulate,' there being—at most—but four distinct joints, while in some species the number is reduced to two. The definition of the form of the body and of the hairs of the anal ring must be regarded as of specific importance only.

The genus is of widespread distribution, in both hemispheres, though only about fourteen species have been recognised. They are confined to plants of the order *Gramineæ*.

SYNOPSIS OF SPECIES OCCURRING IN CEYLON.

- A. Species completely covered with a felted or cottony ovisac.
  - (a) Abdominal segments evenly rounded ..... *indica*.
  - (b) Terminal abdominal segments demarked by slight lateral indentations ..... *maritima*.
- B. Species naked or without complete ovisac.
  - (a) With a distinct flattened pygidiform anal segment. .... *bambusæ*.
  - (b) Posterior extremity globose, with no demarked anal segment ..... *zonata*.

ANTONINA INDICA, *Green*.

(PLATE CLXV.)

*Antonina indica*, *Green, Mem. Dep. Ag. Ind., Ent. Ser., Vol. II. p. 2 (1908)*.

Female enclosed in a felted white sac (*fig. 2*) which fits closely upon the body of the insect, but is easily removable in a single piece. This covering often becomes yellowish, especially after the death of the insect. The sac is open at the part covering the rostrum and at the posterior extremity, from which point a brittle glistening tubular filament projects. The liquid excreta are carried to the extremity of this tube where they gather in the form of a globular bubble which eventually bursts, scattering the liquid in a fine spray.

Adult female (*figs. 3, 4*) dark purplish brown, usually paler on the ventral surface, the stigmatic and genital orifices dusted with white mealy powder. Surface smooth. Form subovoid to subcircular; sometimes narrowed behind, sometimes broadly rounded. The actual extremity is very slightly indented at the anal region but is otherwise evenly rounded, without any indication of anal lobes. Terminal segment not demarked. The derm is at first soft and pliant, but the posterior extremity soon becomes densely chitinous and finely rugose. In very old examples the whole of the derm becomes more or less rigidly

chitinized. Examples from Hakgala (elevation 6000 feet) are very weakly chitinous. Antennæ rudimentary; reduced to two (*figs.* 5, 7) or three (*fig.* 6) joints, with a few spiny hairs at the apex; the junctions of the joints are often very indistinct. Spiracles large and conspicuous; with a strongly chitinous cup-shaped orifice, in the sides of which are numerous ceriferous (parastigmatic) pores (*fig.* 9). Derm with numerous circular pores, of two sizes, intermingled with some minute spinelike hairs. The pores, which are sometimes (especially in older examples) rendered more conspicuous by a thickened chitinous rim, are more densely crowded on the marginal and post-abdominal regions, especially on a transverse zone that lies across the anal pit. Anal ring sunk in a well-defined pit (*fig.* 8), with six stout setæ. In the original description of the species (*loc. cit.*), it is stated that the anal setæ do not reach the margin of the body; but I find that this condition is not constant; in many examples the anal setæ project slightly beyond the margin. Posterior margin of body (*fig.* 8) with a few stout spiniform hairs. Length (under compression) 1·50 to 3·50 mm. Breadth 1·0 to 3·0 mm.

Male not observed in any stage.

Newly hatched larva (*fig.* 10) oblong oval; cream-coloured, the median area tinged with purple. Very active.

At the base of the stems and upon the rhizomes of various grasses. Usually attended by ants. Pundaluoya; Peradeniya; Colombo; Hakgala. Occurs also in India.

#### ANTONINA MARITIMA, *nov.*

(PLATE CLXVI.)

Sac of adult female pinkish ochreous to white; loose and irregular in form.

Adult female (*fig.* 1) broadly oval to subcircular. Not densely chitinous, except at the posterior extremity. Antenna (*fig.* 2) very small and rudimentary; consisting of a more or less globular free segment, with some longish stout hairs at its extremity; and an incomplete basal segment, irregular in outline and roughly lunate in form, bearing three or four stout hairs. Spiracles large and conspicuous, of the same form and structure as those of *A. indica*. Posterior extremity (*fig.* 3) with marginal indentations indicating the terminal segments and with some spiniform hairs both on the margin and on the submarginal area. Anal ring with six stout setæ, sunk in a rather narrow but deep pit. Derm with numerous circular pores, more crowded towards the margins, especially on the denser posterior segments where they are much larger and more conspicuous. Length 1·75 to 3·0 mm. Breadth 1·25 to 2·50 mm.

Other stages not observed.

On the rhizomes of a species of *Cyperus* growing in sandy soil at high-water mark on the sea-shore. Colombo. Received also from Coimbatore, S. India, where it is said to occur in 'wet places' (coll. T. V. Ramakrishna Aiyer).

Differs from *Antonina indica* in the form of the posterior extremity which is slightly incised at the junctions of the segments; in the smaller anal ring and narrower anal pit; and in the still more rudimentary antennæ, the terminal hairs of which are longer and stouter.

## ANTONINA BAMBUSÆ, Mask.

(PLATE CLXVII.)

*Sphaerococcus bambusæ*, Maskell, *Trans. N.Z. Inst.*, Vol. XXV. p. 237, Pl. XVI. figs. 12-19 (1892).

*Chatococcus bambusæ*, Maskell, *Trans. N.Z. Inst.*, Vol. XXX. p. 249 (1898).

Adult female either naked or partially covered with white waxy secretion. The development of this secretion varies according to the position of the insect. It usually takes the form of a waxy cushion interposed between the venter of the insect and the surface upon which it is resting (*figs.* 1, 2). A similar waxy pad protects the dorsum from the enfolding leaf-sheath of the plant, when the insect is concealed beneath that covering. In situations where the insect is exposed by the fall of the leaf-sheath, it may secrete a considerable quantity of waxy matter on the sides of the body, and a dense column of white wax covering the median dorsal area of the thorax and sloping in a forward direction (*fig.* 3); but this process is very easily detached and is absent in most examples. A stout but fragile tubular filament is produced from the anal orifice. The insects show a considerable variation in size, form and colour, according to their situation on the plant. Such as are permanently covered by the leaf sheaths attain a much larger size, but are flattened by the compression in the confined space; these are of a reddish brown colour and the derm is less dense (*fig.* 4). Individuals that are exposed at a comparatively early stage of their development, become strongly convex and assume a darker colour—dark castaneous to deep slaty brown (*fig.* 1); the derm thickens and becomes roughened and densely chitinous, arresting further growth. Examples that are partly exposed and partly concealed often have the anterior segments flattened by pressure (*fig.* 2).

The cephalo-thorax, which occupies by far the greater part of the body, is broadly rounded. The abdominal segments are sharply defined and narrow consecutively to the anal segment, which is always more densely and evenly chitinous than those preceding it. Antenna (*figs.* 9, 13) rudimentary; consisting of a conical or truncate terminal joint with a group of stout setæ at its extremity, and one or two ill-defined basal joints. The tentorium is unusually extended anteriorly (see *fig.* 12). The spiracles are large and conspicuous. The anal segment (*figs.* 10, 11) is broadly rounded, with the anal pit opening on the dorsal surface. In the larger depressed form this pit is situated just within the margin (*fig.* 10). In the smaller form it assumes a more vertical position, at a little distance from the margin (*fig.* 11). The anal ring bears six stout setæ which scarcely project beyond the rim of the pit. There are a few short setæ on the marginal area, those on the anal segment being stouter and more conspicuous than the others. The dermal pores are of two distinct forms:—numerous small trilocular pores (see *fig.* 13) evenly distributed over both surfaces of the body, and larger thick-rimmed circular pores (*fig.* 14) confined to the venter of the anal segment. In old fully matured females the derm is so dense that these pores are more or less obscured; but their form and

structure may be observed in early adult individuals, where also they are seen to be very crowded (*fig.* 12). Owing to expansion of the integument the pores become more widely separate during subsequent growth. Immediately behind each of the posterior spiracles is a clearly defined shallow oval pit containing numerous minute thick-rimmed circular pores.

The early adult female is of a pinkish ochreous colour, with the terminal segment only dark brown. It is surrounded by a mass of white cottony secretion (*fig.* 5). The crumpled exuviae of the nymphal and larval stages may be seen at the posterior extremity of the insect, entangled in the secretory matter.

Dimensions of fully matured female: Large flat form, length, 5 to 6 mm.; breadth 3 to 3.50 mm. (an example from Southern India measures 6.50 by 4.25 mm.). Smaller convex form, length 2.25 to 4 mm.; breadth 2 to 3 mm.

Female nymph similar in form to early adult female, but differing in the dermal characters, there being (in addition to the small trilocular pores) an irregular submarginal series of comparatively large and conspicuous circular thick-rimmed pores (see *fig.* 15). Only two joints can be distinguished in the nymphal antennæ, and the free terminal joint is more globose than in the adult insect.

Young larva (*fig.* 7) pale pink or purplish pink, very slightly powdered with whitish secretion. Rather elongate in form. Antenna six-jointed, the terminal segment longest. Margin of abdomen (*fig.* 8) with a series of strong setæ, each seta associated with a large and conspicuous trilocular pore. Length 0.6 mm.

Male unknown in any stage. The species is ovoviviparous and is probably reproduced asexually.

On the 'Giant Bamboos' (*Dendrocalamus gigantea* and *Gigantochloa aspera*), Peradeniya; and on the 'Male Bamboo' (*Dendrocalamus stricta*), Colombo. On the 'Giant Bamboos,' the insects are congregated around the nodes of the main stems; on the smaller 'Male Bamboo,' they occur at the nodes of the branches.

Found also in Southern India and in the Sandwich Islands.

In allocating this species to the genus *Antonina*, I am aware that I am going against the opinion of the late Mr. W. M. Maskell, who placed it in a special family—*Idiococcina*—which he erected to contain his peculiar genera *Cylindrococcus* and *Spharococcus*. In his very last paper on Coccidæ, published shortly before his death, after erecting a new genus—*Chatococcus*—to contain his previously described *Spharococcus bambusæ*, he comments upon a letter in which I had drawn his attention to the affinities of the species, and remarks that 'there is no resemblance between *A. purpurea* and *C. bambusæ* except externally and superficially.' Personally, I can see very little external or superficial resemblance between the two species; but I maintain that, in all essential details of structure, they are congeneric. The validity of Maskell's judgment in this case is discounted by the fact that he immediately proceeds to describe, as a new species, *Chatococcus graminis*, an insect that is now recognised as a typical *Antonina*. This reference to *Chatococcus graminis*, by the way, is omitted in Mrs. Fernald's comprehensive *Catalogue of the Coccidæ of the World*.

## ANTONINA ZONATA, Green.

(PLATE CLXVIII.)

*Antonina zonata*, Green, *Ent. Mo. Mag.*, 3rd ser., Vol. V. p. 175 (1919).

Adult female (*figs.* 1, 8, 9) naked, resting on a bed of white mealy secretion. There is also a small patch of greyish secretion, at the anterior extremity, of the consistency of beeswax, which appears to serve the purpose of fixing the insect in position. A colourless tubular filament usually projects from the anal orifice, carrying a globule of liquid excreta at its extremity. The insect is actually pyriform, though it has the appearance of being globular owing to the anterior thinner prolongation being concealed in the angles of the branches. Superficially, it might be described as baccate (*fig.* 1). Smooth; roundly distended behind, bluntly pointed in front (*fig.* 9). Colour olivaceous, with deep brown transverse mottled bands (medially interrupted) on the dorsum; deepening to almost uniform brown in old examples. Antenna (*fig.* 15) consisting of an irregularly conical terminal joint, the truncate extremity concave and bearing a group of stout curved setae, and a broad shallow basal joint. Spiracles (*fig.* 19) large and conspicuous, the walls of the external aperture closely studded with trilocular ceriferous pores; many other simple pores surrounding the aperture. Anal ring set in a wide pit with a comparatively small broadly oval or circular orifice through which the anal setae project (*fig.* 16). The external orifice is surrounded by circular ceriferous pores and many stout hairs (*fig.* 18). The anal ring itself (*fig.* 17) has a deeply milled circumference and bears six long, stout setae. The derm varies in density according to the age of the insect. In fully mature examples it becomes almost rigid and opaque, when it displays numerous small oval translucent cells (*fig.* 20). These cells are scarcely noticeable in the early adult insect. Length 2·75 to 5 mm. Breadth 2·50 to 4 mm.

Nymphal female (*figs.* 5, 6) oval, flattish, dull red. Antenna (*fig.* 7) similar in form to that of the adult. The insect, in this stage, is completely concealed beneath the leaf-sheaths of the plant.

Young larva (*fig.* 2) pinkish ochreous, thinly dusted with white mealy secretion. Resembling a small *Pseudococcus*, like which it has two pairs of conspicuous glandular foveae on the dorsum—on the prothoracic segment and at the junction of the penultimate and antepenultimate abdominal segments (*fig.* 4). Length 0·75 mm.

Adult male (*fig.* 13) minute; dull brown; wings whitish; with a pair of stout white caudal filaments. Sheath of penis short and stout. Legs and antennae comparatively short, the latter considerably less than half the length of the body. Antenna (*fig.* 14) ten-jointed; terminal joint as long as the eighth and ninth together, with three longish fine knobbed hairs at the extremity. Length (without appendages) 1 mm.

Male puparium (*fig.* 12) in the form of an elongate narrow felted sac. The puparia are usually attached to the inner surface of a stipule (*fig.* 11).

The adult females are clustered in the axils of the branches of a Bamboo

(*Teinostachyum attenuatum*) (*fig. 1*). The colonies are almost invariably attended by ants (*Cremastogaster dohrni*) which construct fibrous shelters over them. The position and globular form of the insects gives them the appearance of sessile berries growing upon the plant.

Though differing widely, in form and colouring, from typical species of *Antonina*, all the structural characters of the insect, and its early development, point to its position in this genus.

#### Genus LACHNODIUS, *Maskell.*

*Lachnodi*us, Mask., *N.Z. Trans.*, Vol. XXVIII. p. 400 (1896).

This genus was erected by Maskell to contain species differing from *Pseudococcus* in having more than eight setæ on the anal ring. That author gives, as one of the characters of his genus, 'Antennæ of seven or eight joints, of which the last is not longer than the others.' This definition would limit it to the Australian species, of which three have been recorded. I am now including a species from Ceylon that differs from the typical species in having the terminal antennal joint elongated and longer than the others. Monsieur Vayssiere has recently described a species (*L. greeni*), with similar antennal characters from Madagascar. It is doubtful, however, if these two insects from Ceylon and Madagascar are strictly congeneric with *Lachnodi*us *eucalypti* (the type species).

#### LACHNODIUS HUMBOLDTIÆ, *nov.*

(PLATE CLXIX.)

Adult female (*figs. 1, 2*) at first pinkish yellow, afterwards purplish grey; slightly pruinose; circular or broadly oval; strongly convex above. Segments demarked by deep transverse furrows. Antenna (*figs. 3, 4, 5*) six- or seven-jointed, in almost equal proportions. The six-jointed form may have the third joint comparatively short as in *fig. 3*, or very long, with a partial division, as shown at *fig. 4*. In the seven-jointed form, which is probably the normal one, the terminal joint is the longest, and the fifth shortest. The antenna is but sparsely hairy. Legs rather stout, though comparative small; tarsus slightly shorter than tibia, the two together markedly shorter than the femur (*fig. 6*); very sparsely spiny. Anal ring (*fig. 8*) with from twenty-four to forty stout setæ. The posterior extremity (*fig. 7*) bears two rounded cushion-like prominences, with a few small conical spines. The derm of the dorsum bears numerous similar spines intermingled with small ceriferous pores, the latter obscurely trilobulate (*fig. 9*). Length of body varying from 1.50 to 2.50 mm.

Other stages not observed ; but well-developed embryos were found in the bodies of the females.

Habitat : In the hollow joints of young branches of *Humboldtia laurifolia*. Yatiyantota, November.

At the distal extremity of each joint, between the bases of the bracts and opposite the insertion of the leaf petiole, there is a minute passage communicating with the cavity of the internode below it. This passage is enlarged by ants of several species which form their nests in the cavities, but is not of sufficient size to permit of the entry or exit of the full-grown *Lachnodius*. It is probable that the ants introduce the young larvæ and plant them on the inner walls of the cavity, where they feed and attain their full size. From one to three full-grown Coccids may be found in a single cavity, though not in every joint.

The species has been found in one locality (Yatiyantota) only. *Humboldtia* trees growing in the Peradeniya Gardens and other districts, although colonised by ants, do not appear to harbour these insects.

The ants associated with *Lachnodius* at Yatiyantota have been determined as *Cremastogaster subnuda*, Mayr., subsp. *rabula*, For., var. *nicevillei*, For., and *Monomorium floricola*, Jerd.

## CHAPTER X.

## SUB-FAMILY TACHARDIINÆ.

Contains the single genus *Tachardia*, the characters of which will, consequently, stand for those of the sub-family.

*Gascardia*, at one time included in this sub-family, is now known to be a Lecaniid—allied to *Ceroplastes*.

Genus TACHARDIA, *R. Blanchard*.

*Carteria*, Sign., *Ann. Soc. Ent. Fr.*, (5), Vol. IV. p. 101 (1874).

*Tachardia*, R. Blanch., *Zoologie Médicale*, Vol. I. (1886).

*Tachardia*, Sign., *Bull. Soc. Ent. Fr.*, (6), Vol. VI. p. lxii (1886).

THE genus, as originally erected by Signoret in 1874, was called *Carteria*; but that name having been preoccupied by Diesing, in 1865, for a genus of *Protozoa*, is now superseded by *Tachardia*, as designated by Blanchard in 1886.

The species, of which some thirty have been described, have peculiar characters that distinguish them from those of any other sub-family. The most noticeable of these (in the adult female) are the distinct caudal extension, carrying at its extremity the anal orifice; a prominent dorsal spine, situated immediately above the base of the caudal extension; and a pair of more or less prominent stigmatic processes—the so-called ‘lac tubes’ of earlier authors, whose function is, however, quite unassociated with the secretion of the resinous product known as ‘lac.’ All these organs are described more minutely below.

The popular name—‘Lac insects’—by which species of this genus are commonly known, indicates another character that is common to all of them, namely, the production of a hard resinous secretion (soluble in alcohol) which completely envelops them, either in the form of separate cells or as a more or less continuous incrustation in which the insects are embedded. The latter arrangement really consists of a mass of confluent cells. The resinous cells—or tests—when isolated, conform approximately to the shape of the contained insects, but may be sculptured or diversely moulded externally (*e.g.*, *conchiferata*, *minuta*, *decorella*). The cavity of each cell communicates with the surface by three small apertures, two of which are associated with the stigmatic processes, the third being



in apposition with the caudal extension and anal orifice. During the life of the insect these apertures are occupied by tufts of delicate white filaments emanating from ceriferous pores on the organs concerned. The deposition of lac commences during the larval stage, and is continued—increasing in thickness with the development of the insect—throughout the nymphal and adult stages.

As the insects, while still quite small, are closely imprisoned within a rigid case of resin, it is evident that their growth must be accompanied by a corresponding augmentation of the internal dimensions of the cell. The final size of the adult female is many times greater than that of the nymph or of the early adult female, necessitating a great increase in the size of the cavity. It is a little difficult to understand how this is effected. The probable explanation is that the resinous secretion, though apparently a solid substance, is, in reality, a viscous fluid which would respond to slow pressure exerted by the growth of the contained insect. We know that a very small amount of heat will make a stick of sealing-wax (which is derived from lac) sufficiently plastic for it to bend by its own weight or to adapt itself to the shape of any surface upon which it may be resting. Possibly the heat of the tropical sun comes to the assistance of the imprisoned insect by inducing the necessary plasticity in its resinous envelope.

The male puparium is similarly constructed, but is usually of a more or less slipper-shaped form, with the posterior aperture proportionately larger and closed by a dense resinous operculum.

The form of the female insect itself varies with each species and is affected—to a considerable extent—by contiguity, and by the depth of the resinous deposit. In *T. lacca*, where the lac may attain a thickness of seven millimetres or more, the insect is correspondingly elongated, assuming an irregularly fusiform shape, the mouth parts alone being in contact with the plant. Other species are subglobular or even somewhat depressed, while others have a symmetrical lobate form.

The antennæ are usually very rudimentary, consisting merely of more or less pronounced tubercles surmounted by a few bristles; in *conchiferata* they are rather more developed, exhibiting four distinct joints, while in *minuta*, though they are elongated, no definite segmentation can be distinguished.

The mouth parts are of the usual structure, but are associated with a pair of small but prominent post-oral lobes (situated immediately behind the mouth), the function of which is not clear. They

may possibly represent the vestiges of anterior limbs, the insect being otherwise completely apodous.

The spiracles, during the development of the adult insect, so completely alter their normal positions that the two pairs can do no longer be described as anterior and posterior. The originally anterior spiracles may even finally assume a position considerably behind the true posterior pair (as in *albizzia* and *lacca*). They are always more strongly developed than those of the other pair, and, though originally situated on the venter, are gradually carried round to the dorsum of the insect. The normally posterior spiracles remain small and retain their original ventral position. Under these conditions it is more convenient to describe the two pairs of spiracles as dorsal and ventral respectively.

Associated with the large dorsal spiracles are the stigmatic processes. These organs have been described by some authors as 'lac-tubes,' under the impression that they are principally concerned in the secretion of the lac. As a matter of fact, they have an exactly opposite function, namely—to prevent the accumulation of the secretion at the particular spots where they are situated, and to keep open the stigmatic orifices and permit the ingress of air to the spiracles. This they effect by the secretion of waxy filaments from special ceriferous pores which are grouped (usually in a denser chitinous tract) on their apices. The processes may be approximately sessile—as in *albizzia*, or greatly elongated—as in *conchiferata* and *lacca*. They are usually soft and fleshy, with a densely chitinous tract (carrying the ceriferous pores) at the apex of each; but, in *conchiferata*, the processes are completely indurated, resembling horns. In some species the stem of the process is so thin and delicate that, under compression, it may be flattened down and overlooked, when the denser apical tract will appear to be sessile.

The dorsal spine is a character that is peculiar to the genus. It occurs on the adult female of every species of *Tachardia*. One species (*aurantiaca*) was originally described as being without this peculiar organ; but subsequent study has shown that it is present on fresh examples of the insect, but has such a slender pedicel that it is easily detached and lost. It is a conspicuous, stout, densely chitinous spine, surmounted upon a fleshy tubercle or pedicel, and is situated on the dorsum immediately above the base of the caudal extension. The pedicel may be short and stout, or long and slender. In the latter condition the spine is readily detached when the specimens are dried, or during the process of preparation for microscopical study. The spine is perforated by a central channel

which opens close to the apex, and associated with it are numerous minute glandular bodies communicating with the channel by thread-like ducts (see Pl. CLXXII. *fig.* 17). The function of this organ is a puzzle. That it *has* some special function is evident from its structure and from the presence of the associated glands. Its point is not sharp enough to allow of its employment as a sting; nor is there any indication of the special muscles that would be necessary for its efficacy in such a capacity. Moreover its position—boxed up within the hard resinous cell—would seem to preclude any such use. Its absence in all but the adult stage might suggest some association with the sexual functions, but it is difficult to conceive why this particular genus should have acquired such a peculiar accessory sexual organ.

The caudal extension probably comprises almost the whole of the abdominal segments, the bulk of the body representing the thoracic area. (It should be recognised that, in the *Coccidae*, the ovaries are not confined to the abdominal area, but extend upwards throughout the cavity of the body.) The number of visible segments varies, but not more than two or three can usually be distinguished. In some species this area is soft and flexible; in others the terminal segments may be more or less densely chitinous. The extremity is truncate, and is surrounded by a laciniate fringe enclosing a circular space in the centre of which is the anal orifice, encircled by ten stout setæ. The setiferous anal ring is broad, and is composed of six distinct plates which may become confluent in the adult insect.

With insects that exude such a copious and dense secretion, one might expect to find definite areas of specialised glandular pores for the purpose. But no such glands have been demonstrated. The only pores that are noticeable are upon areas where wax is deposited, and must be regarded as of a ceriferous nature. A series of such ceriferous pores are to be found surrounding the base of the caudal extension and upon its apex, around the spiracles, and on the extremities of the stigmatic processes. Additional groups occur, in some species, at intervals along the lateral areas. The lac appears to be exuded from the general surface of the body. A study of the deposition of the lac, throughout the various stages of the insects, supports this supposition.

The adult male may be either apterous or alate, both forms usually occurring in the same species. The antennæ are normally ten-jointed, the terminal joint tapering to a point and bearing one or more knobbed hairs at its apex. In the apterous form the

number of antennal joints is often reduced to nine. The head carries four prominent black ocelli. The penial sheath is long and slender, acutely pointed. The posterior extremity of the body carries a pair of long white waxy filaments.

The female nymph differs from the early adult female principally in the absence of the dorsal spine.

The young larvæ are characterised by the form and structure of the antennæ, which are six-jointed, the third very long, the fifth with two very long whip-like hairs on one side, and the sixth broader than the preceding segments. In all the species that I have examined, the tarsal digitules, instead of being at the same level, spring from two points at some distance one behind the other.

The resinous secretion affords the commercial product known as 'lac' or 'shellac,' which forms the basis of sealing-wax, French polish, and various varnishes.

The genus, though not very rich in species, is distributed over both hemispheres. Central America (including the West Indies) heads the list with eighteen species; Australia comes next with six species; closely followed by the Indian region with five; three species have been recorded from Africa, and one from Java.

#### SYNOPSIS OF CEYLON SPECIES.

- A. Stigmatic processes rigid, densely chitinous; antennæ, three to four-jointed .....CONCHIFERATA.
- B. Stigmatic processes soft and pliable; antennæ rudimentary.
  - (a) Stigmatic processes elongate .....LACCA.
  - (b) Stigmatic processes sessile or very short.
    - (a<sup>1</sup>) Resinous capsule more or less spherical ...ALBIZZIE.
    - (b<sup>1</sup>) Capsule conspicuously lobed .....MINUTA.

TACHARDIA CONCHIFERATA, *nov.*

(PLATE CLXX).

Resinous test of adult females (*figs.* 1, 2) globose or approximately hemispherical, smooth above, with six deep depressions above the marginal area, each surrounded by prominent radiating ridges forming a definite and graceful shell-like pattern (*fig.* 2). In the older examples this sculpturing is concealed from above by the convexity of the test. The usual three apertures are small and widely separated, their position indicated by the presence of small tufts of white filaments. The tests are usually isolated, but may occur in blocks of from three to six cells. Colour bright pale castaneous, partly due to the colour of the contained insect, the lac being semitranslucent. Diameter of isolated tests 4 to 6 mm.

Test of early adult female smaller, less strongly convex, and darker in colour. At this stage the sculptured areas project around the base of the test as a series of rounded crenulated lobes (*fig.* 3).

Male puparium (*fig.* 6) oblong, broadest behind, the margins obscurely lobulate. Stigmatic orifices minute but prominent, marked by spots of white secretion. Posterior orifice large, closed by an obscurely hexagonal operculum. Dorsal area depressed behind the stigmatic areas, with the usual median carina, which is continued—as an indistinct ridge—across the operculum. Colour dark castaneous. The puparia are usually agglomerated together in large masses, in which condition the form of the individuals is completely obscured. Length of an isolated example 2 mm.

Adult female insect bright salmon-red (*fig.* 9); stigmatic and caudal processes dark brown. There are white waxy patches surrounding the base of each of the processes, and also in the six depressions that surround the base of the insect. Form, before oviposition, trilobate in outline (*figs.* 7, 8), the two stigmatic processes and the caudal process occupying the angles between the lobular expansions. Dorsum strongly convex, produced behind into a broadly rounded lobe, demarked from the surrounding area by deep sulci (see *fig.* 8), and supporting at its posterior extremity the dorsal spine. A sharply defined furrow extends from the base of each stigmatic process across the under surface—passing immediately in front of the rostrum (see *fig.* 7), and a short sulcus extends forward from the rostrum towards the anterior margin. The medio-ventral area between the rostrum and the base of the caudal process is occupied by an ovate concave space, bounded behind by a pair of small round fleshy lobes. The stigmatic and caudal processes project outwards and upwards. After oviposition the abdominal segments contract, and the body is raised up from behind. Stigmatic processes elongate and comparatively slender; so densely chitinous that the characters of the secretory area at the apex are completely obscured. The caudal process is composed of at least four visible segments, of which the basal two are soft and flexible, the apical two being rigid; the terminal segment is densely chitinous and clothed with minute adpressed spines (*fig.* 12), its apical margin sharply serrate

and with four longer spines projecting beyond the serrated fringe. Anal ring with ten stout setæ. Rostrum approximately central. Antennæ comparatively well developed, four-jointed (*fig. 15*); situated close to and immediately in front of the rostrum. Dorsal spiracles large (*fig. 13*); situated laterally near the bases of the stigmatic processes (see *fig. 10*); each spiracle set in an area crowded with ceriferous pores and surrounded by a subcircular or broadly pyriform chitinous plate. Ventral spiracles smaller, placed shortly behind the rostrum, surrounded by a dense group of ceriferous pores (*fig. 14*). Dorsal spine (*fig. 11*) slender, acutely pointed, with its base abruptly expanded into a transversely flattened disc. The spine is set upon a long and slender pedicel which is easily detached (and lost) during the preparation of dried examples of the insect. After maceration several series of ceriferous pores—each of which has distinct characters—can be observed (see *fig. 10*). There is a submarginal series of six linear groups associated with the submarginal pits, the pores trumpet-shaped when viewed in profile (*fig. 16*); four scattered groups of small tubular pores (*fig. 17*) surrounding the rostrum, and a series of crowded groups of circular pores encircling the base of the caudal process, each group broken into irregular smaller clusters (*fig. 18*). Length of extended insect (under compression) 3 to 4 mm.

The early nymphal test is stellate (*fig. 5*), with three rays on each side. Increase in growth is effected by the extension of larger processes from the intervals between the rays of the earlier stage (see *fig. 4*). The later nymphal test is accordingly still six-rayed, but the direction of the rays is different, there being now two stout conical arms on each side, with single anterior and posterior truncate processes in the direction of the main axis of the body. The earlier form is still traceable upon the disc of the later test. I have been unable to follow out the subsequent transformations; but, from the position of the crenulate lobes on the test of the early adult female (see *fig. 3*) it is probable that increase in size continues to be effected by interstitial growth.

On *Mimosa* sp., *Anona palustris*, *Excœcaria agallocha*, and *Croton lacciferum*. Kandy; Matale; Jaffna; Tangalla.

This species is much less abundant than *T. albizzia*. The resin is considered to be superior, and is greatly valued by the lac-workers of Matale and Tangalla, who distinguish it by the name of 'Tela-kiriya laccada.'

#### TACHARDIA LACCA, Kerr.

(PLATE CLXXI.)

*Coccus lacca*, Kerr, *Philos. Trans.*, Vol. LXXI. p. 374, 1782.

*Coccus ficus*, Fab., *Mant. Ins.*, Vol. II. p. 319, 1787.

*Carteria lacca*, Sign., *Ann Soc. Ent. Fr.* (5), Vol. IV. p. 102, 1874.

*Tachardia lacca*, Green, *Cocc. Ceylon*, Vol. I. p. 3, 1896.

Resinous tests of adult females closely agglomerated, forming an incrustation upon the branches (*fig. 1, 8*) varying in thickness from 4 to 7 mm. At an early stage of development, while the individuals are still isolated, the test of the female is of a symmetrical form (*fig. 11*), with a double lateral series of rounded

or bluntly pointed radiating processes, of which there are six superimposed pairs on each side. These tests contain nymphs and the earliest adult females. The median dorsal area is occupied by a ridge, with indications of segmentation, which represents the larval exuviae. It terminates behind in an oval operculum covering the anal aperture. The small stigmatic apertures open, one on each side, near the anterior extremity of the median ridge. There are usually three or more small bead-like protuberances on each side of the disc. Subsequently, by a process of accretion, the irregularities are filled in, and the test assumes a subglobular form, the surface of which is studded with more or less concentric series of small rounded pustules which possibly represent the apices of the earlier processes. In this stage the median dorsal area is somewhat depressed. Further accretions of lac obliterate all trace of the earlier characters, and the individuality of the tests is merged into the general mass. In weak colonies the incrustation is thinner and not so continuous, under which conditions the globular form of some of the tests may be retained. A section of the incrustation (see upper end of *fig. 1*) reveals numerous pyriform or fusiform cells which are adapted to the form of the mature insect. Each cell communicates with the exterior surface by the usual three orifices which (in fresh, living material) are marked by tufts of slender white filaments.

Male puparium small; the form usually obscured by the coalescence of numerous individuals; an isolated example (see *fig. 12*) may be described as roughly coffin-shaped, with the posterior extremity covered by a large oval operculum. The covering of lac is of sufficient thickness only to render the puparium hard and rigid. Length approximately 2 mm.

Adult female of a rich dark crimson colour, becoming blackish after death. It attains the adult characters (recognised by the presence of the dorsal spine) while still quite small (see *fig. 10*); but the stigmatic processes are then practically sessile. At this period the insect rests in the normal position, with the venter in apposition to the floor of the cell. The body, viewed from above (see *fig. 14*), has a broadly rounded lobe in front and rounded tumescent sides; the dorsal spine occupying a median position between the stigmatic and caudal processes, the latter process being recurved over the dorsum. During subsequent growth the body first assumes a subglobular form and, later, becomes greatly extended in an upward direction, until it attains a pyriform (*fig. 9*) or fusiform (*fig. 2*) contour, with a corresponding increase in the length of the stigmatic processes. In this later condition the caudal process, with the dorsal spine and the two stigmatic processes, are clustered at the upper extremity, while the lower extremity is occupied by the mouth parts. After oviposition the ventral side of the insect, which has now assumed an erect position, becomes slightly concave. The length and shape of the stigmatic processes, in this species, have such a wide range of variation that forms at opposite extremes might almost be accepted as distinct species. They may be either comparatively short and stout, or long and proportionately slender, with all intermediate degrees; but the structure of the apical ceriferous tracts, and all other essential characters, are identical in all the forms. The truncate apex of the stigmatic process is occupied by a densely chitinous area (*fig. 5*) in the centre of which is a shallow depression (the ceriferous tract) with a sharply defined but irregularly lobate contour. This depression is closely packed with small circular pores and exhibits—irregularly disposed

upon its floor—from five to seven conical circular pits. At the fundus of each pit is a single larger pore communicating with a short cylindrical duct (*fig. 6*). At the base of each process is a large trumpet-shaped spiracle (*fig. 4*), the orifice of which is surrounded by an irregular chain of ceriferous pores. The ventral spiracles are of similar form and structure, but much smaller. The dorsal spine (*fig. 7*) is stout, broad at the base and tapering gradually to the apex; there are one or more small denticulations on each side of the basal area; the spine is placed on the summit of a longish, slender, fleshy tubercle. The caudal process, in this species, remains soft and pliable, and does not exhibit any definite segmentation; its extremity, however, is densely chitinous and is surrounded by a laciniated fringe which is incomplete on the venter (*fig. 3*); the ten anal setae spring from clusters of ceriferous pores on a broad chitinous ring. An interrupted series of small globular groups of pores surrounds the base of the caudal process. Antennæ minute and inconspicuous; each consisting of a small chitinous tubercle, with irregularly truncate apex bearing a few stout bristles. Mouth parts small; but the post-oral lobes are comparatively large and well-defined. Length of mature insect (under compression) averaging 5 mm.

The nymphal insect can be distinguished from the early adult female by the absence of the dorsal spine; the body is more depressed and the stigmatic processes are sessile; otherwise the structural characters are similar to those of the adult. The covering of lac is comparatively thin; the individual tests are small and of the symmetrical form described above (see *fig. 11*).

The adult male may be either winged or apterous. In the winged form, the thoracic segments are broad and strongly developed, to give attachment to the muscles actuating the long hyaline wings which have an expanse (according to Imms) averaging 4.5 mm. The thorax, in the apterous form, is little or no broader than the base of the abdomen and remains soft and undeveloped. Both forms are of a bright crimson colour, and are provided—at the posterior extremity—with a long-pointed penial sheath and a pair of slender white filaments which are twice or more the length of the actual body of the insect. The antennæ are normally ten-jointed; but it has been observed by Dr. Imms that—in the apterous form—the number is frequently reduced to nine. The head bears four prominent black ocelli, of which one pair has a ventral and the other a dorsal aspect. Length (including penis) 1.75 mm.

Habitat. The list of plants upon which *Tachardia lacca* occurs naturally, or upon which it has been cultivated in India, is a long one, including nine species of *Ficus*, three of *Dalbergia*, three of *Grewia*, two each of *Butea*, *Zizyphus*, *Albizzia*, *Acacia* and *Shorea*, and single species of the genera *Schleichera*, *Ougenia*, *Xylia*, *Prosopis*, *Cajanus*, *Kydia*, *Pithecolobium*, *Cassia*, *Dipterocarpaceae*, *Pentacme*, *Tamarindus*, *Garuga*, *Streblus* and *Casalpinia*; but by far the more usual host plants appear to be (in the order named) *Butea frondosa*, *Zizyphus jujuba*, *Schleichera trijuga* and *Ficus religiosa*.

The species is not indigenous in Ceylon, but has been introduced and successfully established within the last few years; but has never produced such profuse incrustations of lac as it does in India.

My description and figures have been drawn up partly from Indian and partly from Ceylonese examples.

*Tachardia lacca* is the source of the commercial shellac that is used so largely in the composition of varnishes, French polish, sealing wax, &c. A



minor use in India is in the ornamentation of woodwork and in the manufacture of cheap bracelets and other fancy articles. It should be understood that 'lac-work' has no connection with the 'lacquer' employed for somewhat similar purposes in China and Japan. The latter is compounded principally from vegetable gums.

The body of the insect itself provides a crimson dye which has now been largely replaced by aniline extracts. It gives its name to the pigment known as 'crimson lake.'

### TACHARDIA ALBIZZIAE, Green.

(PLATE CLXXII.)

*Tachardia albizzia*, Green, *Ind. Mus. Notes*, Vol. V. p. 98, 1903 (*sine descr.*).

„ „ Green, *Journ. Econ. Biol.*, Vol. VI. p. 32, May, 1911.

Resinous tests of adult female (*fig. 1*) bright castaneous when fresh, darkening with age; but usually so covered with sooty fungus as to appear black. An isolated test (*fig. 11*) is subglobose, flattened beneath—where it adheres to the stem of the plant. The usual three conspicuous orifices are arranged approximately in an equilateral triangle, on the dorsal surface; each orifice on a separate prominence, the posterior one larger than the other two. The three prominences are connected by more or less distinct carinæ which meet at a point near the centre of the triangular space. In living examples, a small tuft of white cottony filaments projects from each aperture. The surface of the test may be smooth or granulo-rugose. When crowded together, the tests become agglomerated into masses containing from two (*fig. 13*) to six or more cells. Diameter of an isolated test 2.5 to 3.5 mm.

Male puparium (*fig. 18*) smaller and usually of a darker colour; of an oblong form, rather broader in front; with a more or less distinct medio-longitudinal ridge; surface finely rugulose. At the posterior extremity is a large oval operculate opening, through which the perfect insect eventually makes its escape. Length 1.5 mm.

A median longitudinal section through the resinous case of the female reveals the body of the insect occupying the anterior half of the cavity (*fig. 12*), with the abdominal segments retracted and the caudal process directed upwards. At first the insect completely fills the cell. As oviposition proceeds, the body contracts, and the resulting space is closely packed with ova, the young larvae making their exit through the posterior orifice.

The adult female insect is normally of a uniform rich crimson colour; but there is a variety that is of a bright gamboge yellow colour, in all stages.

The fully extended insect (*fig. 15*, antero-dorsal view) is roughly cordate in form, with a prominent caudal process at the extremity of which is the anal orifice with its ring of setæ. The dorsal area is broadly rounded, and demarked by a shallow groove from the remainder of the body. The ventro-lateral areas are roundly produced on each side. The stigmatic processes are reduced to small tubercles which are placed towards the posterior extremity of the dorsum. At the base of the caudal process, situated dorsally, is a prominent fleshy

tubercle which bears at its apex the characteristic dorsal spine. The only other feature that is noticeable, on a superficial examination, is the pair of minute post-oral lobes, projecting from the under surface.

After maceration and compression (see *fig.* 23) other characters can be distinguished. The minute rudimentary antennæ—each consisting of an irregular truncate tubercle with a few stout bristles at its apex—are situated immediately anterior to the mouth parts. The small ventral spiracles (*fig.* 26) are placed close behind the post-oral lobes, with their apertures directed outwards. The larger dorsal spiracles are situated in a denser chitinous area, immediately exterior to the two stigmatic processes, and are inwardly directed. Each spiracle is associated with a scattered group of small ceriferous pores. The stigmatic processes are mammiform, with a densely chitinous cap (*fig.* 16); in the centre of each is a shallow depression, of an irregularly pentagonal form, in which are numerous ceriferous pores arranged in rosette-shaped clusters; six or seven of these clusters are more prominent than the remainder (see *fig.* 27); the circumference of the depression is defined by a close palisade of denser cells. The dorsal spine (*figs.* 7, 28, 29) is slightly curved, stout at the base and tapering to a more or less acute point; there is a conspicuous tooth-like prominence at its base, on the upper surface, and some smaller and more obscure dentations on the under surface. The spine itself is tubular, with an obscure orifice at its apex. There are, associated with it, numerous clavate gland cells disposed either singly or in small groups, which lie in the fleshy tubercle that supports the spine and communicate by thread-like ducts with the tubular channel (see *fig.* 17). On each side of the body, immediately surrounding the base of the caudal process, is a loose series of compound ceriferous glands (see *fig.* 23), each of which consists of a compact cluster of pores (*fig.* 24). The caudal process has a fleshy base and a terminal rigid segment, the distal extremity of which is furnished with a fringe of irregularly toothed and lanceolate spines, incomplete on the ventral margin (see *fig.* 25). Within this fringe lies the setiferous anal ring, which consists of a more or less confluent series of porous plates bearing ten stout setæ. Length of extended insect (under compression) 1.75 to 3 mm. Breadth averaging 2.5 mm.

The adult male is of a rich crimson colour and may be either apterous (*fig.* 19) or fully winged. In both forms there is a pair of long opaque-white caudal filaments. In the winged form the antennæ are ten-jointed, and the notal plates are more distinct; the wing has a pinkish costal nervure. In the apterous form the antennæ have nine joints only, and the thorax remains soft and undeveloped. The terminal joint of the antenna (in both forms) bears two knobbed hairs at its apex (*fig.* 21). There are four prominent black ocelli on the head, two on the upper and two on the under surface. The genital sheath is elongate, slender, and sharply pointed; about two-thirds the length of the abdomen. Length (from frons to extremity of genital sheath) 1.5 mm. Both forms of the male are sexually complete. Apterous males were observed to copulate freely with the early adult females, six or seven insects being fertilised by a single male.

The nymphal test of the female is very much smaller than that of the adult. It is of a more or less symmetrical six-lobed form (*fig.* 8); the lateral areas depressed; the dorsal area with a medio-longitudinal rounded carina, terminating behind at the large posterior orifice. The small stigmatic orifices are situated on the anterior half of the test, on a level with the junction of the first

and second lateral lobes. There is a beak-like prominence above the anterior extremity. Approximate length 1 mm.

The female nymph itself is also obscurely lobed (*fig. 9*), though the lobes do not correspond with those of the test. There is a broadly rounded anterior lobe; a medio-lateral lobe on each side, occupying the space between the two stigmatic areas; and a postero-lateral lobe on each side of the prominent caudal extension. Colour rich crimson (or, occasionally, bright yellow), each of the anterior stigmatic areas indicated by a small patch of white secretion which covers an irregularly perforate chitinous plate (*fig. 10*). Anterior spiracles large and conspicuous; posterior spiracles comparatively small and inconspicuous. The extremity of the caudal process (*fig. 10, a*) has similar characters to that of the adult; but the anal ring is divided into six distinct plates, four of which (the upper and lower pairs) carry two setae apiece, the remaining two plates each bearing a single seta. Length approximately 0.75 mm.

Newly hatched larva (*fig. 2*) bright crimson (or yellow). Antenna (*fig. 6*) six-jointed; third and fourth joints longest; fifth with two extremely long whip-like hairs, equalling or exceeding the length of the antenna. Limbs well developed: foot (*fig. 3*) with unguis and tarsal knobbed digitules, the tarsals unequal in length, one of them springing from a point considerably behind the other. Anterior stigmatic area with a marginal plate bearing a group of mucronate papillae (*fig. 4*). Posterior extremity of body (*fig. 5*) with a pair of long caudal setae springing from an outer chitinous ring bearing several smaller setae and with some irregular dentate processes on its outer margin. Anal ring composed of six distinct oval plates, each bearing a single longish seta.

The young insect is at first very active and quickly migrates from the older to the younger parts of the plant. Having reached its objective, it finally settles down and secretes a resinous covering (*fig. 7*), which is deposited first in a thick rim round the margin of the body, terminating in a beak-like point in front. There is a stigmatic orifice on each side, from each of which protrudes a tuft of short white filaments; a similar tuft projects from the posterior (anal) orifice. The dorsal covering is very thin and is deposited in transverse plates corresponding with the segments of the body: there is usually a gap between two of the plates at a point slightly anterior to the anal orifice.

On the smaller branches of *Albizia stipulata*, *Filicium decipiens*, *Harpullia cupanioides*, *Nephelium litchi*, *Amherstia nobilis*, *Hemicyclia sepiaria*, *Schleichera trijuga*, *Croton lacciferum*, *Theobroma cacao*, *Ficus nervosa* and *Landolphia* sp. Kandy; Peradeniya; Watagama; Kelani Valley; Tangalla; Anaradhapura. Received also from Darjiling, India, on *Croton caudatum*.

The colonies of insects are very heavily attacked by larvæ of a moth (*Eublemma amabilis*) and also by several *Tiniinae*. Chalcid parasites, bred from this species, have been named by Ashmead *Tachardiaphagus thoracicus*, and a Braconid (which is probably parasitic upon the larva of the *Eublemma*) has been called *Bracon greeni*, Ashmead.

As noted above, there are two distinct varieties of the insect—the one crimson and the other yellow. They are distinct in all stages, the crimson adult producing crimson larvæ, and the yellow adult yellow larvæ. I have not, however, observed any yellow males. Nor have I seen any intermediate forms. The two colours may be confined to separate colonies, or they may be mingled together. In a block of three cells, one of the insects was red, the other two yellow. A pure yellow colony was observed upon *Harpullia cupa-*

*nioides*; but both yellow and red forms were freely intermingled upon a plant of *Nephelium litchi*. The red form is by far the more common, and this form only has been observed upon *Albizzia*.

Nearly allied to *T. lacca*, from which it may be distinguished by its smaller size and by the completely sessile stigmatic processes. It must be admitted, however, that there are degrees in the prominence of these processes in *T. lacca* that, with a more extended knowledge of the various forms occurring in India, may eventually provide a complete gradation between the sessile and stalked races of the insect.

The resin of this species is the principal material employed in the local lac industry. It is known to the Matala lac-workers as 'Keppitiya laccada,' and to those of Tangalla as 'Kon laccada.'

#### TACHARDIA MINUTA, *Morrison.*

(PLATE CLXXIII.)

*Tachardia minuta*, Morrison, *Philippine Journ. Sci.*, Vol. XVII, No. 2, Aug. 1920, p. 179.

The resinous case of the adult female varies—in colour—from bright castaneous to dark reddish-brown. In old examples the colour is often obscured by a coating of blackish fungus. The surface is minutely and irregularly rugulose. The form is very characteristic, especially in isolated examples, the free development of which has not been affected by crowding. In such examples (see *fig. 2*) the case assumes a regular lobate outline. Three main divisions are noticeable—a bilobate anterior portion, and two posterolateral portions, each of the latter being angularly trilobate. In the older examples the general form is maintained, but the subdivision into smaller lobes is more or less obscured. The usual medio-longitudinal carina is distinct, and extends to the rounded posterior orifice which is, however, usually closed by a thin operculum. The usual stigmatic orifices are apparently represented only by a pair of semi-lunar cicatrices—situated close to the anterior extremity of the median carina. All three orifices appear to be sealed up and do not emit the curling white filaments that are so conspicuous in *T. albizzia* and several other species. In very fresh examples, a small nipple-shaped prominence is observable on each side of, and slightly anterior to, the posterior orifice. Length of test 1.75 to 2 mm. Breadth (across posterior lobes) 1.25 to 1.75 mm.

Male puparium usually of a rather paler colour than that of the female; of a narrow oval form, slightly tapering behind. The posterior extremity is turned sharply upwards and somewhat recurved. Median carina distinct. A lateral view of the puparium is strongly suggestive of the conventional representation of a dolphin (see *fig. 3*). Length 1 to 1.5 mm.

The adult female insect (removed from its covering) is of a rich crimson colour (*fig. 4*). It retains roughly the form of the case, except that the lobes are more evenly rounded. A deep lateral cleft, on each side, marks the position of the dorsal spiracles. The stigmatic processes are small but prominent,

with truncate extremities, and have an approximately central position. The stout caudal process projects more or less vertically from a position well within the margin. Midway between the stigmatic processes and the base of the caudal process is the usual dorsal spine, on a prominent tubercle. On each side, close to the caudal process, is a small fleshy pointed tubercle which is presumably associated with the nipple-shaped prominences in the same position on the resinous case. After maceration in potash and compression, the lobate form is modified and assumes somewhat the shape of a cottage loaf (see *fig.* 6), while the structural characters are more clearly revealed. The rudimentary antennæ are so weakly chitinized that, when flattened down by pressure, in a microscopical preparation, they are extremely difficult to locate. Each antenna (*fig.* 14) consists of an elongate fleshy tubercle, surmounted by three strong bristles. They are widely separated, being placed close to, and often partially obscured by, the dorso-lateral spiracles. The mouth parts occupy an approximately central position, and are followed by a pair of minute fleshy papillæ. The dorsal spiracles are large and conspicuous, and have assumed a dorso-lateral position, with their orifices directed inwards. The minute ventral spiracles are situated near the centre: one on each side of the rostral apparatus. Both pairs of spiracles are accompanied by small groups of parastigmatic pores (see *figs.* 7, 8). The short but stout stigmatic processes are each surmounted by a densely chitinous, irregularly ovoid or slipper-shaped plate, which is perforated—on the outer half—by a group of from twenty to thirty pores (*fig.* 12). The dorsal spine is acuminate, moderately stout, with a broadly expanded base, and is placed on a soft fleshy process (see *fig.* 10). The processes carrying the perforated plates and the dorsal spine become so translucent—after maceration—that they may be easily overlooked, and the organs in question may be thought to be sessile. The caudal process (*figs.* 10, 11) is stout and conical. It appears to consist of three or four segments which become increasingly dense and rigid towards the extremity. The anal orifice, the characters of which are difficult to determine, owing to the density of the surrounding tissues, is guarded by an irregular laciniate palisade enclosing the anal ring, which bears ten stout setæ. In some examples the setæ project beyond the extremity (*fig.* 11); in others they are completely retracted (*fig.* 10). A series of eight compact clusters of minute pores is noticeable on each side at a short distance within the margin of the body (see *fig.* 6). Of these clusters the first, fifth, sixth, and seventh are larger than the others. The pores in each individual cluster are of two distinct sizes (see *fig.* 9). Average length of insect (under compression) 1.5 mm.

The early adult female is smaller, narrower, and less conspicuously lobate; but all the organs being of the same size as those of the fully mature insect, they occupy a proportionately larger area of the body and are comparatively more conspicuous (see *fig.* 13). In this stage the grouped pores and dorsal spiracles are more definitely marginal; and an inner series of groups of small pores is noticeable.

The female nymph is enclosed in an oblong case somewhat resembling that of the male, but without the upturned posterior extremity. The insect itself is narrow ovoid; the stigmatic perforated plates sessile; no dorsal spine; the marginal clusters of pores more diffuse and containing fewer pores.

The adult male (of which winged forms only have been observed—see *fig.* 5) is of a bright crimson colour; with four prominent black ocelli (two on upper

and two on under surface of the head); rudimentary eyes lateral, minute and colourless; wings ample, slightly dusted with mealy powder, iridescent in reflected light; genital sheath slender, moderately long; caudal filaments slender, opaque white, equal in length to the thorax and abdomen of the insect; antenna ten-jointed, with three small knobbed hairs at the apical extremity. Length 1.25 mm.

On small branches of *Flacourtia Ramontchi* (Kandy); also on *Fluggea leucopyrus* (Peradeniya).

Chalcid parasites bred from this insect were determined by Ashmead as *Marietia leopardina* (Motsch).

Although I have known of this insect for more than twenty years, and have distributed specimens under the manuscript name of *lobata*, no formal description of the species has appeared in print until quite recently, when it has been described (*loc. cit.*) from examples collected in the Philippine Islands. Ceylon examples differ from the type only in the more elongate form of the perforate stigmatic plates. The species occurs in S. India also, where it has been taken on coffee, *Thespesia populnea*, *Michelia champaca* and *Pongamia glomerata*.

CHAPTER XI.

SUB-FAMILY ORTHEZIINÆ.

THIS sub-family provides a connecting link between the *Maigarodinae*, in which the males have compound eyes and the females are without a setiferous anal ring, and the preceding sub-families which are characterised by the presence of a setiferous anal ring in the females and simple eyes in the males.

The adult males of the *Ortheziinae* have large, lateral, moruli-form eyes; the abdomen is furnished with a dorsal tuft of long, slender, silky filaments. In at least one species (*O. insignis*) there are three or more pairs of abdominal spiracles.

The adult females are more or less clothed with flattened waxy plates and marginal processes. There is a strongly developed anal ring, bearing long stout setæ. Abdominal spiracles are present in at least some of the species. There are sharply defined ceriferous tracts, crowded with tapering spines. The development of the antennæ of the adults varies greatly in the several genera: from three in *Nipponorthesia*, to eight (or nine) in *Orthesia*. The limbs show a tendency to the suppression of the tibio-tarsal joint.

The insects are active throughout life, even during the egg-producing period. To suit this active habit, the ovisac has a firm nacreous covering, and is firmly attached to the insect.

The members of the sub-family have been separated into four genera, of which one only (*Orthesia*) has been recognised in Ceylon. They may be distinguished by the following characters:—

- A. Antennæ of adult female with eight or more joints; tarsus more or less distinct from tibia ..... ORTHEZIA.
- B. Antennæ with less than eight joints; tibio-tarsal articulation obliterated.
  - a. Eye fused to basal joint of antenna; antenna four-jointed (ORTHEZIOLA.)
  - b. Eye separate from base of antenna.
    - a<sup>1</sup>. Antenna three-jointed .....(NIPPONORTHEZIA.)
    - b<sup>1</sup>. Antenna six (or seven) jointed.....(NEWSTEADIA.)

## Genus ORTHEZIA.

Species with eight or more joints in the antennæ of the adult female. Limbs with the tarsus distinctly demarked from the tibia, though the junction is so close and firm that it is doubtful if there can be any functional articulation. Other characters as given under the description of the sub-family. A single species only is recorded from Ceylon.

ORTHEZIA INSIGNIS, *Dougl.*

- Orthezia insignis*, Douglas, *Journ. Quekett Micr. Club*, p. 169 (1887).  
 " " " *Ent. Mo. Mag.*, Vol. XXIV. p. 169 (1889).  
 " *nacrea*, Buckton, *Ind. Mus. Notes*, Vol. III. No. 3, p. 103 (1894).  
 " *insignis*, Green, *Tropical Agriculturist*, p. 437 (1895).

Adult female (*figs.* 2, 3, 4, 12) dull olive green or olivaceous brown; antennæ reddish brown, the apical joint blackish; limbs reddish brown. Broadly oval; flattish or slightly concave above, tumescent beneath. Margin with a series of ten white, flattish, laminate, waxy processes on each side; the processes short and broad on the thoracic area, elongate and tapering on the abdomen. Dorsum with a median series of twelve pairs of smaller white processes; the anterior three directed upwards and forwards; the following three pairs more widely separate, directed upwards and outwards; the remaining six approximate, narrow, elongate, and directed backwards; the dorsal surface otherwise naked, showing distinct segmentation (see *fig.* 2). Under surface (*fig.* 4) with incomplete rings of white secretion encircling the rostrum and limbs; a pair of white processes projecting backwards from between the hind legs; abdomen with a broad white band across the base and a broad white submarginal zone which eventually form the support of the ovisac. Antennæ (*fig.* 9) moderately stout; eight-jointed; tapering from the broad base to the sixth joint, sixth to eighth of approximately equal diameter; eighth longest, a little longer than the previous two together; all the joints with a few short spiniform hairs, the apex of the eighth with a longish stout spine (see *fig.* 10). Eyes prominent, truncately conical. Rostrum stout, conical, prominent, longer than broad, with a group of short setæ at its apex. Legs long and strongly developed; trochanter so closely fused with the femur (see *fig.* 13) that its boundaries are indistinguishable; tibia of same length as the femoral segment; tarsus rather less than half the length of the tibia; the junction between tibia and tarsus distinct, but the two segments are so firmly and closely attached to each other that it is doubtful if there can be much movement between them; claw (*fig.* 14) with a distinct denticule on the inner edge, at a distance of about one-third from the apex; ungual digitules simple, tarsal digitules absent or represented by two small spines; the whole limb with series of short spiniform hairs. Anal ring (*fig.* 5) with six longish stout setæ. Thoracic spiracles large; but rather inconspicuous, being situated near the margin of the body where they are obscured by the ceriferous tracts. There are seven small spiracles on each side of the abdomen, of which the



hindermost two pairs are approximated and situated close to the anal orifice (see *fig.* 5). Derm with large, circumscribed ceriferous tracts crowded with stout, curved, tapering spines (*fig.* 11), corresponding with the areas supporting the waxy processes. The naked areas of the dorsum are sparsely sprinkled with small quadrilocular or quinquelocular pores. Dimensions of denuded insect: length 1.5 mm., breadth 1 to 1.2 mm.

The ovisac, which is firmly attached to and carried about by the insect, tapers slightly from the base to the truncate extremity, where there is a large aperture through which the larvæ make their escape. It is of a firm but brittle texture and, in fully developed examples, describes a gradual curve of which the concavity is uppermost (see *figs.* 3). It is longitudinally ribbed above (*fig.* 2) and transversely banded below (*fig.* 4). In well-developed examples the ovisac extends to a length of from 4.5 to 6 mm.

Nymph very similar to adult; but with seven-jointed antennæ. Young larva (*fig.* 7) pale green, with a median series of V-shaped white waxy patches and slight indications of marginal processes; antennæ (*fig.* 8) six-jointed.

The eggs, which are carried within the ovisac, packed in a loose cottony matter, are at first almost white. They soon deepen to yellow, then orange, and, just before the emergence of the larva, become of a greenish tint.

Adult male (*figs.* 15, 16) slaty gray, dusted with greyish white powdery matter. Wings greyish white, the nervures and costal margin brownish. A long tuft of delicate, silky, colourless filaments springs from the dorsum of the antepenultimate segment, extending backwards to a length equalling or exceeding that of the insect itself. Antennæ nine-jointed, very long and slender, considerably longer than the body of the insect; the first two joints short, the remaining seven greatly elongated; a longish slender spine at the apex of the ninth (*fig.* 20); all the joints clothed with short hairs. Legs long and slender; tarsus approximately one-quarter the length of tibia, and much longer than femur; claw (*fig.* 21) slender and acutely pointed. Eyes large and prominent, lateral, moruliform (see *figs.* 17, 18); a single lateral ocellus immediately behind each eye. Halteres (*fig.* 19) with thickened costal margin; a single, longish, hooked bristle at the distal extremity. Abdomen with the dorsum membranous; the venter with transverse chitinous plates. Penis (see *fig.* 22) large, falciform, densely chitinous. Dorsum of antepenultimate segment with a transverse cluster of about thirty tubular pores, which give rise, in the living insect, to the caudal tuft of filaments. Each pore, viewed in profile (*fig.* 23), is seen to project above the surface of the body for about one-third of its length; when viewed vertically the pores have the appearance shown at figure 24, the pattern being produced by internal ribs, which are strongest at the inner extremity but fade out on the walls of the tube. There are four pairs of abdominal spiracles, situated on the penultimate and preceding three segments, and opening on to the lateral area. Membranous areas of the body with large, circular, trilocular (occasionally quadrilocular) pores (*fig.* 25), arranged in transverse groups and series on the abdomen. Length (exclusive of filaments) 2 mm.

The male insect, after the first moult (*figs.* 26, 27, 28) is readily distinguishable from the early stages of the female. It is of a pale green colour, without waxy processes, but enveloped in loose woolly secretion. In the advanced nymphal stage (*fig.* 28) the antennæ are nine-jointed and are folded back along the sides of the body; wing-pads are apparent in this stage. It has long, well-

developed legs, which it can use when disturbed, though it usually remains quiescent beneath its woolly covering.

More or less omnivorous, but showing some preference for plants belonging to the Natural Orders *Acanthaceae*, *Verbenaceae*, and *Compositae*. Though occasionally found upon outlying bushes, it has—at present—failed to establish itself as a serious pest of either Tea or Coffee. It has found a congenial host-plant in the common Lantana (*L. mixta*) which, though not a native of Ceylon, has become widely established throughout the island, with the result that the insect is locally known as the 'Lantana Bug.' In flower gardens the following plants are particularly subject to attack:—*Crossandra*, *Justicia*, *Thunbergia*, *Meyenia*, *Stachytarpheta*, *Duranta*, *Habrothamnus*, *Coleus*, *Salvia*, *Iresine*, *Cuphea*, &c. Though this pest does not necessarily kill the plants, it destroys their vitality and renders them most unsightly by reason of the thick growth of sooty fungus that invariably accompanies its attacks. The partiality of the insect for Lantana has led to the idea that it would prove to be an efficient check to the extension of this troublesome weed. I have received several applications from other countries asking for consignments of living 'Lantana bugs' to combat the Lantana pest. I have always discouraged such experiments. Apart from the fact that the insect does not kill the Lantana, even when the plant is heavily infested, its polyphagous habits and its apparent freedom from natural enemies make it a most undesirable alien to bring into any country.

Natural enemies may possibly exist in the native country of *Orthezia insignis*; but, so far, the career of the pest in Ceylon has been unchecked by any such causes. Birds ignore it, and I have not found a single insect parasite—external or internal—preying upon it. I have tried to induce various species of ladybird beetles to feed upon it, but they all preferred starvation.

The appearance of *Orthezia insignis* in Ceylon, dates from January, 1893, when a serious outbreak occurred in the Royal Botanic Gardens at Peradeniya. The plague was reputed to have originated from infected plants that arrived in a Wardian Case from Kew; but the Kew authorities strenuously repudiated the possibility of any such introduction. Since then, the pest has steadily increased in strength and extended its range. Though at first confined to the neighbourhood of Kandy, it was not many years before other districts were invaded, and it is now widely distributed up to an elevation of about 4000 feet.

The original home of *Orthezia insignis* is a matter of some doubt. The species was first described from specimens collected in the plant houses of the Royal Botanic Gardens, Kew, where it found a congenial home. Its introduction to Kew was attributed to British Guiana, where it is now known to occur in an apparently wild condition. It has been reported from Trinidad, Jamaica, Antigua, Mexico, Brazil, China, Mauritius, Italy, and, quite recently, has been observed in Madeira. In the United States it has become a common greenhouse pest, and it has been recognised in South Africa for at least a quarter of a century.

There appears to be a constant succession of broods. I have examined infected plants at all times of the year, and have always found the insects in every stage, from the newly hatched larva to the adult female. I have kept isolated females under observation. After the first commencement of the formation of the ovisac, a period of three weeks elapses before the emergence of the first larva, after which the young insects hatch out at the rate of about

five a day for a period of six weeks or more ; by which time the parent is exhausted and dies, and the earliest hatched larvæ have commenced ovipositing on their own account. The length of life of a single insect is therefore about fifteen weeks ; but, as it commences to produce larvæ at the ninth week, there may be five generations within the year. This fecundity is more or less independent of the attentions of the male insects, which appear only at irregular intervals. It is doubtful whether a generation of males is produced even once a year. An interval of four years occurred between the first and second observed broods. On both of these occasions the male insects occurred in enormous numbers, hovering in the air like gnats, the silky tufts on their tails glistening in the sunlight.

The 'Lantana bug' is one of, if not the most, resistant of all scale-bugs towards insecticides. It is therefore a useful subject upon which to test various treatments. An insecticide that will kill *Orthezia* can be guaranteed against any scale pest. It is remarkable that the half-grown insects will often survive treatment that has successfully destroyed the younger and older individuals. Treatment with hydrocyanic acid gas is effective in the case of isolated plants, and in confined spaces such as Wardian Cases and greenhouses. The gas treatment, however, though really very simple, requires considerable care in application and is subject to certain dangers. It cannot therefore be recommended for general use without previous demonstration by a trained operator. Spraying is the next best measure. But however thoroughly this work may be done, a certain proportion of the insects will be sure to escape, and the process must be repeated at intervals until the pest has disappeared. I have found that mixtures of which soap is the principal component are more efficacious against *Orthezia* than any other kind of spray. Besides killing the insect, the soapy matter blocks the aperture of the ovisac, preventing the emergence of the young larvæ. It should be noted that the insects will remain attached to the plant for a long time (sometimes for two or three weeks) after they are dead. Examination with a hand lens is often necessary to determine whether the application has been successful or not. If the legs remain rigid and do not move when the insect is disturbed, it may be presumed to be dead.

With regard to the mode of distribution, the young larvæ of all scale insects are very easily transported from one place to another. They are minute and active and can exist for several days without food. The young *Orthezia* is particularly resistant in this respect. They may crawl on to the feet of birds, or even on to larger insects that may be resting on the bug-infested plant, and may be conveyed in this manner to a considerable distance before being dislodged. They may be brushed off and carried away on the clothing of passers-by. The rough cumblyies worn by coolies are particularly liable to carry the infection. Wandering cattle also are unconscious distributors of the pest. The young insects are so light that they may be transported by wind. The conspicuous way in which the pest is spreading along the sides of the railway track points to the supposition that they are carried along by the draught of passing trains. Running water is another fertile source of distribution. An infested plant growing on the banks of a stream or river is sure to shed some of the insects into the water, when they may float down for miles before effecting a landing. The interchange of garden plants is a source of danger. It must have been in this way that the pest obtained a footing in Ceylon. This introduction occurred before the establishment of a Quarantine Station at Colombo.

## CHAPTER XII.

## SUB-FAMILY MARGARODINÆ.

THIS is a well-defined group characterised by a quiescent encysted stage, in the female, interpolated between the active larval and adult stages. The nymph (or nymphs—for there may be more than one of these quiescent stages) is without any rudiment of limbs, and the antennæ—if present at all—are reduced to the merest vestiges, comparable with the same organs in the *Diaspidinae*. Nothing remains but the mouth parts, and it is doubtful if these are fully functional during the ultimate nymphal stage. This is a remarkable divergence from the normal procedure of development in the *Rhynchota*, which belongs to the section *Ametabola*, characterised by a gradual and uninterrupted development from the larva to the adult insect. Mouth parts are altogether wanting in the adult females of most of the genera, vestigial in others, and fully developed in one genus only (*Stomacoccus*).

Abdominal spiracles probably occur in all the genera, though they have not yet been recorded for *Callipappus*. In this character, and in the possession of compound eyes in the males of most of the genera, the *Margarodinae* show their relationship with the *Monophlebinae*. The males of *Stingelia* and *Stomacoccus* are exceptional in being provided with simple ocelli only. The males of those genera in which the eyes are more highly developed (e.g. *Margarodes*, *Callipappus*, *Xylococcus*, *Kuwania*) are also distinguished by the presence of a dorsal tuft of long silky filaments springing from the penultimate segments of the abdomen, in which characters they are associated with the *Orthesiinae*; whereas such genera as *Stingelia* and *Stomacoccus*, in which the eyes are of a simpler type, lack the dorsal tuft, but may carry a pair of simple white caudal filaments similar to those found in the males of the *Dactylopiinae*. *Calostomidia* appears to fill an intermediate position, the males of this genus having faceted eyes, but no dorso-abdominal tuft of filaments.

*Margarodes*, the type genus of the sub-family, contains species adapted to a subterranean life. The anterior limbs in both sexes

are modified for a fossorial habit, and the nymphs are enclosed in a firm nacreous test.

*Callipappus* has been shown by Fuller (*Trans. Ent. Soc. Lond.*, 1899, p. 436) to be particularly characterised by an 'intussusception of several of the abdominal segments of the mature females, in the form of a marsupium, in which the eggs are laid and incubated.' MacGillivray (*The Coccidæ*, p. 94) erects a separate sub-family for *Callipappus* on the supposition that the limbs are retained throughout the nymphal stages; but I have been unable to discover a description of the nymphs of any single species of the genus. Maskell expressly states that he has never met with the earlier stages. Fuller makes no reference to them; while Westwood describes only the embryonic larva extracted from the body of the mature female.

The species of the remaining genera have their habitat mostly on the stems of various trees, the nymphal stages being passed either within the tissues of the bark, or in dense waxy cells on the surface. *Stomacoccus* is exceptional in that the nymphal stage (of the one known species) is completely exposed.

At present, one genus only (*Kuwania*) is known to occur in Ceylon; but it is highly probable that further search will reveal one or more species of *Margarodes*, three of which have been described from Southern India.

KEY TO GENERA OF MARGARODINÆ.

- A. Males with faceted eyes and dorso-abdominal tufts of silky filaments. Females with not more than two digitules on claw.
  - a. Males with branched antennæ. Female unknown  
(NEOMARGARODES.)
  - b. Males with simple antennæ.
    - a<sup>1</sup>. Males and females with anterior limbs fossorial  
(MARGARODES.)
    - a<sup>2</sup>. Males and females with anterior limbs normal.
      - a<sup>3</sup>. Abdomen of female invaginated to form a marsupium..... (CALLIPAPPUS.)
      - b<sup>3</sup>. Abdomen of female not invaginated.
        - a<sup>4</sup>. Tibiæ of female with a group of knobbed setæ at distal extremity..... KUWANIA.

- b*<sup>4</sup>. Tibiæ of female without knobbed setæ.
- a*<sup>5</sup>. Antenna eight-nine-jointed ; limbs of larva normal ..... (XYLOCOCCUS.)
- b*<sup>5</sup>. Antenna ten-jointed ; limbs of larva crab-like  
(MATSUCOCCUS.)
- B. Males with faceted eyes, but without dorso-abdominal tufts.  
Females with not more than two digitules on claw  
(CÆLOSTOMIDIA.)
- C. Males with simple eyes ; without dorso-abdominal tufts.  
Females with more than two digitules on claw.
- a*. Antenna of female eight-jointed ; buccal apparatus vestigial..... (STEINGELIA.)
- b*. Antenna of female seven-jointed ; buccal apparatus well developed and functional ..... (STOMACOCCUS.)

## Genus KUWANIA, Cockerell.

*Sasakia*, Kuwana, *Pr. Cal. Ac. Sci.* (3), Vol. III. p. 47 (1902).

The name *Sasakia* being preoccupied, Cockerell has proposed *Kuwania* as a new name for the genus.

Kuwana's diagnosis of *Sasakia* is as follows: 'Adult female with nine-segmented antennæ; body distinctly segmented, mouth-parts wanting in the adult stage; no digitules on claw nor on tarsus; anal tube absent; enclosed in cottony secretion. Larva with six-segmented antennæ, anal tube wanting.'

With respect to this description I would point out that examination of actual specimens of *K. quercus* (the type species of the genus) show that the antennæ are in reality ten-jointed. The author has apparently not taken count of the large and prominent basal joint, regarding it, presumably, as no true joint, but as a frontal tubercle supporting the antennæ. I believe this interpretation to be incorrect. In a properly stained preparation of the insect it can be seen that the process in question, though weakly chitinized, has clearly defined boundaries, and is undoubtedly homologous with the more rigid basal joint of the antenna in other *Coccidæ*. The mouth-parts in *K. quercus* are entirely wanting, but in *zeylanica*, which I am now assigning to this genus, the rostral skeleton is present. The apparatus is, however, functionless, owing to the absence of any rostral filaments. It is possible that intermediate degrees of development of the mouth-parts may occur in other species, as is found to be the case in the allied genus *Nylococcus*. Kuwana makes the absence of digitules a character of his genus; but the absence or presence of these organs can hardly be regarded as of generic importance. I can, moreover, detect on all the claws of his *quercus* a pair of fine simple setæ occupying the usual position of unguinal digitules. Though there may be no functional anal tube, there is a distinct bifurcated chitinous plate occupying the usual position of the anal orifice.

The young larva of *zeylanica* has the unusual number of seven joints to the antennæ.

Besides the type species—*quercus* (from Japan), the genus at present contains only one other species—*zeylanica* (from Ceylon). The insect described under the name of *Kuwania britannica* (from England) has now been proved to be identical with *Steingelia gorodetskia* (from Russia).

## KUWANIA ZEYLANICA, Green.

(PLATE CLXXV.)

*Monophlebus zeylanicus*, Green, *Ind. Mus. Notes*, Vol. IV. p. 6 (1896).

Adult female (*fig.* 1) bright reddish orange; eyes black. Body (*figs.* 2, 3) elongate, bluntly pointed in front, rounded behind; moderately tumescent; distinctly segmented. Naked or slightly powdered with whitish meal;

secreting, after gestation, a mass of white woolly matter in which the eggs are loosely embedded. Antenna (*figs.* 7, 8) ten-jointed, the tenth small and very indistinctly divided from the ninth; first and second joints stout, cylindrical; third with the basal half cylindrical, the apical half smaller and rounded; the remaining joints narrowed basally and expanded distally. All the joints have a transverse, slightly constricted median zone, and there is a whorl of setæ on the apical half of each. Rostral apparatus completely concealed within a deep fold, in the living insect, but conspicuous after maceration; consisting of well-developed tentorium and rostrum, but with no rostral filaments. Limbs (*fig.* 4) strongly developed; the tibia long, slightly constricted at a point a little before the end, and with a dense terminal tuft of stout setæ the majority of which are knobbed (see *fig.* 5); tarsus strongly bowed; claw (*fig.* 6) stout, with three strong teeth on the apical half of the inner edge; digitules represented by fine simple setæ. Thoracic spiracles (*fig.* 9) trulliform (ladle-shaped), the hollow of the bowl lined with polygonal glandular cells, the anchoring piece (which represents the handle of the ladle) terminating in a series of hook-like processes. Abdominal spiracles (*figs.* 10, 11) six on each side, one pair on each of the first six abdominal segments, opening on the venter just within the margin; visible, on the living insect, as a series of small punctures filled with white secretion. The abdominal spiracles (*fig.* 10) are slightly smaller than those of the thorax, and are poculiform (of the shape of a goblet), the base of the hollow lined with glandular cells. Derm with numerous conspicuous saucer-shaped compound pores (see *figs.* 10, 11, 12), each with a thickened rim and a rosette of either five or six translucent cells surrounding the central aperture; there is also a ring of minute circular cells between the rim and the median cluster. A few, much smaller, simple pores, are scattered sparsely around each stigmatic orifice. Each segment is encircled by a transverse series of setæ, which are longer and stouter on the venter, more particularly so on the abdominal segments. Anal orifice (*fig.* 13) minute, demarked by a semi-circular chitinous band, and surrounded by irregularly concentric dermal folds, on the outermost of which are six short setæ (three on each side). Length 7 to 8 mm. Breadth 2.5 mm.

Young larva (*fig.* 17) elongate, tapering in front; bright yellow, eyes black. Antenna (*fig.* 18) seven-jointed, the two terminal joints largest; the seventh with four or five long hairs on its truncate extremity. Posterior extremity with a fringe of short hairs and a pair of longer caudal setæ. Length 1.5 mm.

A later larva (probably that of a male) was found within a small mass of woolly secretion, in a crevice of the bark. It is of a very pale yellow colour; the antennæ eight-jointed, all the joints—except the second—short and broad. No trace of rostral apparatus. Legs with a small group of knobbed hairs at the end of the tibia. Length 2.75 mm.

Nymph occupying cavities constructed in the soft inner bark of the tree (see *fig.* 14), from a quarter to half an inch from the surface. The cavities are lined with a thin deposit of greyish wax. Insect (*fig.* 15) long-ovate, narrower behind, unsegmented; yellow, the skin smooth and polished; limbs and antennæ absent; rostral apparatus present, complete with functional setæ; eight pairs of spiracles, of which two are thoracic and the remaining six abdominal; anal orifice small, horseshoe-shaped (*fig.* 16). Derm with compound pores (similar to those of the adult), restricted to an area extending inwards from the margin as far as the spiracles, irregularly scattered on the



cephalo-thorax, but aggregated into double transverse bands on the abdominal segments (see *fig.* 22). Length 3 mm. Breadth 2 mm.

Adult male (*fig.* 19) dull brown, darker above. Wings smoky grey (in some examples almost colourless), costal area dull brown or blackish, the costal nerve ending in a diffused fuliginous fascia. Halteres with a single hooked bristle. Eyes dark chocolate brown, moruliform. Antennæ ten-jointed, long and slender, strongly pubescent. A sparse tuft of fine silky filaments springs from the dorsum, near the extremity of the abdomen. Examination of a macerated preparation shows that these filaments are produced from short secretory ducts, arranged in two transverse rows (see *figs.* 20, 21). Each segment of the abdomen carries a transverse series of very short setæ, springing from comparatively large bases; and, on each side, two or three compound pores. Length 2 to 2.5 mm.

Male nymph elongate; pale yellow. The short wing-pads are folded along the sides and the ten-jointed antennæ turned back on each side of the head. The insect, though possessing well-developed legs, is very sluggish. It rests in crevices of the bark, enveloped in loose cottony secretion.

The adult females were found wandering upon the stems of *Antidesma bunius*: Pundaluoya. The anterior half of the body is often thrust into a crevice of the bark. When walking, the abdomen is slightly elevated (see *fig.* 1). When confined in a glass tube, the insects buried themselves in the cork, forcing their way through crevices and holes seemingly much smaller than their own girth and—in some instances—working themselves completely through the cork.

The seven-jointed antenna of the early larva is an unusual character. It is possible that the larvæ may differ sexually in this respect. Unfortunately, the drawing (*fig.* 18) was made from the only available example of the insect in this stage.

This insect, in general characters, conforms to the description of Kuwana's genus *Sasakia* (since renamed *Kuwania*). The apparent discrepancy in the number of antennal joints is explained in the foregoing notes on the genus. But a more serious difficulty arises with regard to the mouth parts, which are totally wanting in *quercus* (the type of the genus), but are comparatively well developed—though functionless—in *zeylanica*. In the allied genus *Xylococcus*, however, a similar condition has been observed, different species showing various degrees in the development of these parts. The knobbed hairs on the tibiæ are characteristic of *quercus* also. The only other doubtful point concerns the characters of the males. The male of *K. quercus* is unknown; that of *zeylanica* has compound eyes. But the males of the otherwise closely allied *Steingelia gorodetskia* have simple eyes. If those of *Kuwania quercus* should eventually prove to be of this type, then *zeylanica* will have to find accommodation elsewhere—in a distinct genus.

## CHAPTER XIII.

## SUB-FAMILY MONOPHLEBINÆ.

THIS sub-family, although containing the largest members of the whole family, is perhaps less perfectly known than any other. This is chiefly due to the difficulty of obtaining material in sufficient abundance for really accurate study. Many of the genera are represented in most collections by a few individuals too often in a poor state of preservation, and the types have largely been described from superficial characters only. With very few exceptions the species are confined to the tropical and subtropical regions.

The insects are provided with antennæ, limbs, and buccal apparatus in all stages. The limbs are usually robust and densely chitinous. Dermal pores of a complex structure are a conspicuous feature. There is no setiferous anal ring. Abdominal spiracles are present in all the species.

Attempts have been made to classify the genera by the number of such spiracles; but, apart from the fact that their position is usually difficult to locate (owing to the presence of crowded setæ or other dermal processes), the species are not yet sufficiently well known to justify such a classification.

I am unable to find any satisfactory generic distinctions between *Monophlebus*, *Drosicha*, *Llaveia*, *Tessarabolus*, *Ortonia*, *Guerinia*, and *Monophlebulus*, and have, accordingly, included them all in the type genus.

The characters of the two aberrant genera *Stigmaccocus* and *Cryptokermes* are not sufficiently well known to enable me to place them with any confidence, and they have been omitted from the following table. It seems possible that both may be more nearly associated with the *Margarodinae* than with the *Monophlebinae*. The basal joint of the antenna of *Stigmaccocus* is membranous, as in *Xylococcus* and its allies. *Cryptokermes* is said to lack mouth-parts in the adult female stage, and to secrete a long tubular anal filament in the nymphal stage.

SYNOPSIS OF GENERA.

- A. Larvæ with six-jointed antennæ. Adult females naked, or with mealy or woolly covering, or with fragile secretory appendages ; never with hard, dense, waxy appendages.
  - a. With a clypeus-like lobe covering the mouth parts  
(CLYPEOCOCCUS.)
  - b. Mouth parts exposed.
    - a<sup>1</sup>. Dermal pores all of approximately one size and type.  
Antennal joints of male tri-nodose ... MONOPHLEBUS.
    - b<sup>1</sup>. Dermal pores usually of two or more sizes and forms.  
Antennal joints of male bi-nodose.
      - a<sup>2</sup>. Adult female with a deep invagination of the venter  
(STEATOCOCCUS.)
      - b<sup>2</sup>. Adult female without invagination of venter...ICERYA.
- B. Larvæ with five-jointed antennæ. Adult females with dense, hard waxy appendages on the dorsum, or on the marginal area alone.
  - a. Adult female with ten-jointed antennæ.
    - a<sup>1</sup>. Adult female without invagination of venter  
WALKERIANA.
    - b<sup>1</sup>. Adult female with invaginated venter.
      - a<sup>2</sup>. Entrance to invagination closed by an operculum.
      - a<sup>3</sup>. Dorsum with prominent chitinous process or processes .....(LOPHOCOCCUS.)
      - b<sup>3</sup>. Dorsum without chitinous processes  
ASPIDOPROCTUS.
    - b<sup>2</sup>. Invagination closed by lateral labiæ, without operculum..... LABIOPROCTUS.
  - b. Adult female with eleven-jointed antennæ.....NIETNERA.

Genus MONOPHLEBUS, *Burmeister.*

- Monophlebus*, Burmeister, *Handb. Ent.*, Vol. II. p. 80 (1835).  
*Drosicha*, Walker, *Cat. Brit. Mus. Hom.*, Vol. IV., Supp. p. 306 (1858).  
*Tessarabolus*, Montr., *Ann. Soc. Linn. Lyon*, Vol. XI. p. 246 (1864).  
*Guerinia*, Targ., *Catalogue*, p. 31, 1869.  
*Ortonia*, Sign., *Ann. Soc. Ent. Fr.* (5), Vol. V. p. 363 (1875).  
*Llaveia*, " " " " " (5), Vol. V. p. 370 (1875).  
*Monophlebulus*, Ckll., *The Entom.*, Vol. XXXV. pp. 213, 318 (1902).

Burmeister's original diagnosis of the genus runs as follows: 'Male with many (up to twenty-five) antennal joints, contiguous, granular. Small leaf-like halteres, simple claws; two small fleshy tubercles at end of abdomen, beset with a few short bristles. Female provided with antennæ and limbs, antennæ eleven-jointed, body movable, slightly pilose, distinctly articulated during life.' *M. atripennis* is designated as the type of the genus, but the male only of this species has been recognised.

The excessive number of antennal joints that Burmeister has attributed to the males of *Monophlebus* is due to a misconception of the structure of those organs. There are actually ten joints only; but eight of these are tri-nodose. The author has apparently counted each node as a distinct joint.

If followed strictly, this diagnosis would limit the genus to those species in which the males are possessed of but a single pair of caudal appendages; but other species in which the males are provided with three, four, and five pairs are clearly congeneric with the type. The only alternative to their inclusion would be the erection of a separate genus for each different number of such appendages. Similarly the insistence upon eleven-jointed antennæ in the female of *Monophlebus* would exclude all the Indian species, in which the number of antennal joints is found to be eight or nine only, the former being the more usual number.

Separate genera have, in fact, been proposed to satisfy these different conditions. They may be summarised as follows:

1. *Monophlebus*, antenna of ♀ with 11 joints: ♂ with 1 pair of appendages.
2. *Ortonia* " ♀ " 11 " ♂ unknown.
3. *Llaveia* " ♀ " 11 " ♂ with 4 pairs of appendages.
4. *Guerinia* " ♀ " 11 " ♂ unknown.
5. *Tessarabolus* " ♀ " 10 " ♂ with 2 pairs of appendages.
6. *Drosicha* " ♀ " 9 " ♂ " 5 " "
7. *Monophlebulus* " ♀ " 7 " ♂ unknown.

The series might be completed by inserting another new genus between *Drosicha* and *Monophlebulus* to contain the species from the Indian Region with eight-jointed antennæ in the female, and an additional genus would be required for those males provided with three pairs of caudal appendages.

Our knowledge of these large species is still very incomplete, and the actual material available is meagre, some of them being represented by single

examples only. Many of the species are known only from one or the other sex. The total number of species described (or semi-described) attributed to the seven proposed genera is thirty-six—all told. I anticipate that, with increased knowledge, this small number even will be reduced: firstly, by the correct pairing of males and females (at present figuring under distinct specific names); and, secondly, by the reduction of others to the rank of synonyms. Under these circumstances I prefer to regard them all as members of the genus *Monophlebus*, for which I would propose the following wider diagnosis:

Adult females large, corpulent, fleshy, usually ovoid, segments well defined; active in all stages, naked or farinose, sometimes concealed beneath loose woolly or flocculent secretion, but not exhibiting definite waxy plates or processes. Antennæ with from seven to eleven joints. Eyes densely chitinized. Legs stout, usually dark-coloured. Derm pilose, with numerous small circular compound pores, setæ not collared at the base.

Adult males relatively large. Wings ample, dusky, exhibiting two strong nervures and two hyaline folds; membrane corrugated. Halteres spathulate, with an apical row of stout hooked bristles. Antennæ ten-jointed, the basal two joints simple, the remaining eight joints more or less distinctly tri-nodose, each node with a whorl of long hairs. Abdomen with from two to ten fleshy, pilose appendages. Eyes large, prominent, moruliform. Ocelli relatively small, one at the hinder edge of each eye.

The species are mostly confined to the Tropical Regions, but one (*serratulæ*) is found in the Mediterranean Region. I record four species from Ceylon—one known only by females, and three by males only. It is probable that one of these males should be paired with the female; but, at present, I have no clue to the correct association. The species represented by females only is referable to *contrahens* of Walker. The three males may be distinguished by the following characters:

- A. Abdomen with a single pair of caudal appendages ..... *furcatus*.
- B. Abdomen with two pairs of appendages.
  - a. Thorax yellow and black; tarsi strongly bowed, halteres with four bristles..... *variegatus*.
  - b. Thorax red and black; tarsi relatively straight; halteres with five bristles ..... *quadricaudatus*.

MONOPHLEBUS CONTRAHENS, *Walk.*

(PLATE CLXXVI.)

*Drosicha contrahens*, *Walk., Cat. Br. Mus. Hom., Vol. IV., Suppl. p. 306 (1858).*

Adult female (*figs. 1, 2, 3*) ovate, rounded in front and behind; convex above, tumescent below, the segments well defined; dorsum with two concentric sulci dividing it into median, submedian, and marginal areas. Colour dull pinkish purple, thinly but closely covered with a fine whitish mealy powder. A specimen, kept in confinement, produced a few straggling irregular white

filaments from the marginal area. Legs, antennæ, and eyes black. Genital orifice surrounded by a bright pinkish area, free from the mealy secretion.

Antenna (*fig.* 4) eight-jointed, robust; joints one to three subcylindrical; four to seven narrowed at base and more or less gibbous; eighth elongate, equal to or longer than six and seven together.

Legs (*fig.* 5) robust; tarsus of mid leg less than half the length of tibia; tibia considerably shorter than the combined femur and trochanter. Claw varying in form from short and blunt (*fig.* 6), to long and sharply pointed (*fig.* 7); a pair of small and simple unguinal digitules; tarsal digitules represented by slender setæ.

Anal aperture (*fig.* 8) opening into a wide chamber with a fringe of irregular lobes at its inner end.

Dorso-abdominal spiracles (*fig.* 9) large and conspicuous; seven on each side, the fifth pair situated approximately on a level with the anal orifice; the entrance of each spiracle lined with a crowded group of multilocular pores of similar character to the dermal pores.

Derm crowded with large translucent cells, larger and more conspicuous on the dorsum, varying in form from subcircular to irregularly ovoid, or obscurely polygonal; each cell associated with either a pore or a seta (see *figs.* 9, 10).

Dermal pores distributed closely over both surfaces of the body, those on the dorsum more sharply defined. Each pore has a strongly marked chitinous peripheral ring, and a central orifice which may be two-, three-, or four-loculate (*fig.* 10). The space between the peripheral ring and the central orifice is occupied by a circle of from four to six rounded cells separated by sharply defined divisions.

The whole body is densely clothed with comparatively short setæ which are broader towards the base and taper rapidly to a fine point (see *figs.* 9, 10). The anal orifice is surrounded by a lax group of very much stouter setæ, and some still larger setæ occur on the posterior marginal area (*fig.* 11).

My few examples vary in length from 10 to 14 mm., with a breadth of from 6 to 9 mm.

Other stages not observed.

Described from three examples found on the stem of *Phyllanthus* sp., at Haldummulla. Single examples were found, subsequently, on unidentified plants, at Kandy, Matale, and Wellawaya. Received also from India (Sukkur Forest, Scind), on Tamarisk.

Closely allied to *M. tamarindus*, Green, from which this species differs in the presence of enlarged setæ on the posterior margin and surrounding the anal orifice.

The British Museum contains the type of *Monophlebus contrahens*—represented by a single specimen of which the antennæ and limbs are imperfect. In form and all external characters it agrees closely with my examples from Ceylon. Signoret, in his description of the species, draws attention to the presence on the terminal joint of the antennæ of 'three hairs much longer than the others.' In my examples the hairs vary considerably in size, but I cannot detect any particular three of outstanding length. As such hairs are easily detached and lost during the process of preparation, I am not inclined to separate my insects on the strength (or weakness) of this negative character.

Walker's type is labelled as from China. Signoret's more detailed descrip-

tion was drawn up from specimens received from Ceylon. It appears that the type specimen is *ex coll.* Cumming, whose collection was purchased partly from Fortune (whose material was gathered in North China) and partly from Thwaites (from Ceylon). It seems possible, therefore, that there may have been some confusion in the registered locality of this particular type. However, there is nothing impossible—or even improbable—in the same species ranging from Ceylon to China. I feel convinced, at least, that my specimens are equivalent to *contrahens* as determined by Signoret.

MONOPHLEBUS FURCATUS, *sp. nov.*

(PLATE CLXXVII.)

Adult male (*fig.* 1) dull brick-red, pruinose; notal plates darker; scutellum pale reddish brown. Wings ample, dull black, with a greyish bloom; costal nervure pale brown, second nervure deep black, the interneural folds white; minutely rugose between the nervures (see *fig.* 4). Halteres (*figs.* 5, 6) with six (rarely five only) stout hooked bristles at the distal extremity. Antennæ dark brown; ten-jointed; basal joint short (see *fig.* 7), with scattered short hairs; second joint approximately twice as long as the first, with scattered long hairs; other joints elongate, tri-nodose, with a whorl of long hairs on each node. Compound eyes black, moruliform (*fig.* 8), the facets large (*fig.* 9); a prominent simple ocellus above the inner edge of each eye. Legs reddish brown; tarsus straight or slightly curved (*fig.* 3), with a sharply demarked triangular segment at its base; rather less than half the length of the tibia; unguai digitules long and slender, simple. Caudal appendages (one on each side) wrinkled; with comparatively short hairs. Dermal pores (*fig.* 10) with a central orifice surrounded by four or five large translucent cells. Length (without appendages) 4.5 to 6 mm. Expanse of wings 10 to 13 mm. Length of antennæ 4.5 to 5 mm. Length of caudal processes 1 to 1.5 mm.

Taken at high elevations only: Pattipola, Pundaluoya, Maskeliya.

It is possible that this insect may be identical with *Mon. atripennis* of Burmeister from Java.

MONOPHLEBUS VARIEGATUS, *sp. nov.*

(PLATE CLXXVIII.)

Adult male (*fig.* 1); head and thorax yellow, eyes crimson; mesonotal plates shining black, with a large, lunate, clear, central space; posterior segments of abdomen dull crimson; legs and antennæ black; wings deep slaty black, dull, the interneural folds whitish. The abdomen is narrowed at the base, widening posteriorly (see *fig.* 2); the extremity with two elongate, wrinkled, hairy, fleshy appendages on each side. Antennæ ten-jointed; the basal joint

short and stout, with a few short hairs, second joint slightly shorter than first, with two rather confused whorls of long hairs and some scattered short hairs; the remaining eight joints elongate, tri-nodose, a distinct whorl of long hairs radiating from each node. Compound eyes very prominent, moruliform, the facets rather widely spaced (see *fig.* 6). There is a large ocellus at the inner angle of each eye. Legs rather long; tibia slender, its distal extremity recurved almost at right angles (*fig.* 3); tarsus very slender, strongly bowed, sickle-shaped; claws relatively stout, distorted into various forms (see *fig.* 4); unguinal digitules short and simple; no tarsal digitules. Wings ample, transversely and irregularly rugose between the nervures; membrane (except costal area) minutely aerolate. Halteres wrinkled, each with four stout, hooked bristles on its truncate extremity (*fig.* 5). Dermal pores (*fig.* 7) relatively large, quadrilocular (occasionally trilocular). Length of body (exclusive of appendages) 5 mm. Expanse of wings 12 mm. Length of antenna 6 mm. Length of caudal appendages 1 mm.

Described from a single example. Kandy, July.

MONOPHLEBUS QUADRICAUDATUS, *sp. nov.*

(PLATE CLXXIX.)

Adult male (*fig.* 1) dull brick red, pruinose; mesonotal plates black. Wings dull black, the interneural folds white; reddish brown towards the base, the extreme base hyaline. Legs, antennæ, and eyes black. Caudal processes bright red. Antennæ ten-jointed; basal joint stout (see *fig.* 7), with scattered short hairs; second joint narrower and slightly shorter than first, with some scattered short hairs and two—somewhat confused—whorls of long hairs; remaining joints elongate, tri-nodose, with a distinct whorl of long hairs radiating from each node. Compound eyes moderately prominent, the facets (*fig.* 3) strongly convex. Wings ample; coarsely rugose between the nervures. Halteres with five stout, hooked bristles (*fig.* 2). Limbs well developed; tarsus (*fig.* 4) straight or slightly curved, about half the length of the tibia; claw (*fig.* 5) long, acutely pointed, unguinal digitules small and simple, no tarsal digitules. Caudal appendages (two on each side) wrinkled, hairy, with some longer and stouter hairs towards their apices. Dermal pores (*fig.* 6) with a circular central orifice surrounded by four opaque rounded cells. Length (exclusive of appendages) 4.5 mm. Expanse of wings 11.5 mm. Length of antenna 6 mm. Length of caudal processes 0.75 mm.

Described from three examples, taken at Peradeniya, October, 1911.



Genus ICERYA, *Sign.*

*Icerya*, Signoret, *Ann. Soc. Ent. Fr.* (5), Vol. V. p. 351, 1875.

*Crossotosoma*, Douglas, *Ent. Mo. Mag.*, Vol. XXVI. p. 79, 1890.

*Proticerya*, Cockerell, *Psyche*, Vol. VII. Suppl. 1, p. 15, 1895.

The genus was erected to contain the species *seychellarum*, but now accommodates some twenty or more distinct species, of which the best known is the notorious 'Fluted Scale' (*Icerya purchasi*). It is a fairly compact genus, characterised by insects of comparatively large size, having a more or less complete covering of mealy or powdery secretion intermingled with erect, glassy, tubular filaments. There is usually a marginal series of compact, waxy processes, the hindermost of which are greatly elongated and form a covering to the ovisac. The antennæ of the adult female are typically eleven-jointed, but, in a few species the number is reduced to ten (*e.g.*, *rileyi*, *jacobsoni*, *minor*), or even nine (*filosa*). The eyes are well-defined, broadly and truncately conical. The limbs are strongly developed, densely chitinous, and usually dark-coloured. The derm is more or less clothed with long setæ, certain of which are usually markedly longer than the others. The setæ are raised on small chitinous tubercles and their bases are often surrounded by a translucent collar (see Plates CLXXX, *fig.* 12 ; CLXXXII, *fig.* 22). There are numerous multicellular pores, usually of two or more forms and sizes. This differentiation in the character of the pores reaches its maximum in such species as *seychellarum* and *filosa*. The smaller pores are apparently responsible for the mealy secretion and the larger pores for the production of the tubular filaments. Several of the species exhibit ventral cicatrices immediately behind the genital aperture, and in some species (notably *nigro-areolata*) the cicatrices are filled in with pigmented cells.

Nymphs very similar to adults ; but with a reduced number of antennal joints.

Larvæ with six-jointed antennæ, the terminal joint largest and bearing four or more very long, whip-like setæ. Posterior extremity of the body with six exceptionally long setæ.

Adult males relatively large. The antennal joints (with the exception of first and second) bi-nodose, each node with a whorl of long setæ. Eyes prominent, compound. A single ocellus on each side, close to the hinder edge of the compound eye. Wings ample, dusky. Posterior extremity with a single pair of wrinkled, fleshy, setose appendages.

Three species appear to be indigenous in the Island, and a fourth (*purchasi*), through some unfortunate accident, has been introduced within recent years.

SYNOPSIS OF CEYLON SPECIES.

A. Larger dermal pores not differing markedly from the smaller pores ; central area relatively small.

(a) Adult female without conspicuous waxy appendages ; glassy filaments numerous. Ovisac large and conspicuous ..... *purchasi*.

- (b) Adult female with conspicuous, radiating, white, waxy appendages; glassy filaments few. Ovisac relatively small and inconspicuous ..... *egyptiaca*.
- B. Larger dermal pores ring-shaped: with large, clear, central area; diameter greatly exceeding that of the smaller pores.
- (a) Antenna of adult female eleven-jointed.
- (a) Claw smooth; larger pores conspicuously beaded ..... *seychellarum*.
- (b) Claw minutely serrate, larger pores not conspicuously beaded ..... *seychellarum nardi*.
- (b) Antenna of adult female six- to nine-jointed..... *pilosa*.

ICERYA PURCHASI, *Maskell*.

(PLATE CLXXX.)

*Icerya purchasi*, Mask., *N.Z. Trans.*, Vol. XI. p. 221 (1878).

This insect, having made its appearance in Ceylon since my departure from the Island, I have had no opportunity of examining living material. The detailed description given below, and the accompanying figures, were made from specimens that had been preserved in alcohol. Many of the superficial characters of the fresh insect have consequently been lost. Under these circumstances, I have resorted to the account of the living insect given by Maskell in his volume on the Scale Insects of New Zealand. He there describes the adult female as being 'dark reddish brown, covered with a thin powdery secretion of yellowish meal, and with slender glassy filaments; stationary at gestation, and gradually raising itself on its head, lifting the posterior extremity until nearly perpendicular, filling the space beneath it with thick white cotton which gradually extends for some distance behind it in an elongated ovisac, longitudinally corrugated; ovisac often much longer than the insect.'

The attitude of the insect is depicted in my *fig. 1*, which also shows the characteristic fluted appearance of the ovisac; but the long glassy filaments, which gives to the living insect a conspicuously hairy appearance, have been dissolved by the alcohol in which it was preserved. After complete denudation the insect is seen to be strongly convex (*fig. 2*), rising—at the middle—into a series of more or less prominent humps, which are accentuated by the presence of dense tufts of stout blackish setæ (see *fig. 14*). There are similar tufts of setæ surrounding the lateral margin of the insect, and the whole dorsal area is thickly clothed with similar but rather shorter setæ. As in most other members of this genus, each seta arises from a prominent tubercular base which is surmounted by a translucent collar (*fig. 12*). Antenna (*fig. 3*) eleven-jointed; second joint cylindrical, third usually constricted about its middle, fourth to tenth narrowed at base and expanded distally, the eleventh very irregularly ovate. Limbs black; well developed; the tibia approximately as long as the femur; the tarsus half as long as the tibia, strongly bowed; claw (*fig. 4*)

strongly falcate, with two simple hair-like digitules. Derm with numerous conspicuous pores, of two forms, more particularly crowded upon the marginal area. The larger form of pore, as viewed from above (*fig. 5*), has a circular outline and a circular median orifice around which is a ring of (usually) nine beads; when viewed at an angle (*fig. 6*), or in profile (*fig. 8*), the beads take the form of deep fluting surrounding the orifice of the central tube, and the circular rim is in the form of a broad funnel, so that the aperture of the pore is sunk below the surface, or 'countersunk.' In some cases, there appears to be a second inverted funnel below and opposed to the other (see *fig. 7*). Maskell has incorrectly described and figured these pores as standing out prominently above the surface of the body. The smaller pores (*figs. 9, 10, 11*), which are by far the more numerous, are of the same general structure as the others, but have a more oval outline and an elongated central aperture; the number of beads surrounding the aperture may be either seven or eight. The larger pores are confined to the marginal area. Abdominal spiracles three on each side; one pair on each of the three terminal segments. There are three, more or less conspicuous, oval cicatrices on the venter, posterior to the genital aperture. Length of fully developed female, 4 to 5 mm.

Nymph similar to adult, but smaller. Antennæ nine-jointed.

Young larva with six very long setæ radiating from the posterior extremity of the body. Antennæ six-jointed. Derm with pores of the smaller, oval type only.

I have not seen the adult male; but it is described by Maskell as being 'red, with a shining, diamond-shaped black patch on the dorsal surface of the thorax: legs and antennæ black. Wings dark brown . . . main nervure red.'

The species has a wide range of food plants in different parts of the world, though it is as an enemy of plants of the Citrus family that it has become notorious. In Ceylon its principal host appears to be *Acacia decurrens*—a plant introduced from Australia (the original home of the 'Fluted Scale'). But as the Acacias are always grown from seed the advent of the pest cannot be attributed to this cause. It has also been recorded (in Ceylon) from *Casuarina*, *Citrus*, and (very occasionally) from tea, though it does not appear to have attacked any of these last-named plants to a serious extent.

The introduction of this notorious pest into Ceylon is somewhat of a mystery. It was first noticed in the year 1916, infesting *Acacia decurrens* in the district of Ambawella; but reports received early in the following year showed it to have extended to the Agras, Lindula, Galaha, Hewaheta, and Peradeniya districts. The fact that, when first observed, it was already strongly established upon the Acacias, suggests that it must have been in the country for several years; but I feel sure that it could not have escaped my attention if it had been present in Ceylon before 1912. With the strict quarantine regulations that have been in force since early in the present century it is difficult to understand how it could have come in unobserved. The Pests Ordinance of Ceylon provides that every growing plant, and most fruits (including all of the Citrus family) must be subjected to fumigation with Hydrocyanic Acid Gas, in a properly constructed Fumigatorium, at the port of entry before being handed over to the consignee. Colombo being the sole port of entry for ocean-going steamers it is a comparatively simple matter to enforce this Ordinance.

Writing in February 1917 the Acting Government Entomologist reported that the pest 'does not seem to attack tea or any other product of importance, so far. At present the N.E. Monsoon rains seem to have killed it off everywhere. Every specimen sent in is found to have been destroyed by fungus disease. As for the small colony that was found at Peradeniya it seems to have been killed out by a Coccinellid beetle that has been preying upon it. I have only been able to find one or two specimens of the scale, and they have had their ovisacs full of the larvæ of the Coccinellid. This is not *Vedalia cardinalis*, but a species of a uniform light chestnut colour.'

I understand that steps are being undertaken to introduce *Vedalia cardinalis*, the beetle that has proved of such immense value in other countries in keeping this pest in check. The history of the discovery and utilisation of this natural enemy of the 'Fluted Scale' is one of the romances of Economic Entomology. The pest, having been accidentally introduced into California some forty years ago, found its new home so congenial, and spread and multiplied to such an extent that it threatened to destroy the great orange-growing industry of that country. In the absence of its proper enemies which it had left behind in the country of its origin it was able to increase without any hindrance. At this juncture the United States Department of Agriculture advised the appointment of an expert to search for the natural enemies of the insect, and selected Mr. Albert Koebele for the mission. In Australia Mr. Koebele was successful in discovering a 'Ladybird Beetle' (*Vedalia cardinalis*) that was preying upon the *Icerya*, and efficiently holding it in check in that country. He collected and transported to the United States large numbers of the beetles, where they (and subsequent consignments) were established so successfully that the pest was reduced to a negligible quantity, and the threatened industry saved from ruin. From America this useful beetle has been sent to other countries (Portugal, South Africa, &c.), into which the 'Fluted Scale' had found its way with equally good results. We may confidently expect that the importation and establishment of the *Vedalia* in Ceylon will similarly mark the decline of our newly acquired pest.

*Icerya purchasi* apparently claims Australia as its original home, whence it has been introduced into New Zealand, and subsequently into South Africa, Fiji, the Sandwich Islands, the West Indies, and the Southern States of America. This pest has obtained a footing also in parts of Southern Europe (Portugal, France, Italy), and recently I have received examples from the island of Madeira. First observed and described in 1878 it has been nearly forty years in making its way to the Indian Region. It has not yet been recorded from the Continent of India, and if proper precautions are taken it should be possible to exclude it.

## ICERYA ÆGYPTIACA, Dougl.

(PLATE CLXXXI.)

*Crossotosoma ægyptiacum*, Douglas, *Ent. Mo. Mag.*, Vol. XXVI. p. 79 (1890).*Icerya ægyptiacum*, Riley and Howard, *Ins. Life*, Vol. II. p. 256 (1890).*Icerya ægyptiaca*, Newstead, *Ent. Mo. Mag.*, Vol. XXIX. p. 167 (1893).*Icerya tangalla*, Green, *Ind. Mus. Notes*, Vol. IV. p. 7 (1896).

Adult female (*figs.* 1, 4) orange red or brick red, limbs blackish, the dorsum more or less completely covered with cushions of white mealy secretion intermingled with pulverulent or granular wax. In the early adult the secretory cushions are distinct and separate, the intermediate parts being lightly dusted with white powdery wax, through which the colour of the body of the insect appears of a salmon-pink tint. Later, the waxy cushions coalesce and completely cover the dorsum, with but faint traces of segmentation. Margin of body with a complete fringe of stout, irregularly sinuate, tapering, snow-white processes, numbering (in perfect examples) eleven on each side. Douglas gives the number of processes as 'seven-eight'; but his examples were almost certainly imperfect. The processes are very brittle and easily detached or mutilated (see *fig.* 16). Those processes emanating from the anterior half of the body are considerably stouter than the remainder. After oviposition the narrower abdominal processes lie closely over and conceal the ovisac.

Limbs and antennæ blackish or dark brown; the former eleven-jointed (*fig.* 5), occasionally nine- or ten-jointed—by fusion or suppression of intermediate joints; terminal joint irregularly oblong ovate, longest; the three basal joints broad and stout, approximately cylindrical; the remaining joints broader at the distal extremity. Legs large and stout; tibia approximately equal in length to femur and trochanter combined; tarsus approximately half the length of tibia, occasionally less; claw (see *fig.* 13) strong and falcate; digitules simple. Eyes (see *fig.* 5) blackish, truncately conical. Thoracic spiracles large and conspicuous, heavily chitinized. Abdominal spiracles (*fig.* 12) small and inconspicuous; three on each side, near the extremity of the body. Derm with numerous pores of two forms and sizes. The smaller pores (which are the more numerous) have a trifoliate central aperture (*fig.* 9) surrounded by a ring of eleven contiguous beads; the centre, as seen in profile (*fig.* 10), projects above the beaded ring. There is a crowded transverse series of these small pores, on the venter, across the base of the abdomen on a line corresponding with the anterior border of the ovisac. The larger pores (*figs.* 7, 8) have an irregular central aperture surrounded by a double-beaded ring, the inner ring containing seven-eight, and the outer ring fourteen-fifteen beads. Dermal setæ numerous, varying in length and thickness, the larger setæ more abundant on the marginal area (*fig.* 6). Each seta springs from a prominent tubercular base surmounted by a translucent collar (*fig.* 11) which appears to be closed at its distal extremity. In the smaller setæ the collar is very short and inconspicuous. Size very variable. Average length about 5 mm., with a breadth of 4 mm.;

occasional examples may attain a length of 6 mm., and I have observed fully matured females measuring little more than 3 mm. in length.

Nymphal stages similar to adult, but with smaller and less-pronounced processes. Antennæ six-seven jointed.

Young larvæ (*fig. 2*) pale pink, thickly dusted with white meal; legs and antennæ very pale brown. Antennæ six-jointed, with long hairs. Posterior extremity with six long radiating setæ.

Adult male (*fig. 14*) brownish red; the metatergal and metasternal plates blackish. Legs and antennæ dark brown. The whole body dusted with whitish meal, which is aggregated into loose tufts on the sides of the abdomen. Wings fuliginous, with a greyish bloom; costal nervure reddish, second nervure black; interneural folds white; membrane with minute transverse corrugations. Eyes prominent, compound. A single prominent ocellus slightly behind each eye. Antennæ long and moderately slender; ten-jointed, each joint (except the basal two) with two prominent thickened nodes (see *fig. 15*), from which spring whorls of long hairs. Posterior extremity with a pair of stout wrinkled fleshy appendages, each bearing at its extremity six or seven longish setæ. Total length (including appendages) 3 mm.

An abundant and widely spread species, occurring throughout the island on numerous plants, amongst which may be mentioned *Acalypha*, *Anona*, *Bragantia*, *Codiaeum*, *Cullenia*, *Montinoa*, Palms, *Psidium*, Rose, Tea, *Strobilanthes*, &c. Often present in such masses as to endanger the health of the plant, but not—at present—reported as a pest of economic importance. Recorded first from Egypt; but ranging throughout the Eastern Tropics.

#### ICERYA SEYCHELLARUM, *Westwood.*

(PLATE CLXXXII.)

*Dorthezia seychellarum*, Westw., *Gard. Chron.* p. 830 (1855).

*Coccus sacchari*, Guer., *Rev. et Mag. Zool.* (2), Vol. XIX. p. 451 (1867).

*Orthezia seychellarum*, Targ., *Catalogue*, p. 30 (1869).

*Icerya sacchari*, Sign., *Ann. Soc. Ent. Fr.* (4), Vol. IX. pp. 90, 94 (1869).

*Icerya seychellarum*, Mask., *N.Z. Trans.* Vol. XXIX. p. 329 (1897).

*Icerya crocea*, Green, *Ind. Mus. Notes*, Vol. IV. No. 1, p. 7 (1896).

? *Icerya okadae*, Kuw., *Bul. Ag. Exp. Sta. Japan*, Vol. I. No. 2, p. 178 (1907).

Adult female orange red or brick red, obscured by a granular covering of waxy secretion which may be either bright canary yellow (*figs. 1, 2*) or white tinged with yellow (*fig. 4*). The bright yellow colour is more usual in the younger individuals, though it may be retained in the later stages. Interspersed with the granular secretion are numerous long silky tubular filaments. Legs, antennæ, and eyes black. The secretory matter is aggregated into short tufts or tassels, of which there is a median longitudinal series on the dorsum and a more or less complete marginal series, the latter being duplicated on the abdominal segments. Finally, a well-developed ovisac is produced from below

the posterior extremity, which may extend to a length approximately equal to that of the body of the insect. The ovisac is smooth below (see *fig.* 3), but is covered above by a close series of long cylindrical waxy processes (see *fig.* 4). Antennæ (*fig.* 14) eleven-jointed, the second, third, fourth, and fifth broadly cylindrical, the remainder narrower at their bases. Eyes prominent, bluntly conical. Legs of the typical form (*fig.* 6), the tarsus strongly curved; claw (*fig.* 7) stout and falcate, its inner edge smooth; with two simple hair-like digitules. Dermal setæ moderately numerous, larger and stouter on the area surrounding the anal orifice; each seta springing from a stout tubercle which is surmounted by a comparatively short collar (*fig.* 16). Derm with numerous small beaded pores, having bilocular or trilocular apertures (*figs.* 12, 13), interspersed with many large and conspicuous prominent ring-shaped pores (*figs.* 9, 10, 11). The number of beads surrounding the small bilocular pores varies from seven to nine. The trilocular form is less common and is surrounded by eleven beads. The appearance of the large ring-shaped pores varies in different aspects. When viewed from above (*fig.* 10) the aperture appears to be encircled by a ring of from twenty to twenty-six oval beads; but when viewed from an angle (*fig.* 11) the beads seem to resolve themselves into a series of flutings lining the short tube of the pore; while, in a profile view (*fig.* 9) the fluting appears to be on the outer face of the tube. The last is probably the correct interpretation of the structure. At the point where the ring projects above the level of the derm it is surrounded by a narrow, irregular chitinous flange. The marginal area of the body is so crowded with pores and setæ that it is difficult to distinguish the abdominal spiracles or to determine their exact number; but there are at least three on each side, towards the hinder end of the body. Length of insect (under compression) 4 to 6 mm. Breadth 3.25 to 4.5 mm.

Young larva (*fig.* 5) pinkish orange; the margins partially concealed by colourless woolly secretion; the dorsum with three large patches of bright yellow secretion; extremity of abdomen with six very long setæ.

Eggs bright yellow.

On *Croton*, *Cocculus* sp., *Citrus*, *Acalypha*, *Grevillea*, and *Pterospermum suberifolium*. Pundaluoya, Madusima, Kandy.

#### ICERVA SEYCHELLARUM var. NARDI, nov.

A form found on *Andropogon nardus*, at Diyatalawa, may eventually prove to be a distinct species; but, until further material is available, I prefer to retain it as a variety of *seychellarum*, from which it differs in the following particulars:—Claw (*fig.* 17) minutely serrate, longer and less strongly falcate; ring-shaped pores (*figs.* 19, 20, 21) only obscurely fluted; small pores (*fig.* 18) with irregularly circular aperture, surrounded by a rosette of seven beads and a well-defined chitinous rim; base of setæ (*fig.* 22) with a deeper collar; abdominal spiracles (*fig.* 23) with a broader duct; dermal setæ proportionately stouter and more numerous. Described from a single example which resembled, externally, the paler forms of typical *seychellarum*.

ICERYA PILOSA, *Green.*

(PLATE CLXXXIII.)

*Icerya pilosa*, Green, *Ind. Mus. Notes*, Vol. IV. No. 1, p. 7 (1896).

Adult female (*figs.* 6, 7, and 14) crimson, the colour almost completely masked, on the dorsum, by a close covering of white or creamy-white meal intermingled with erect tubular filaments; under surface paler, only lightly dusted with mealy powder, except on the marginal area and on a transverse band across the base of the abdomen where the secretion is more continuous. Rather strongly convex above; flattish beneath. Old examples (see *fig.* 14) exhibit short mealy tufts on the margin of the abdomen and a series of long stout mealy processes from the ventro-marginal area, covering an ovisac which extends considerably beyond the body of the insect. There is also a brush of fine silky filaments, projecting backwards from the posterior extremity. Immediately after moulting, the body is free from any secretory covering. Antenna (*fig.* 19) normally nine-jointed; but the division between the eighth and ninth joints is often incomplete, and is sometimes completely suppressed. In some cases there is more or less fusion between joints three and four, or four and five, and occasionally these three joints are united together; so that examples may be found exhibiting six, seven, or eight joints only, instead of the normal number. Joints two, three, and four are broad and more or less cylindrical; five, six, seven, eight, and (sometimes) nine are basally constricted. Eyes prominent, with a diameter slightly less than that of the first joint of the antenna. Legs (*fig.* 15) well developed; tibia approximately as long as the femoral segment; tarsus rather strongly bowed, about two-thirds the length of the tibia. Claw (*fig.* 16) normally acutely falcate, the distal half usually slender; but—occasionally—laterally compressed and dilated (*fig.* 17). The latter form may occur on any of the three pairs of limbs; I have never observed it on all the feet of any single individual, but usually (when present) on a single foot only. Digitules slender, simple. Thoracic spiracles (*fig.* 18) conspicuous; enclosed in a dense chitinous plate of irregular form. I have been unable to detect any abdominal spiracles; but the area where they might be expected to occur is so crowded with setæ and large dermal pores, that their presence would be difficult to determine. Derm closely set with stout brownish setæ; longer and more numerous on the dorsum. The smaller setæ spring from simple tubercles (*fig.* 20); others (larger and stouter) have their bases surrounded by a translucent collar (*figs.* 22, 23); an intermediate form occurs in which the base of the seta is sunk into the supporting tubercle (*fig.* 21). Ceriferous pores of three distinct types are present on both the dorsum and venter, but are more crowded on the dorsum. The largest form (*fig.* 24) consists of a circular ring, beaded at eight regular intervals on its inner edge, and set in a densely chitinous plate of irregular outline; these pores are frequently associated with one of the larger collared hairs (see *fig.* 23). The second form (*fig.* 26) consists of the beaded ring alone, without any surrounding plate. The third form of pore (*figs.* 27, 28) is very much smaller and is surrounded by



seven contiguous beads; there is a crowded band of these small pores across the base of the abdomen, on the venter, defining the anterior limit of the ovisac. The number of beads is constant for each type of pore. The larger pores are probably concerned in the secretion of the tubular filaments, the smaller pores providing the mealy material. There are three large subcircular ventral scars, near the posterior extremity, with a reticulate surface which is occasionally wholly or partly pigmented. Anal orifice surrounded by a rather dense group of stout hairs. Length 2.75 to 4 mm.

Nymph (*figs.* 4, 5) with six-seven jointed antennæ. Derm not so closely covered with hairs and pores; the latter of two types only, the largest form (that surrounded by a chitinous plate) being absent. Tarsus proportionately longer than in the adult.

Young larva (*figs.* 1, 2) at first pale red, deepening later to crimson; the colour afterwards masked by a covering of yellowish, closely curled filaments. Antennæ six-jointed, the sixth with four long whip-like hairs on the apical half (*fig.* 3). Margin of body with a series of long setæ, collared at the base; the last pair on each side (exclusive of the caudal setæ) twice as long as any of the others; similar but rather smaller setæ dispersed over the dorsum. Derm with many small pores, the orifice surrounded by six contiguous beads (*fig.* 29); a marginal series of larger pores, with 8-shaped orifice surrounded by eight beads (*fig.* 30).

Egg bright orange yellow.

Male puparium (*fig.* 9) cylindrical, white, compact; open at posterior extremity. Length 7 to 8 mm.

Male nymph (*fig.* 10) dull purple, dusted with white meal; limbs stramineous.

Adult male (*fig.* 11) dull purplish red, the sides of the abdomen clothed with white woolly secretion; limbs and antennæ purplish brown. Head (*fig.* 12) broad, produced in front between the basal joints of the antennæ. Compound eyes moruloid, on short lateral processes; a prominent black ocellus at the inner angle of each eye. Antennæ ten-jointed, the two basal joints short, the remainder elongate and bi-nodose, with a whorl of long hairs on each node. Wings purplish grey, with a powdery bloom; costal area brownish; surface minutely wrinkled. Abdomen hairy; posterior extremity with a pair of prominent fleshy appendages bearing five or six long setæ (*fig.* 13); penial sheath short; broad at base and tapering to a blunt point. Length 2.5 mm.; expanse of wings 5 mm.

On a coarse grass (*Spinifex squarrosus*) growing on sand along the sea-coast: Chilaw. Received also from India (Madras).

Although normally oviparous, eggs being deposited in a well-developed ovisac, advanced embryos may be observed in many individuals, suggesting a partially ovoviviparous habit.

WALKERIANA, *Sign.*

*Walkeriana*, Signoret, *Ann. Soc. Ent. Fr.* (5), Vol. V. p. 390 (1875).

The species of this genus are all of large size, broadly ovate and usually strongly convex above. The dorsum bears symmetrical series of stout, dense, but brittle processes which are of a chalky rather than waxy consistency. In some species (notably in the type species—*floriger*) the spaces between these processes are occupied by fine, glassy, or silky filaments. The adult female has ten-jointed antennæ. The limbs are strongly developed, and usually dark-coloured. The anal orifice is masked by a more or less crowded group of long, stout setæ. There are usually three or more large cicatrices on the venter, immediately behind the genital orifice. The dermal pores are large and conspicuous, often varying markedly in size and structure on different areas of the body (e.g. *floriger* and *ovilla*). The ceriferous tracts are usually outlined by a series of special pores. The derm bears numerous setæ, which are more densely crowded on the ceriferous tracts. The setæ are of various forms; those on the dorsum being stout and spiniform, or sometimes ampulliform; those on the ceriferous tracts often differing in form from those on the intermediate areas. Abdominal spiracles are present, but difficult to locate. Morrison has observed seven pairs in species that he has examined. The development of a well-defined ovisac (as in *senex*) appears to be exceptional.

Adult male unknown, but probably of similar structure to the males of the closely allied genera *Aspidoproctus* and *Labioproctus*, in which the abdomen terminates in a single pair of fleshy appendages, and the antennal joints are tri-nodose.

Larvæ with five-jointed antennæ, the body clothed with very long, glassy, or silky filaments.

It is probable that insects of this genus are of slow development and relatively long-lived.

## SYNOPSIS OF CEYLON SPECIES.

- A. Calcareous processes of adult female almost concealed by masses of silky filaments ..... *floriger*.
- B. Processes conspicuous and exposed.
  - (a) Spiniform setæ of dorsum with apices blunt or slightly expanded ..... *compacta*.
  - (b) Spiniform setæ of dorsum acutely pointed.
    - (a<sup>1</sup>) Dermal pores not markedly differing in size; ova contained in a well-developed ovisac ..... *senex*.
    - (b<sup>1</sup>) Large conspicuously rosette-shaped pores intermingled with smaller pores; no definite ovisac ..... *ovilla*.

WALKERIANA FLORIGER, *Walk.*

(PLATE CLXXXIV.)

*Coccus floriger*, Walk., *Cat. Br. Mus. Hom.*, Vol. IV. Suppl. p. 205 (1858).*Walkeriana floriger*, Sign., *Ann. Soc. Ent. Fr.* (5), Vol. V. p. 391 (1875).*Coccus laniger*, Kirby, *Journ. Lin. Soc. Lond.*, Vol. XXIV. p. 175 (1891).

Adult female (*fig. 1*) broadly oval, covered above with longish, dense, plush-like tomentum which is concentrated—on the medio-longitudinal area—into close, forwardly directed tufts, with some shorter and broader transverse tufts on the abdomen. The tomentum varies in colour according to age and exposure, and may be whitish, yellow, olivaceous, grey or brown. More or less concealed beneath the tomentous covering are concentric series of white, chalky, lamellar processes, often transversely banded with brown. In the older examples the tomentum becomes dishevelled and matted. Under surface purplish pink, thickly coated with white powdery secretion. Limbs castaneous. Antennæ (*fig. 3*) ten-jointed, the second and tenth elongate, the remainder short; the distal extremity of each joint with a series of shortish hairs, and a few similar hairs on the sides of the joints. Eyes comparatively small, conical. Legs (*fig. 4*) comparatively small (for the size of the insect); the femur (without trochanter) shorter than the tibia; the tarsus slightly less than half the length of the tibia; claw comparatively slender, with simple digitules (often missing on old examples). There are some longish hairs on the trochanter, and a few short spiniform hairs on the femur. The derm of the dorsum is densely covered with slender flask-shaped spines (spiniform setæ), those of the ceriferous tracts being smaller and with slightly dilated tips (see *fig. 8*). The ceriferous tracts are demarked by series of prominent quadrilocular pores, but have few or no pores within the defined areas. The intermediate areas are crowded with similar but much larger quadrilocular pores, in addition to the spines (see *fig. 9*). The anal orifice is masked by a conspicuous group of long stout setæ set on a somewhat irregular but clearly defined tract (*fig. 6*) which is densely crowded with small thick-rimmed simple pores. *Fig. 7* shows the peculiar structure of the bases of the anal setæ and the irregular form of the surrounding pores. The abdominal spiracles (of which I have been able to detect five pairs only) are of simple structure, consisting of a plain ring of dense chitin (*fig. 11*). The derm of the venter is set with longish stout setæ—some of them with collared bases (see *fig. 13*), intermingled with large and prominent multilocular pores, each pore having an elongate or obscurely 8-shaped central orifice within a ring of (usually) ten bead-like cells, the whole surrounded by a broad chitinous wall. At intervals, along each side of the abdomen, are restricted groups of small quadrilocular pores (*fig. 12*). There are three sharply defined cicatrices towards the posterior extremity of the venter. A fully grown female, with its covering of tomentum, may attain a length of from 20 to 24 mm., with a breadth of from 18 to 20 mm., but denudation reduces the dimensions of the actual insect by nearly half, an average example measuring 12 by 9 mm.

In the nymph (*fig.* 2) the tomentum is shorter and not nearly so dense, while the chalky processes are conspicuous and strongly developed. The antennæ in this stage have eight joints only.

The young larva is coated with white meal, and secretes numerous long colourless glassy filaments. Antennæ five-jointed. Dermal characters similar to those of the adult, but the spines and pores are smaller and less crowded (*fig.* 14). There is a marginal series of long setæ, with two or three large and strongly chitinous tubular pores at the base of each seta (*fig.* 15). Length 1.35 mm.

On stems of *Litsea zeylanica*: Pundaluoya; and on Grevillea, Maskeliya.

The insect apparently has a life extending over several years. Old examples, with matted and discoloured tomentum, may be readily mistaken for tufts of moss or lichen.

The species is recorded from Ceylon only. I have myself found it only on the stems of a small group of trees on the Fernlands Tea Estate—once the residence of Mr. Nietner, who is believed to have been the original discoverer of the species. I think it probable that the type specimens may have been derived from this identical group of trees. Mr. J. C. Hutson has more recently taken the same species on the stems of Grevillea trees in the Maskeliya district.

#### WALKERIANA COMPACTA, *Green.*

(PLATE CLXXXV.)

*Walkeriana compacta*, Green, *Ind. Mus. Notes*, Vol. IV. No. 1, p. 6 (1896).

Adult female (*figs.* 1, 2 and 3) broadly oval; strongly convex above; flattish beneath. Dull pale reddish; the colour obscured or concealed by a thin covering of greyish white waxy secretion. Legs reddish brown: coxæ darker. Dorsum (*fig.* 2) with longitudinal series of stout, truncate, conical, waxy or chalky processes which are usually of an ochreous white tint, except on the truncate extremities, which remain dead white. In some examples the processes are somewhat widely separated; in others they are broader, covering practically the whole surface of the dorsum. The median series is composed of six paired processes on the thoracic area, followed by the same number of broadly transverse single plates on the abdominal area. The next series, which may be called the sub-median, consists of smaller processes and is interrupted on the anterior part of the thorax. This again is followed by a dorso-lateral series, with large stout processes; a lateral, with small slender processes; and a marginal (which forms a radiating fringe round the body of the insect) with large stout processes. There are some delicate silky filaments projecting from the margin, between the processes. Ventral surface thinly coated with whitish powder. Antenna (*fig.* 4) ten-jointed; all the joints, except the tenth, broader than long; tenth approximately twice as long as it is broad; a ring of short hairs near the distal extremity and many similar hairs on the outer side of each joint. Legs comparatively small; tarsus rather more than half the length of the tibia (*fig.* 6). Claw (*fig.* 7) slender; acutely

pointed and strongly falcate; unguis and tarsal digitules represented by very slender, simple hairs. Dorsum with numerous stout curved spines (*figs.* 10, 12) which are broad on the basal half, then tapering to near the apex which is very slightly expanded. The ceriferous tracts are raised above the level of the intermediate areas and are characterised by a closer covering of spines (see *fig.* 12). The anal orifice is masked by a dense tuft of long stout setae which—in early adult examples—may extend beyond the posterior margin of the body (*fig.* 9). Venter thinly clothed with stout setae, which are longest on the frontal area (*fig.* 13). The dermal pores vary on different areas of the body. Small quadrilocular pores occur, amongst the spines, on the ceriferous tracts (see *fig.* 12). Slightly larger quadrilocular pores, mingled with others containing six or seven translucent cells (*fig.* 10), are found on the intermediate areas. There is a dense cluster of large, thick-rimmed, saucer-shaped pores (*fig.* 11) surrounding the anal orifice. The pores of the ventral surface are distinctly larger and more complex. Those occurring on the frontal and marginal areas have a well-defined trilocular central orifice surrounded by a ring of bead-like cells varying in number from five to nine (see *fig.* 13). On the median thoracic area are circular and oval pores, with a simple oval central aperture and a surrounding ring of from five to ten cells (see *fig.* 14); while, on the hinder edge of the abdominal segments, pores of all these types appear to be mingled together (see *fig.* 15). Venter with three conspicuous cicatrices below the genital opening (*fig.* 8). Dorso-abdominal spiracles small, inconspicuous and difficult to distinguish amongst the dense covering of spines. Length of complete insect, with processes intact, 12 mm. Breadth, 9 mm.

Nymph very similar to adult, but smaller, and with the processes more closely adpressed to the body. Antenna (*fig.* 5) short and stout; seven-jointed.

Larva not observed.

On the stem of undetermined tree. Kelani Valley.

### WALKERIANA SENEX, *Green.*

(PLATE CLXXXVI.)

*Walkeriana senex*, *Green, Ind. Mus. Notes*, Vol. IV. No. 1, p. 6 (1896).

Adult female (*fig.* 1) strongly convex; the form concealed by a number of stout, curved, whitish, waxy processes which are arranged in definite series, viz., two medio-dorsal series, forwardly directed, those on the thorax larger and more widely separated than those on the abdomen; a dorso-lateral series, radially directed, those on the thorax larger and stouter; a dorso-marginal series, of which the posterior processes are the longer; and a marginal series which is more or less hidden by the super-imposed dorso-marginal series, except towards the posterior extremity where they are much longer and eventually coalesce to form an ovisac (see *figs.* 3 and 4). The posterior extremity of the ovisac is closed below by an operculum of brown earthy matter. In many examples the processes are beautifully and regularly banded with brown

(see *fig.* 2). Antenna (*fig.* 6) ten-jointed, sometimes with an incomplete hyaline band across the tenth; tenth longest and tapering to a bluntly pointed extremity; each of the first nine joints with a ring of setæ on its anterior rim, the tenth with scattered setæ. Legs comparatively small (*fig.* 8). Claw (*fig.* 9) stout and falcate, with simple slender digitules. Derm of dorsum clothed with longish hollow spines which are broad at the base but taper to a sharp point (*fig.* 11). These spines are more concentrated and densely crowded on sharply defined ceriferous tracts corresponding with the series of waxy processes (see *fig.* 10); each tract circumscribed by a ring of dense, prominent, tubular pores which—seen in profile—present the appearance shown at figure 12. Viewed from above, the orifice of the pores varies in form at different depths, being somewhat triangular above and cruciform or quadrilocular below (see *fig.* 11). A few simpler quadrilocular pores are scattered over the general surface, and there are a few stout setæ interspersed among the spines. Venter sparsely clothed with similar but more slender spines. A densely crowded band of prominent quadrilocular pores (and a few smaller pores with stellate orifices) extends across the venter, at the base of the abdomen (*fig.* 14). There are at least five pairs of abdominal spiracles, each opening into one of the dorso-lateral ceriferous tracts, under which conditions they can scarcely be functional. Anal aperture marked by a dense cluster of long stout setæ. In addition to the usual three post-genital cicatrices are others on the preceding three segments. Length of old adult female, with ovisac, including processes, 14 mm. Length before formation of ovisac, 10 mm. Length of denuded insect 6 to 8 mm.

Eggs bright pale yellow.

Newly hatched larva (*fig.* 5) pinkish orange; with median, dorso-lateral and dorso-marginal series of small waxy cushions, and numerous extremely long, slender, glassy filaments. Antenna (*fig.* 7) five-jointed, the terminal joint longest. Derm with long, slender, acutely pointed, tubular spines and elongate tubular pores (see *fig.* 15). Length 1.25 mm.

On *Dodonæa viscosa*. Chilaw and Putalam.

#### WALKERIANA OVILLA, *sp. nov.*

(PLATE CLXXXVII.)

Adult female (*fig.* 1) convex; broadly oval. The dorsum completely covered with stout, white or greyish, curved chalky processes (often banded with brown); with a few delicate glassy filaments in the interstices. The processes are arranged in close longitudinal series, the innermost projecting directly forwards and recurved at their tips; the processes of the second series are backwardly directed and sharply incurved; the remaining series are more irregular, the processes radiating more or less from the centre, but with a tendency to curve forwards, except at the posterior extremity. The arrangement of the series is often confused, and varies in almost every individual.

Antenna (*fig.* 4) ten-jointed; the second joint largest, thence gradually

reduced in size to the ninth, which is the smallest; third to sixth slightly gibbous; each joint with a few shortish hairs towards the distal extremity. Limbs moderately large and stout (*fig. 5*); the tarsus rather less than half the length of the tibia, which is equal in length to the femur (without the trochanter). Claw (*fig. 6*) stout and moderately falcate. Tarsal and unguis slender, simple. Ceriferous tracts not sharply defined, but occupying the greater part of the dorsum; somewhat loosely set with large, stout, acuminate spines (*fig. 13*), the basal halves of which are hollow and thin-walled. The tracts are separated from each other by narrow zones, devoid of spines, but with a few slender whip-like setae springing from stout collared bases. Anal orifice masked by a crowded group of stout setae, but without any sharply defined surrounding tract. Venter closely set with long stout curved setae (*fig. 12*). Dermal pores of several types, the largest of which are of a very distinctive character, being in the form of symmetrical rosettes, with an obscurely three-foliate (occasionally four-foliate) central orifice, surrounded by a circle of six (occasionally four, five, or eight) ovate nucleated cells (see *figs. 12, 13*) and a denser outer chitinous rim which follows the contour of the circle of ovate cells. These rosette-shaped pores occupy the intermediate zones on the dorsum and the greater part of the ventral area. The median area of the venter is occupied by somewhat smaller, circular or broadly ovate pores (*fig. 11*) which have an elongate or obscurely 8-shaped central orifice, surrounded by a raised ring of from six to ten (usually nine) bead-like cells. The pores associated with the anal area (*fig. 10*) have a subcircular central orifice surrounded by a prominent chitinous ring obscurely beaded on its inner face. Small circular, densely chitinous pores, with quadrilocular orifices, outline the ceriferous tracts and are scattered amongst the spines; they also occur on the venter, at intervals amongst the rosette-shaped pores. Seen in profile (as in *fig. 13*) they appear as truncately conical bodies, with a short slender tube projecting from the apical orifice. The dorso-abdominal spiracles, of which there are several pairs—(I have been unable to determine the exact number)—are simple chitinous rings (*fig. 9*); some of the rings appear to be incomplete. Length of denuded insect 12 to 15 mm. Breadth 10 mm. With all the processes intact, my largest example measures 25 by 18 mm. The dimensions of average examples would be about 20 by 15 mm.

Newly hatched larva (*figs. 2, 3*) with numerous long, fine, silky filaments springing from the margins of the body, but directed upwards. Antenna five-jointed. Derm. of dorsum (see *fig. 8*) with ceriferous tracts bearing longish stout acute spines, each tract defined by a close series of small but prominent quadrilocular pores; the intermediate areas with larger, rosette-shaped pores of which the central orifice may be either three- or four-lobate, encircled by from four to eight (usually four) large nucleated cells. Length 1.5 mm.

On stems of *Eugenia subavenis* and *Michelia nilagirica*. Botanic Gardens, Hakgala.

Genus ASPIDOPROCTUS, *Newst.**Aspidoproctus*, Newstead, *Proc. Zool. Soc. Lond.*, p. 948 (1900).

Characters of the female as in *Walkeriana*, from which it differs in the presence of a deep invagination of the venter, closed by a stout waxy or felted operculum.

Males of *A. maximus* (the only species of which this sex is known) are very similar to those of *Monophlebus*. They have tri-nodose antennal joints, each node with a whorl of long hairs; and the abdomen terminates in a pair of elongate, wrinkled, setose fleshy appendages.

Larvæ with five-jointed antennæ.

The type of the genus is *pertinax*, from Central Africa. The genus has the distinction of containing the largest known Coccid—*Aspidoproctus maximus*—a comparatively gigantic species from South Africa.

The two species here described are very closely allied to each other, and may possibly be forms of a single species. They are separable by their size and colour only.

Female very large; colour cinereous grey..... *cinerea*.  
 ,, comparatively small, colour of waxy appendages white..... *euphorbia*.

ASPIDOPROCTUS CINEREA, *Green.*

(PLATE CLXXXVIII.)

*Walkeriana cinerea* (*sine descr.*), *Mem. Dep. Ag. Ind.*, Vol. II. (2), p. 18 (1908).

Adult female (*fig.* 1) varying greatly in size; the smallest examples—though fully mature and containing eggs and young larvæ in the marsupium—being scarcely half the size of the largest. The body is strongly convex behind—above the abdomen—but usually abruptly depressed in front. The dorsal surface is closely covered with ashy-grey granular secretion between the widely separated series of stout, tapering, curved waxy processes, which may be banded either longitudinally or transversely (or both) with brown. The several series may be distinguished as a double medio-dorsal, of which the hindermost three or four pairs are usually coalescent; on each side of which is a dorso-lateral series, meeting behind at the anal orifice; followed by a lateral overlapping a marginal series. The processes of the last two series are usually longer than the others. Venter of abdomen deeply concave below; the cavity covered by a pad of waxy matter, forming a marsupium for the reception of the young larvæ. Antennæ (*fig.* 3) ten-jointed; each joint with a cirlet of setæ at the distal



extremity and with several similar setæ on the inner side. Limbs varying in size and proportions (see *figs.* 4, 6), the principal difference being in the thickness of the femora; but they have all one common character, namely, the presence of one long and several shorter setæ on the inner edge of the femur, in addition to the usual setæ on the trochanter. The claw is, normally, acutely falcate (*fig.* 7); but, in one individual, the claws on all the limbs were short and blunt (*fig.* 5). The anal ring (see *fig.* 8) is characterised by a conspicuous circle of crowded polygonal cells, and the anal orifice is masked by a dense cluster of longish stout setæ. The ceriferous tracts are recognisable by the more crowded condition of the spines. They are not so sharply defined as might be expected from the arrangement of the waxy processes. The spines on the ceriferous tracts (*fig.* 9) are somewhat abruptly acute at the apex and swollen towards the base. Exceptional forms are slightly expanded towards the apex (*fig.* 10), while others (*fig.* 11) have the basal expansion terminating above in a more or less distinct shoulder. The spines on the intermediate areas taper evenly from the base to an acute apex (*fig.* 12). Small quadrilocular pores outline the ceriferous tracts (see *fig.* 9) and are scattered amongst the spines of both the tracts and the intermediate areas, extending also on to the venter. Larger quadrilocular pores (*fig.* 14) are crowded upon the area surrounding the abdominal concavity. These pores, seen in profile, show a delicate membranous outward extension (*fig.* 15). The pores associated with the anal tract are of a more complex character, having two concentric beaded rings surrounding a central oval, trilocular or quadrilocular aperture (*fig.* 16). The outer beaded ring is often obscured by a thickening of the chitinous wall of the pore. Pores with oval or obscurely triangular apertures, encircled by a single beaded ring (*fig.* 17) occur on the area immediately surrounding the genital orifice. As they recede from the genital tract these pores acquire definite trilocular or quadrilocular apertures, while still retaining the beaded ring (*fig.* 18). Wherever the derm is thicker or more densely chitinised translucent dermal cells can be observed, in close association with the spines and pores. There is a marked differentiation, on the venter, between the derm of the thorax and abdominal regions. The derm on the central area of the abdomen—corresponding with the marsupoid concavity—is very thin and but sparsely clothed with small setæ and pores (see *fig.* 2). Some of the setæ, on this area, are in small groups of from two to five, each group arising from an irregular, slightly prominent plate (*figs.* 19, 20). More rarely there are irregular tubercles bearing from eight to ten setæ (*fig.* 21). The genital orifice occupies an approximately central position in this area. There are five small, translucent oval cicatrices towards the posterior extremity. The derm of the thorax, on the other hand, and of the margins of the abdomen, is thicker and more densely clothed with pores, spines, and setæ. The area immediately surrounding the mouth-parts is densely clothed with long, stout setæ, with simple abruptly expanded bases, amongst which are a few rather larger setæ arising from collared sockets (see *fig.* 13). I have been unable to determine the number of abdominal spiracles, though I have observed their occurrence in the species. As noted above, the size of fully adult examples varies to an unusual extent, the over-all dimensions ranging from  $9.5 \times 7.5$  to  $22 \times 14$  mm.

Young larva with dorsal spines similar to those of adult. Antenna five-jointed, the fourth joint very short, the fifth broadest. Anal ring with a double row of elongate cells. Length averaging 1.12 mm.

On stems of *Grevillea*, *Citrus*, *Terminalia*, *Thespesia*, and unidentified jungle trees. Kandy, Gampola, Galagedara, Passara, and Delft Island. Received also from South India.

A form with the derm more densely clothed with spines and setæ, and with more crowded pores, may eventually prove to be distinct; but the available material is insufficient to determine this point.

#### ASPIDOPROCTUS EUPHORBIAE, *Green.*

(PLATE CLXXXIX.)

*Walkeriana euphorbiae*, Green, *Ind. Mus. Notes*, Vol. IV. No. 1, p. 6 (1896).

Adult female (*fig.* 1, 2, 3 and 4) ovoid, narrower in front; the abdominal area highly convex after gestation. Colour dull reddish orange, paler beneath; the dorsum closely covered with greyish granular wax. Waxy processes white, stout, curved, either truncate or pointed; arranged as in *W. cinerea*, viz., a double median series of from eight to ten pairs, directed upwards and forwards, the posterior three or four pairs sometimes confluent; a dorso-lateral series of ten to twelve on each side, directed downwards and backwards; followed by overlapping submarginal and marginal series, the former directed downwards, the latter directed outwards and slightly upturned at the tips. Venter with thin whitish mealy secretion. Abdomen concave below, with a felted operculum stretched across the cavity (see *fig.* 2). Median thoracic area usually with a blackish pad (? congealed latex of the plant) occupying the space between the limbs and concealing the mouth parts. Antenna (*fig.* 8) normally ten-jointed occasionally eleven-jointed by subdivision of one of the median joints (*fig.* 9); the terminal joint with scattered hairs, the other joints each with an irregular circlet of hairs on the distal margin. Legs (*fig.* 12) comparatively small; the inner face of femur and trochanter each with two projecting setæ, one very much longer than the other; tarsus approximately half the length of tibia; claw (*fig.* 13) falcate; ungual and tarsal digitules simple, slender. Abdominal spiracles in the form of a simple chitinous ring; at least three pairs, probably more. Dermal characters scarcely distinguishable from those of *cinerea*; the spines (*figs.* 19, 20) slightly smaller and more slender than in that species. Ceriferous tracts ill-defined. Anal ring (*fig.* 11) composed of very irregularly polygonal cells. Over all dimensions 9 mm. by 6 to 7 mm. Denuded insect 5 to 6 mm. long.

Ova bright yellow.

Newly hatched larva (*figs.* 5, 6) orange yellow, lightly dusted with whitish mealy powder. Legs and antennæ ochreous. Eyes black, placed on the under surface of the head, close to the base of each antenna. Margin with a fringe of long, delicate, glassy filaments. Antenna (*fig.* 10) five-jointed; the terminal joint largest, claviform; the fourth joint smallest. Length 1.25 mm.

Later larva (*fig.* 7) with loose white tufts, in series corresponding with the processes of the adult insect.

On *Euphorbia antiqorum*; Hambantota and Habarana.

Very closely allied to *cinerea*, of which it may possibly be merely a dwarf form. It is a smaller and more compact insect, with pure white waxy processes. The ventral operculum is more sharply defined, and has a conspicuous terminal aperture for the exit of the young larvæ.

LABIOPROCTUS, *gen. nov.*

Insects allied to *Aspidoproctus*, but differing from that genus in that the ventral invagination of the female is not closed by a secretory operculum, but by prominent lateral labiæ.

Males similar to those of *Aspidoproctus*.

Larvæ with five-jointed antennæ.

Type *L. polei*.

LABIOPROCTUS POLEI, *Green.*

(PLATE CXc.)

*Walkeriana polei*, Green, *Ind. Mus. Notes*, Vol. IV., No. 1, p. 6 (1896).

Adult female (*figs.* 1 to 4) oblong oval, the dorsum strongly convex, the sides compressed and slightly concave (see *fig.* 4). Dorsum of thorax with five longitudinal series each containing four truncate-conical processes widely spaced, those of the median series broadest, those of the outer series small and comparatively slender. Dorsum of abdomen without processes. There is a complete dorso-lateral series on each side, containing about twelve processes, which increase in length towards the posterior extremity where they closely overlap each other, and a complete marginal series of similar processes. The dorso-lateral is widely separated from the marginal series, except at the two extremities, where they approach each other. All the processes are of a dense chalky consistency, the sides ribbed, and of an ochreous tint, the truncate extremities white. The colour of the dorsum between the processes is dull pinkish red, with a superficial whitish bloom. Venter, with a deep median cleft immediately behind the third pair of legs; its sides guarded by raised lips meeting behind to form a V-shaped prominence (see *fig.* 3). This cleft communicates with an invaginated chamber forming a marsupium for the reception of the newly hatched larvæ. Antennæ (*fig.* 7) ten-jointed, of normal form; each of the first nine joints with a ring of setæ near its distal extremity. Legs (*fig.* 5) normal, the femur stout, the tarsus more than half the length of the tibia. Claw (*fig.* 6) stout, falcate, unguinal digitules small and very slender; tarsal digitules equally slender, but considerably longer. Spines of ceriferous tracts (see *fig.* 13) abruptly expanded on the basal fourth; the distal extremity rounded and slightly expanded. Spines of intermediate areas (*fig.* 12) longer and stouter, tapering more evenly to the

apex. The derm on the ceriferous tracts is usually more translucent than that of the intermediate areas. The denser areas show small translucent dermal cells. Venter with scattered spiniform setæ and a few trilocular pores. The pores surrounding the ceriferous tracts are of two types (see *fig.* 13), some with quadrilocular orifices, forming the front row immediately adjoining the ceriferous spines, and others with obscurely trilocular orifices, encircled by six oval cells forming the outer ranks. A few pores of the quadrilocular type are scattered very sparsely amongst the spines of both ceriferous tracts and intermediate areas, the latter having also a few pores of the trilocular type. Pores with simple circular or oval orifices (*fig.* 14) are crowded on the anal tract, together with numerous long stout setæ springing from socketed bases. Abdominal spiracles in the form of a deep circular ring, number undetermined. Anal ring with a single row of irregular shaped cells, the passage from the ring to the external orifice densely chitinous. Length (including processes) 11 to 14 mm.; breadth 6.5 to 7.5 mm.; height approximately 6 mm.

Female nymph similar but smaller. Antennæ eight-jointed.

Newly hatched larva (*fig.* 9) pale pinkish orange, the dorsum thinly coated with white mealy secretion, and with a marginal series of very long, colourless, glassy filaments. Antennæ (*fig.* 10) five-jointed. Length approximately 1 mm.

Eggs pale yellow.

Adult male (*fig.* 11) blackish, pruinose, the prothorax sometimes slightly reddish. Wings dark slaty grey, ample; minutely transversely rugose, except the costal area which is granulose; with two stout and prominent black nervures and two whitish longitudinal creases. Antennæ ten-jointed, the two basal joints short, the remainder elongate and obscurely tri-nodose; with many longish hairs arranged in rather indefinite whorls on the nodes. Eyes large and prominent, with numerous facets. A rudimentary ocellus immediately behind each eye. Abdomen setose; the posterior extremity with a pair of stout, fleshy, setose processes. Length 4 mm. Expanse 9 mm.

Male puparium (*fig.* 8) consisting of an oblong mass of flocculent white wax, at the anterior extremity of which can be seen the remains of the larval exuviae. In some examples there are a few straggling white filaments on the sides and at the posterior extremity. Length 10 to 12 mm.; breadth 5 mm.

Nymph dull purplish grey. Length 4 mm.

On the twigs and smaller branches of *Dodonaea viscosa*, *Psidium* ('Guava'), and *Eugenia rotundifolia*. Chilaw; Kandy; Dolosbage; Mahintale; Nuera Eliya. Received also from Java, on *Citrus*; and from South India, on an undetermined plant. The winged males were observed in March and April.

#### NIETNERA, *Gen. nov.*

Allied to *Walkeriana*, but differing, primarily, in the antennæ of the adult female which are normally eleven-jointed. The derm of the dorsum is closely covered with short, stout spines, which are acute on the ceriferous areas, but bluntly rounded on the intermediate areas. In the adult stage the waxy pro-

cesses are mostly slender and widely spaced. The processes may be gradually shed during subsequent growth, the oldest examples retaining a few of the marginal processes only. Before oviposition the insects envelop themselves in loose, white, woolly secretion. Pores saucer-shaped. Venter without invagination.

Early nymphal stages more closely covered with relatively stouter waxy processes.

Larvæ with five-jointed antennæ.

Male unknown.

Type *pundaluoya*.

The new genus is named in honour of J. Nietner, a naturalist whose name was closely associated with entomology, in Ceylon, during the middle of the last century.

NIETNERA PUNDALUOYA, *sp. nov.*

(PLATE CXCI.)

Adult female (*figs.* 6, 7, 8), in life, of a dull purplish grey colour, thinly dusted with greyish white granular secretion. A marginal series of flattened, ochreous-yellow, waxy processes. Immediately above the marginal series, on each side of the thorax, are three longer horn-shaped processes, projecting laterally. Shortly within the anterior margin are two strap-shaped processes, projecting upwards and forwards; and on each side of the abdomen is a series of six sickle-shaped, forwardly-curved waxy processes. A pair of white curling filaments projects from the anal area. The foregoing description has been drawn up from two examples in which many of the processes had been broken off. Figure 6 must be regarded as partly diagrammatic, the processes having been restored from a comparison of the two specimens. Other examples were found in which the processes had almost completely disappeared (see *fig.* 8) and others, again, in which there remained no trace of any processes at all. These naked examples, when kept in confinement, concealed themselves beneath voluminous masses of flocculent white secretion. It is probable that the compact waxy processes are gradually shed during the final stage of the life of the insect. The adult insect is of a short oblong form (see *figs.* 6 and 7), narrower in front, rather broadly rounded behind, the segments clearly indicated, the margin irregularly crenate, the posterior extremity with a shallow cleft; dorsum strongly convex and tumescent. After death, the body contracts and assumes the characteristic form shown at *fig.* 8.

The antennæ are normally eleven-jointed; but in one example these organs are asymmetrical, one of them (*fig.* 10) having twelve joints, and the other (*fig.* 11) eleven joints only. The first three joints are larger and stouter than the others, and approximately equal in length, the third being slightly shorter than the other two; the terminal joint is elongate, and approximately equal to the third. All the joints bear stout setæ which are disposed—principally—near the distal extremity of each segment. Legs (see *fig.* 17) large and stout; the femur with numerous small bristles; the tarsus with two rows of bristles on the

inner side; tarsus (excluding claw) approximately half as long as tibia. Claw (*fig.* 18) long, slender and sharply pointed, falcate; with two simple hair-like digitules. Derm of dorsum closely covered with short stout spines, their extremities bluntly rounded (*figs.* 19, 20); except on the ceriferous tracts where there are crowded clusters of more elongate, somewhat flask-shaped, sharply acuminate spines (*figs.* 21, 22). Anal aperture opening on to an area which is devoid of spines, but crowded with circular pores (*fig.* 23) which vary in size, but are all of the same structure—saucer-shaped, with a central circular orifice (see *fig.* 24). Surrounding the anal area are some irregular cicatrices or folds bearing, on their margins, stout acuminate spines similar to those on the ceriferous tracts. Large circular or broadly ovoid pores are scattered over the derm, sparsely on the dorsum but thickly on the venter. These pores have elongate, bilocular (occasionally trilocular) orifices (*fig.* 26). The ceriferous tracts are encircled by a row of smaller pores with quadrilocular orifices (see *fig.* 28). There are six abdominal spiracles (*fig.* 25) on each side, opening on the dorsum at some little distance within the margin; the sixth pair situated close behind the anal aperture (see *fig.* 23). Venter closely covered with longish stout setæ; a few similar isolated setæ, amongst the spines, on the dorsum. Length (exclusive of processes) 6·75 to 7·5 mm. Breadth across middle 4·75 mm.

No males, in any stage, have been observed.

Paucity of material makes the determination of the sequence of the earlier stages difficult. No ova or early larvæ have been found. In the earliest stage observed, the dorsum is closely covered with curling white or yellow (*fig.* 4) waxy filaments. In this stage the antennæ (*fig.* 14) are five-jointed, the third elongate, the fifth fusiform and clavate, with longish slender setæ. Limbs comparatively slender; the tarsus more than half as long as the tibia. The dorsum is rather closely covered with acuminate spines similar in structure to those found on the ceriferous tracts in the later stages. These spines are collected into irregular clusters circumscribed by a row of quadrilocular pores, and intermingled with longish setæ. There are two very simple abdominal spiracles on each side, near the posterior extremity of the body. Length (exclusive of waxy appendages) 2 to 2·25 mm.

What I believe to be the next stage has been identified from the exuviae only (*fig.* 9), in which the dorsum is closely covered with stouter and more compact yellowish or white processes.

Immediately after the next moult the insect appears as at *figs.* 2 and 3. It is then of a dark purple-brown colour above; pale orange beneath. The dorsum is minutely punctured and the segments indicated by well-defined transverse furrows. There is a close marginal fringe of white (or pinkish orange) flattish truncate waxy processes; a double medio-dorsal series (six pairs) of short truncate cylindrical processes; and a dorso-lateral series (eight on each side) of similar, but slightly larger, processes. Three similar, but considerably larger, processes are placed on each side of the thorax, between the dorso-lateral and marginal series. All of these processes increase in length during the subsequent growth of the insect. Antennæ (*fig.* 13) six-jointed. In this stage the dermal spines have become differentiated into compact clusters of acuminate spines on the ceriferous tracts, with bluntly rounded spines completely covering the intermediate areas. Length of body 3 mm.

The succeeding stage (*fig.* 5) is characterised by dorsal, dorso-lateral, dorso-

marginal and marginal series of forwardly curved compact waxy processes which may be either of an ochreous-yellow or orange-yellow colour, and three longer horn-shaped processes on each side of the thorax. The antennæ (fig. 11) are still six-jointed, but the proportionate length of the joints is different (compare figs. 12 and 13). Legs (fig. 15) still comparatively slender; but the tarsus is reduced to rather less than half the length of the tibia. The dermal spines covering the area between the ceriferous tracts are longer and slightly tapered to a rounded point. Pores and setæ as in the adult insect, but less numerous. Length of body 3.5 to 4 mm.

I have been unable to determine, exactly, whether there is a later nymphal stage, intermediate between the one just described and the adult insect. But a single individual has been observed, associated with exuviae corresponding to the previous stage, which appears to combine characters of both the nymphal and adult stages. The antennæ are eleven-jointed, but shorter than those of the fully mature insect, and the divisions of the antennal joints are not so strongly defined. The legs, also, while showing a great increase in size, are still not so large or stout as those of the adult. The dermal spines (figs. 27, 28) conform more with those of the previous nymphal stage, the spines of the intermediate areas being elongate and tapered to a rounded point (compare figs. 20 and 28). I can detect four pairs only of abdominal spiracles in this individual. Length of body 7 mm.

It is remarkable that there seems to be no graduation in the number of antennal joints between the six-jointed and eleven-jointed stages.

In the nymphal stages, during life, a long slender glassy tube projects upwards from the anal aperture.

On *Litsea*, *Cinnamomum*, *Mallotus*, *Loranthus*, *Eurya*, *Psychotria*, and *Vitis* sp. Pundaluoya; Watawela; Maskeliya; Hakgala; Namunakuli; Haldummulla; Bandarawela; Patipola; Horton Plains and Nuera Eliya. Occurring singly; the earlier stages on the foliage, the more advanced stages on the stems of the plants. Apparently confined to the hill districts. I have never taken it at elevations much below 4000 feet.





## APPENDIX I.

Part I. of this work was published in 1896, Part II. in 1899, Part III. in 1904, Part IV. in 1909, and Part V. bears the date 1922.

During the years that have elapsed since the issue of the earlier parts, increased knowledge has necessitated various corrections, emendations, and additions, which are presented in the following notes :—

### **Preparation for Microscopical Study** (p. 10).

During the course of years I have modified my earlier methods considerably, partly as a result of my own experience, and partly from a study of the methods of other microscopists. The process that I now employ is as follows :—

(1) Boil the specimens in strong liquor potassæ for from three minutes upwards (according to the size of the subject).

N.B.—It is better to under-boil the specimens than to over-boil them. The former fault can be rectified by further treatment, but, if the maceration has proceeded too far, the objects will not take the stain properly.

(2) Remove the objects to distilled water, and put them aside for twenty-four hours.

(3) Make a small opening on the under surface of the body, and squeeze or wash out the contents.

(4) Transfer to glacial acetic acid for two or three minutes.

(5) Mount temporarily on a glass slip, add two drops of carbol-fuchsin ; add one drop of dilute glycerine (to prevent evaporation of the stain) ; warm gently, and put aside for twenty-four hours.

(6) Wash in 70 per cent. alcohol (to remove superfluous stain), transfer to absolute alcohol, if too deeply stained immerse momentarily in phenol-chloral ; transfer to phenol-xylol for a few minutes ; mount finally in xylol-balsam.

### **Synopsis of Sub-families** (pp. 16, 17).

The sub-family *Hemicoccinæ* has been abandoned, having been founded upon a misinterpretation of the structure of the insects referred thereto.

*Idiococcinæ* also has been abandoned, as consisting of species referable to other sub-families.

The name *Coccinæ* is no longer applicable to the Cochineal insects, which are now referred to the sub-family *Dactylopiinæ*.

The *Eriococcinæ* and *Asterolecaniinæ* groups may be conveniently separated from the *Dactylopiinæ* and given rank as sub-families.

A sub-family *Margarodinæ* should be interpolated between the *Otheziinæ* and the *Monophlebinae*.

### **Aspidiotus osbeckiæ** (p. 47).

This species is referable to *orientalis* of Newstead.

**Aspidiotus lataniæ** (p. 49).

The species here described under this name is not *lataniæ* of Signoret, but must revert to its earlier name *transparentis*, Green (which is doubtfully distinct from *destructor* of Signoret).

**Aspidiotus cydoniæ** (p. 62).

The oriental examples attributed to *cydoniæ* are referable to *lataniæ* of Signoret. American authorities are of opinion that *cydoniæ* of Comstock is a distinct species.

**Aspidiotus secretus** (p. 64), **Aspidiotus inusitatus** (p. 66).

These two species are now referred to the genus *Odonaspis*.

**Aonidia corniger** (p. 69).

The specific name should read '*cornigera*.' Cockerell has proposed a new genus (*Greeniella*) for this and allied species characterised by the presence of glassy, horn-like processes on the larval pellicle.

**Aonidia bullata** (p. 72) should be referred to the genus *Gymnaspis*.

**Mytilaspis** (p. 77) has to give place to *Lepidosaphes* of Schimer, which has precedence over Signoret's better-known name for the 'Mussel Scales.'

**Mytilaspis gloverii** var. **pallida** (p. 85).

I now regard this insect as a distinct species.

**Diaspis amygdali** (p. 87) gives way to the earlier name *pentagona* of Targioni-Tozzetti.

**Fiorinia secreta** (p. 102).

Leonardi has referred this species to his new genus *Adiscofiorinia*.

**Chionaspis**. Synopsis of Species (p. 107).

Species falling under section I. of the synopsis ('Median lobes approximate; their inner edges in close apposition') form a sharply defined group which has been separated from *Chionaspis* and referred to the genus *Hemichionaspis* of Cockerell. I am, however, in agreement with Lindinger in the opinion that *Hemichionaspis* is a synonym of *Pinnaspis*—proposed by the same author (Cockerell) five years earlier.

The genus *Phenacaspis* has been proposed for another group, represented in this synopsis under Section II. B. While agreeing that there is a more or less natural group surrounding the type species *nysæ*, its boundaries are so ill defined—grading off in one direction into *Chionaspis* proper, and in the other direction into the *Aulucaspis* section of *Diaspis*—that I prefer to leave these species in their present position, trusting that further study may enable us to define the limits of the group with more accuracy.

**Chionaspis aspidistræ** (p. 110), **Chionaspis theæ** (p. 113), **Chionaspis mussændæ** (p. 117), **Chionaspis rhododendri** (p. 119), and **Chionaspis scrobicularum** (p. 121).

I now refer all these species to the genus *Pinnaspis*.

**Chionaspis albizziæ** (p. 115) is a synonym of *Chion. minor* of Maskell, and must now be known as *Pinnaspis minor*.

**Chionaspis permutans** (p. 130) should be referred to the genus *Dinaspis*, of Leonardi.

**Chionaspis biclavis** (p. 152) has been removed to the genus *Howardia*.

**Chionaspis fodiens** (p. 155).

This insect is certainly not rightly placed in the position to which I had assigned it. I would, for the present, allow it a place in Ferris's genus *Ancephaspis*, though I appreciate the fact that it is not strictly congeneric with the type of that genus.

It is problematical whether the male puparium, described and figured as of this species, is correctly assigned to *fodiens*.

**Chionaspis simplex** (p. 160) is referable, more probably, to the genus *Odonaspis*.

**Parlatoria mytilaspiformis** (p. 164) is now regarded as an exceptionally elongate form of *proteus*.

**Lecanium** (p. 177).

As pointed out in a footnote on this page (and with more detail on p. 248), the name *Lecanium* has been superseded by *Coccus*, with a corresponding change in the name of the sub-family. The old genus has also been subdivided by the erection of numerous new genera and sub-genera, the characters of which (with a few exceptions) appear to me to be too elastic for practicable adoption. As the name *Lecanium* has never been applied to any other genus, while *Coccus* is the more generally known name of the Cochineal insects, no confusion can arise from the retention of the former name in the present work.

**Lecanium subtessellatum** (p. 206), **Lecanium tessellatum** var. **perforatum** (p. 207).

Examination of long series, from various host plants, has convinced me that both of these species are referable to *tessellatum* of Signoret.

**Neolecanium crustuliforme** (p. 252).

Professor Cockerell has advised me that *crustuliforme* cannot be included in his genus *Neolecanium*, but that it would be referable, with more justice, to the genus *Platysaissetia*.

**Asterolecanium lineare** (p. 336).

The name *lineare* being preoccupied, the name *lanccolatum* has been adopted for the species here represented. (See Prefatory Note to Part IV.)

**Pollinia ceylonica** (p. 341).

My original description of this insect was drawn up from inadequate and badly preserved material. Fresh material, obtained since the publication of Part IV., reveals several characters that could not be observed in the older specimens. There is a continuous marginal series of equidistant, simple, circular pores, with other similar (but slightly larger) pores distributed sparsely over the dorsum. There is a complete absence of paired (8-shaped) pores. The ovisac bears scattered, isolated, crook-shaped, glassy filaments, but no definite marginal fringe. The margin of the ovisac is narrowly flattened and out-turned.

The species is clearly not congeneric with *Pollinia pollini*; and the absence of paired pores precludes its inclusion in the genus *Asterolecanium*, to which, in all other respects, it is most closely allied. I therefore propose to erect a new genus (the characters of which will be found below) for its reception. I call this new genus *Polea*, in commemoration of the late John Pole, who assisted me so assiduously in the collection of material for the present work.

**POLEA**, *gen. nov.*

Species belonging to the sub-family *Asterolecaniinae* and with characters resembling those of the genus *Asterolecanium*. Ovisac with single (unpaired), crook-shaped, glassy filaments. Adult female differing from species of *Asterolecanium* in the complete absence of paired (8-shaped) pores. Anal ring without setae.

Type : *ceylonica*, Green.

**Pseudococcus bromeliæ** (p. 381).

An unfortunate error occurs in the description of the limbs of this species. In place of the words 'and approximately . . . . tarsus' read 'tarsus more than half the length of the tibia.'

## APPENDIX II.

*A List of Species newly recorded and of New Species described since the publication of Parts I, to IV. of this work.*

- Aspidiotus cistuloides**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 342 (1905). On *Cinnamomum*. Peradeniya.
- Aspidiotus cuculus**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 341 (1905). In empty galls of *Amorphococcus mesuae* on *Mesua ferrea*. Peradeniya.
- Aspidiotus destructor**, Sign. *Ann. Soc. Ent. Fr.* (4), ix. p. 120 (1869). On various plants. Pundaluoya : Kandy.
- Aspidiotus dictyospermi**, Morg. *Ent. Mo. Mag.*, xxv. p. 352 (1889). On various plants. Watagoda : Kandy.
- Aspidiotus irrepta**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 26 (1914). On *Acalypha* sp. Peradeniya.
- Aspidiotus longispinus**, Morg. *Ent. Mo. Mag.*, xxv. p. 352 (1889). On *Artocarpus integrifolia*. Peradeniya.
- Aspidiotus malleolus**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 342 (1905). On *Minusops hexandra*. Elephant Pass.
- Aspidiotus occultus elongatus**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 345 (1905). On *Grewia* sp. Nuera Eliya.
- Aspidiotus oreodoxæ**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 260 (1914). On *Oreodava* sp. Peradeniya.
- Aspidiotus panici**, Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 113 (1915). On *Panicum uncinatum*. Peradeniya.
- Aspidiotus pedronis**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 341 (1905). On undetermined tree. Nuera Eliya.
- Aspidiotus phyllanthi**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 344 (1905). On *Phyllanthus myrtifolius*. Peradeniya.
- Aspidiotus pothi**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 262 (1914). On *Pothos scandens* and *Loranthus* sp. Peradeniya.

- Aspidiotus quadriclavatus**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 343 (1905). On *Murraya exotica*. Peradeniya.
- Aspidiotus sacchari**, Ckll. *Journ. Inst. Jamaica*, i. p. 255 (1893). On rhizomes of grasses. Peradeniya. Colombo.
- Aspidiotus taprobanus**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 344 (1905). On *Phyllanthus myrtifolius*. Peradeniya.
- Aspidiotus theae rhododendri**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. 1, p. 67 (1899). On *Rhododendron*. Nuera Eliya.
- Pseudoparlatoria parlatorioides**, Comst. *2nd Rep. Dep. Ent. Corn. Univ.*, p. 64 (1883). On *Psidium* sp. Peradeniya.
- Odonaspis canaliculatus**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 72 (1899). On Bamboo. Pundaluoya. Nuera Eliya.
- Odonaspis penicillata**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 346 (1905). On Bamboo. Peradeniya.
- Odonaspis ruthæ**, Ehrh. *2nd Bien. Rep. Com. Hort. Cal.*, p. 26 (1907). On grasses. Colombo.
- Aonidia crenulata**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 74 (1899). On *Memecylon umbellatum*. Peradeniya.
- Aonidia echinata**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 347 (1905). On *Hemicyclea sepiaria*. Anaradhapura.
- Aonidia ferrea**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 265 (1914). On *Mesua ferrea*. Peradeniya.
- Aonidia mesuæ**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 74 (1899). On *Mesua ferrea*. Peradeniya.
- Aonidia perplexa**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 252 (1900). *Mesua ferrea*. Peradeniya.
- Aonidia planchonioides**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 252. On *Ficus* sp. Peradeniya.
- Aonidia pusilla**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 347 (1905). On *Carissa spinarum*. Elephant Pass.
- Aonidia spatulata**, Green. *Journ. Nat. Hist. Bomb. Soc.*, xiii. p. 73 (1899). On *Psychotria* sp. Pundaluoya.
- Gymnaspis spinomarginata**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 348 (1905). On *Mesua ferrea*. Peradeniya.
- Lepidosaphes ambigua**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 264 (1914). On *Mesua ferrea*. Peradeniya.
- Lepidosaphes auriculata**, Green. *Trans. Linn. Soc. Lond.*, xii. 2, p. 205 (1907). On *Codiaeum*. Pundaluoya : Kandy : Colombo.
- Lepidosaphes erythrinæ**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 264 (1914). On *Erythrina lithosperma*. Peradeniya.
- Lepidosaphes lasianthi**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 250 (1900). On *Lasianthus strigosus*. Pundaluoya.
- Lepidosaphes piperis**, Green. *Mem. Dep. Ag. Ind.*, ii. 2, p. 34 (1908). On *Piper nigrum*. Peradeniya.
- Lepidosaphes rubrovittatus**, Ckll. *Proc. Dav. Ac. Sci.*, x. p. 135 (1905). On *Hevea brasiliensis*. Heneratgoda.

- Lepidosaphes vandæ**, Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 116 (1915). On *Vanda spathulata*. Peradeniya.
- Ichnaspis filiformis**, Dougl. *Ent. Mo. Mag.*, xxiv. p. 21 (1887). On *Dracena* sp. and various Palms.
- Diaspis barberi**, Green. *Mem. Dep. Ag. Ind.*, ii. 2, p. 35 (1908). On *Myristica fragrans*. Peradeniya.
- Diaspis boisduvali**, Sign. *Ann. Soc. Ent. Fr.*, (4), ix. p. 432 (1869). On *Orchidaceæ*. Maskeliya : Peradeniya.
- Diaspis flacourtiae**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 259 (1914). On *Flacourtia ramontchii*. Peradeniya.
- Diaspis loranthi**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 254 (1900). On *Loranthus tomentosus*. Pundaluoya.
- Diaspis myristicæ**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 260 (1914). On *Myristica laurifolia*.
- Diaspis uncinati**, Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 117 (1915). On *Panicum uncinatum*. Peradeniya.
- Fiorinia atalantiæ**, Leon. *Redia*, iii. p. 54 (1906). On *Atalantia zeylanica*. Haragama.
- Fiorinia bidens**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 351 (1905). On undetermined plant. Anaradhapura.
- Fiorinia juniperi**, Leon. *Redia*, iii. p. 39 (1906). On *Juniperus bermudiana*. Peradeniya.
- Fiorinia odinæ**, Leon. *Redia*, iii. p. 24 (1906). On *Odina Woodier*. Haragama.
- Fiorinia proboscidiaria**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 256 (1900). On *Piper* sp. Peradeniya.
- Fiorinia rubrolineata**, Leon. *Redia*, iii. p. 44 (1906). On *Murraya exotica*. Peradeniya.
- Fiorinia sapsomæ geloniæ**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xiii. p. 256 (1900). On *Gelonium lanccolatum*. Pundaluoya.
- Fiorinia theæ**, Green. *Ind. Mus. Notes*, v. p. 3 (1900). On *Ostodes zeylanicus*. Peradeniya.
- Fiorinia tumida**, Leon. *Redia*, iii. p. 38 (1906). On *Grewia* sp. Peradeniya.
- Pinnaspis alata**, Ruthfd. *Bul. Ent. Research*, v. 3, p. 262 (1914). On *Cassia alata*. Peradeniya.
- Pinnaspis cyanogena**, Ckll. *The Entom.*, xxxiv. p. 226 (1901). On undetermined plant. Trincomali.
- Pinnaspis dracænæ**, Cooley. *Spec. Bul. Mass. Exper. Stat.*, p. 57 (1899). On *Hevea brasiliensis*. Elpitiya.
- Pinnaspis theæ ceylonica**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 254 (1905). On Tea plant. Pundaluoya.
- Chionaspis cinnamomi**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 354 (1905). On *Cinnamomum* sp. Pundaluoya.
- Chionaspis coronifera**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 352 (1905). On undetermined plant. Galagammuwa.

- Leucaspis cockerelli**, de Charm. *Proc. Soc. Amic. Sci.*, p. 33 (1899). On various Palms. Peradeniya.
- Leucaspis limoniæ**, Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 117 (1915). On *Limonia alata*. Peradeniya.
- Parlatoria atalantiæ**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 350 (1905). On *Atalantia zeylanica*. Haragama.
- Parlatoria cinnamomi**, Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 114 (1915). On *Cinnamomum* sp. Peradeniya.
- Parlatoria mangiferæ**, Marlatt. *Bul. U.S. Bur. Ent., Tech. Sec.* 16, ii. p. 28 (1908). On *Euphorbia antiquorum*. Elephant Pass.
- Parlatoria mesuæ**, Ruthfd. *Bul. Ent. Research*, v. 3. p. 266 (1914). On *Mesua ferrea*. Peradeniya.
- Parlatoria zeylanica** (A), Ruthd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 113 (1915). On Bamboo. Peradeniya.
- Parlatoria zeylanica** (B), Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 114 (1915). On *Cinnamomum* sp. Peradeniya.
- (Note.—Rutherford has described two completely distinct species under the same name on two consecutive pages of his paper. To rectify this mistake, I propose the name *rutherfordi*, in place of *zeylanica* (B).
- Parlatoria pergandei phyllanthi**, Green. *Journ. Bomb. Nat. Hist. Soc.*, xvi. p. 350 (1905). On *Phyllanthus myrtifolius*. Peradeniya.
- Parlatoria proteus**, Curtis. *Gard. Chron.*, p. 676 (1838). On *Cymbidium bicolor*. Peradeniya.
- Lecanium litseæ**, Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 111 (1915). On *Litsea longifolia*. Peradeniya.
- Cribrolecanium formicarum**, Green. *Ann. and Mag. Nat. Hist.*, 9, viii. p. 639 (1921). In hollow branches of *Stereospermum chelonioides*. Peradeniya.
- Neolecanium cinnamomi**, Ruthd. *Bul. Ent. Research*, v. 3, p. 265 (1914). On *Cinnamomum* sp. Peradeniya.
- Neolecanium pseudoleae**, Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 112 (1915). On *Cinnamomum* sp. Peradeniya.
- Pulvinaria maxima**, Green. *Ent. Mo. Mag.*, xl. p. 206 (1904). On *Peperomia*. Peradeniya.
- Inglisia castilloæ**, Green. *Journ. Econ. Biol.*, vi. pt. 2., p. 29 (1911). On *Castilloa elastica*. Koslanda.
- Cerococcus hibisci**, Green. *Mem. Dep. Ag. Ind., Ent. Ser.*, ii. 2, p. 19 (1908). On *Tephrosia candida*. Peradeniya.
- Ripersia theæ**, Ruthfd. *Journ. Bomb. Nat. Hist. Soc.*, xxiv. p. 111 (1915). On tea plant. Peradeniya.





## INDEX OF GENERA AND SPECIES.

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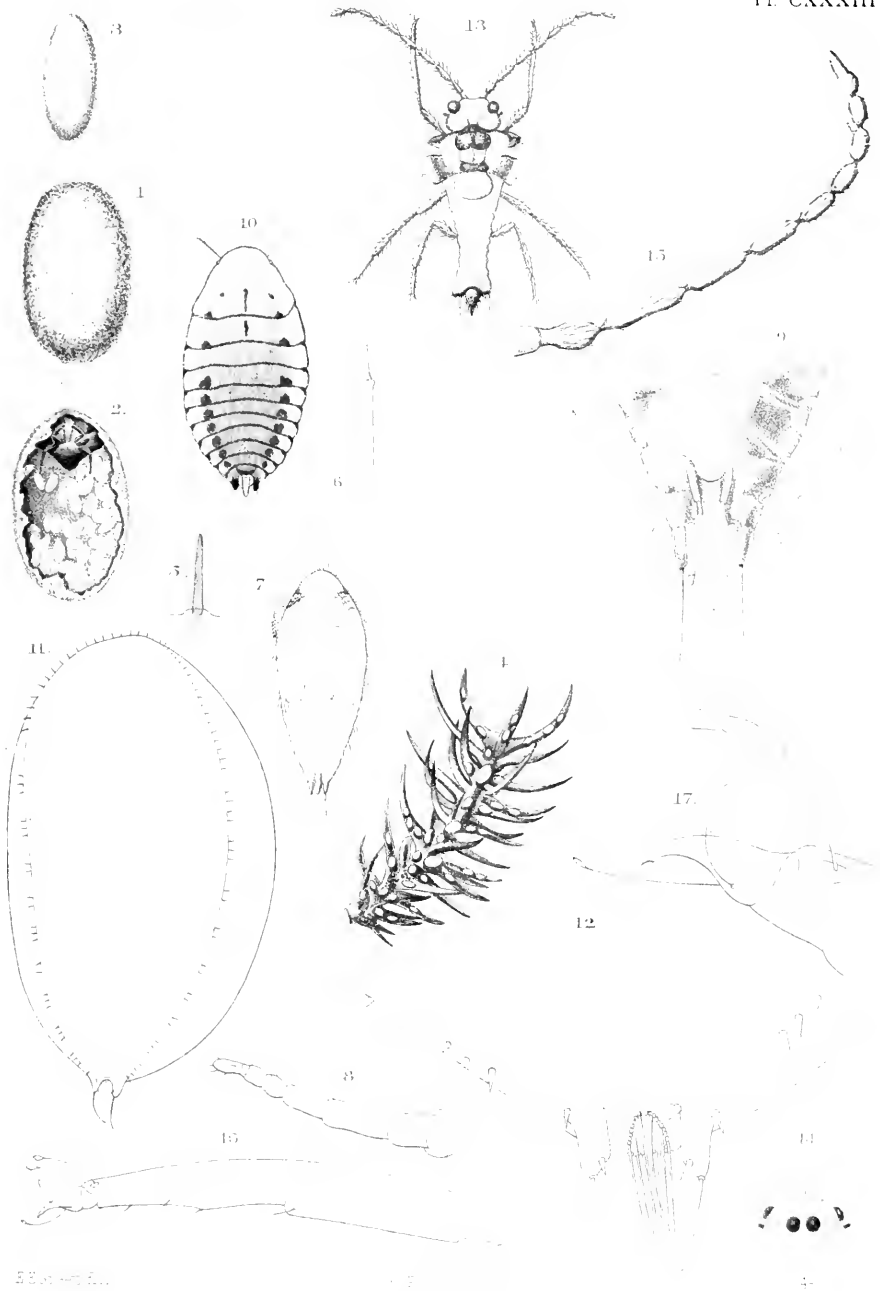
EXPLANATION OF PLATE CXXXIII.

ERIOCOCCUS ARAUCARIE.

- Fig. 1. Ovisac of female, from above,  $\times 9$ .  
2. " " " from below, showing ova and shrivelled insect,  $\times 9$ .  
3. Male puparium,  $\times 1$ .  
4. Insects, *in situ*, on Araucaria, nat. size.  
5. Glassy marginal process from living larva,  $\times 400$ .  
6. Marginal spine,  $\times 400$ .  
7. Advanced larva,  $\times 50$ .  
8. Antenna of adult female,  $\times 135$ .  
9. Posterior segments of larva,  $\times 300$ .  
10. Early adult female, dorsal aspect,  $\times 20$ .  
11. Mature female, showing arrangement of spines,  $\times 30$ .  
12. Posterior extremity of adult female,  $\times 135$ .  
13. Adult male, dorsal aspect,  $\times 30$ .  
14. Head of male, from below,  $\times 45$ .  
15. Antenna of male,  $\times 100$ .  
16. Mid leg of male,  $\times 280$ .  
17. Foot of male,  $\times 800$ .







ERIOCOCCUS ARAUCARIÆ.



EXPLANATION OF PLATE CXXXIV.

ERIOCOCCUS NUERÆ.

- Fig. 1. Adult female, showing arrangement of spines,  $\times 30$ .
2. Antenna,  $\times 280$ .
3. Anterior leg,  $\times 280$ .
4. Posterior extremity,  $\times 135$ . (The setæ of the anal ring have been omitted to avoid confusion of detail).





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ERIOCOCCUS NUERÆ



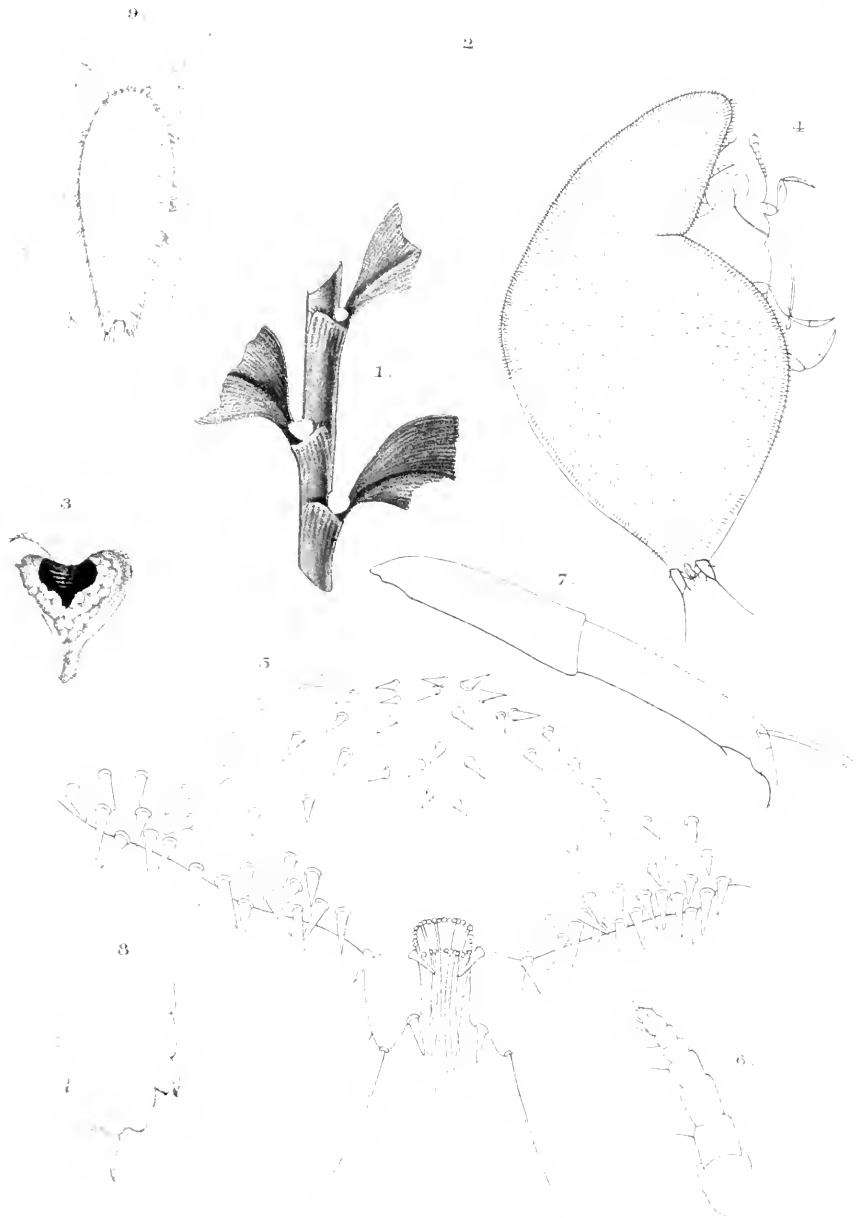
EXPLANATION OF PLATE CXXXV.

ERIOCOCCUS BAMBUSÆ.

- Fig. 1. Branch of bamboo, with female ovisacs *in situ*, nat. size.
2. Ovisac of female, dorsal view,  $\times 6$ .
3. " " " from below,  $\times 6$ .
4. Adult female, showing distribution of dorsal spines,  $\times 30$ .
5. Posterior extremity of female, dorsal view,  $\times 135$ .
6. Antenna,  $\times 135$ .
7. Mid leg,  $\times 280$ .
8. Posterior extremity of adult male,  $\times 80$ .
9. Young larva,  $\times 70$ .







REBER.

ERICOCOCUS

ERICOCOCUS BAMBUSÆ.

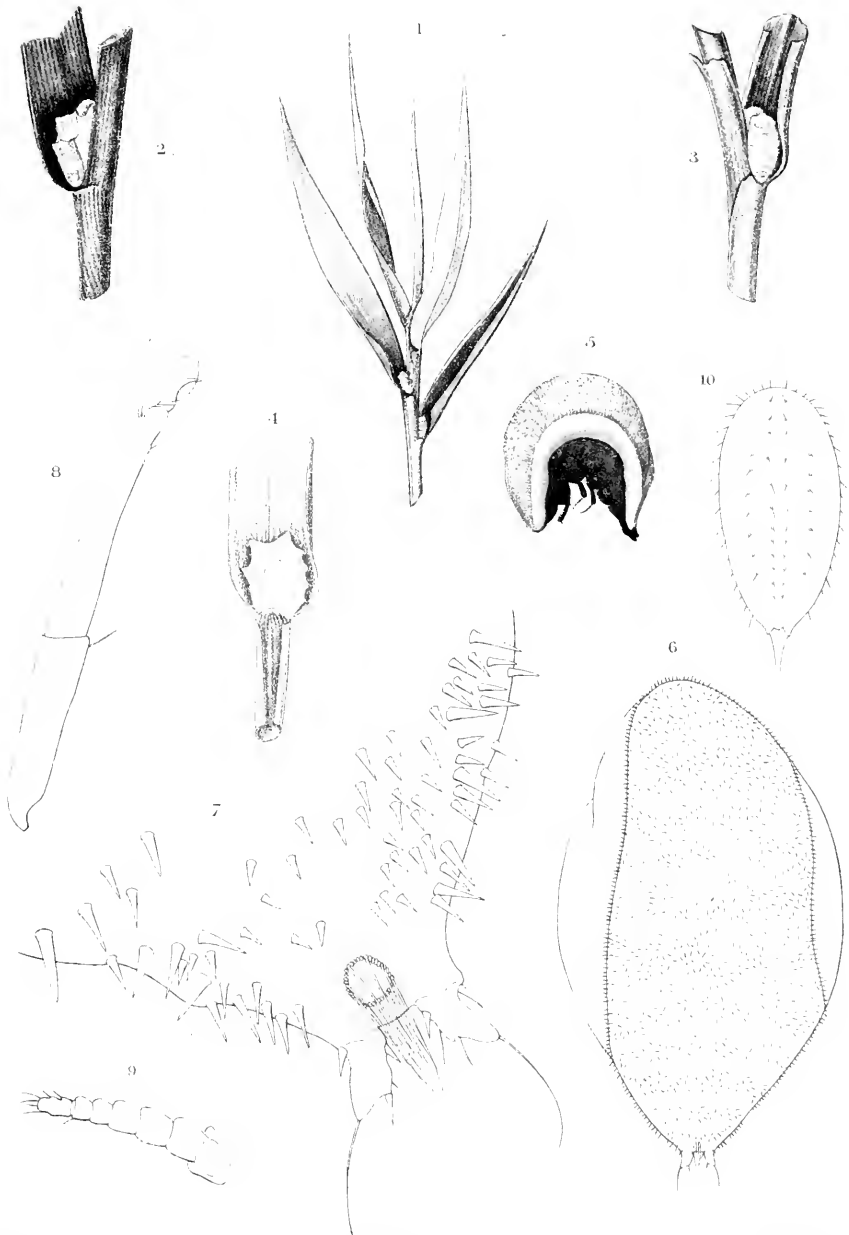


EXPLANATION OF PLATE CXXXVI

ERIOCOCCUS TRANSVERSUS.

- Fig. 1. Insects *in situ*, in axils of leaves of bamboo, nat. size.  
2. Female ovisac, anterior view,  $\times 4$ .  
3. " " posterior view,  $\times 4$ .  
4. " " lateral view,  $\times 4$ .  
5. Adult female, removed from puparium, lateral view,  $\times 15$ .  
6. " " dorsal view, showing arrangement of spines,  $\times 30$ .  
7. " " posterior extremity,  $\times 135$ .  
8. Mid leg,  $\times 280$ .  
9. Antenna,  $\times 135$ .  
10. Young larva,  $\times 80$ .





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*ERIOCOCCUS TRANSVERSUS.*



EXPLANATION OF PLATE CXXXVII.

ERIOCOCCUS TENUIS.

- Fig. 1. Insects, *in situ*, on leaves of grass, nat. size.  
2. Adult female (before gestation), dorsal view,  $\times 25$ .  
3. " " ventral view,  $\times 25$ .  
4. Pattern of dorsal spines of adult female,  $\times 35$ .  
5. Posterior extremity of adult female,  $\times 140$ .  
6, 7. Antennæ of female,  $\times 140$ .  
8. Part of mid leg of female,  $\times 300$ .  
9. Adult male, dorsal view,  $\times 35$ .







22. 100x.

FRUITING INF.

ANTENNA.

ERICOCOCCUS TENUIS.



EXPLANATION OF PLATE CXXXVIII.

ERIOCOCCUS RHODOMYRTI.

- Fig. 1. Leaf of *Rhodomyrtus*, with insects *in situ*, nat. size.  
2. Young larva, × about 140.  
3. Claw of the adult female, × 600.  
4. Male puparium, × about 12.  
5. Female ovisac, × about 12.  
6. Posterior extremity of early adult female, ventral view, × 200.  
7. Posterior extremity of older female, dorsal view, × 140.  
8. Pattern of dorsal spines of adult female, × 35.  
9. Antenna, normal form, × 140.  
10. „ variety from Namunakuli, × 140.  
11. Part of median limb, normal form, × 300.  
12. „ „ „ variety, × 300.





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ERIOCOCCUS RHODOMYRTI.



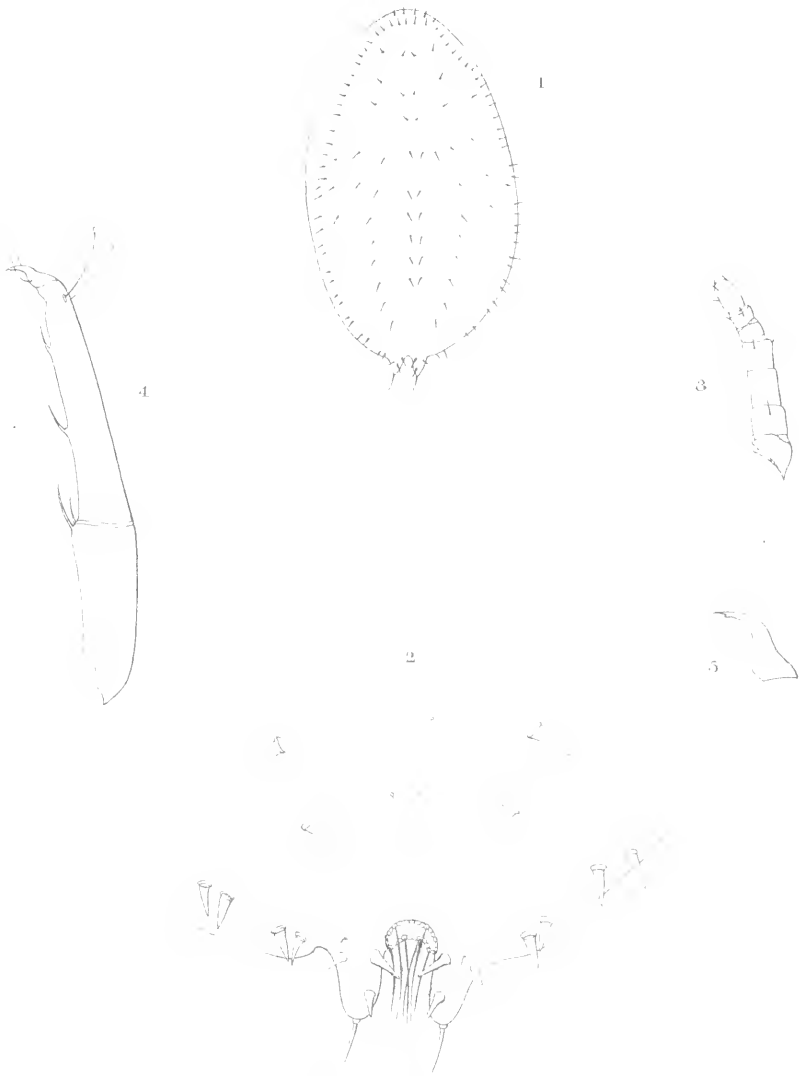
EXPLANATION OF PLATE CXXXIX.

ERIOCOCCUS OSBECKIÆ.

- Fig. 1. Adult female, showing arrangement of spines,  $\times 35$ .  
2. Posterior extremity,  $\times 140$ .  
3. Antenna,  $\times 140$ .  
4. Mid leg,  $\times 290$ .  
5. Claw,  $\times 550$ .







ERIOCOCCUS OSBECKIÆ

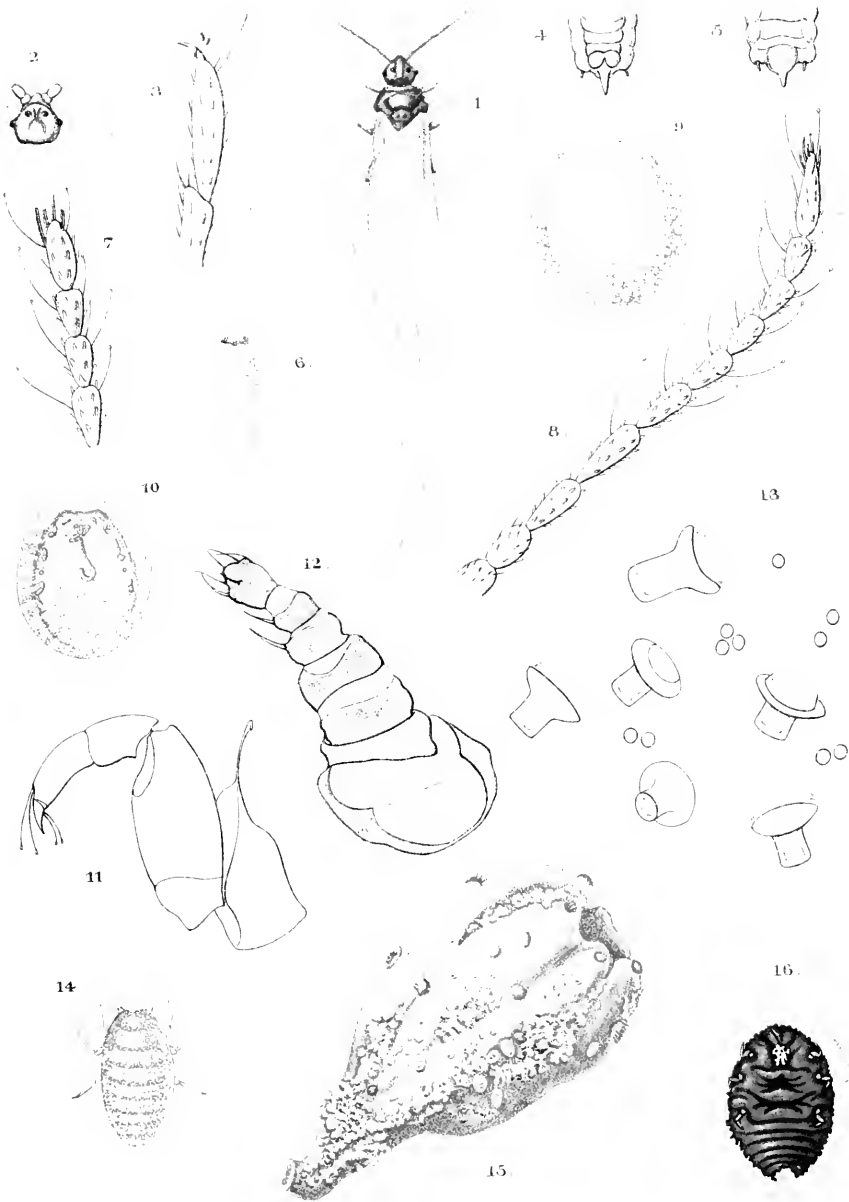


EXPLANATION OF PLATE CXL.

DACTYLOPIUS INDICUS.

- Fig. 1. Adult male, dorsal view,  $\times$  about 28.  
2. " " head, from below,  $\times$  36.  
3. " " foot,  $\times$  175.  
4. " " extremity of abdomen, ventral view,  $\times$  36.  
5. " " " " dorsal view,  $\times$  36.  
6. Male puparium,  $\times$  10.  
7. Terminal joints of male antenna, normal form,  $\times$  100.  
8. Antenna of male, with elongated terminal joint,  $\times$  100.  
9. Adult female, with covering of tomentum,  $\times$  10.  
10. " " after maceration, ventral view,  $\times$  10.  
11. " " mid leg,  $\times$  135.  
12. " " antenna,  $\times$  280.  
13. " " spines (and dermal pores), viewed from different angles,  $\times$  300.  
14. Larva,  $\times$  about 40.  
15. Fruit of *Opuntia*, with insects, nat. size.  
16. Adult female, ventral view,  $\times$  10.





E. Green del.

F. F. W. T. imp.

A. G. W. L. h.

DACTYLOPIUS INDICUS.



EXPLANATION OF PLATE CXLI.

HALIMOCOCCUS BORASSI.

- Fig. 1. Insects on leaf of *Borassus*, nat. size.  
2. Puparium of adult female, showing partial secretory covering, dorsal view,  $\times 70$ .  
3. Early puparium, with nymphal pellicle,  $\times 70$ .  
4. Exposed puparium, side view,  $\times 70$ .  
5. Adult female, side view,  $\times 50$ .  
6. Optical section of female,  $\times 80$ .  
7. Frons and antennae,  $\times 450$ .  
8. Posterior extremity of adult female,  $\times 450$ .  
9. ? Fully grown larva,  $\times 70$ .  
10. Posterior extremity of ? larva,  $\times 280$ .





2



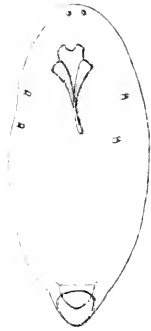
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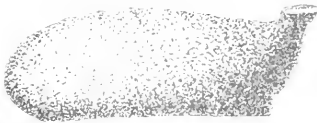
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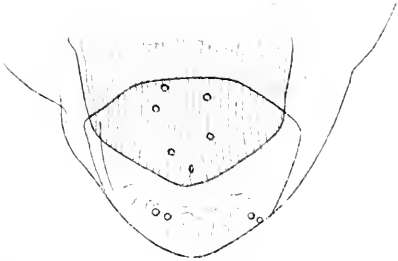
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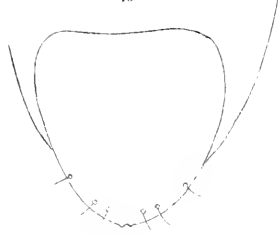
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**FALIMOCOCCUS BORASSI.**

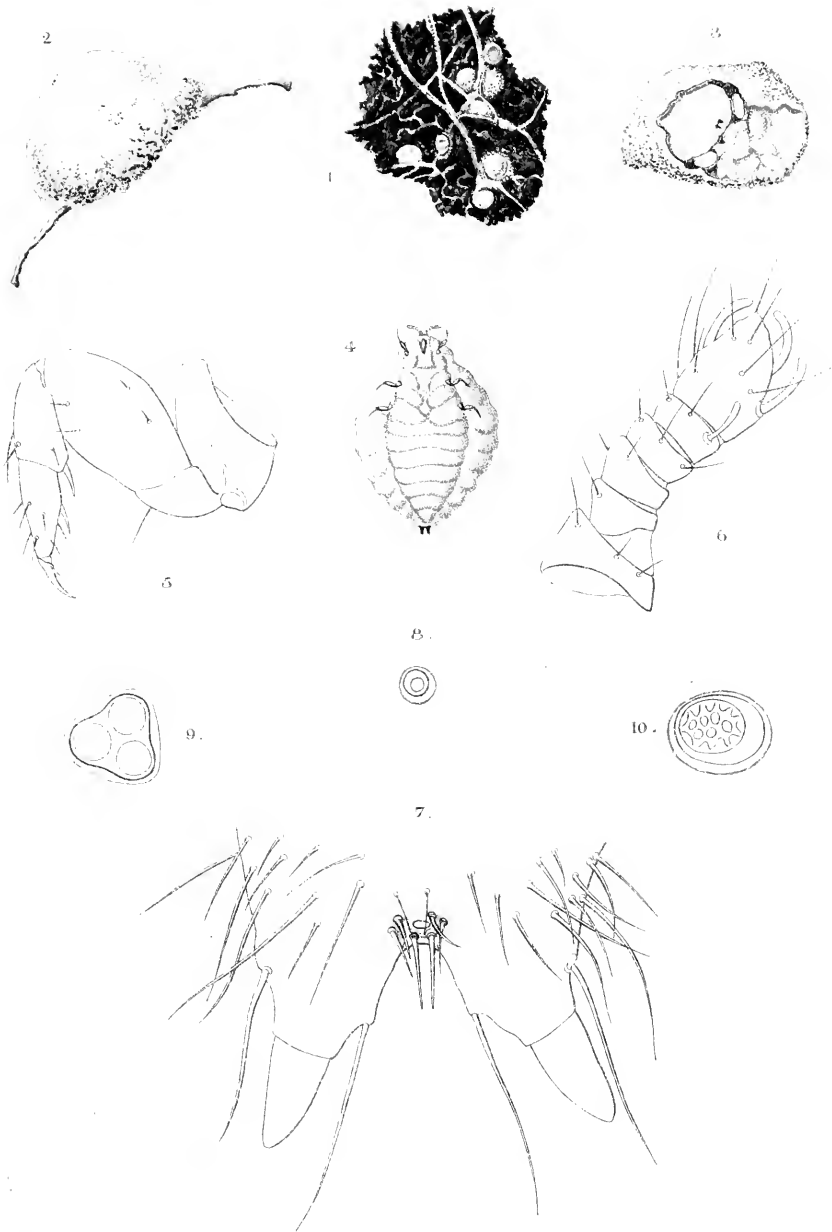


EXPLANATION OF PLATE CNLII.

GEOCOCCUS RADICUM.

- Fig. 1. Insects, *in situ*, on roots of grass, nat. size.  
2. Puparium of adult female,  $\times 10$ .  
3. " with part removed to show the insect and eggs,  $\times 10$ .  
4. Adult female, ventral view,  $\times 17$ .  
5. Mid leg of adult female,  $\times 280$ .  
6. Antenna of adult female,  $\times 280$ .  
7. Posterior extremity of adult female, ventral view,  $\times 280$ .  
8. Simple dermal gland of adult female,  $\times 700$ .  
9. Compound dermal gland of adult female,  $\times 700$ .  
10. Cribriform organ of adult female,  $\times 700$ .  
11. Young larva, optical section,  $\times 135$ .  
12. Antenna of larva,  $\times 500$ .  
13. Posterior extremity of larva,  $\times 280$ .  
14. Nymph, optical section,  $\times 35$ .  
15. Antenna of nymph,  $\times 280$ .  
16. Posterior extremity of nymph,  $\times 280$ .  
17. Compound dorsal gland of nymph,  $\times 700$ .  
18. Cribriform organ of nymph,  $\times 700$ .





E. E. Green del.

F. W. M. C. imp.

A. S. W. 1876.

*GEOCOCCUS RADICUM.*







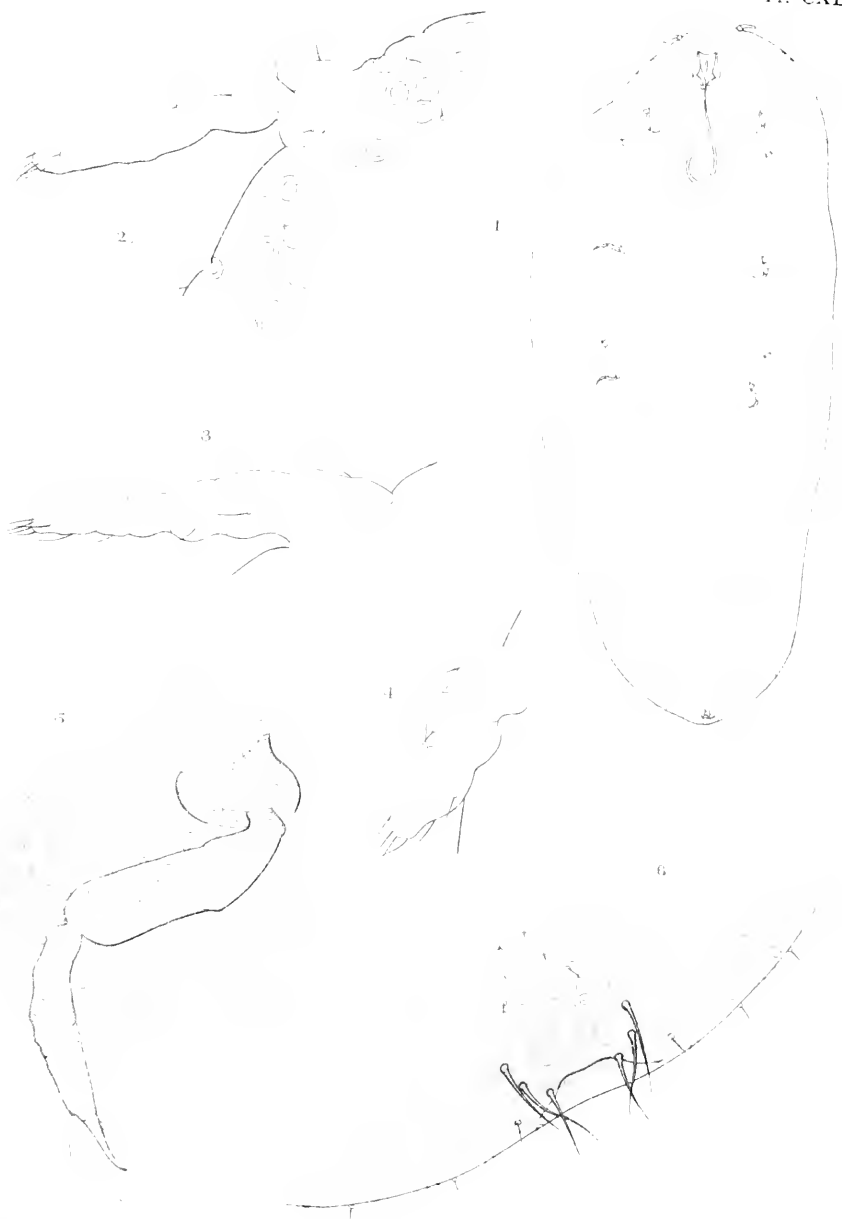


EXPLANATION OF PLATE CXLIII.

PSEUDANTONINA BAMBUSÆ.

- Fig. 1. Adult female,  $\times 20$ .
2. Antenna (five-jointed form), and part of anterior margin,  $\times 280$ .
  3. " (six-jointed form),  $\times 280$ .
  4. " (three-jointed form),  $\times 280$ .
  5. Mid leg and superimposed patch of dermal pores,  $\times 500$ .
  6. Posterior extremity,  $\times 280$ .





PSEUDANTONINA BAMBUSÆ

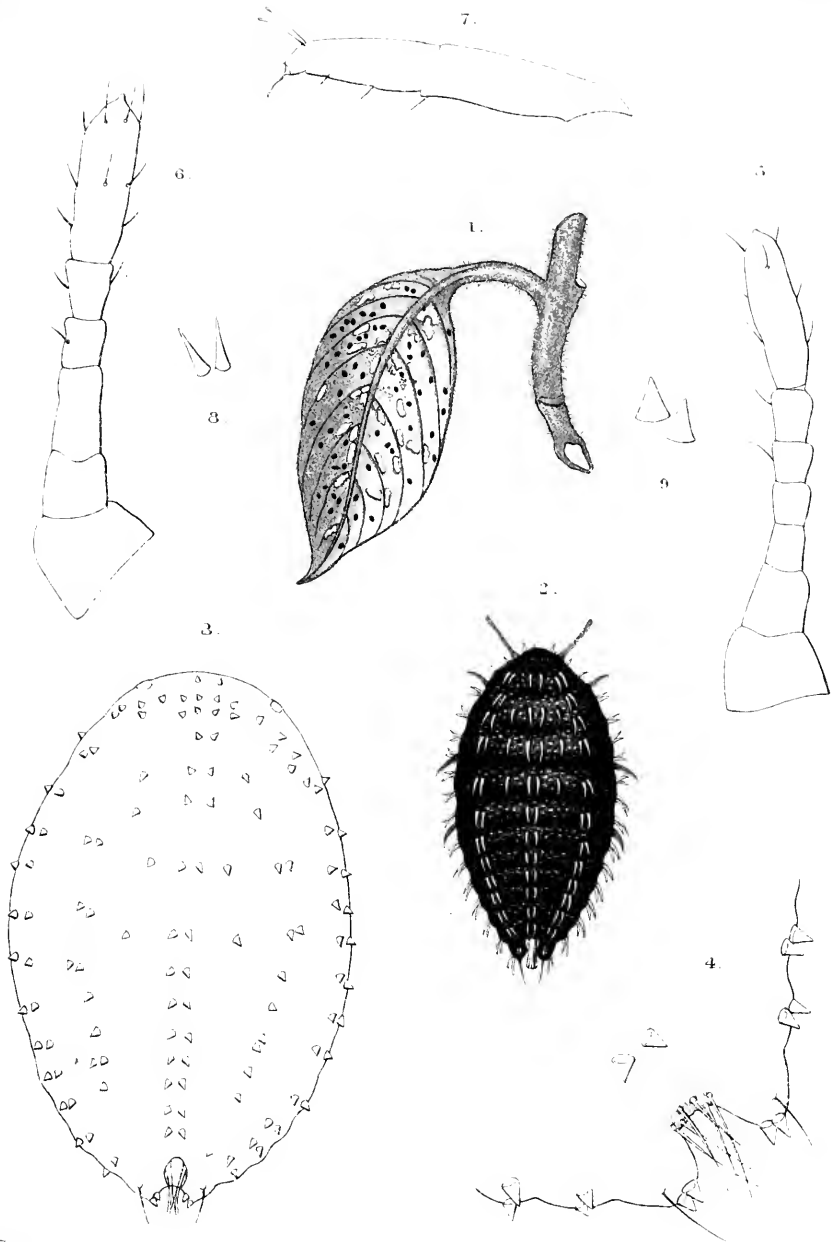


EXPLANATION OF PLATE CXLIV.

PEDRONIA STROBILANTHIS.

- Fig. 1. Insects on leaf of *Strobilanthes*, nat. size.  
2. Adult female, dorsal view,  $\times 40$ .  
3. " " showing arrangement of dorsal spines,  $\times 65$ .  
4. " " posterior extremity,  $\times 135$ .  
5. Antenna, normal seven-jointed form,  $\times 280$ .  
6. " " six-jointed form,  $\times 280$ .  
7. Mid leg,  $\times 280$ .  
8. Slender spines of var. *tenuispina*,  $\times 280$ .  
9. Stout spines of typical form,  $\times 280$ .





E.S. Green del.

FEDRONIA

STROBILANTHIS.

A. C. COCHRAN



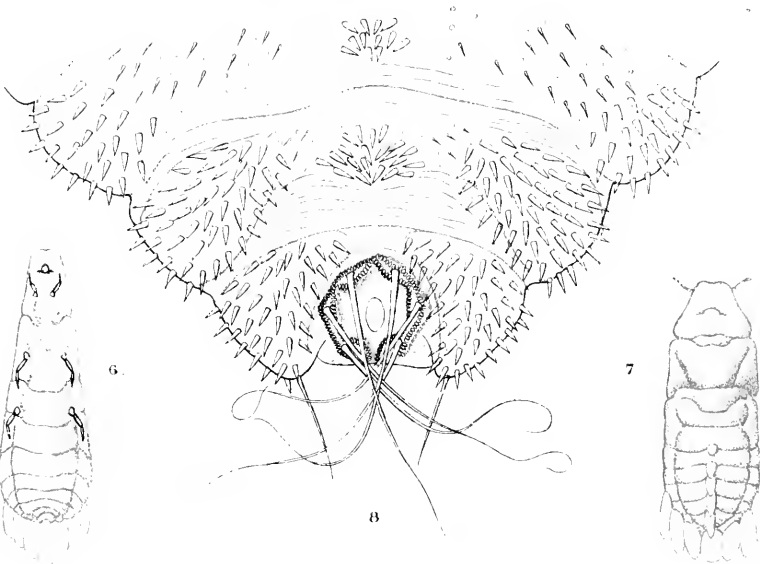
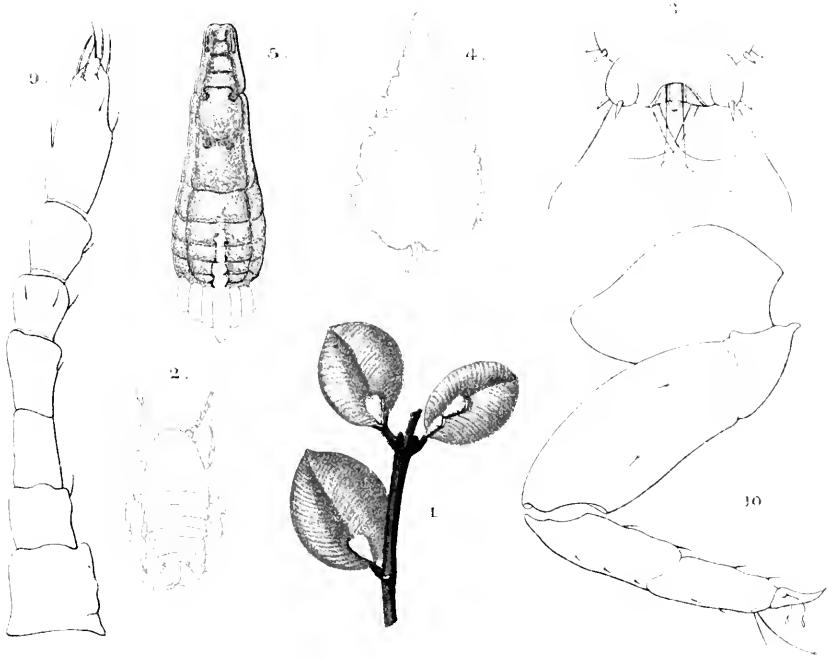


EXPLANATION OF PLATE CXLV.

ERIOIDES CUNEIFORMIS.

- Fig. 1. Female puparia, on leaf of *Eugenia*, nat. size.  
2. Young larva,  $\times 35$ .  
3. Posterior extremity of larva,  $\times 175$ .  
4. Puparium of adult female,  $\times 8$ .  
5. Old adult female, dorsal view,  $\times 15$ .  
6. " " ventral view,  $\times 15$ .  
7. Early adult female, dorsal view, 15.  
8. Posterior extremity of adult female, dorsal view,  $\times 135$ .  
9. Antenna of adult female,  $\times 280$ .  
10. Mid leg of adult female,  $\times 280$ .





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F. W. W. H. Lang

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*ERIOIDES CUNEIFORMIS.*

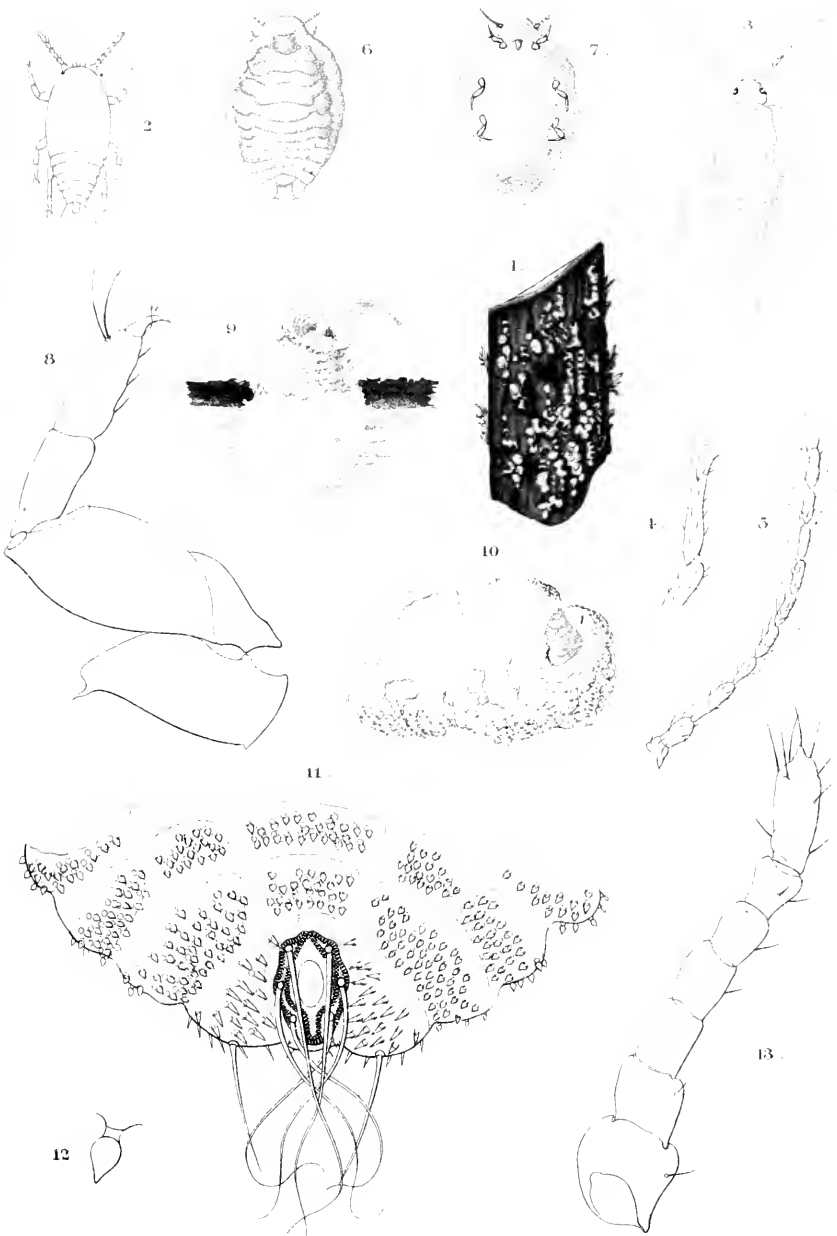


EXPLANATION OF PLATE CXLVI.

ERIOIDES RIMULÆ.

- Fig. 1. Insects on bark of *Phyllanthus*, nat. size.
2. Young larva,  $\times$  about 20.
  3. Adult male,  $\times$  30.
  4. Foot of male,  $\times$  150.
  5. Antenna of male,  $\times$  90.
  6. Adult female, dorsal view,  $\times$  15.
  7. " " ventral view,  $\times$  15.
  8. Foot of female,  $\times$  280.
  9. Early sac of female, in crevice of bark,  $\times$  13.
  10. Sac of older female, from surface of bark,  $\times$  13.
  11. Posterior extremity of female, dorsal view,  $\times$  135.
  12. One of the spines from the penultimate segment,  $\times$  500.
  13. Antenna of female,  $\times$  280.





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ERIOIDES RIMULÆ.



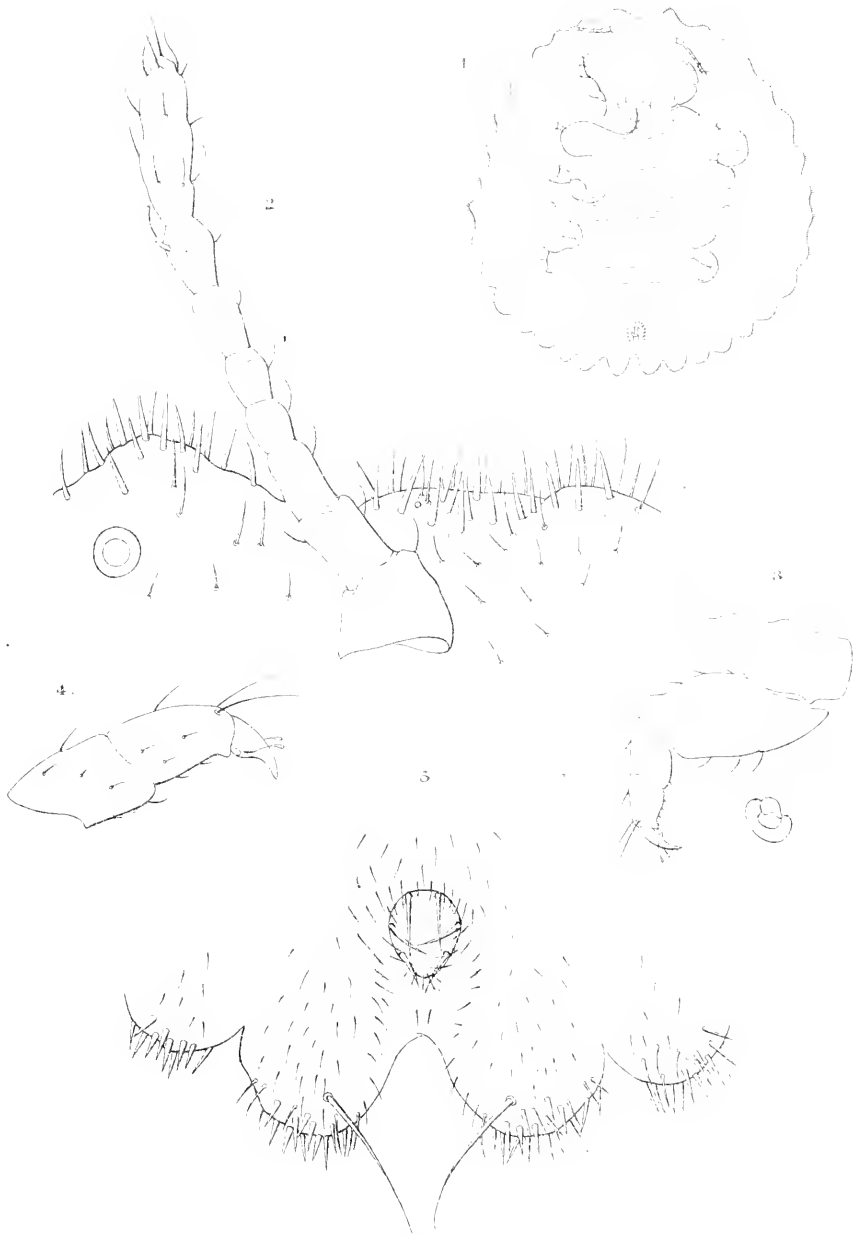


EXPLANATION OF PLATE CXLVII.

TYLOCOCCUS FORMICARII.

- Fig. 1. Adult female, optical section,  $\times 30$ .  
2. Part of anterior margin, with antenna and eye,  $\times 280$ .  
3. Mid leg and posterior spiracle,  $\times 135$ .  
4. Foot,  $\times 280$ .  
5. Posterior extremity,  $\times 135$ .





EE Green del

F&W McDougall

1907

**TYLOCOCCUS FORMICARII.**



EXPLANATION OF PLATE CNLVIII.

TYLOCOCCLUS SIMPLICIOR.

- Fig. 1. Adult female (after maceration),  $\times 30$ .
2. Antenna,  $\times 135$ .
  3. Mid leg,  $\times 135$ .
  4. Anterior spiracle,  $\times 280$ .
  5. Posterior spiracle,  $\times 280$ .
  6. Frons : (a) base of antenna, (b) eye,  $\times 280$ .
  7. Posterior extremity of body,  $\times 135$ .





H.B. Swarth del.

TYLOCOCCLUS SIMPLICIOR.





EXPLANATION OF PLATE CXLIX.

PSEUDOCOCCUS VIRGATUS.

- Fig. 1. Insects on branchlets of *Talinum*, nat. size.  
2. Adult female, dorsal view,  $\times 9$ .  
3. Early adult female, ventral view,  $\times 12$ .  
4. Female, at period of oviposition,  $\times 4$ .  
5. Adult female, after maceration,  $\times 18$ .  
6. Antenna,  $\times 135$ .  
7. Mid leg,  $\times 80$ .  
8. Foot,  $\times 280$ .  
9. Posterior extremity of adult female,  $\times 135$ .  
10. Tubular gland, from margin of thorax,  $\times 280$ .  
11. Adult male, side view,  $\times 30$ .  
12. Head of male, from above,  $\times 60$ .  
13. " " from below,  $\times 60$ .  
14. Anterior spiracle of adult female,  $\times 280$ .  
15. Posterior " " "  $\times 280$ .





*PSEUDOCOCCUS VIRGATUS.*

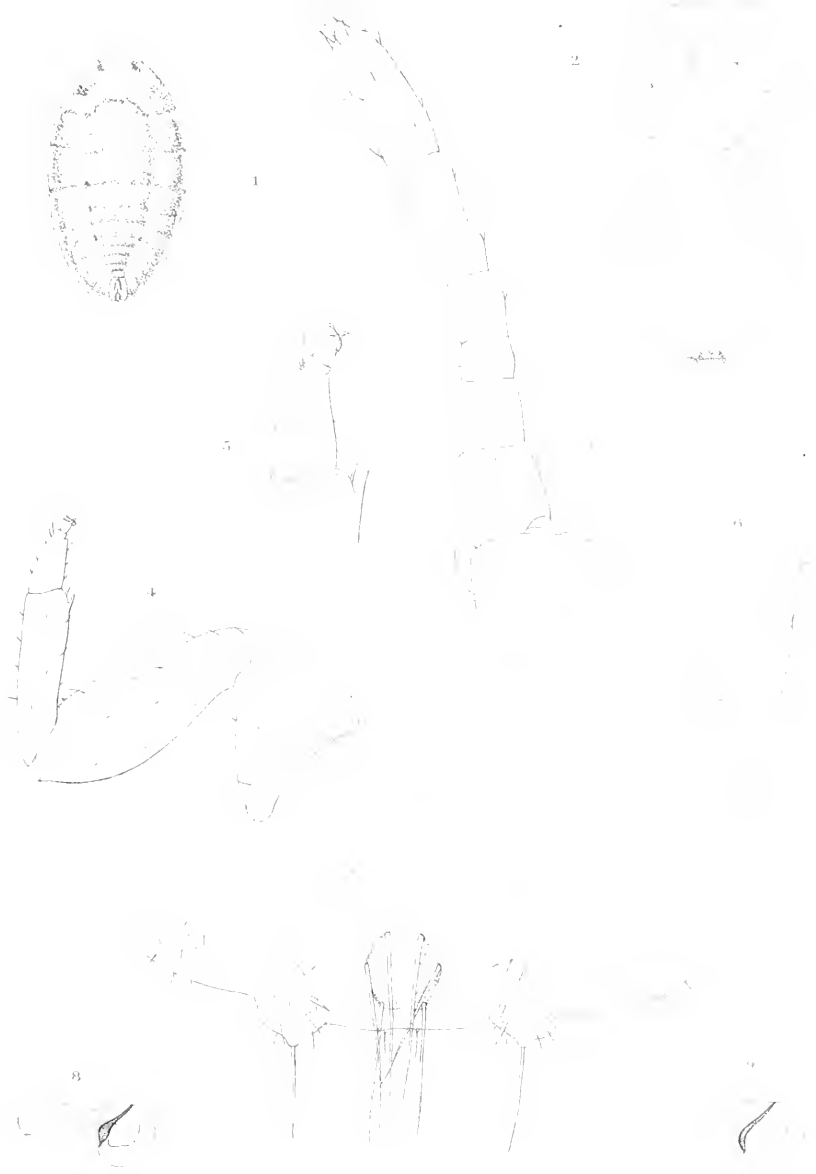


EXPLANATION OF PLATE CL.

PSEUDOCOCCUS KANDYENSIS.

- Fig. 1. Early adult female, dorsal view,  $\times 12$ .  
2. Adult female, after maceration, ventral view,  $\times 18$ .  
3. Antenna,  $\times 280$ .  
4. Mid leg,  $\times 135$ .  
5. Foot,  $\times 280$ .  
6. Glandular pores from margin of thorax,  $\times 280$ .  
7. Posterior extremity,  $\times 135$ .  
8. Anterior spiracle,  $\times 280$ .  
9. Posterior „ „  $\times 280$ .





PSEUDOGOCCUS KANDYENSIS.





EXPLANATION OF PLATE CLI.

PSEUDOCOCCUS PULVERARIUS.

- Fig. 1. Stem of grass, showing insects *in situ*, nat. size.  
2. Adult female,  $\times 30$ .  
3, 4. Antennæ,  $\times 280$ .  
5. Mid leg,  $\times 280$ .  
6. Anal segment,  $\times 280$ .

PSEUDOCOCCUS PULVERARIUS BAMBUSÆ.

- Fig. 7. Insects on young stems of bamboo, nat. size.  
8. Antenna,  $\times 280$ .  
9. Mid leg,  $\times 280$ .  
10. Posterior extremity,  $\times 280$ .





Figs. 1—6 PSEUDOCOCCUS PULVERARIUS.  
 ,, 7—9. PSEUDOCOCCUS PULVERARIUS var. BAMBUSÆ.

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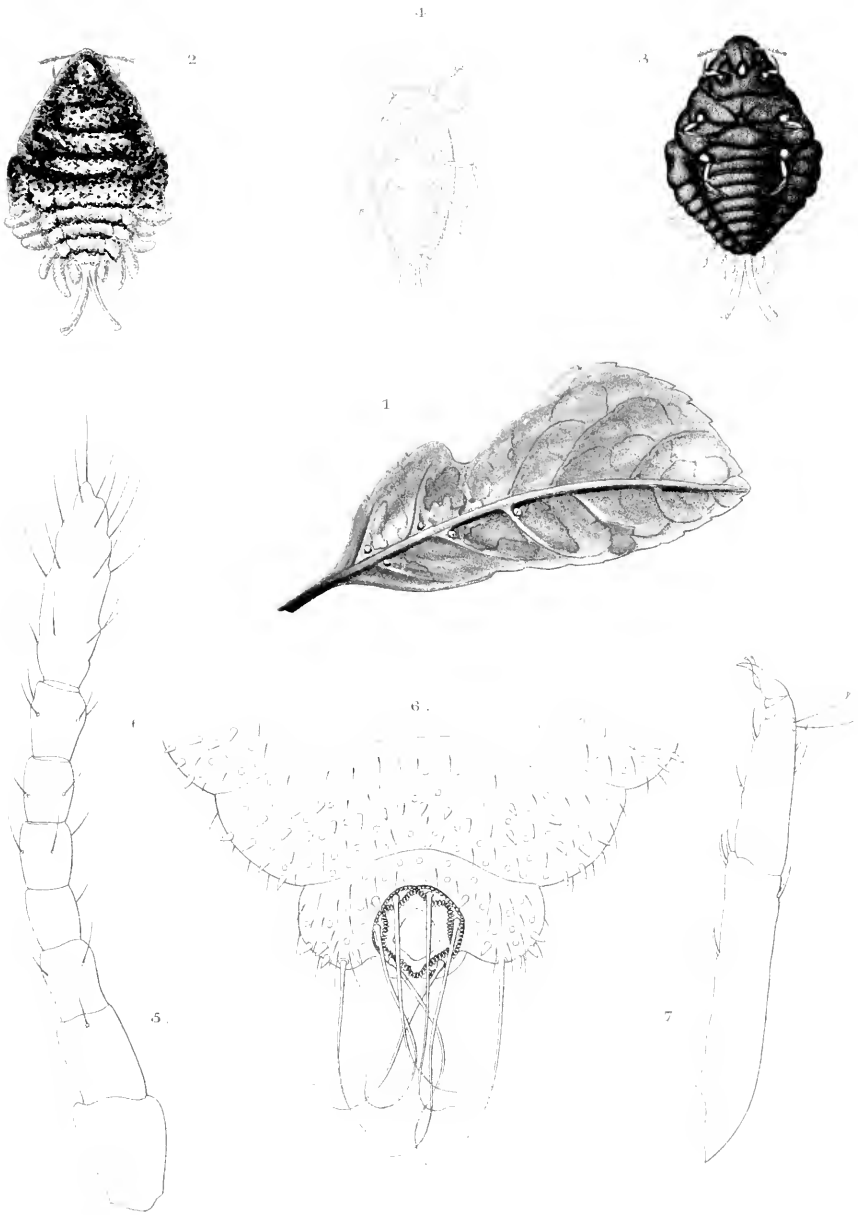


EXPLANATION OF PLATE CLII.

PSEUDOCOCCUS SCROBICULARUM.

- Fig. 1. Leaf of *Elaeocarpus*, with scrobiculæ occupied by the insects  
nat. size.
2. Adult female, dorsal view,  $\times 15$ .
  3. " " ventral view,  $\times 15$ .
  4. Young larva,  $\times 50$ .
  5. Antenna of adult female,  $\times 280$ .
  6. Posterior extremity,  $\times 135$ .
  7. Part of mid leg,  $\times 280$ .





REPRODUCED

FROM THE

PLATE

*PSUDOCOCCUS SCROBICULARIUM.*



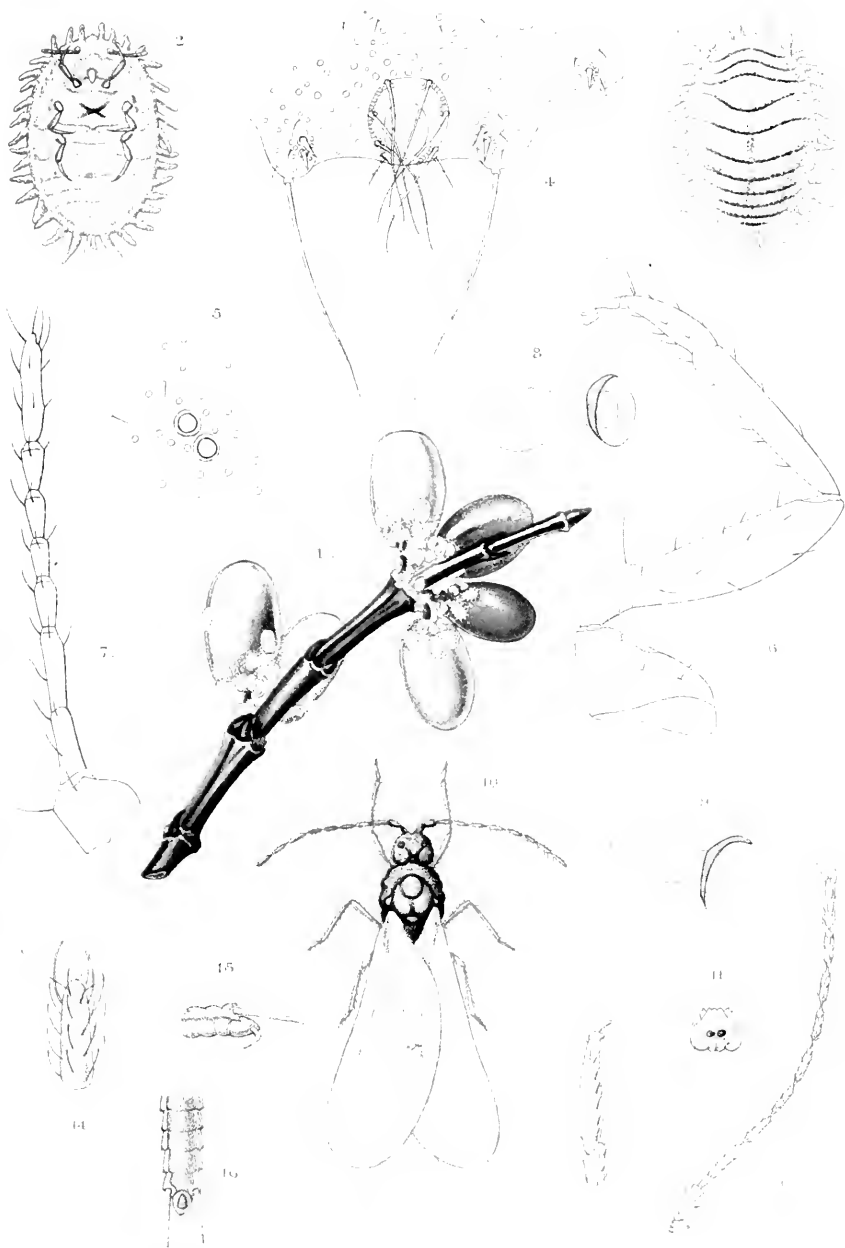


## EXPLANATION OF PLATE CLIII.

### PSEUDOCOCCUS CITRI.

- Fig. 1. Coffee berries, with colony of insects, nat. size.
2. Adult female, ventral view,  $\times 12$ .
  3. " " dorsal view,  $\times 12$ .
  4. " " posterior extremity,  $\times 135$ .
  5. " " ceriferous tract of anal segment,  $\times 425$ .
  6. " " mid leg,  $\times 135$ .
  7. " " antenna,  $\times 135$ .
  8. " " anterior spiracle,  $\times 280$ .
  9. " " posterior spiracle,  $\times 280$ .
  10. Adult male, dorsal view,  $\times$  about 25.
  11. " " head, from below,  $\times$  about 25.
  12. " " foot,  $\times$  about 150.
  13. " " antenna,  $\times$  about 200.
  14. " " terminal joint of antenna,  $\times$  about 400.
  15. " " extremity of abdomen, side view,  $\times$  about 50.
  16. " " " " " from below,  $\times$  about 50.





PSEUDOCOCCUS CITRI.

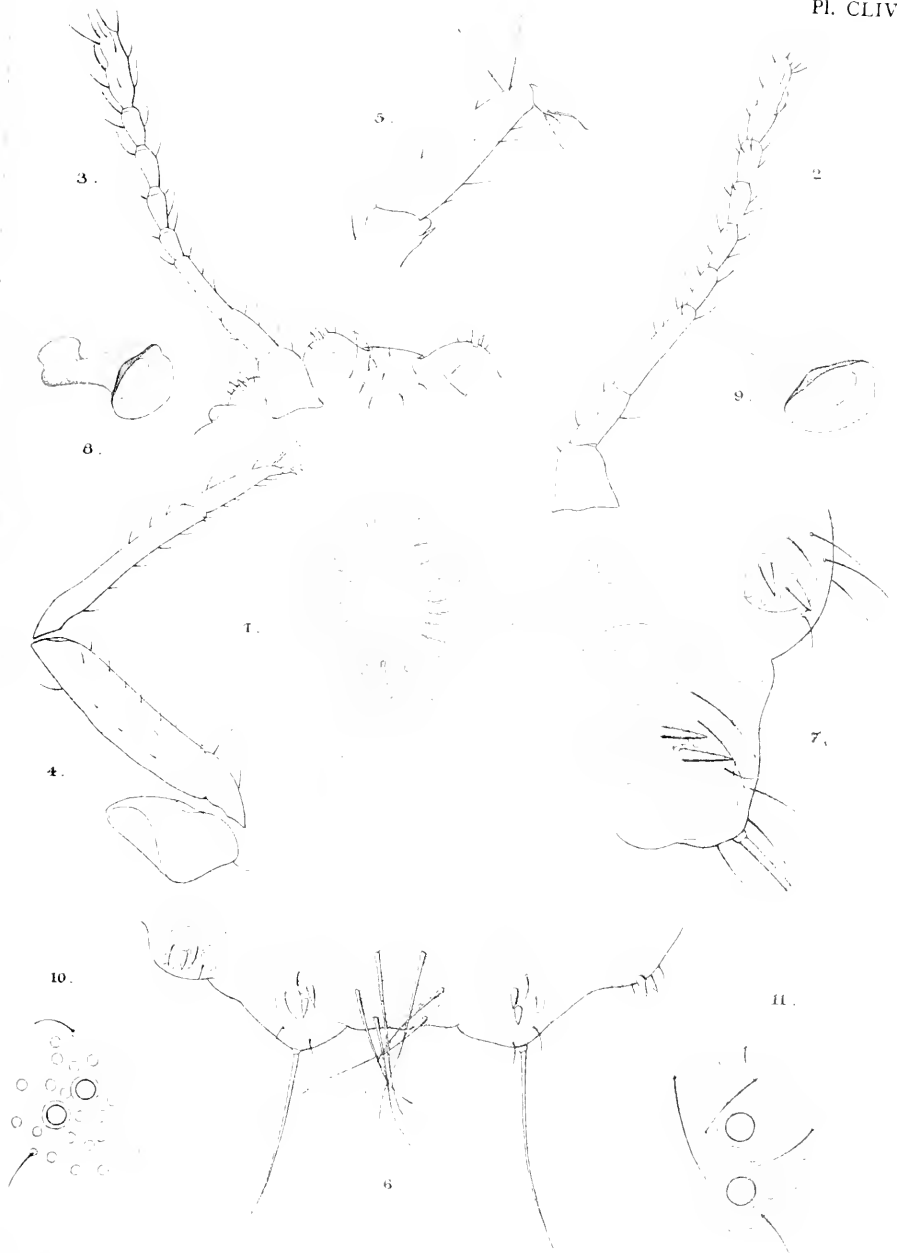


EXPLANATION OF PLATE CLIV.

(PSEUDOCOCCUS CITRICULUS).

- Fig. 1. Adult female, dorsal view,  $\times 18$ .  
2. Antenna,  $\times 135$ .  
3. Frons, eye and antenna  $\times 135$ .  
4. Mid leg,  $\times 135$ .  
5. Foot  $\times 280$ .  
6. Posterior extremity,  $\times 135$ .  
7. Ceriferous tracts of terminal segments,  $\times 280$ .  
8. Anterior spiracle,  $\times 280$ .  
9. Posterior „  $\times 280$ .





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*PSEUDOCOCCUS CITRICULUS.*



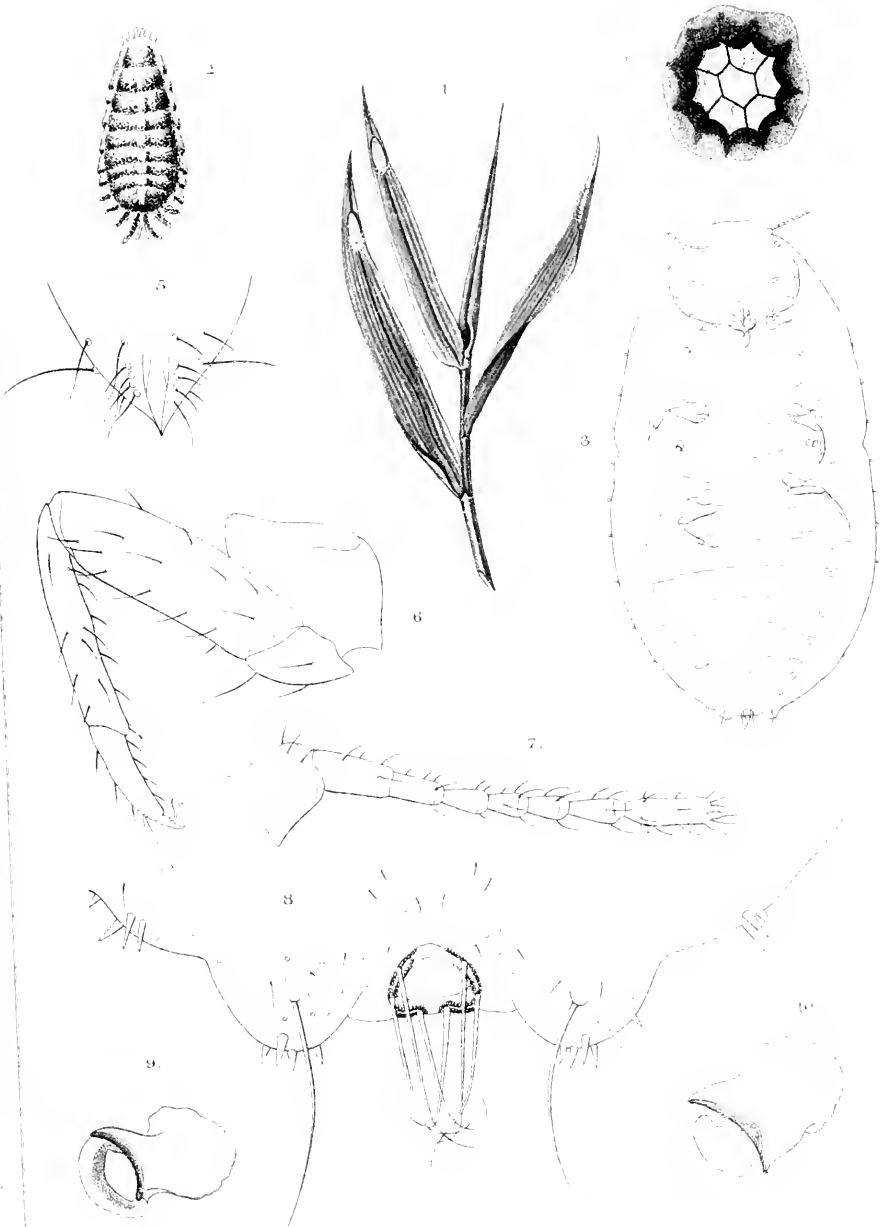


EXPLANATION OF PLATE CLV.

PSEUDOCOCCUS MONTICOLA.

- Fig. 1. Insects on bamboo leaves, nat. size.  
2. Adult female, dorsal view,  $\times 6$ .  
3. Optical section of female,  $\times 18$ .  
4. Sublateral gland,  $\times 500$ .  
5. Tip of mentum,  $\times 280$ .  
6. Mid leg,  $\times 135$ .  
7. Antenna,  $\times 135$ .  
8. Anal segment,  $\times 135$ .  
9. Anterior spiracle,  $\times 280$ .  
10. Posterior ,,  $\times 280$ .





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*PSEUDOGOCOCUS MONTICOLA*

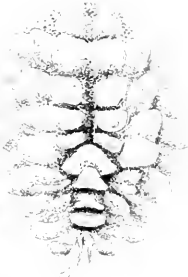


EXPLANATION OF PLATE CLVI.

PSEUDOCOCCUS FILAMENTOSUS VAR. CORYMBATUS.

- Fig. 1. Ovisacs, on branch of *Breyenia*, nat size.  
2. Adult female, before oviposition,  $\times 10$ .  
3. „ „ after maceration,  $\times 18$ .  
4. Antenna,  $\times 135$ .  
5. Mid leg,  $\times 135$ .  
6. Spines on marginal area of thorax,  $\times 280$ .  
7. Pits from submarginal area,  $\times 280$ .  
8. Anterior spiracle,  $\times 280$ .  
9. Posterior spiracle,  $\times 280$ .  
10. Frons, dorsal aspect,  $\times 280$ .  
11. Posterior extremity, dorsal aspect,  $\times 135$ .





PSUDOCOCCUS FILAMENTOSUS var. CORYMBATUS.



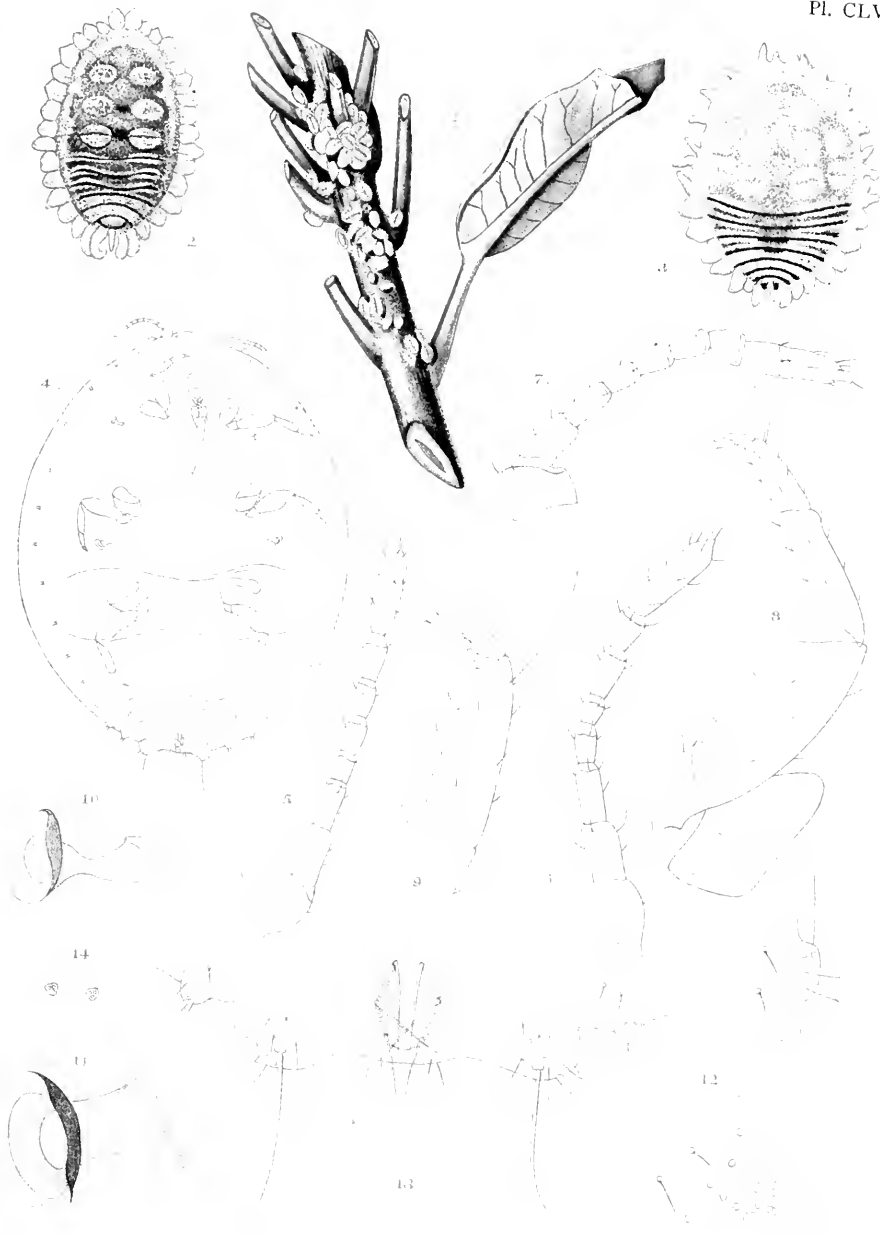


EXPLANATION OF PLATE CLVII.

PSEUDOCOCCUS LILACINUS.

- Fig. 1. Insects, on branch of *Codiaeum*, nat. size.  
2. Early adult female, dorsal view,  $\times 18$ .  
3. Old adult female,  $\times 15$ .  
4. " " after maceration,  $\times 30$ .  
5. Antenna (from example on *Castilleja*),  $\times 135$ .  
6. " " " *Erythrina*,  $\times 135$ .  
7. " " " *Codiaeum*,  $\times 135$ .  
8. Mid leg,  $\times 135$ .  
9. Foot,  $\times 280$ .  
10. Anterior spiracle,  $\times 280$ .  
11. Posterior "  $\times 280$ .  
12. Ceriferous tracts (penultimate and antepenultimate segments)  $\times 280$ .  
13. Posterior extremity,  $\times 135$ .  
14. Ceriferous pores,  $\times 425$ .





PSEUDOCOCCUS LILACINUS



EXPLANATION OF PLATE CLVIII.

PSEUDOCOCCUS LONGISPINUS.

- Fig. 1. Insects on foliage of Jasmine, nat. size.  
2. Adult female, dorsal view,  $\times 10$ .  
3. " " ventral view,  $\times 10$ .  
4. Antenna,  $\times 135$ .  
5. Mid leg,  $\times 135$ .  
6. Foot,  $\times 280$ .  
7. Posterior extremity,  $\times 135$ .  
8, *a*. Pattern of ceriferous tract on anal segment,  $\times 425$ .  
8, *b*. " " " from near base of abdomen,  $\times 425$ .  
9. Adult male, ventral view,  $\times 25$ .  
10. Head of male, dorsal view,  $\times 50$ .  
11, *a*. Anterior spiracle of female,  $\times 280$ .  
11, *b*. Posterior " " ,  $\times 280$ .









EXPLANATION OF PLATE CLIX.

PSEUDOCOCCUS DEBREGEASIE.

- Fig. 1. Antenna,  $\times 135$ .  
2. Mid leg,  $\times 135$ .  
3. Foot,  $\times 280$ .  
4. Anterior spiracle,  $\times 280$ .  
5. Posterior spiracle,  $\times 280$ .  
6. Frontal ceriferous tract,  $\times 280$ .  
7. Posterior extremity,  $\times 135$ .





H.E. S. del.

P. DEBREGESIAE

PSUDOCOCUS DEBREGESIAE.



EXPLANATION OF PLATE CLX.

PHENACOCCLUS GLOMERATUS.

- Fig. 1. Branch of *Thespesia*, with mass of insects and eggs ; nat. size  
2. Antenna, normal form,  $\times 135$ .  
3. „ form with fourth and fifth joints equal,  $\times 135$ .  
4. „ exceptional ten-jointed form,  $\times 135$ .  
5. Foot of mid leg,  $\times 280$ .  
6. Posterior extremity,  $\times 135$ .





PHENACOCUS GLOMERATUS.



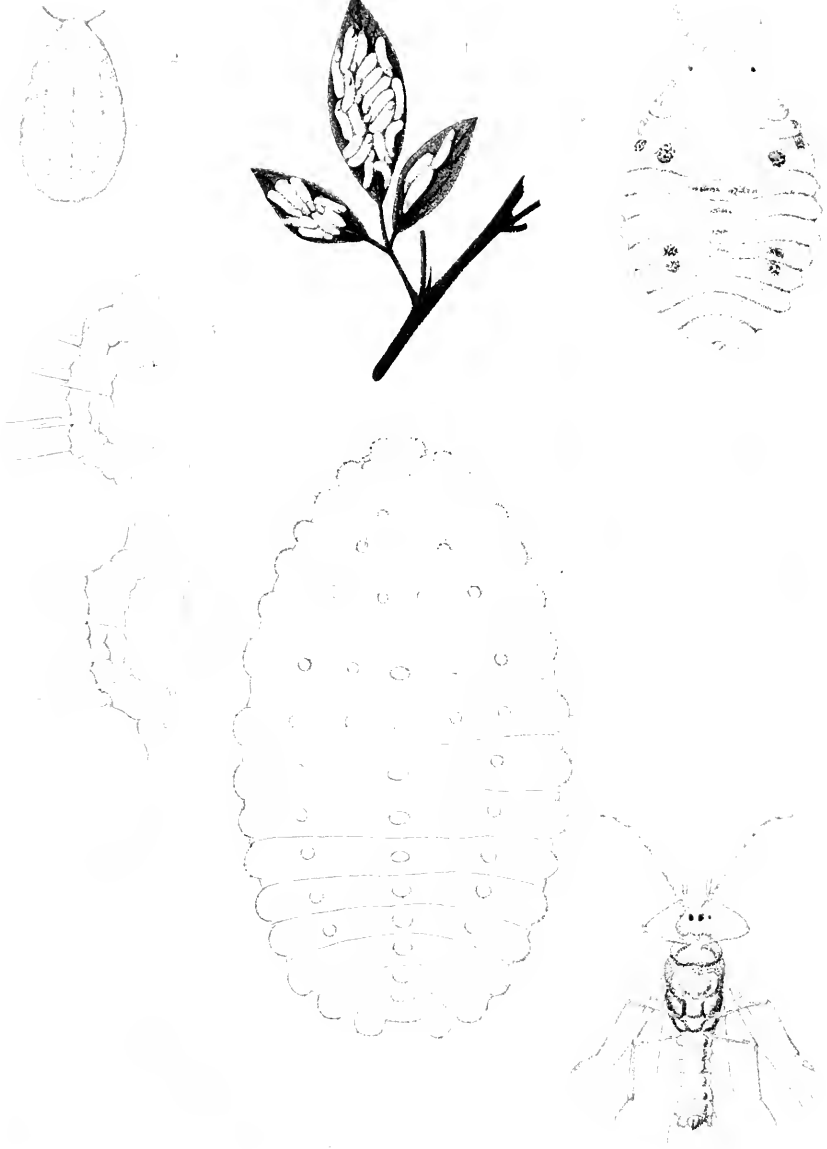


EXPLANATION OF PLATE CLXI.

PHENACOCCLUS INSOLITUS.

- Fig. 1. Insects, on leaf of *Cajanus*, nat. size.  
2. Early adult female, from *Cajanus*,  $\times 20$ .  
3. Later adult female, from *Solanum*,  $\times 16$ .  
4. Diagrammatic view of dorsum, showing arrangement of spiniferous tubercles,  $\times 65$ .  
5. Marginal tubercles,  $\times 280$ .  
6, 7. Antennæ of adult female, nine-jointed form,  $\times 135$ .  
8. Antenna, eight-jointed form,  $\times 135$ .  
9. Foot of adult female,  $\times 280$ .  
10. Adult male, ventral view,  $\times 30$ .





*PHENACOCUS INSOLITUS.*

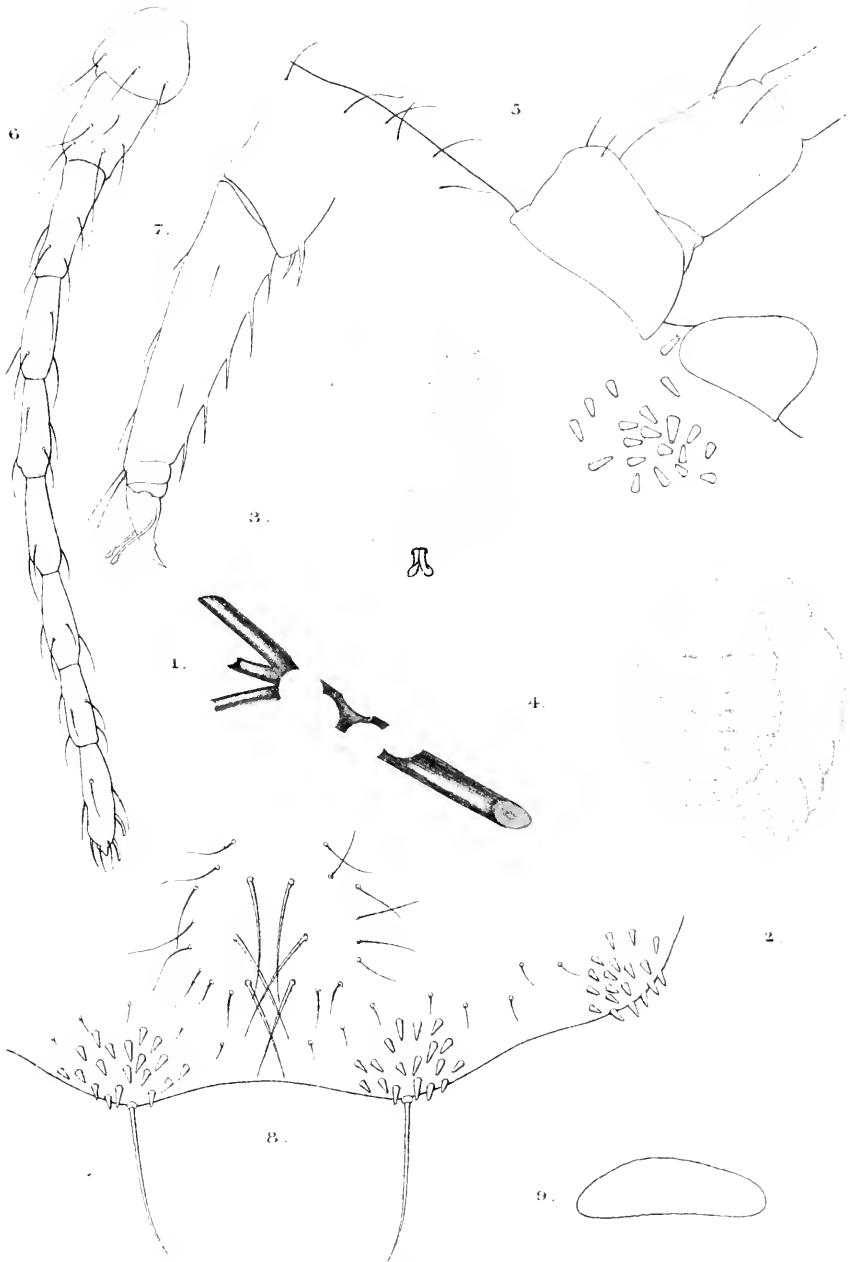


EXPLANATION OF PLATE CLXII.

PHENACOCCLUS ICERYOIDES.

- Fig. 1. Adult females (with ovisacs), nat. size.  
2. Adult female and ovisac, side view,  $\times 4$ .  
3. „ „ before oviposition, dorsal view,  $\times 12$ .  
4. Early adult female, dorsal view,  $\times 15$ .  
5. Eye and base of antenna,  $\times 280$ .  
6. Antenna,  $\times 135$ .  
7. Foot,  $\times 280$ .  
8. Posterior extremity of early adult female,  $\times 135$ .  
9. Cicatrice on venter of second abdominal segment,  $\times 50$ .





E. E. H. in 52

F. F. W. M. in 10

A. M. in 10

PHENACOCUS ICERYOIDES Green



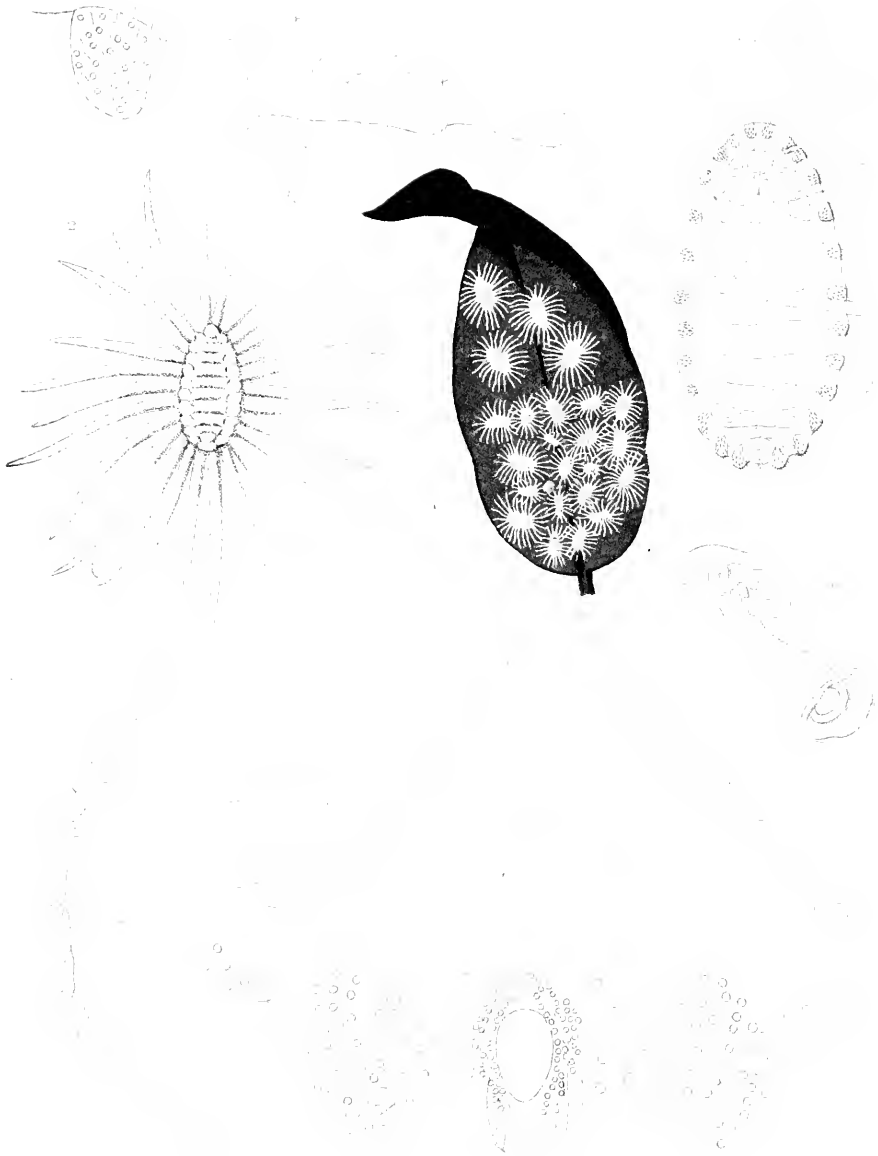


EXPLANATION OF PLATE CLXIII.

PHENACOCCLUS ORNATUS.

- Fig. 1. Leaf of Jasmine, with insects, nat. size.  
2. Adult female, dorsal view,  $\times 6$ .  
3. „ „ after maceration,  $\times 18$ .  
4. Base of antenna and eye,  $\times 135$ .  
5. Spiracle,  $\times 250$ .  
6. Antenna,  $\times 80$ .  
7. Mid leg,  $\times 80$ .  
8. Anal segment,  $\times 135$ .





PHENACOCCLUS ORNATUS.



EXPLANATION OF PLATE CLXIV.

PHENACOCCUS MANGIFERÆ.

- Fig. 1. Adult male,  $\times 25$ .  
2. Head of male, from below,  $\times 75$ .  
3. Head of male, side view,  $\times 75$ .  
4. Part of Mango leaf, with insects, nat. size.  
5. Adult female, dorsal view,  $\times 15$ .  
6. " " ventral view,  $\times 15$ .  
7. Nymph,  $\times 12$ .  
8. Early adult female,  $\times 12$ .  
9. Empty puparium of male,  $\times 15$ .  
10. Adult female, after maceration,  $\times 18$ .  
11. Antenna,  $\times 80$ .  
12. Mid leg,  $\times 80$ .  
13. Anterior margin, with base of antenna and eye,  $\times 135$ .  
14. Posterior extremity,  $\times 135$ .  
15. Truncate spines,  $\times 450$ .  
16. Claw of mid leg,  $\times 450$ .  
*Phenacoccus spinosus*.  
17. Claw of mid leg,  $\times 450$ .





1-16. PHENACOCUS MANGIFERÆ.  
 17. " SPINOSUS.

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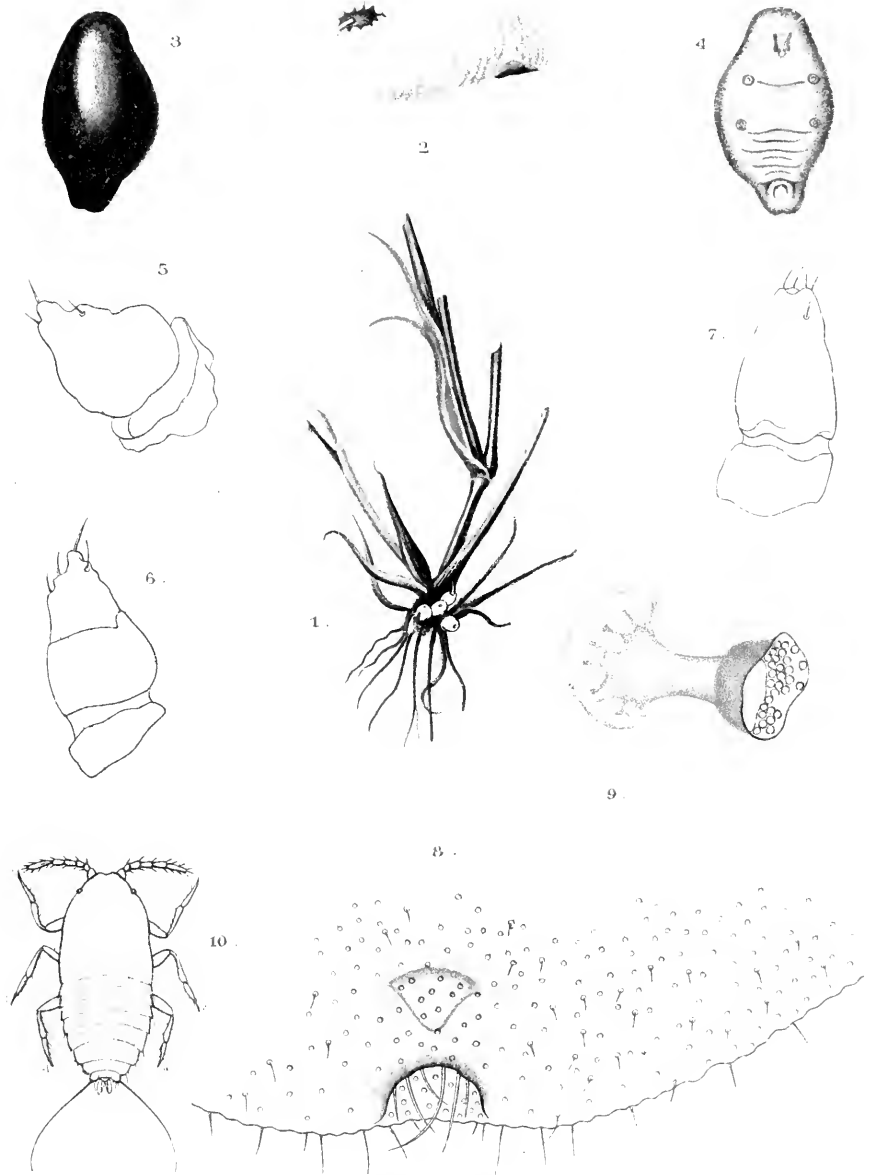


EXPLANATION OF PLATE CLXV.

ANTONINA INDICA.

- Fig. 1. Grass plant, showing insects at base of stems, nat. size.  
2. Isolated female, with sac, side view,  $\times 10$ .  
3. Adult female, removed from sac, dorsal view,  $\times 10$ .  
4. " " " " " ventral view,  $\times 10$ .  
5, 6, 7. Different forms of antennæ,  $\times 500$ .  
8. Posterior extremity of adult female,  $\times 135$ .  
9. Posterior spiracle,  $\times 300$ .  
10. Newly hatched larva,  $\times 50$ .



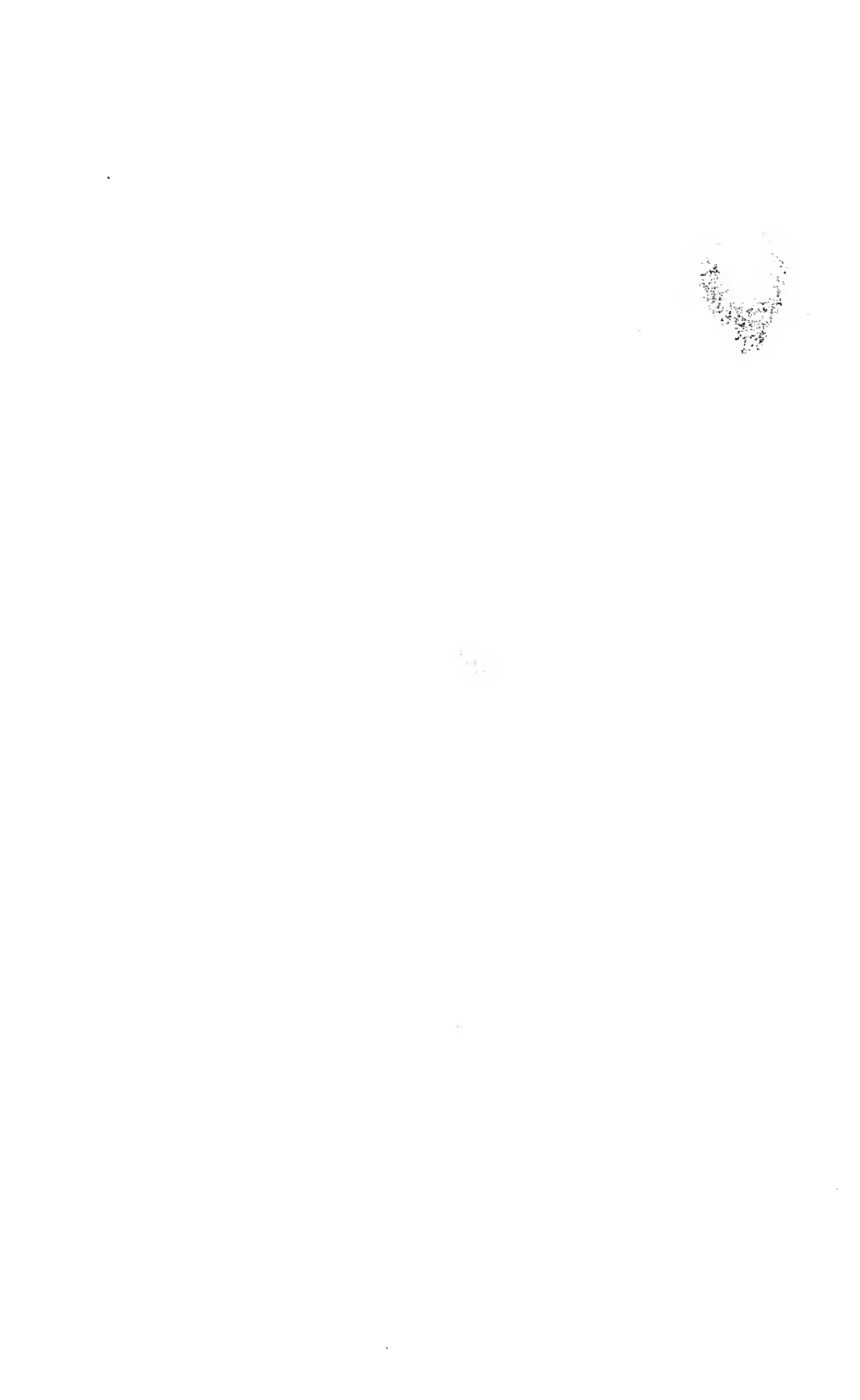


B.E. Green del.

F. P. B. W. M. Thoms

1873

ANTONINA INDICA Green.



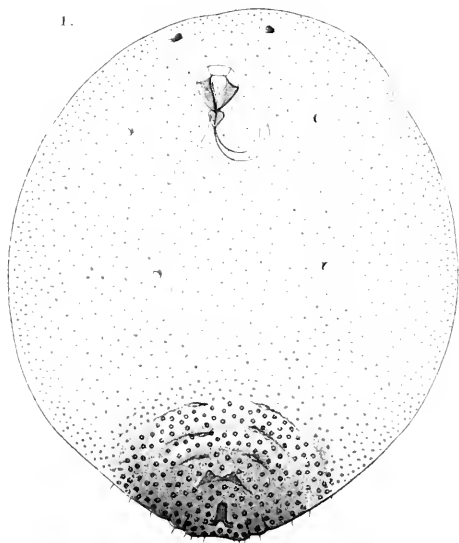
EXPLANATION OF PLATE CLXVI.

ANTONINA MARITIMA.

- Fig. 1. Adult female (under compression), ventral view,  $\times 35$ .  
2. Antenna,  $\times 500$ .  
3. Posterior extremity,  $\times 135$ .



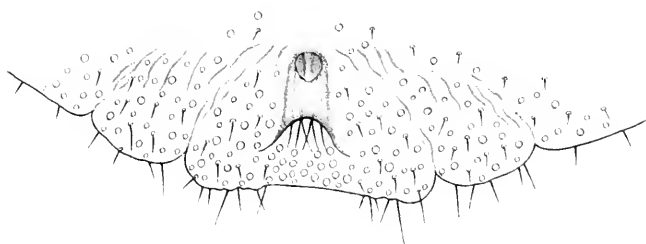
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E. Green del.

P. P. W. M. T. imp. r.

ANTONINA MARITIMA.

A. J. W. lith.





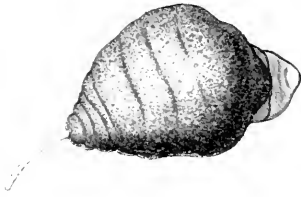
EXPLANATION OF PLATE CLXVII.

ANTONINA BAMBUS.E.

- Fig. 1. Branch of 'Male Bamboo,' with insects in situ, nat. size.  
2. Adult female, small form, dorsolateral view,  $\times 10$ .  
3. " " " with dorsal pad of wax  $\times 10$ .  
4. " " " large form,  $\times 6$ .  
5. Early adult female, dorsal view,  $\times 10$ .  
6. " " " ventral view,  $\times 10$ .  
7. Young larva,  $\times 35$ .  
8. " " abdominal margin, showing trilocular pores,  $\times 500$ .  
9. Antenna of adult female,  $\times 500$ .  
10. Anal segment of adult female, large form,  $\times 135$ .  
11. " " " " " small form,  $\times 135$ .  
12. Early adult female, optical section,  $\times 30$ .  
13. " " " antenna and margin of body,  $\times 500$ .  
14. Circular ceriferous pore from anal segment,  $\times 500$ .



2.



3.



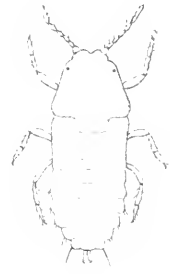
6.



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7.



4.



5.

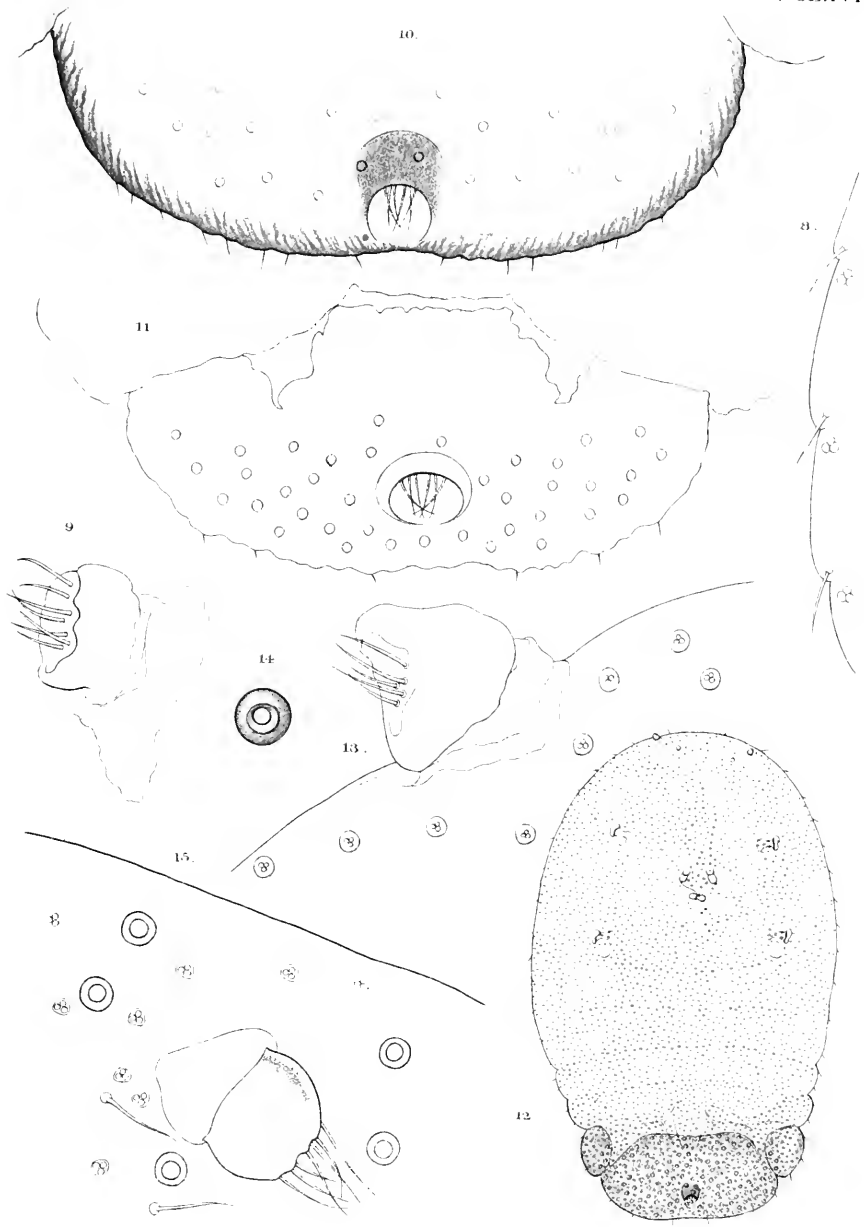


E. S. Green's del.

F. W. Y. 1871

ANTONINA BAMBUSÆ.





H. Green del.

PLATE CLXVIIa.

ANTONINA BAMBUSAE.



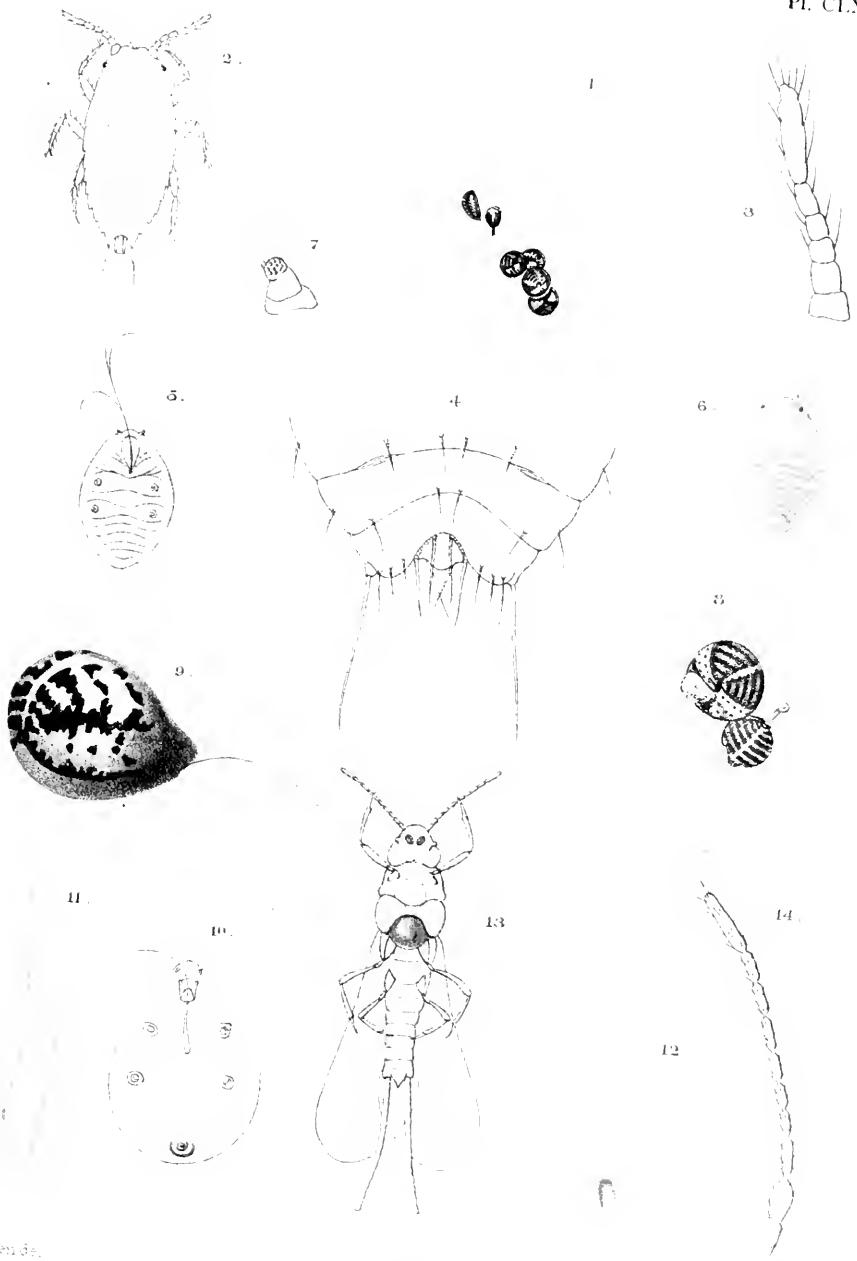
EXPLANATION OF PLATE CLXVIII.

ANTONINA ZONATA.

- Fig. 1. Adult females, *in situ*, nat. size.  
2. Young larva,  $\times 35$ .  
3. Antenna of larva,  $\times 190$ .  
4. Posterior segments of larva,  $\times 200$ .  
5. Female nymph, ventral view,  $\times 12$ .  
6. " " dorsal view,  $\times 12$ .  
7. Antenna of nymph,  $\times 100$ .  
8. Adult females, *in situ*,  $\times 2\frac{1}{2}$ .  
9. Adult female, side view,  $\times 6$ .  
10. " " as seen after maceration,  $\times 6$ .  
11. Bamboo stipule, with male puparia, nat. size.  
12. Male puparium, after emergence of adult,  $\times 3$ .  
13. Adult male, ventral view,  $\times 35$ .  
14. Antenna of male,  $\times 135$ .  
15. Antenna of adult female,  $\times 500$ .  
16. Anal pit, with orifice and anal ring,  $\times 135$ .  
17. Anal ring,  $\times 280$ .  
18. Anal orifice and surrounding parts,  $\times 280$ .  
19. Spiracle,  $\times 280$ .  
20. Dermal cells,  $\times 280$ .







E. P. B. de.

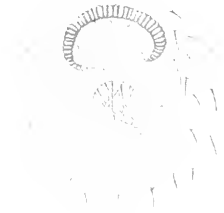
ANTONINA ZONATA.



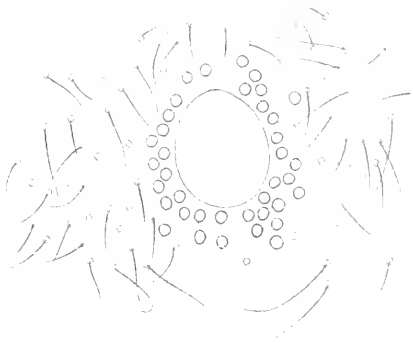


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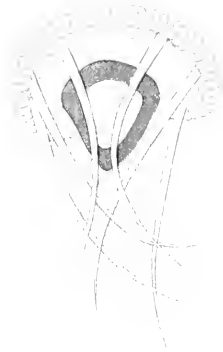


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Zeitschr. f. Naturg.

F. v. Schlegel

ANTONINA ZONATA.



EXPLANATION OF PLATE CLXIX.

(LACHNODIUS HUMBOLDTII.)

- Fig. 1. Branch of Humboldtia, with internodes cut open to show insects  
*in situ*, nat. size.
2. Adult female, dorsal view,  $\times 10$ .
  - 3, 4, 5. Several forms of antenna,  $\times 225$ .
  6. Mid leg,  $\times 135$ .
  7. Posterior extremity of female,  $\times 135$ .
  8. Anal ring,  $\times 500$ .
  9. Dermal spines and pores,  $\times 700$ .





H. E. Green del.

H. E. Green del.

H. E. Green del.

LACHNODIUS HUMBOLDTII.



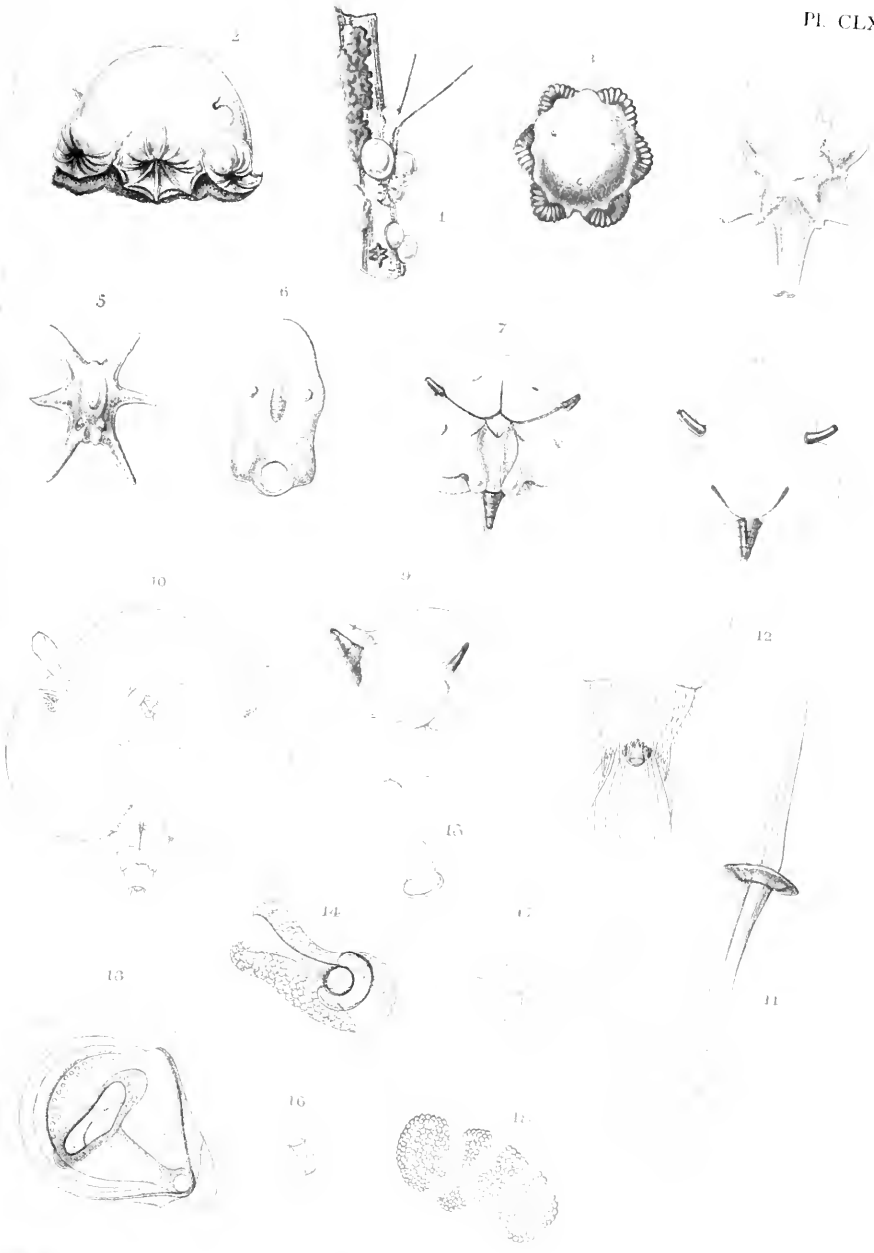


## EXPLANATION OF PLATE CLXX.

### TACHARDIA CONCHIFERATA.

- Fig. 1. Piece of *Anona* stem, with insects, nat. size.  
2. Test of adult female, lateral view,  $\times 5$ .  
3. Test of early adult female, dorsal view,  $\times 6$ .  
4. Test of female nymph, late stage,  $\times 8$ .  
5. " " " " early stage,  $\times 14$ .  
6. Male puparium,  $\times 16$ .  
7. Adult female insect, ventral view,  $\times 5$ .  
8. " " " dorsal view,  $\times 5$ .  
9. " " " lateral view,  $\times 5$ .  
10. " " " optical section, after maceration,  $\times 8$ .  
11. Dorsal spine and accompanying glands,  $\times 150$ .  
12. Caudal extremity, from below,  $\times 75$ .  
13. Dorsal spiracle,  $\times 120$ .  
14. Ventral spiracle,  $\times 150$ .  
15. Antenna,  $\times 150$ .  
16. Ceriferous pore (in profile) from one of the lateral series,  $\times 450$ .  
17. Pores from one of the circumoral groups,  $\times 450$ .  
18. One of the circumcaudal groups of pores,  $\times 220$ .





TACHARDIA CONCHIFERATA

E. 312 - 37



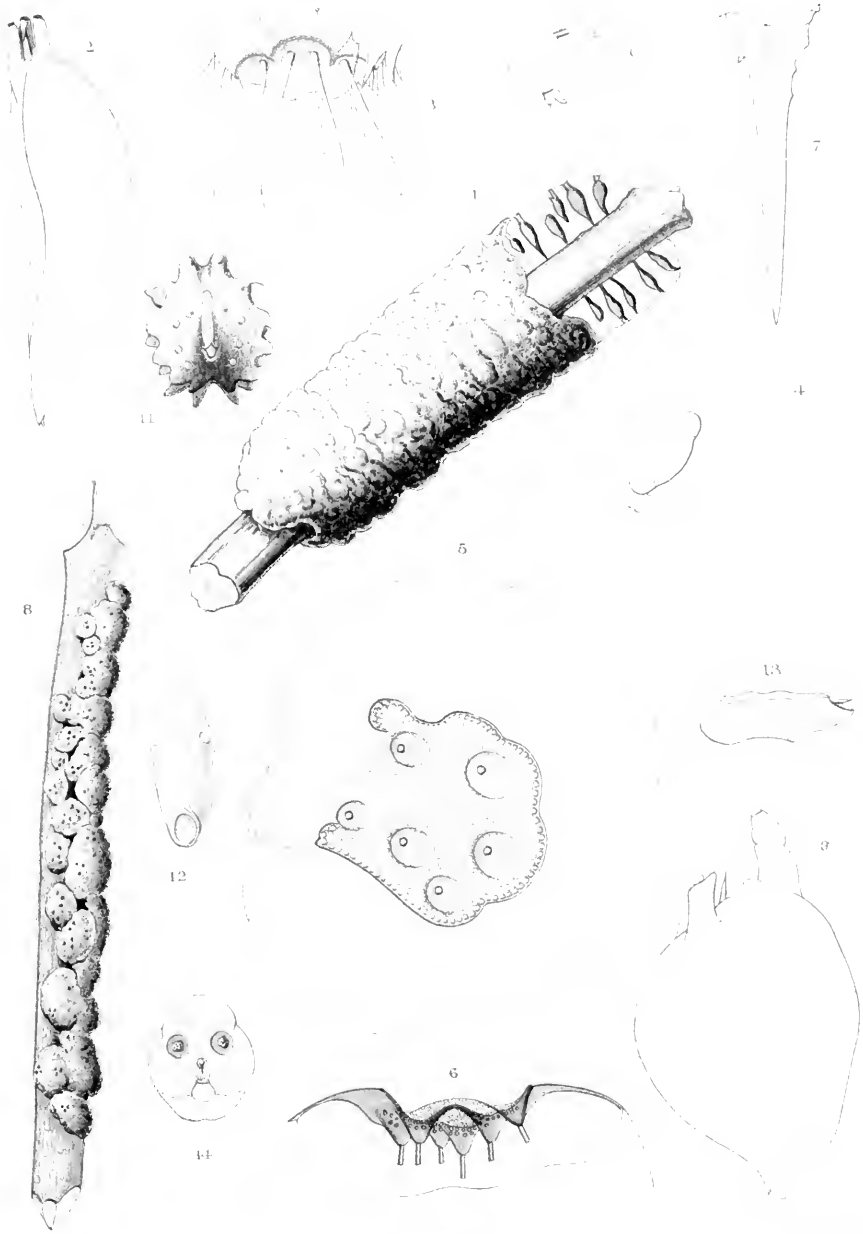
EXPLANATION OF PLATE CLXXI.

TACHARDIA LACCA.

- Fig. 1. Piece of branch thickly encrusted with lac ; part (on right) broken, to show the insects in their cells, nat. size.
2. Adult female, removed from cell, side view,  $\times 8$ .
3. Extremity of caudal process, ventral aspect,  $\times 135$ .
4. Dorsal spiracle,  $\times 220$ .
5. Chitinous cap of stigmatic process, from above.  $\times 220$ .
6. " " " " " " in profile,  $\times 130$ .
7. Dorsal spine,  $\times 220$ .
8. Branch with thin encrustation of lac, nat. size.
9. Mature adult female, removed from cell, lateral view,  $\times 12$ .
10. Early adult female, " " " "  $\times 12$ .
11. Cell of nymph (or early adult female),  $\times 12$ .
12. Puparium of male, dorsal view,  $\times 12$ .
13. " " " " side view,  $\times 12$ .
14. Early adult female, dorsal view,  $\times 12$ .

(Figs. 1-7 prepared from Indian material : figs. 8-14, from material collected in Ceylon.)





EE Green del.

TACHARDIA LACCA.

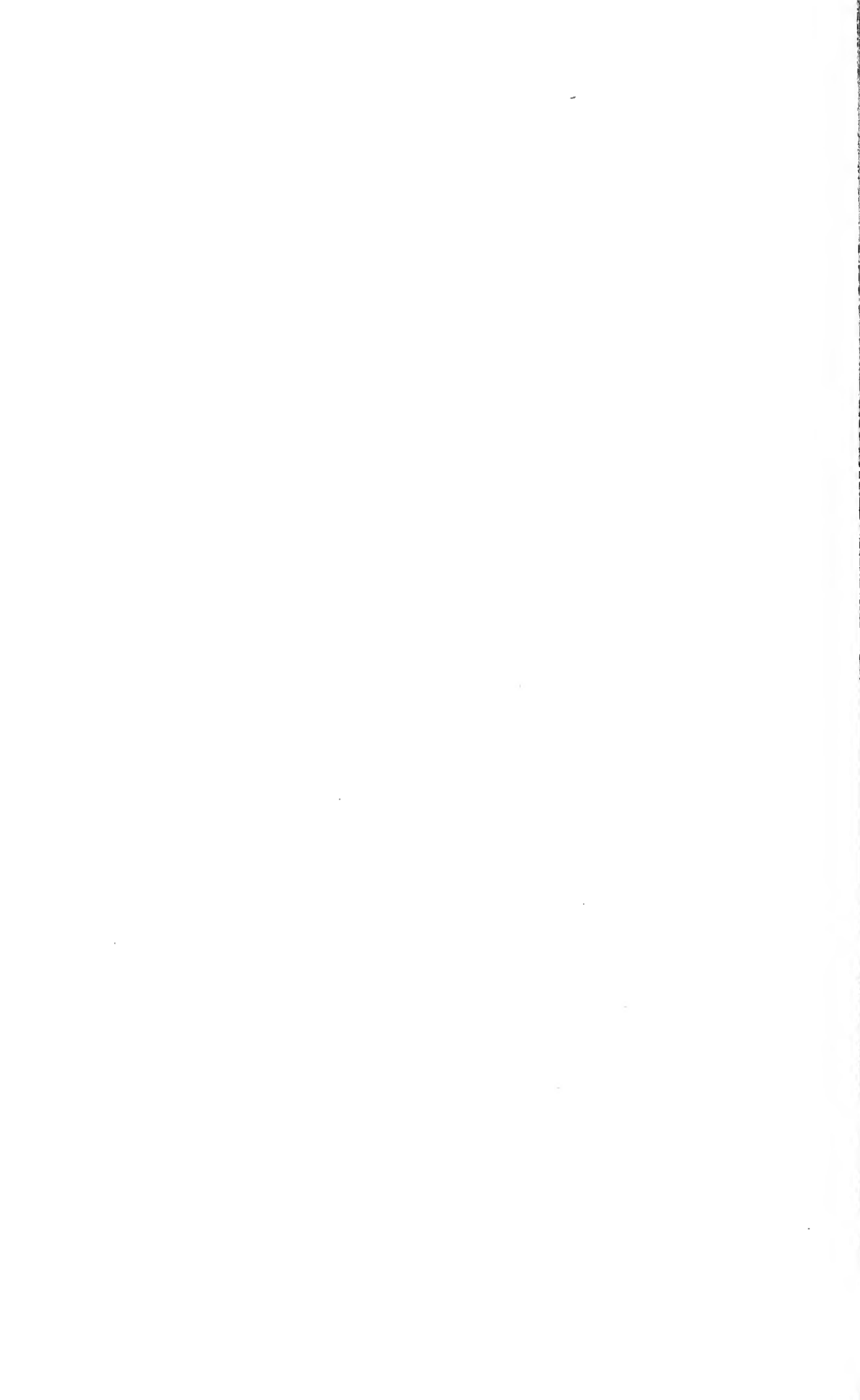


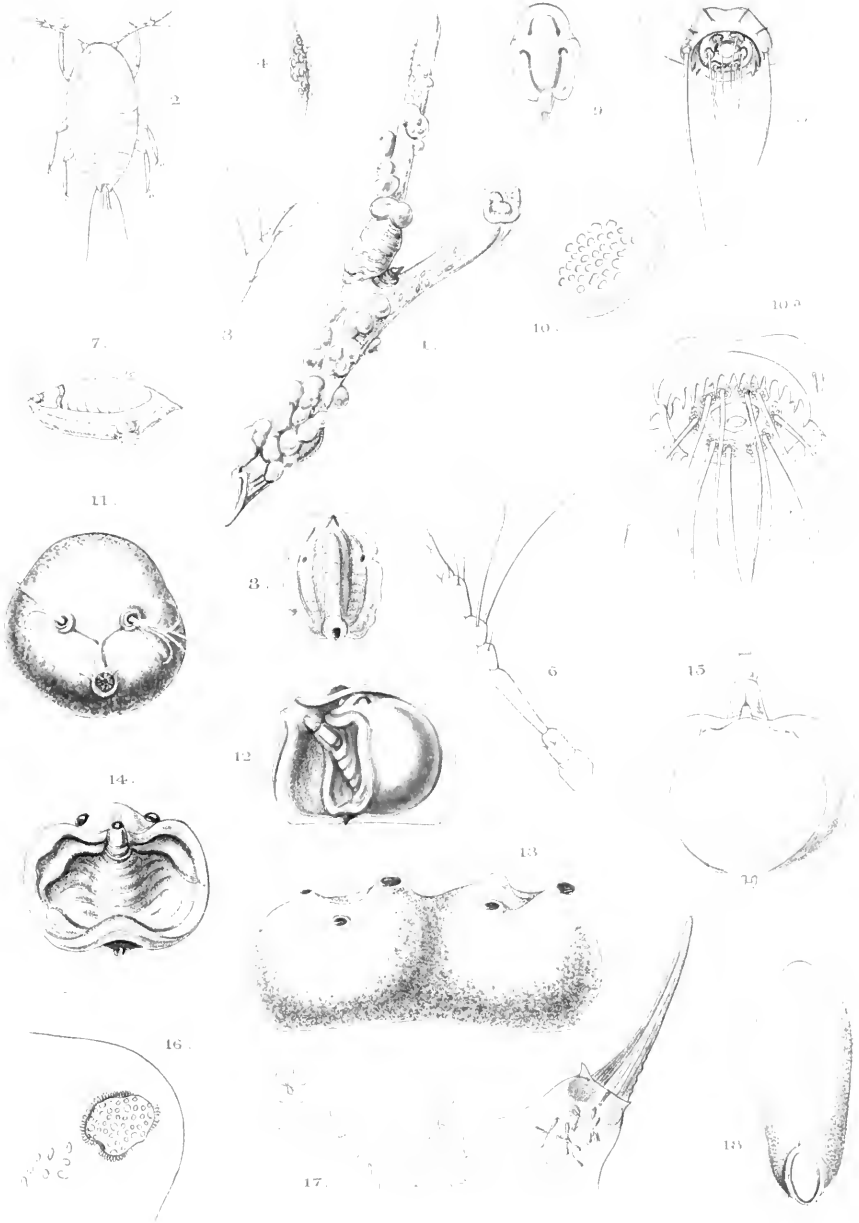


EXPLANATION OF PLATE CLXXII.

TACHARDIA ALBIZZIE.

- Fig. 1. Tests of insects, on twig of *Albizzia*, nat. size.
2. Young larva,  $\times 50$ .
  3. " " foot,  $\times 400$ .
  4. " " stigmatic plate,  $\times 400$ .
  5. " " posterior extremity of body,  $\times 400$ .
  6. " " antenna,  $\times 220$ .
  7. Early larval test,  $\times 35$ .
  8. Nymphal test,  $\times 16$ .
  9. Nymph, removed from test,  $\times 16$ .
  10. " " stigmatic plate,  $\times 220$ .
  - 10a. " " posterior extremity of body,  $\times 220$ .
  11. Test of adult female, from above,  $\times 8$ .
  12. " " " " opened to show the insect,  $\times 8$ .
  13. Two confluent tests, from the side,  $\times 8$ .
  14. Adult female, from behind,  $\times 13$ .
  15. " " antero-dorsal view,  $\times 16$ .
  16. " " stigmatic process,  $\times 220$ .
  17. " " dorsal spine and associated glands,  $\times 220$ .
  18. Male puparium,  $\times 25$ .
  19. Apterous male, dorsal view,  $\times 30$ .
  20. " " head, from below,  $\times 30$ .
  21. " " terminal joint of antenna,  $\times 150$ .
  22. " " foot,  $\times 150$ .
  23. Adult female, optical section,  $\times 30$ .
  24. Group of ceriferous pores from base of caudal process,  $\times 450$ .
  25. Extremity of caudal process, from below,  $\times 135$ .
  26. Ventral spiracle,  $\times 220$ .
  27. Dorsal spiracle and stigmatic process,  $\times 220$ .
  - 28, 29. Dorsal spine,  $\times 220$ .

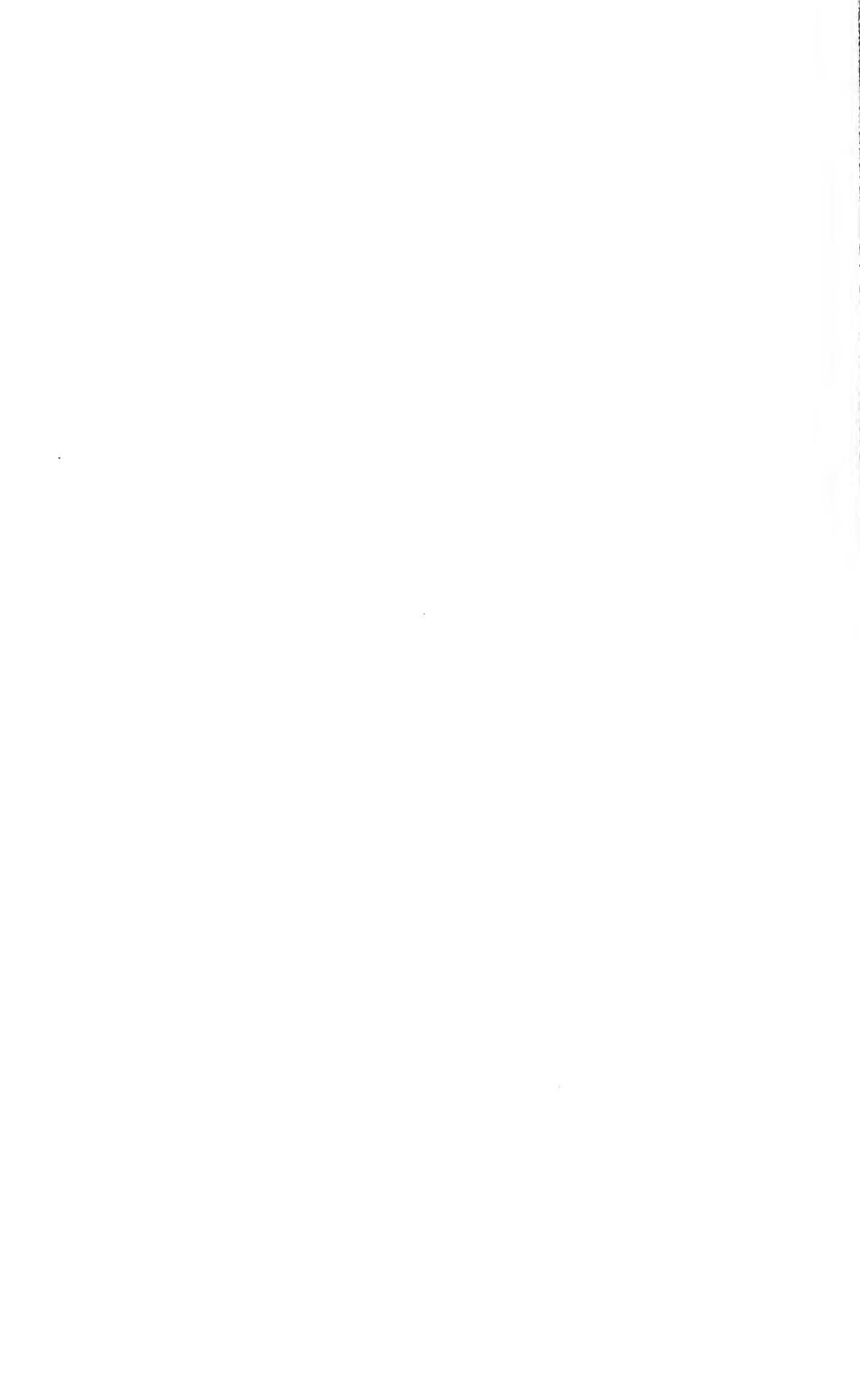


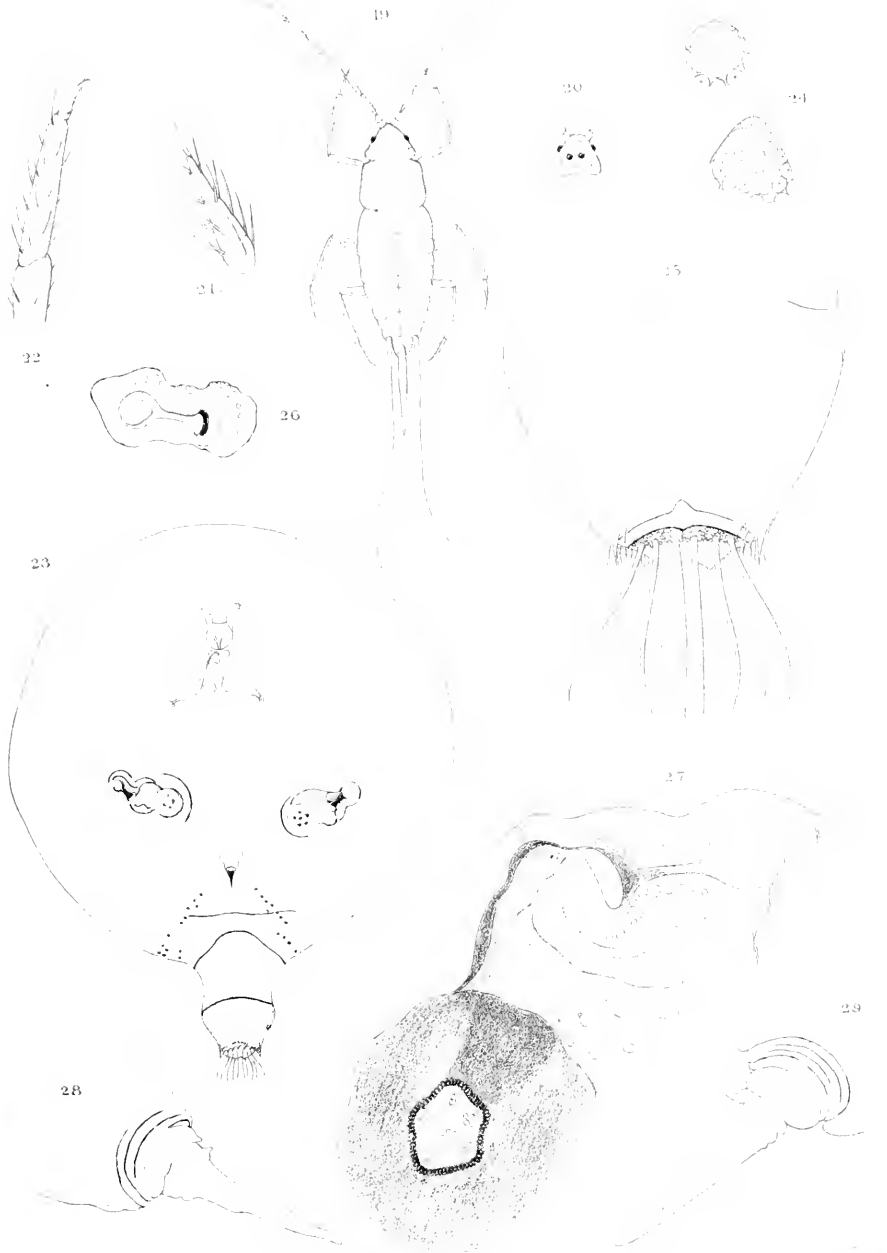


M. G. S. 11 101

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TACHARDIA ALBIZZIÆ





H. E. Green, del.

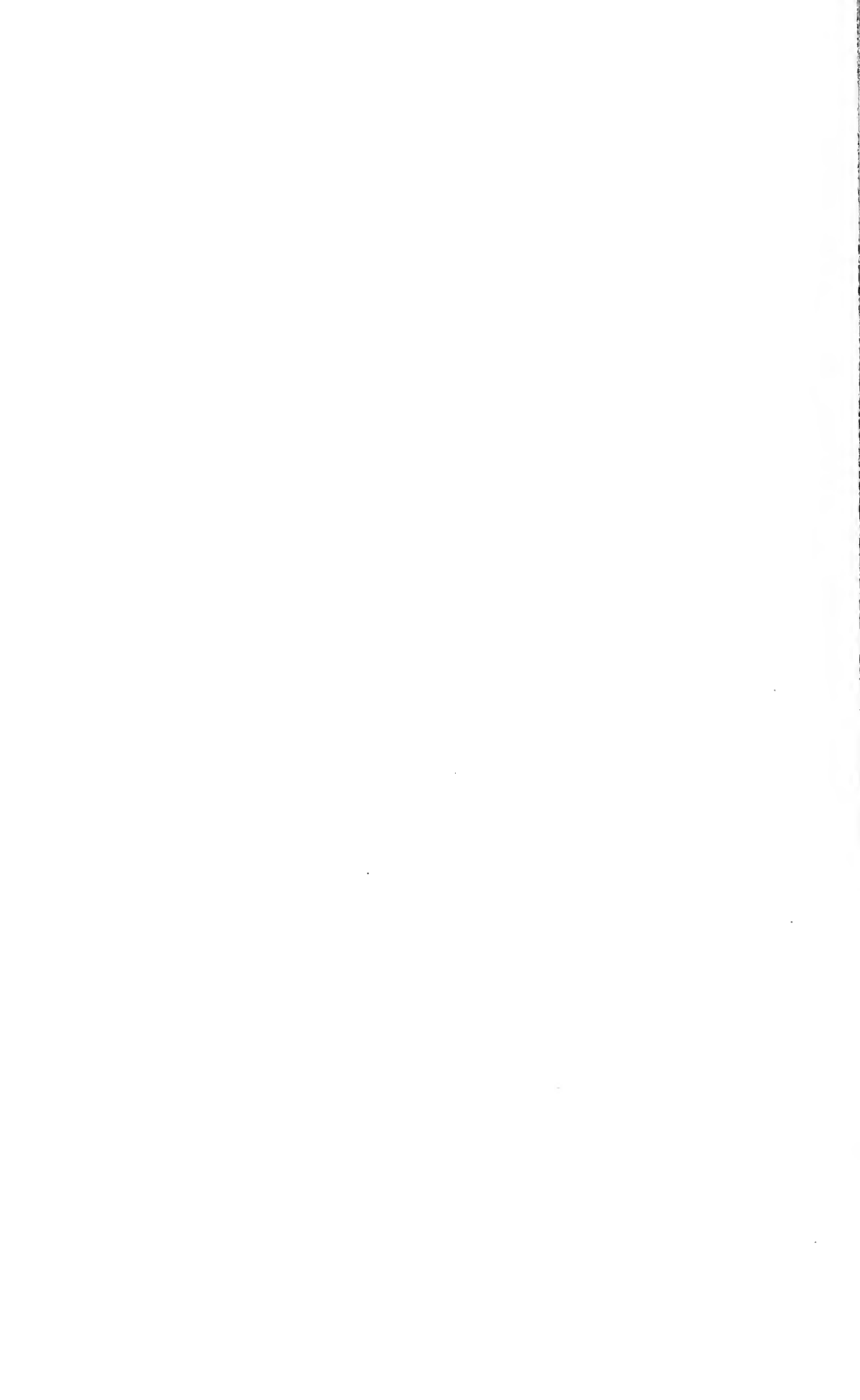
TACHARDIA ALBIZZIAE



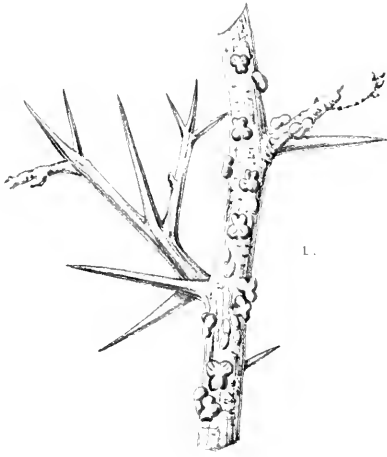
EXPLANATION OF PLATE CLXXIII.

TACHARDIA MINUTA.

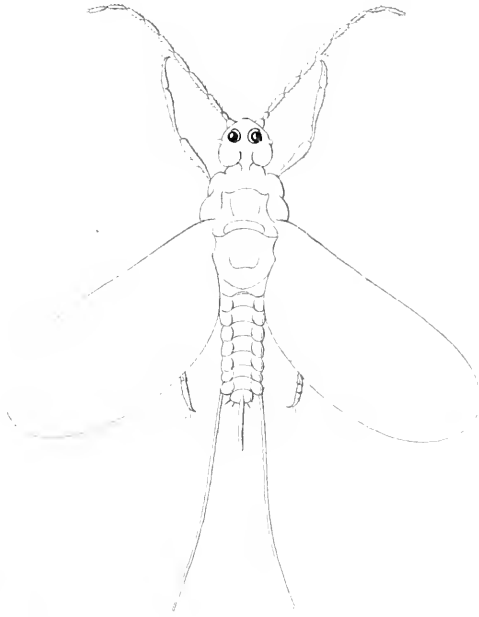
- Fig. 1. Insects, on branch of *Flacourtia*, nat. size.  
2. Resinous case of adult female, dorsal view,  $\times 12$ .  
3. Puparium of male, side view,  $\times 18$ .  
4. Adult female, removed from case, dorsal view,  $\times 12$ .  
5. Adult male, dorsal view,  $\times 36$ .  
6. Adult female, after maceration, opt. sect.,  $\times 30$ .  
7. Dorsal spiracle,  $\times 220$ .  
8. Ventral spiracle,  $\times 220$ .  
9. Anterior cluster of pores,  $\times 220$ .  
10. Caudal process and dorsal spine, side view,  $\times 220$ .  
11. Caudal process, dorsal view,  $\times 220$ .  
12. Stigmatic processes,  $\times 220$ .  
13. Early adult female, opt. sect.,  $\times 65$ .  
14. Antenna of adult female,  $\times 220$ .







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E.E. Green del.

F. E. W. M. T. imp.

A. G. White

TACHARDIA MINUTA.





EE. Queen del.

TACHARDIA MINUTA.

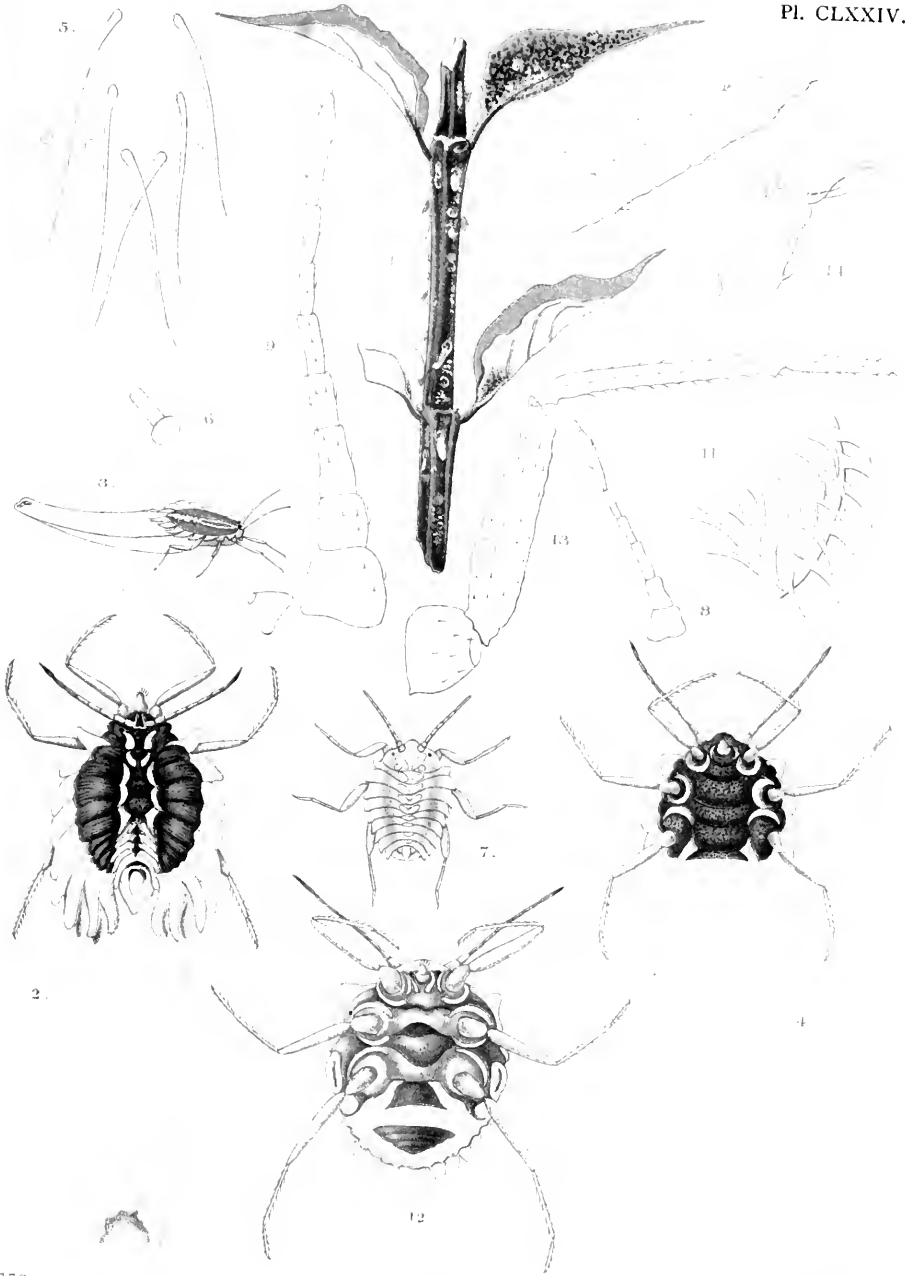


EXPLANATION OF PLATE CLXXIV.

ORTHEZIA INSIGNIS (FEMALE).

- Fig. 1. Insect on stem of *Meyenia*, nat. size.  
2. Adult female, with ovisac, dorsal view,  $\times 20$ .  
3. " " " " lateral view,  $\times 8$ .  
4. " " " " ventral view,  $\times 20$ .  
5. Anal orifice and posterior abdominal spiracles,  $\times 220$ .  
6. Abdominal spiracle,  $\times 450$ .  
7. Newly hatched larva,  $\times$  about 15.  
8. Antenna of larva,  $\times$  about 50.  
9. Antenna and eye of adult female,  $\times 80$ .  
10. Terminal joint of antenna,  $\times 220$ .  
11. Part of ceriferous tract from margin of abdomen,  $\times 450$ .  
12. Adult female before oviposition, ventral view,  $\times 25$ .  
13. Mid leg of adult female,  $\times 65$ .  
14. Foot,  $\times 280$ .





EE Green del.

F. E. W. M. Group

As. 1. 1896

*ORTHOZIA INSIGNIS.*





PLATE CLXXIV (*ct*).  
ORTHEZIA INSIGNIS (MALE).

15. Adult male, side view,  $\times 15$ .
16. " " " "  $\times 15$ .
17. Head of male, from above,  $\times 60$ .
18. Head, from below,  $\times 60$ .
19. One of the halteres,  $\times 120$ .
20. Terminal joint of male antenna,  $\times 155$ .
21. Foot of male,  $\times 220$ .
22. Abdominal extremity of male,  $\times 130$ .
23. Tubular pores from dorsum of antepenultimate segment,  $\times 450$ .
24. One of the pores, vertical view,  $\times 900$ .
25. Group of ceriferous pores from lateral area,  $\times 450$ .
- 26, 27, 28. Successive stages of male nymph,  $\times$  about 20.



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ORTHEZIA INSIGNIS.



EXPLANATION OF PLATE CLXXV.

KUWANIA ZEYLANICA.

- Fig. 1. Adult female insects, on bark, nat. size.  
 2. Adult female, dorsal view,  $\times 7$ .  
 3. " " ventral view,  $\times 7$ .  
 4. " " mid leg,  $\times 65$ .  
 5. " " extremity of leg,  $\times 200$ .  
 6. " " claw,  $\times 450$ .  
 7. " " antenna,  $\times 50$ .  
 8. " " terminal joints of antenna,  $\times 150$ .  
 9. " " thoracic spiracle,  $\times 280$ .  
 10, 11. " " abdominal spiracles,  $\times 280$ .  
 12. " " compound dermal pores,  $\times 840$ .  
 13. " " anal orifice,  $\times 130$ .  
 14. Nymph, *in situ*, in cells of bark, nat. size.  
 15. " ventral view,  $\times 11$ .  
 16. " anal orifice,  $\times 300$ .  
 17. Young larva, dorsal view,  $\times 14$ .  
 18. " " antenna,  $\times 30$ .  
 19. Adult male, dorsal view,  $\times 8$ .  
 20. " " posterior extremity,  $\times 130$ .  
 21. " " dorsal pores, &c.,  $\times 450$ .  
 22. Abdominal margin of nymph,  $\times 30$ .

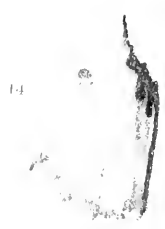




KUWANIA ZEYLANICA.







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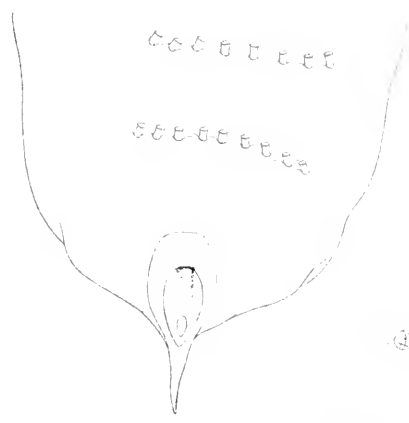


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E. E. Green del.

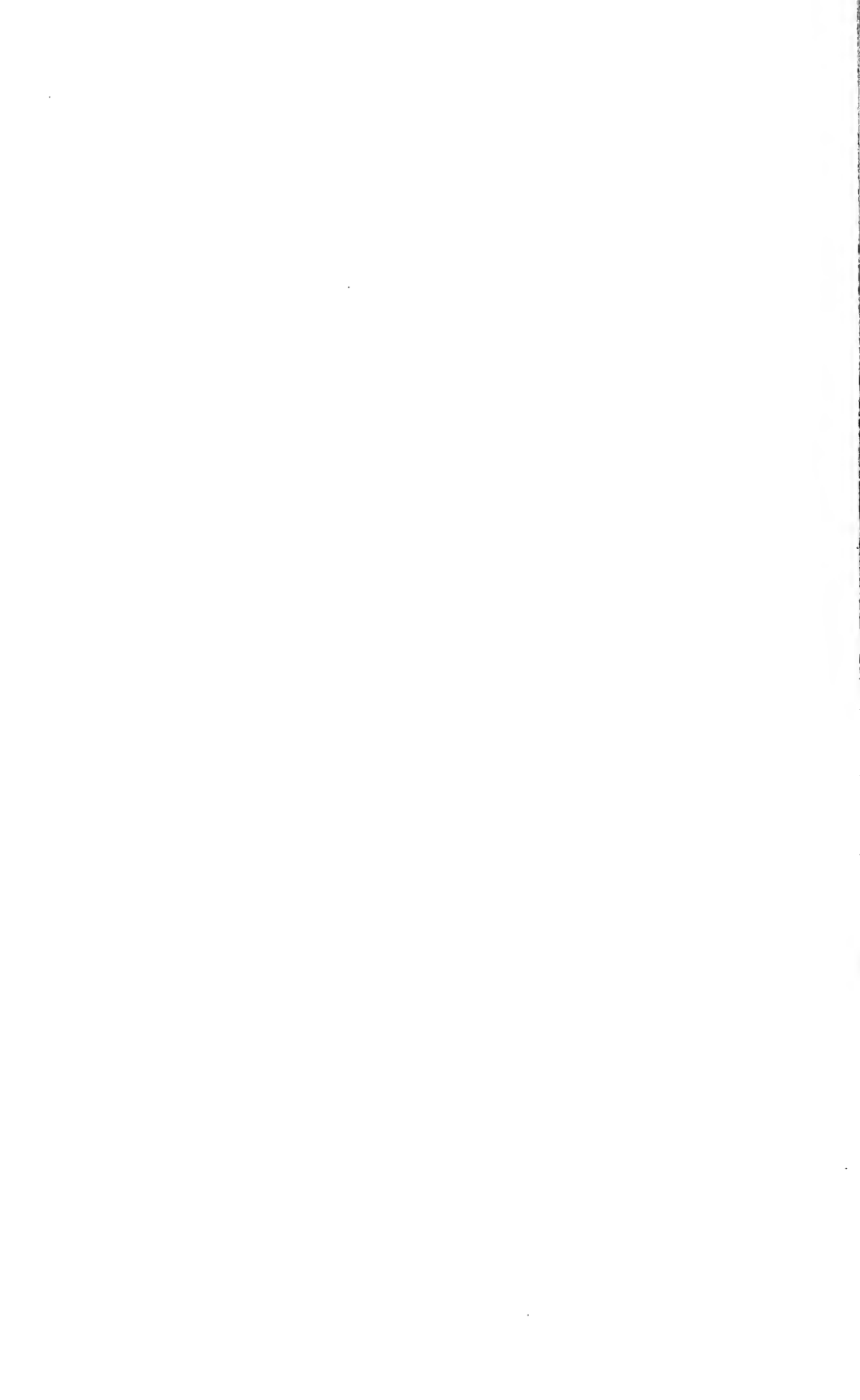
FRONTISPIECE  
KUANIA ZEYLANICA.



EXPLANATION OF PLATE CLXXVI.

MONOPHLEBUS CONTRAHENS.

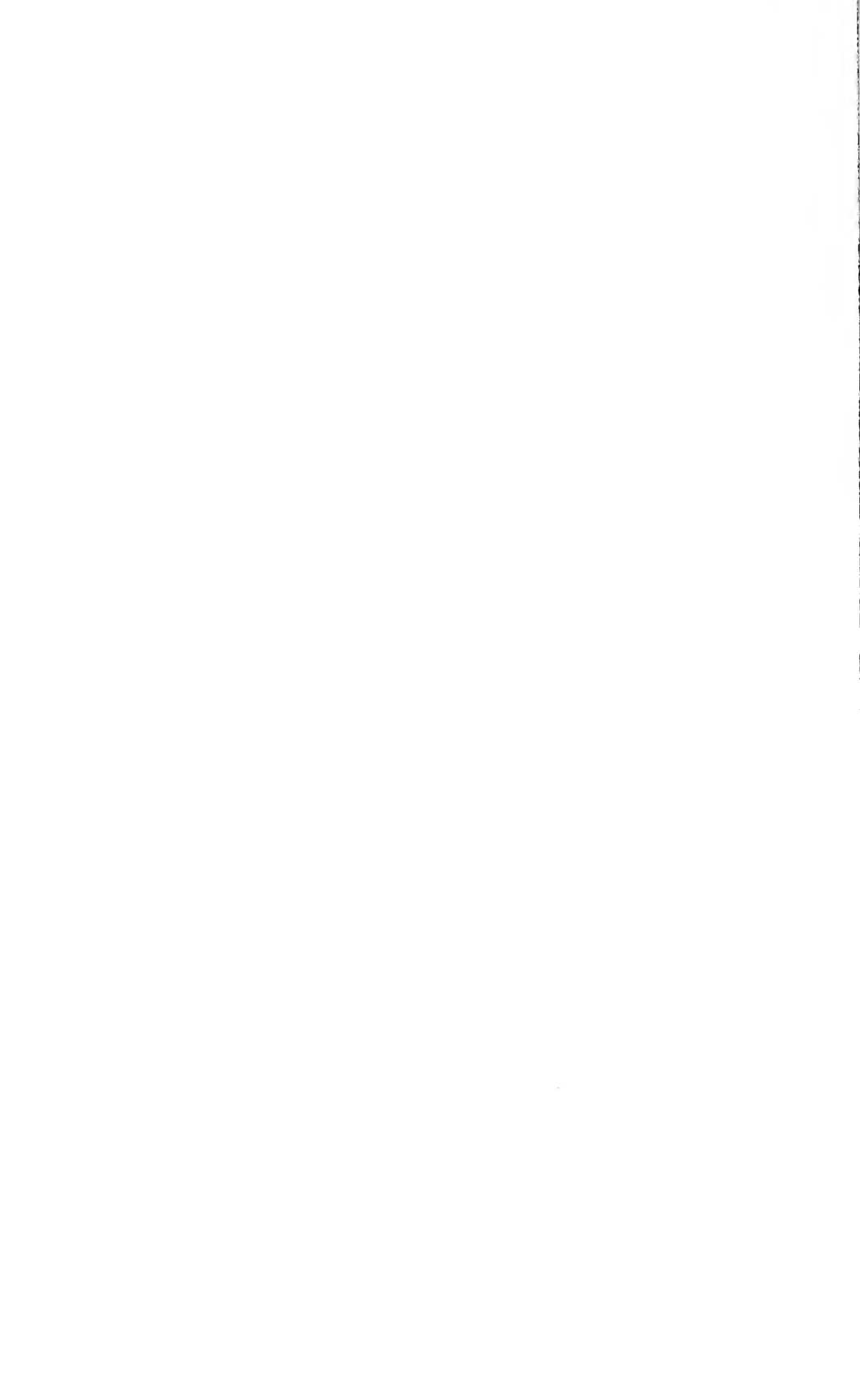
- Fig. 1. Insects on stem of *Phyllanthus*, nat. size.
- 2. Adult female, ventral view,  $\times 2$ .
- 3. Adult female, dorsal view,  $\times 2$ .
- 4. Antenna,  $\times 30$ .
- 5. Mid leg,  $\times 30$ .
- 6, 7. Extreme forms of claw of mid leg,  $\times 130$ .
- 8. Anal orifice,  $\times 130$ .
- 9. Dorso-abdominal spiracle and surrounding area,  $\times 220$ .
- 10. Pores and setae from dorsum,  $\times 450$ .
- 11. Posterior margin, with larger setae,  $\times 130$ .
- 12. Seta from anal area,  $\times 450$ .





M. S. Nixon, 1911.

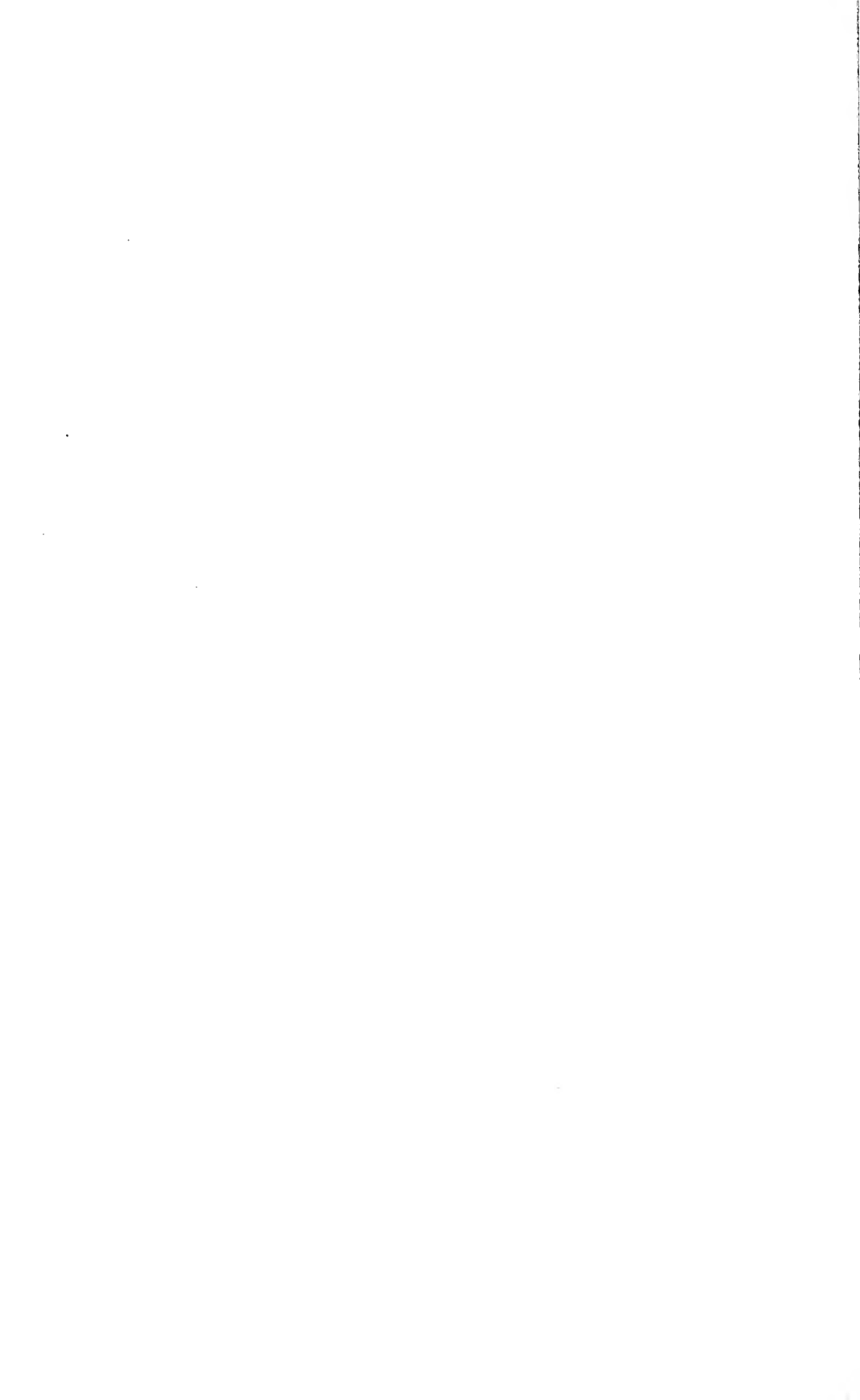
MONOPHLEBUS CONTRAHENS.



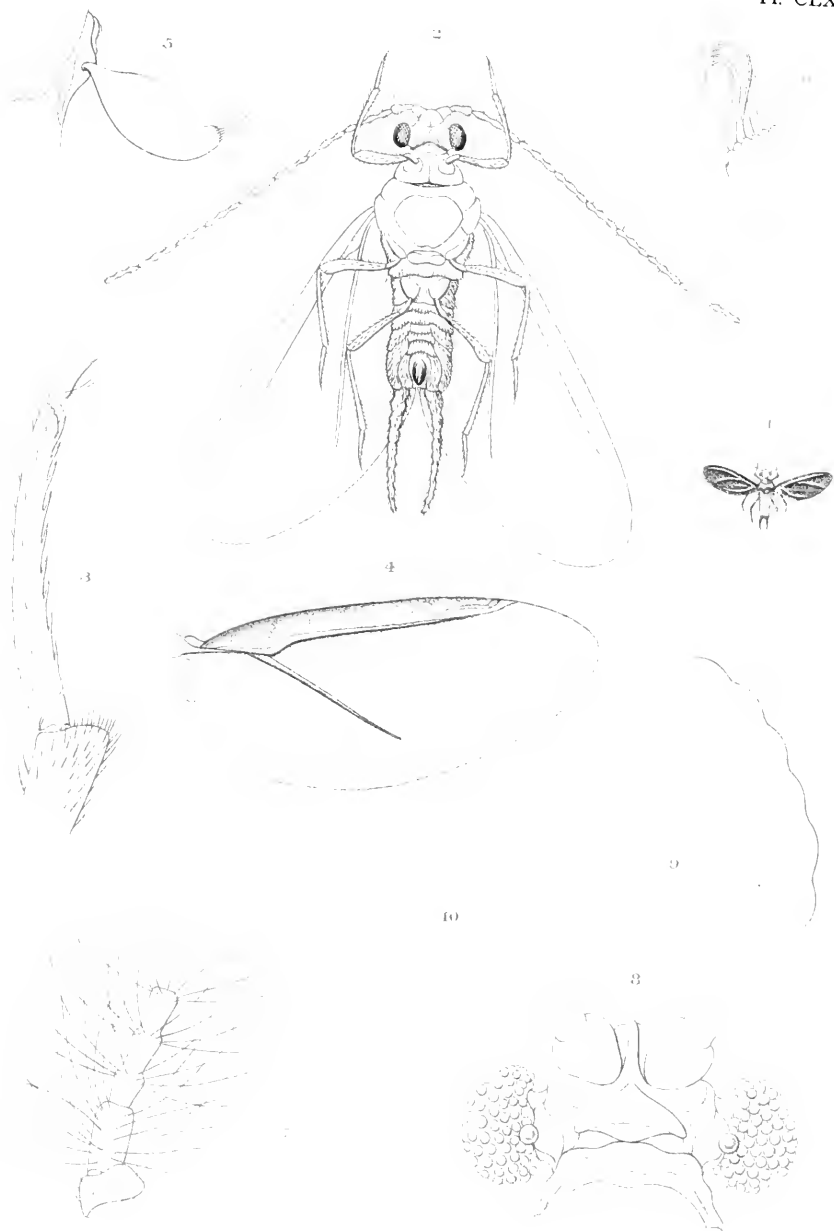
EXPLANATION OF PLATE CLXXVII.

MONOPHLEBUS FURCATUS.

- Fig. 1. Adult male, dorsal view, nat. size.  
2. „ „ ventral view,  $\times 6$ .  
3. Tarsus of anterior limb,  $\times 80$ .  
4. Wing,  $\times 7$ .  
5. One of the halteres,  $\times 14$ .  
6. Distal extremity of halter,  $\times 130$ .  
7. Three basal joints of antenna,  $\times 30$ .  
8. Head, dorsal view,  $\times 36$ .  
9. Part of eye, showing facets,  $\times 130$ .  
10. Pores from margin of abdomen,  $\times 450$ .







MONOPHLEBUS FURCATUS.

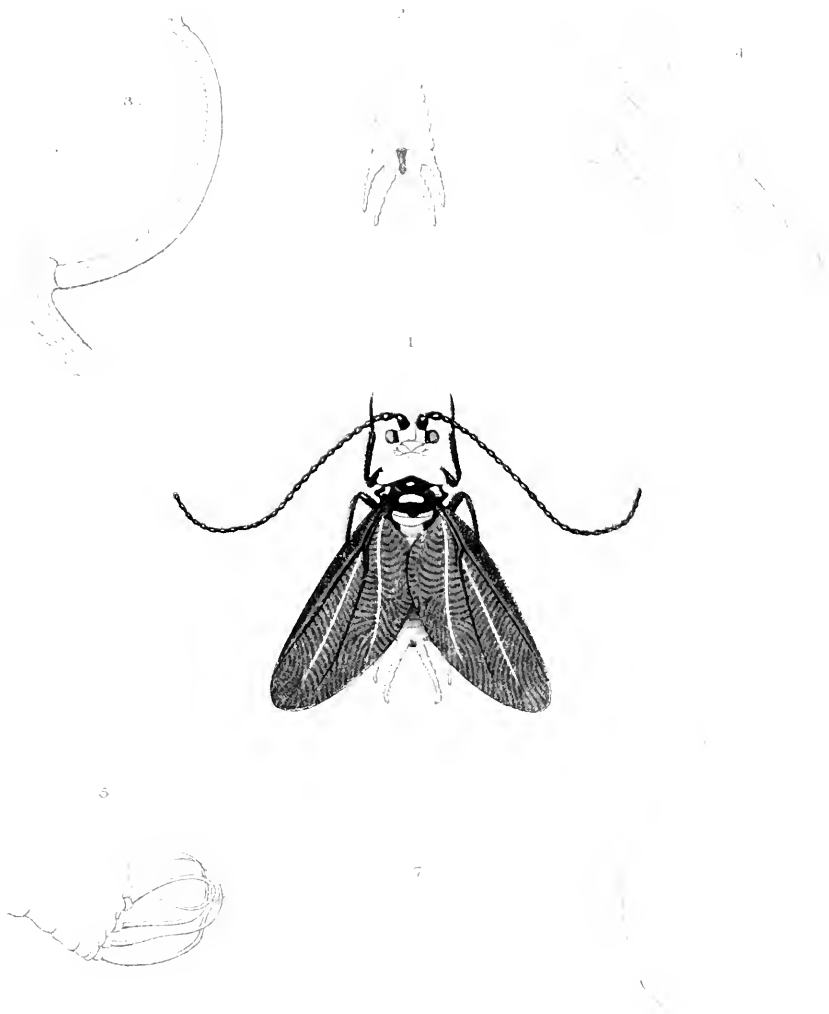


EXPLANATION OF PLATE CLXXVIII.

MONOPHLEBUS VARIEGATUS.

- Fig. 1. Adult male, dorsal view  $\times 6$ .  
2. Ventral view of abdomen,  $\times 60$ .  
3. Tarsus of anterior limb,  $\times 80$ .  
4. Different forms of claw,  $\times 220$ .  
5. Extremity of halter,  $\times 130$ .  
6. Part of eye,  $\times 130$ .  
7. Pores from margin of abdomen,  $\times 450$ .





MONOPHLEBUS VARIEGATUS.



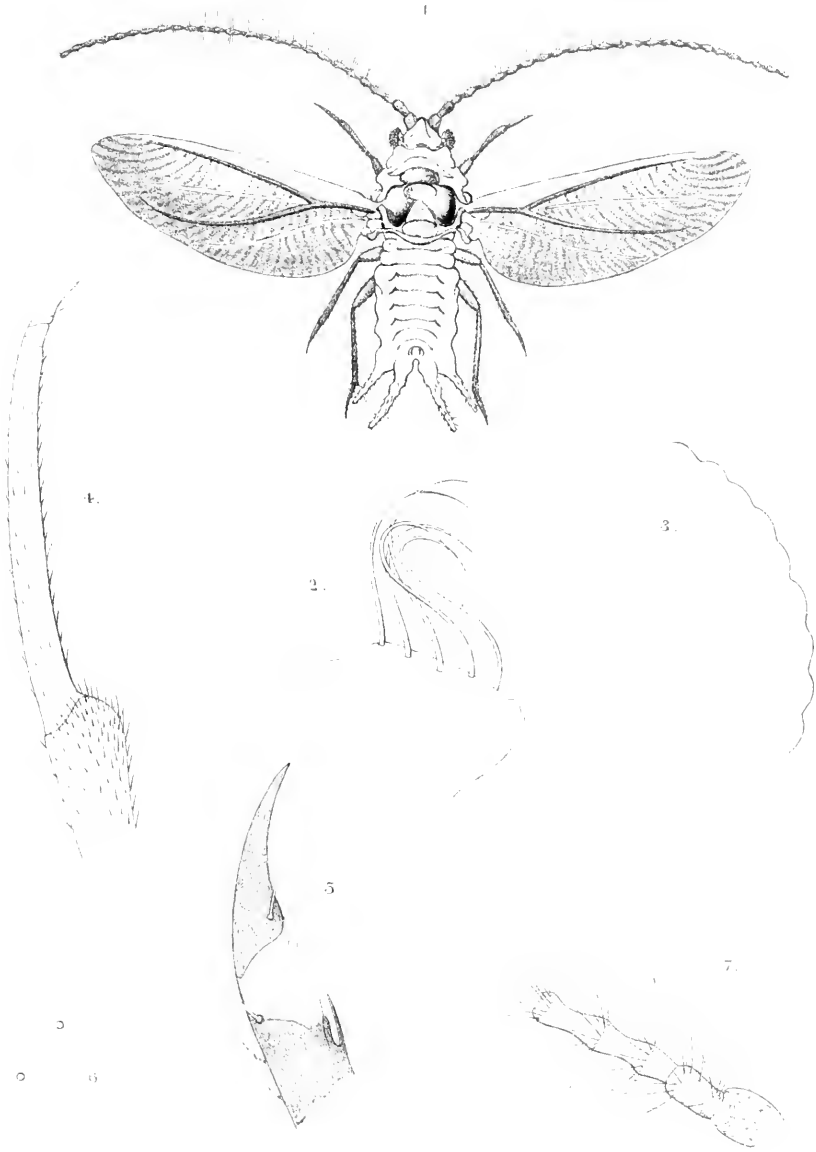
EXPLANATION OF PLATE CLXXIX.

MONOPHLEBUS QUADRICAUDATUS.

- Fig. 1. Adult male, dorsal view,  $\times 8$ .  
2. Extremity of halter,  $\times 130$ .  
3. Part of eye,  $\times 130$ .  
4. Tarsus of anterior limb,  $\times 80$ .  
5. Claw,  $\times 220$ .  
6. Dermal pores,  $\times 450$ .  
7. Basal joints of antenna,  $\times 30$ .







MONOPHLEBUS QUADRICAUDATUS.

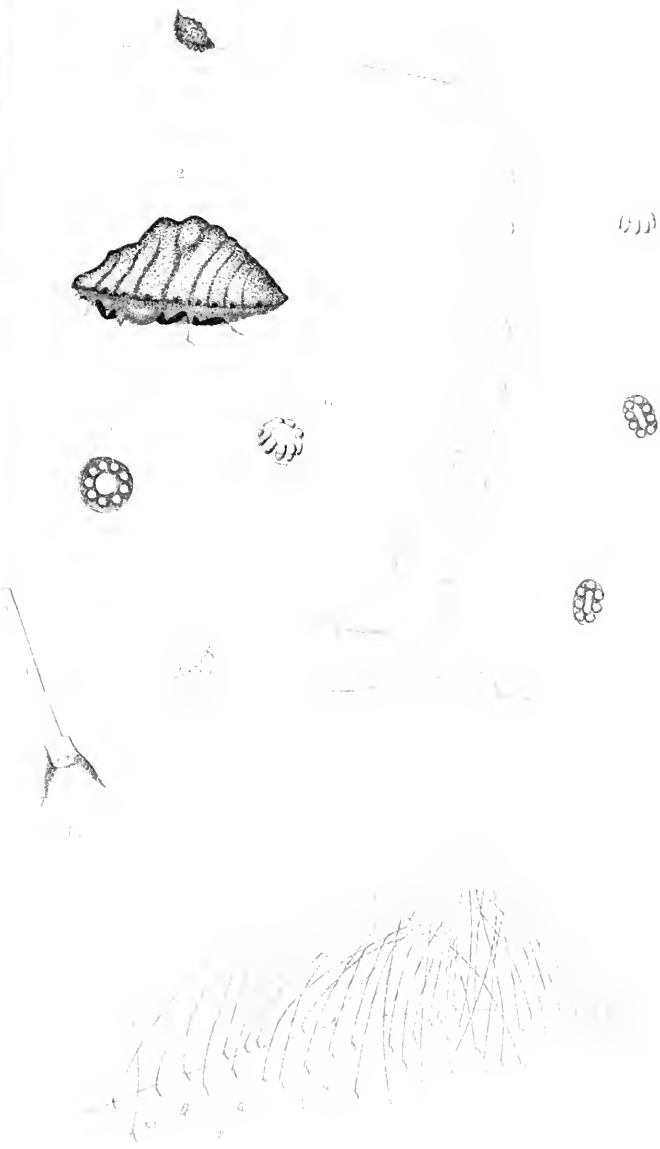


EXPLANATION OF PLATE CLXXX.

ICERYA PURCHASI.

- Fig. 1. Adult female, with ovisac, side view,  $\times 2$ .  
2. " " denuded of secretion,  $\times 9$ .  
3. Antenna and eye,  $\times 80$ .  
4. Foot of mid-leg,  $\times 220$ .  
5, 6, 7, 8. Different aspects of the larger dermal pores,  $\times 450$ .  
9, 10, 11. " " " smaller " "  $\times 450$ .  
12. Base of dermal seta,  $\times 450$ .  
13. Dorsal tuft of setae,  $\times 220$ .





ICERYA PURCHASI.



EXPLANATION OF PLATE CLXXXI.

ICERYA AEGYPTIACA.

- Fig. 1. Insects on leaf of *Codium*, nat. size.
2. Young larva,  $\times 13$ .
  3. Antenna of larva,  $\times 65$ .
  4. Adult female, ventral view, showing ovisac,  $\times 4$ .
  5. Antenna and eye,  $\times 80$ .
  6. Marginal area of mesothorax,  $\times 220$ .
  7. Larger dermal pores,  $\times 450$ .
  8. " " " in profile,  $\times 450$ .
  9. Smaller dermal pore,  $\times 450$ .
  10. " " " in profile,  $\times 450$ .
  11. Base of one of the larger setæ,  $\times 450$ .
  12. Abdominal spiracle,  $\times 450$ .
  13. Foot of mid leg,  $\times 135$ .
  14. Adult male, ventral view,  $\times 13$ .
  15. " " terminal joints of antenna,  $\times 65$ .
  16. Old adult female, dorsal view, with mutilated tassels,  $\times 6$ .

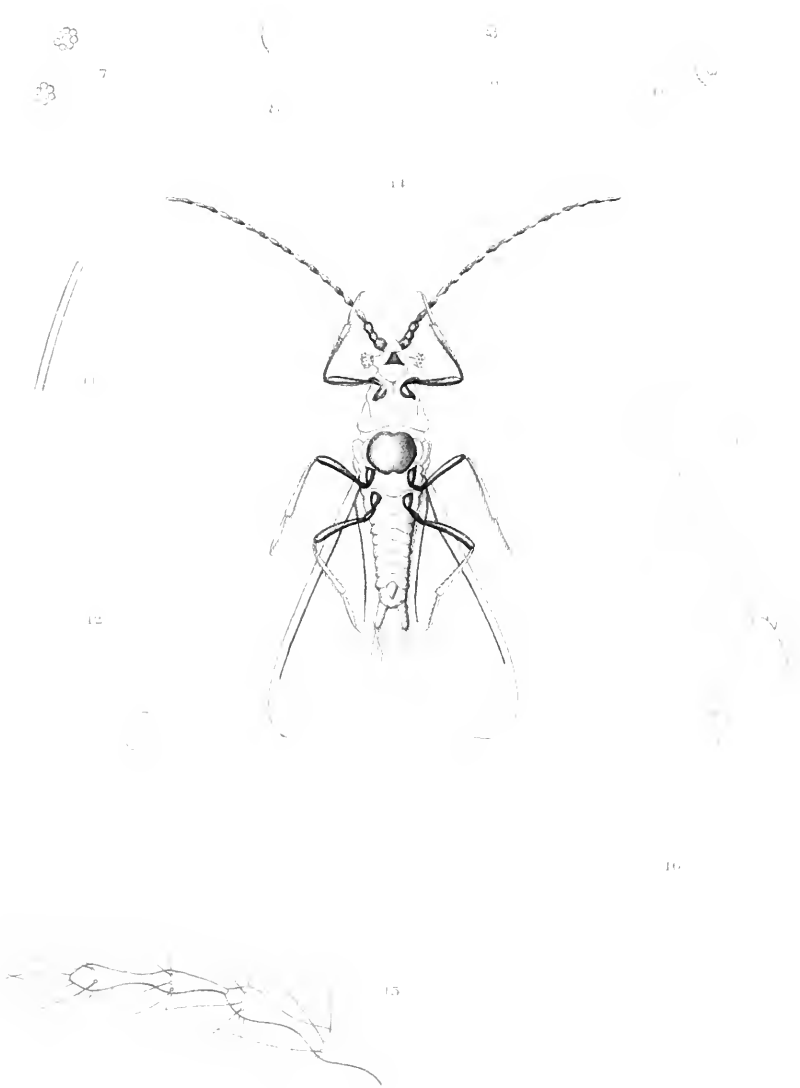






ICERYA ÆGYPTIACA





ICERYA AEGYPTIACA.



EXPLANATION OF PLATE CLXXXII.

ICERYA SEYCHELLARUM.

- Fig. 1. Insects, on branch of Croton, nat. size.  
2. Adult female, dorsal view,  $\times 5$ .  
3. " " ventral view,  $\times 5$ .  
4. " " pale form, with ovisac,  $\times 2$ .  
5. Young larva,  $\times 10$ .  
6. Leg of adult female,  $\times 30$ .  
7. Claw,  $\times 220$ .  
8. Marginal area, with dermal pores and setae,  $\times 220$ .  
9, 10, 11. Various aspects of ring-shaped pores,  $\times 450$ .  
12. Small pore, with trilocular aperture,  $\times 450$ .  
13. " " with bilocular aperture,  $\times 450$ .  
14. Antenna and eye,  $\times 80$ .  
15. Abdominal spiracle,  $\times 450$ .  
16. Dermal seta,  $\times 450$ .

I. SEYCHELLARUM VAR. NARDI

17. Claw of adult female,  $\times 220$ .  
18. Small dermal pore,  $\times 450$ .  
19, 20, 21. Different aspects of ring-shaped pores,  $\times 450$ .  
22. Base of one of the larger setae,  $\times 450$ .  
23. Abdominal spiracle,  $\times 450$ .



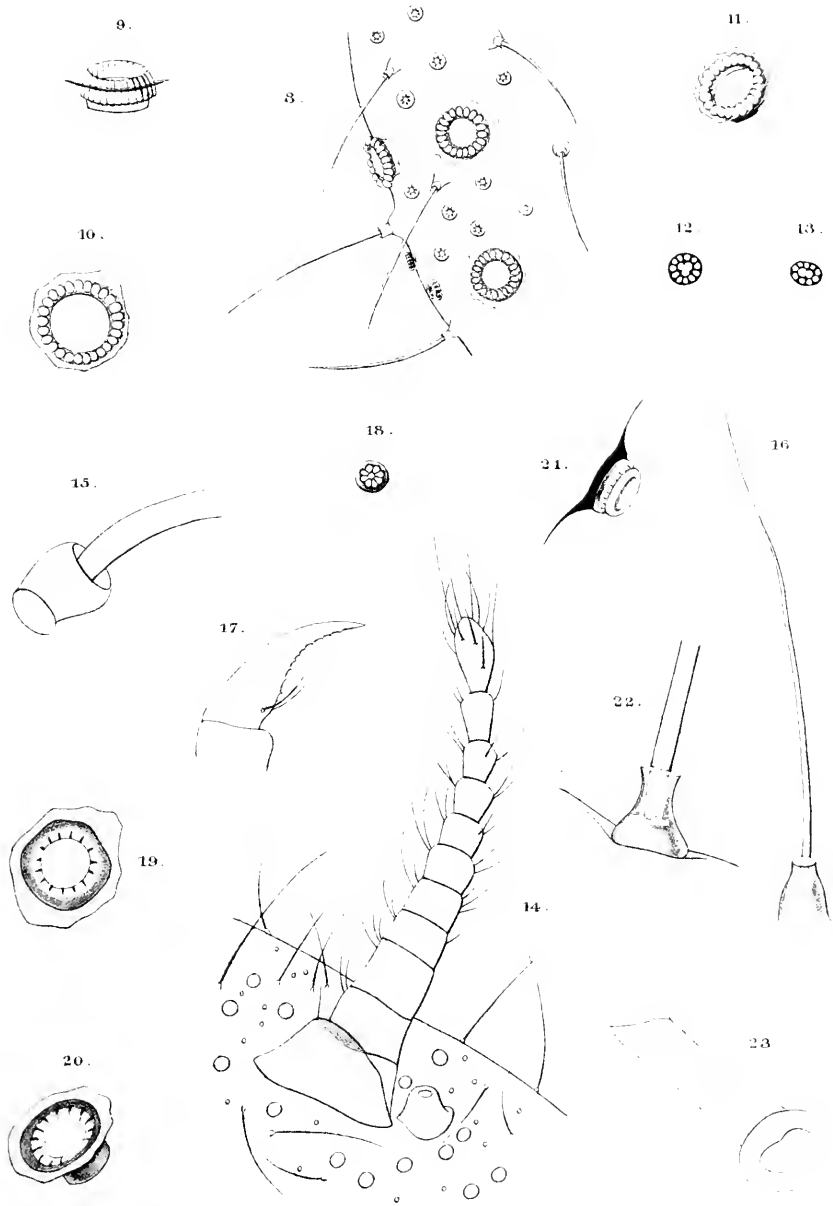


EE 1-

ICERYA SEYCHELLARUM.





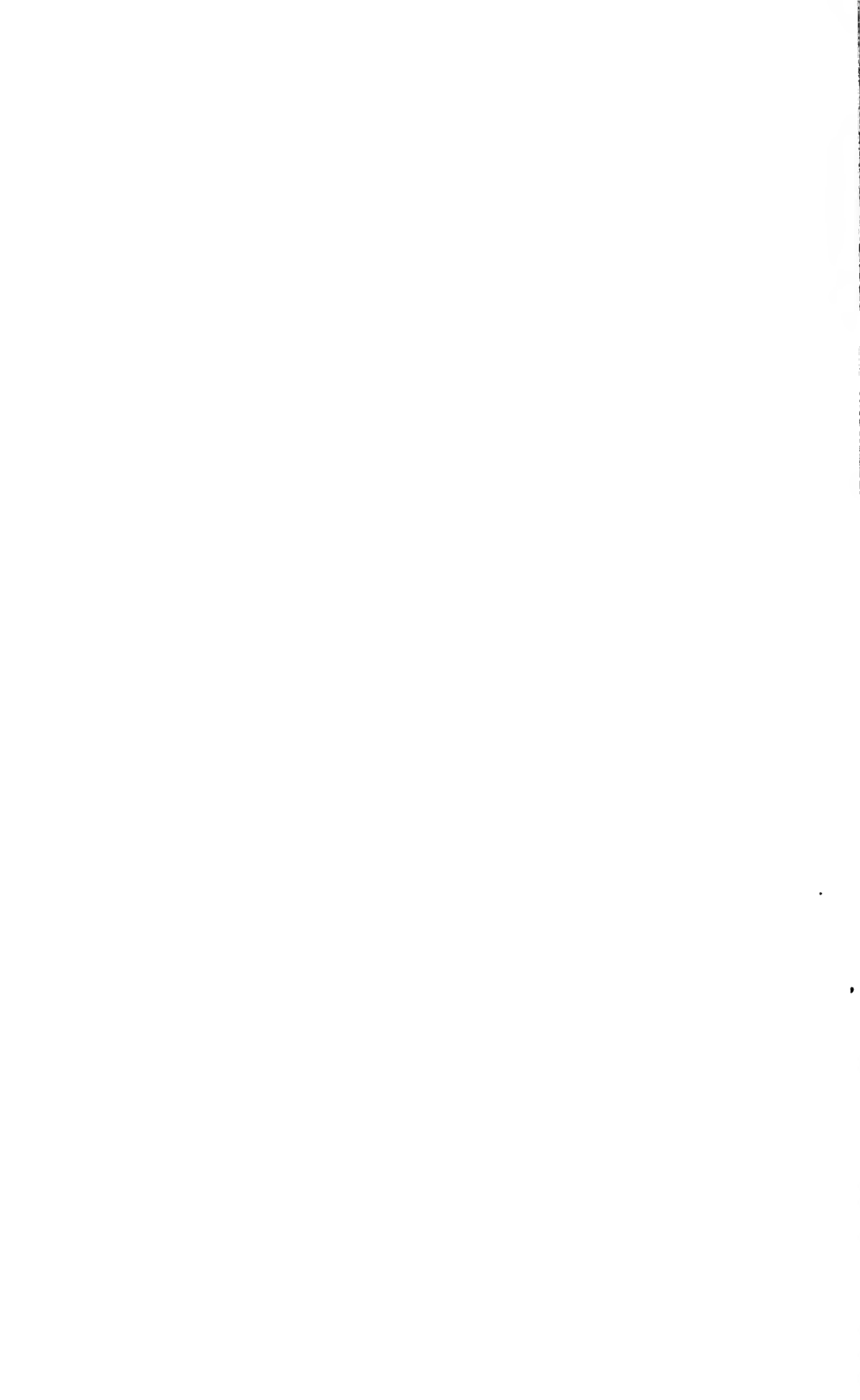


E. E. Druet. del.

F. B. W. M. C. Depp.

A. G. Whitt.

*ICERYA SEYCHELLARUM*



EXPLANATION OF PLATE CLXXXIII.

ICERYA PILOSA.

- Fig. 1. Very young larva,  $\times 17$ .  
2. Larva more advanced,  $\times 17$ .  
3. Antenna of young larva,  $\times 100$ .  
4. Early nymph, shortly after moult,  $\times 12$ .  
5. Later nymph,  $\times 8$ .  
6. Adult female, dorsal view,  $\times 8$ .  
7. „ „ ventral view,  $\times 8$ .  
8. Female emerging from nymphal skin,  $\times 8$ .  
9. Male puparium and adult male, nat. size.  
10. Male nymph,  $\times 14$ .  
11. Adult male,  $\times 10$ .  
12. Head of male,  $\times 30$ .  
13. Posterior extremity of male,  $\times 30$ .  
14. Adult female, with ovisac,  $\times 8$ .  
15. Mid leg,  $\times 50$ .  
16. Foot,  $\times 450$ .  
17. Abnormal form of foot,  $\times 450$ .  
18. Anterior spiracle,  $\times 220$ .  
19. Antenna, eye, and part of frons,  $\times 130$ .  
20. Simple hair,  $\times 450$ .  
21. Hair with recessed socket,  $\times 450$ .  
22. Base of collared hair,  $\times 450$ .  
23. Collared hair, with attached ceriferous pore,  $\times 450$ .  
24. Isolated large ceriferous pore,  $\times 450$ .  
25. Large pore seen in profile,  $\times 450$ .  
26. Ring-shaped pore,  $\times 450$ .  
27. Small pore,  $\times 450$ .  
28. Small pore in profile,  $\times 450$ .  
29. Small dermal pore of larva,  $\times 450$ .  
30. Marginal pore of larva,  $\times 450$ .  
31. Sprig of *Spinifer*, with insects, nat. size.

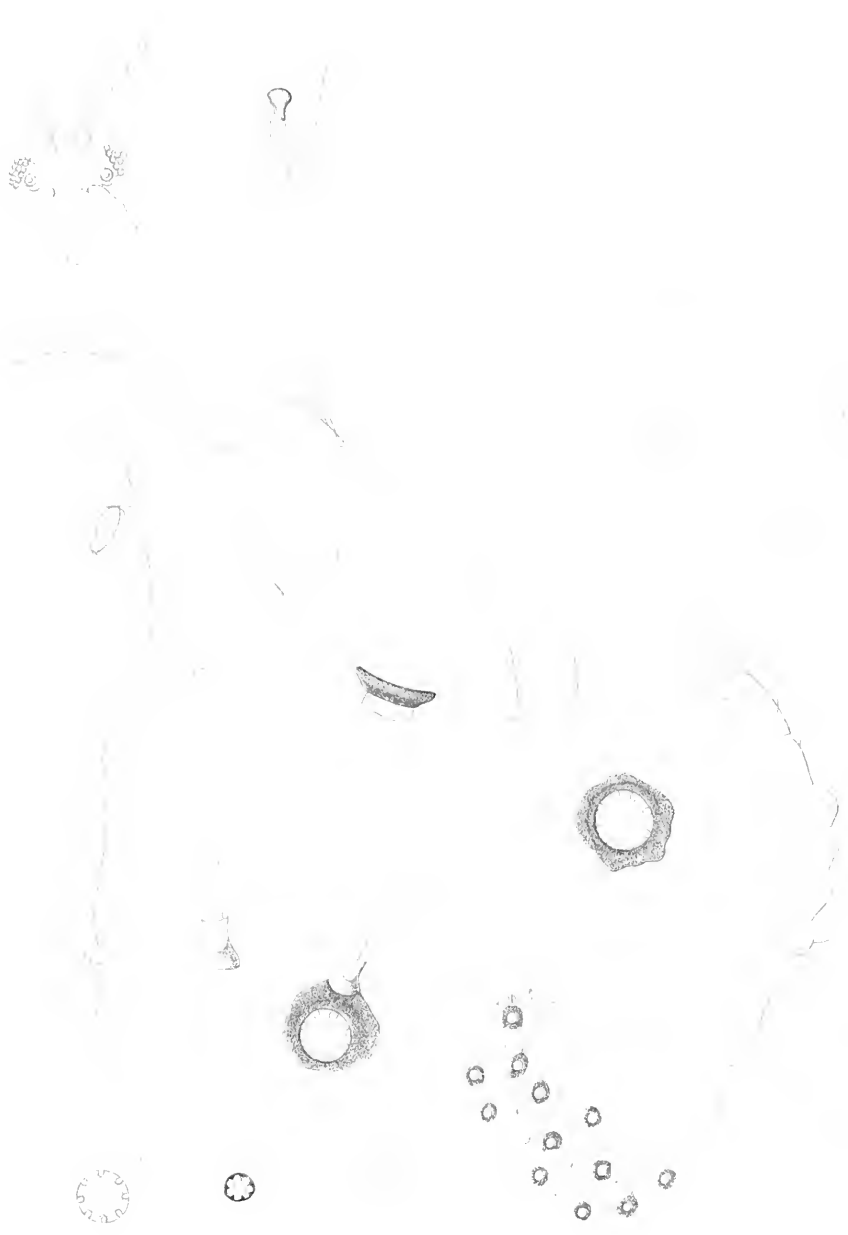




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*ICERYA PILOSA.*





ICBRYA PILOSA.





EXPLANATION OF PLATE CLXXXIV.

WALKERIANA FLORIGER.

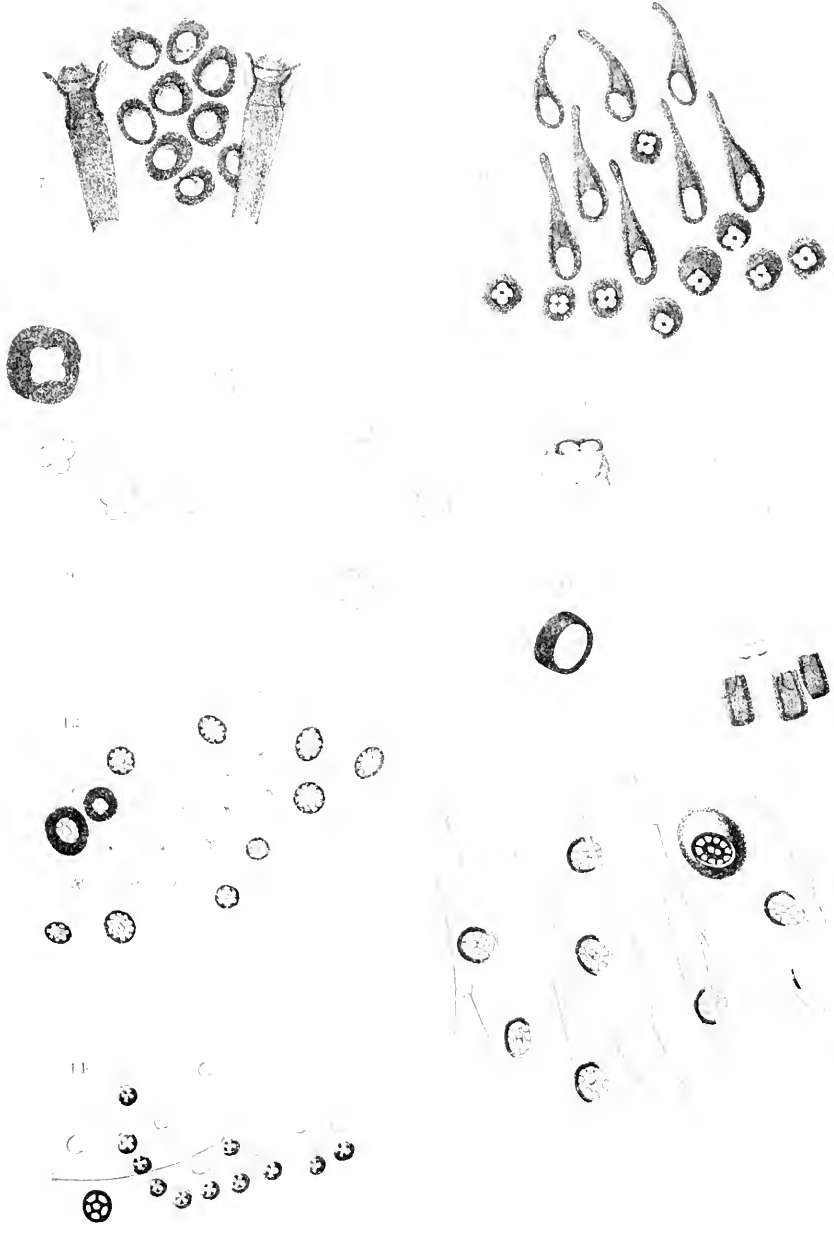
- Fig. 1. Adult female and nymph, on piece of bark, nat. size.  
2. Early nymph,  $\times 4$ .  
3. Antenna of adult female,  $\times 50$ .  
4. Mid leg of adult female,  $\times 30$ .  
5. Foot of adult female,  $\times 130$ .  
6. Anal aperture and surrounding area,  $\times 50$ .  
7. Pores and bases of setæ from anal area,  $\times 450$ .  
8. Spines and pores from ceriferous tract of dorsum,  $\times 450$ .  
9. Spines and pores from intermediate area of dorsum,  $\times 450$ .  
10. One of the pores, as seen in profile,  $\times 450$ .  
11. One of the abdominal spiracles,  $\times 220$ .  
12. Group of smaller pores from venter of abdomen,  $\times 450$ .  
13. Pores and setæ from venter of thorax,  $\times 450$ .  
14. Spines and pores from ceriferous tract of young larva,  $\times 450$ .  
15. Marginal setæ and enlarged pores of young larva,  $\times 450$ .





WALKERIANA FLORIGER.





WALKBRIANA FLORIGER.



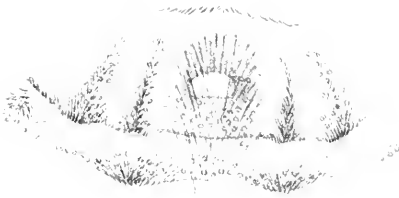
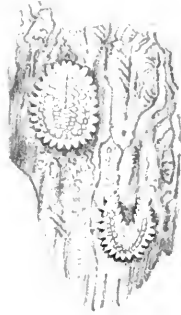
EXPLANATION OF PLATE CLXXXV.

WALKERIANA COMPACTA.

- Fig. 1. Adult female and exuvie of nymph, nat. size.  
2. Adult female, dorsal view,  $\times 3$ .  
3. " " ventral view,  $\times 3$ .  
4. Antenna and eye of adult female,  $\times 50$ .  
5. Antenna of nymph,  $\times 50$ .  
6. Mid leg of adult female,  $\times 30$ .  
7. Foot,  $\times 130$ .  
8. Posterior extremity of venter, showing cicatrices,  $\times 9$ .  
9. " " dorsum, with anal area,  $\times 30$ .  
10. Pores and spines of dorsum, intermediate area,  $\times 450$ .  
11. Pores of anal area,  $\times 450$ .  
12. Spines and pores of ceriferous tract,  $\times 450$ .  
13. Pores and setæ of venter, frontal area,  $\times 450$ .  
14. " " " " " median thoracic area,  $\times 450$ .  
15. " " " " " from margin of posterior segments,  $\times 450$ .

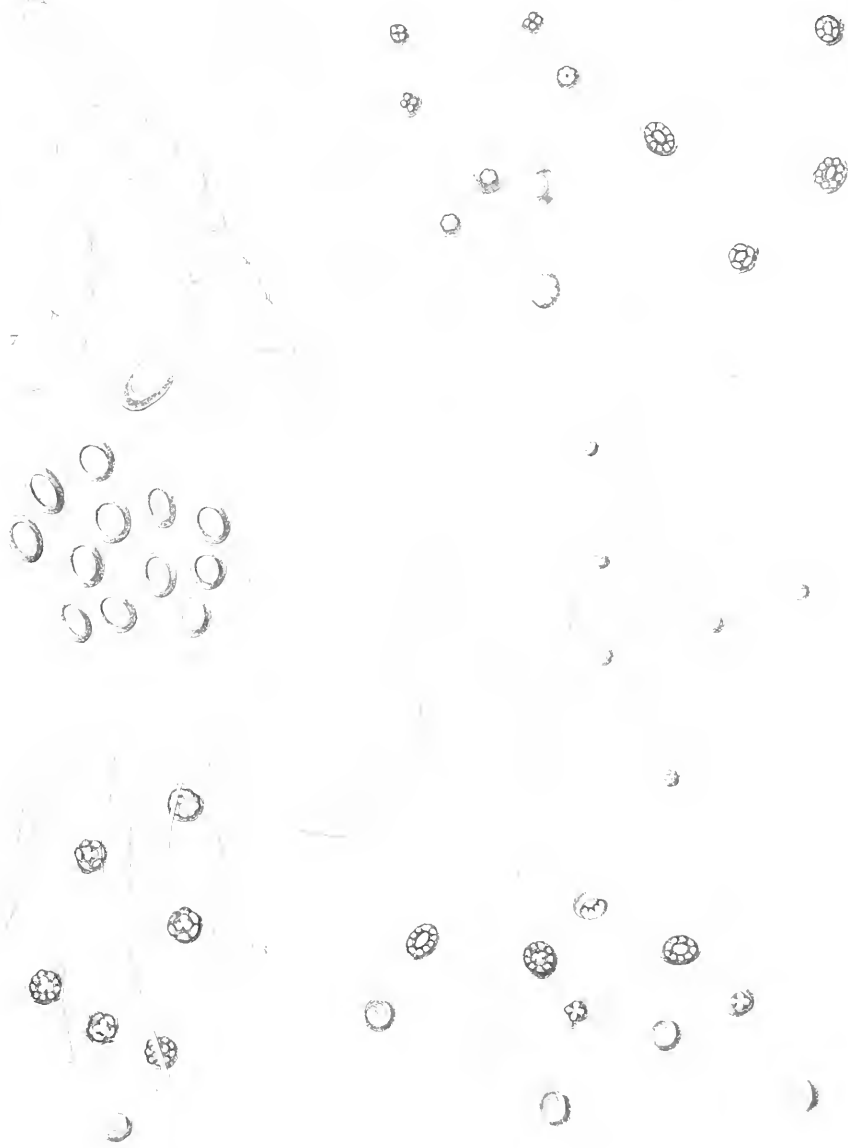






WALKERIANA COMPACTA.





WALKERIANA COMPACTA.

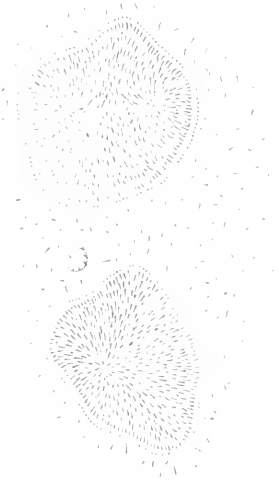
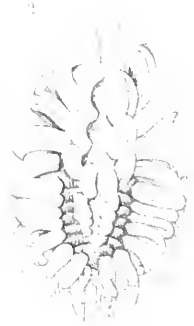


EXPLANATION OF PLATE CLXXXVI.

WALKERIANA SENEX.

- Fig. 1. Adult female, side view, nat. size.  
2. " " dorsal view, before oviposition,  $\times 4$ .  
3. Old female, with ovisac, from below, nat. size.  
4. " " " " side view, nat. size.  
5. Young larva, dorsal view,  $\times 6$ .  
6. Antenna of adult female,  $\times 50$ .  
7. " of young larva,  $\times 130$ .  
8. Mid leg of adult female,  $\times 30$ .  
9. Foot of adult female,  $\times 130$ .  
10. Part of derm of dorsum, with two ceriferous tracts,  $\times 30$ .  
11. Spines and pores from edge of ceriferous tract,  $\times 450$ .  
12. Pores from anal area, in profile,  $\times 450$ .  
13. Abdominal spiracle,  $\times 220$ .  
14. Pores from transverse zone on venter,  $\times 450$ .  
15. Margin of young larva, with spines and tubular pores,  $\times 450$ .

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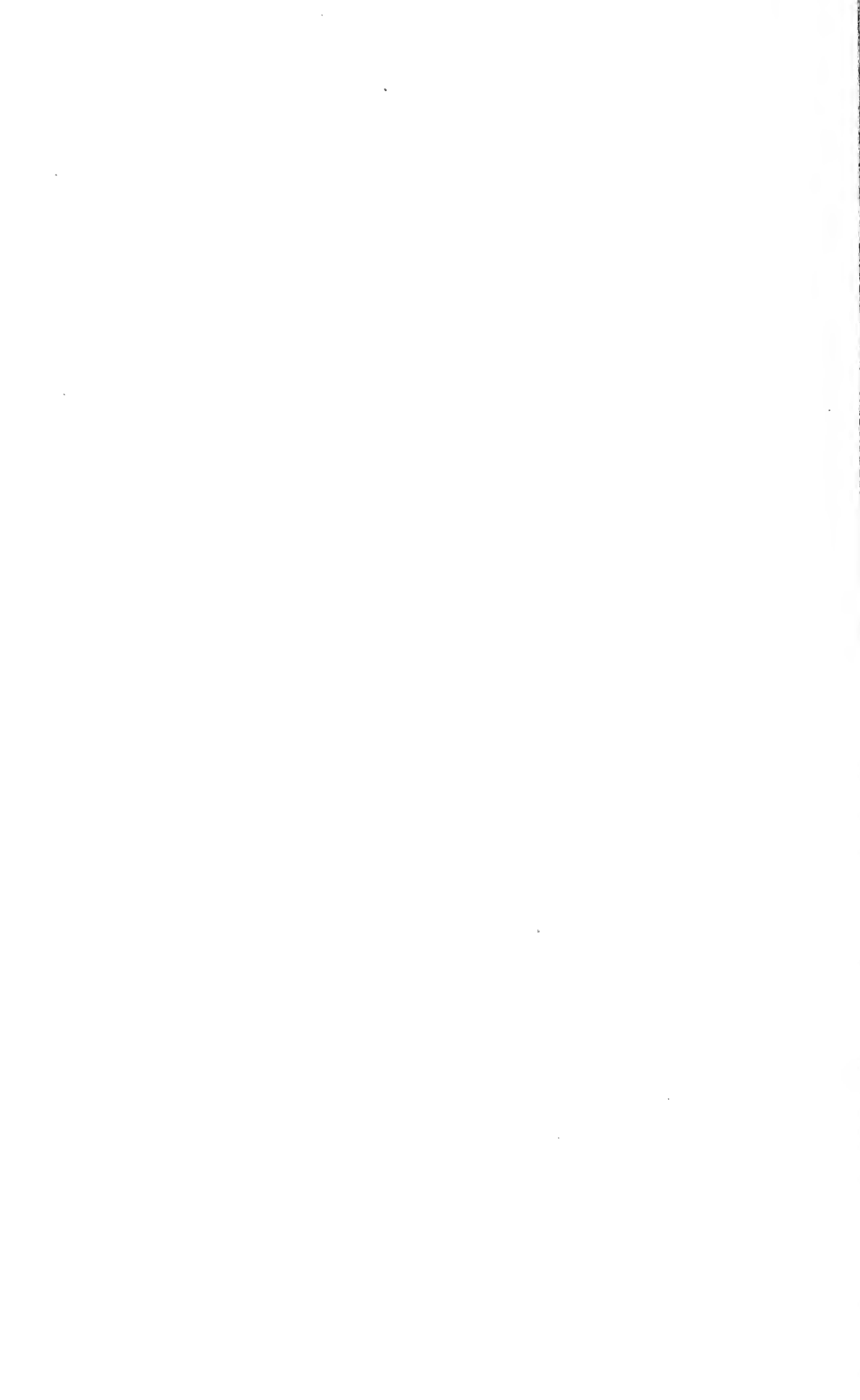




EXPLANATION OF PLATE CLXXXVII.

WALKERIANA OVILLA.

- Fig. 1. Adult female, dorsal view, nat. size.  
2, 3. Young larvæ,  $\times 9$ .  
4. Antenna of adult female,  $\times 50$ .  
5. Mid leg " " "  $\times 30$ .  
6. Foot " " "  $\times 130$ .  
7. Large tubular pores from frontal margin of young larva,  $\times 450$ .  
8. Spines and pores from dorsum of young larva,  $\times 450$ .  
9. Abdominal spiracle of adult female,  $\times 220$ .  
10. Pores from anal tract,  $\times 450$ .  
11. Pores from median area of venter,  $\times 450$ .  
12. Setæ and pores from lateral area of venter,  $\times 450$ .  
13. Spines and pores from dorsum,  $\times 450$ .



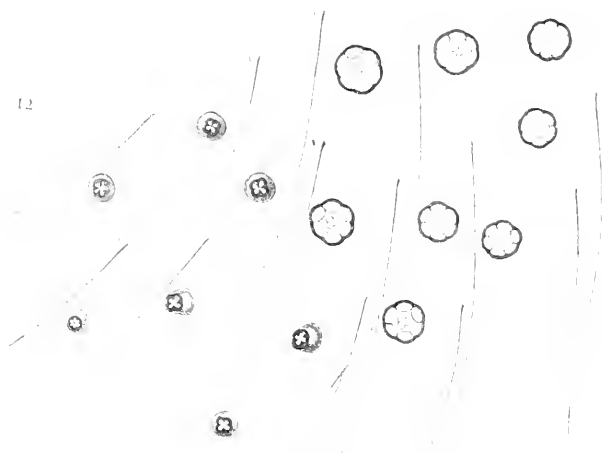


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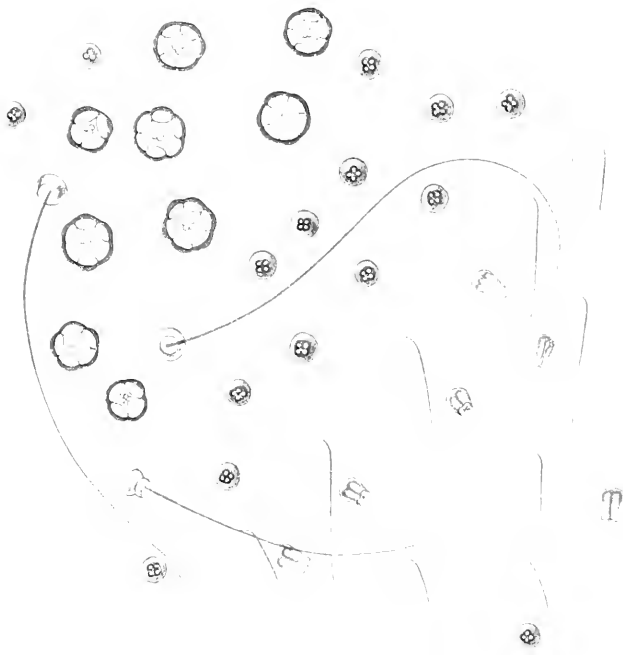
WALKERIANA OVILLA.



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WALKERIANA OVILLA.



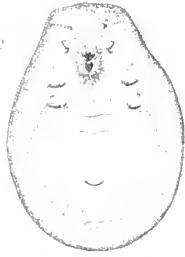
EXPLANATION OF PLATE CLXXXVIII.

ASPIDOPROCTUS CINEREA.

- Fig. 1. Adult female, side view, nat. size.  
2. Venter, after maceration,  $\times 3$ .  
3. Antenna,  $\times 50$ .  
4. Mid leg, small form,  $\times 30$ .  
5. Claw of mid leg,  $\times 130$ .  
6. Mid leg, average form,  $\times 30$ .  
7. Claw of mid leg,  $\times 130$ .  
8. Anal ring and orifice,  $\times 130$ .  
9. Spines and boundary pores of dorsal ceriferous tracts,  $\times 450$ .  
10, 11. Occasional forms of spines „ „ „  $\times 450$ .  
12. Spine from intermediate area,  $\times 450$ .  
13. Setæ from venter immediately surrounding the rostrum,  $\times 430$ .  
14. Pores from submarginal area of venter,  $\times 450$ .  
15. One of these pores, seen in profile,  $\times 550$ .  
16. Various forms of pores from anal tract,  $\times 450$ .  
17. Pores immediately surrounding genital orifice,  $\times 450$ .  
18. Pores from venter of abdomen,  $\times 450$ .  
19, 20, 21. Grouped setæ from venter of abdomen,  $\times 450$ .







15



17



ASPIDOPROCTUS CINEREA.



EXPLANATION OF PLATE CLXXXIX.

ASPIDOPROCTUS EUPHORBLE.

- Fig. 1. Adult females on *Euphorbia antiquorum*, nat. size.
2. Adult female, ventral aspect,  $\times 3$ .
  3. " " dorsal view,  $\times 3$ .
  4. " " side view,  $\times 3$ .
  5. Newly hatched larva, dorsal view,  $\times 14$ .
  6. " " " ventral view,  $\times 14$ .
  7. Larva, shortly before first moult,  $\times 8$ .
  8. Antenna of adult female, normal ten-jointed form,  $\times 50$ .
  9. " " " " abnormal eleven-jointed form,  $\times 50$ .
  10. Antenna of young larva,  $\times 80$ .
  11. Anal ring of adult female,  $\times 130$ .
  12. Mid leg,  $\times 30$ .
  13. Foot,  $\times 130$ .
  14. Pores from venter of abdomen,  $\times 450$ .
  15. " from base of abdomen and marginal area,  $\times 450$ .
  16. " from anal tract,  $\times 450$ .
  17. Pores and setæ surrounding genital orifice,  $\times 450$ .
  18. One of the setæ from rostral area,  $\times 450$ .
  19. Dorsal spine from ceriferous tract,  $\times 450$ .
  20. " " " intermediate area,  $\times 450$ .

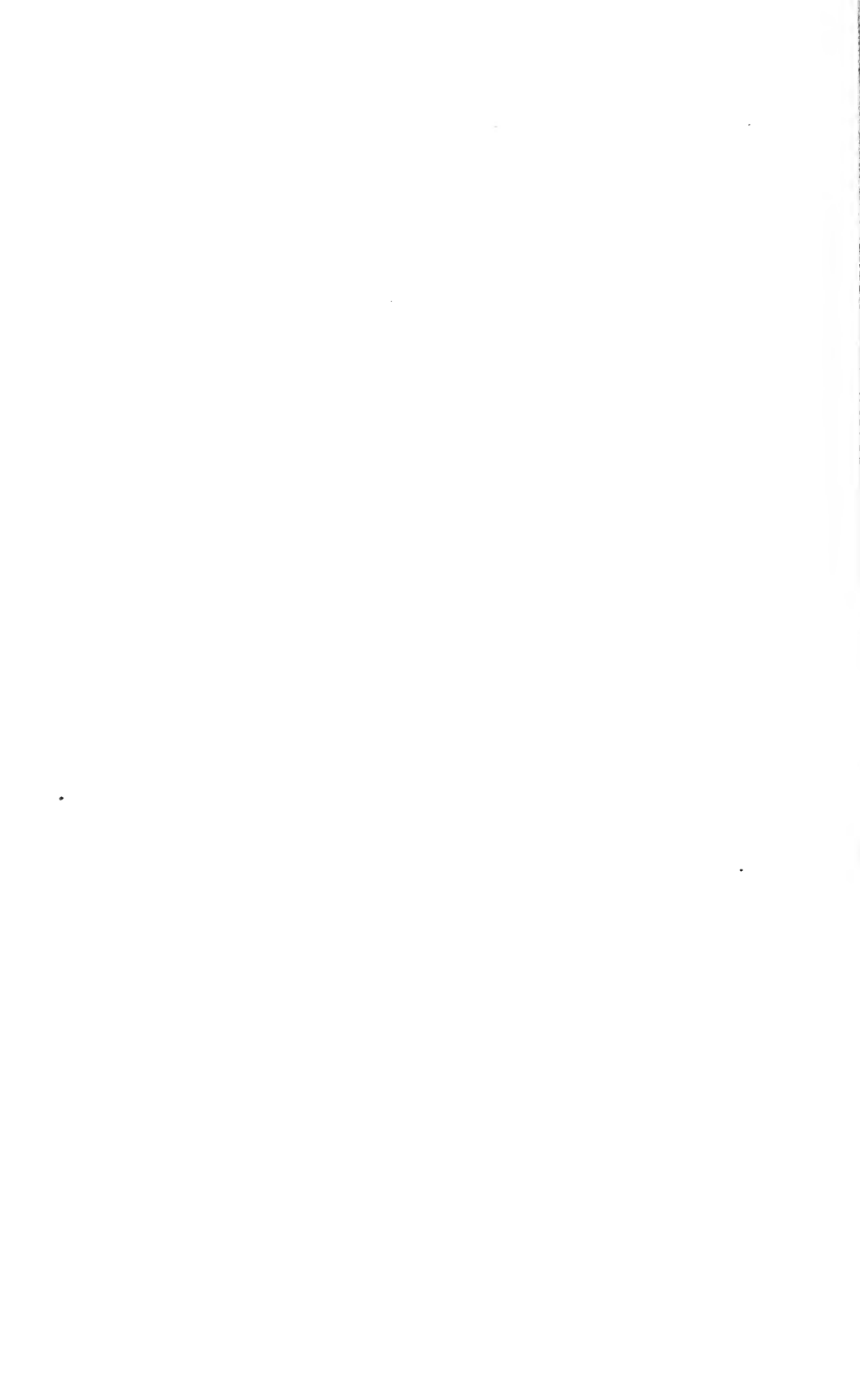




FIG. 1-19.

ASPIDOPROCTUS EUPHOREIÆ.



## EXPLANATION OF PLATE CXC.

### LABIOPROCTUS POLEI.

- Fig. 1. Female insects, on twig of *Dodonaea*, nat. size.  
2. Adult female, dorsal view,  $\times 3$ .  
3. " " ventral view,  $\times 3$ .  
4. " " side view,  $\times 3$ .  
5. Mid leg,  $\times 30$ .  
6. Claw of mid leg,  $\times 130$ .  
7. Antenna of adult female,  $\times 50$ .  
8. Puparia of male, on leaf of *Eugenia*, nat. size.  
9. Newly hatched larva,  $\times 6$ .  
10. Antenna of larva,  $\times 30$ .  
11. Adult male, dorsal view,  $\times 12$ .  
12. Spines of adult female, from intermediate area,  $\times 450$ .  
13. Spines and pores from ceriferous tract,  $\times 450$ .  
14. Pores from anal area,  $\times 450$ .







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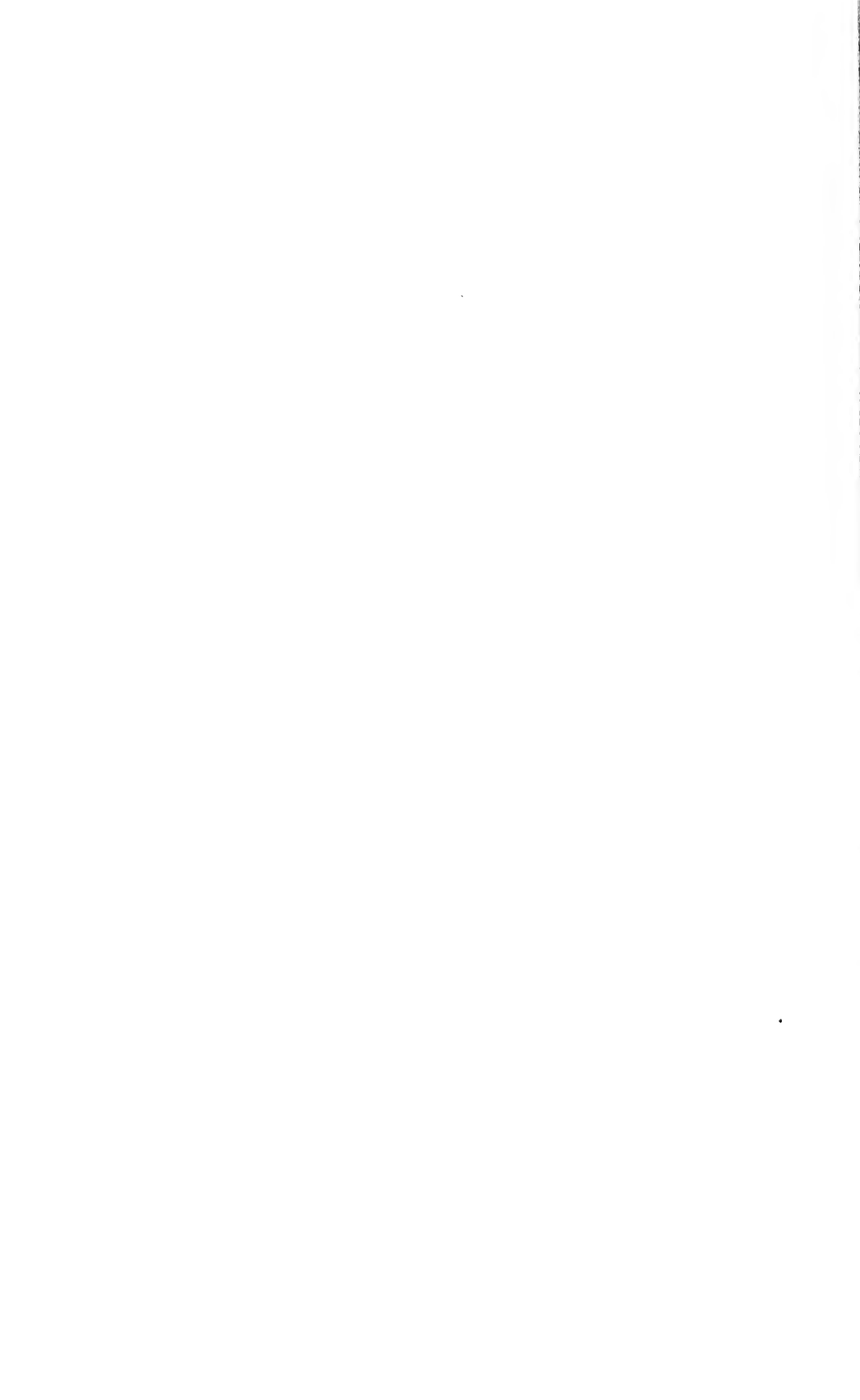


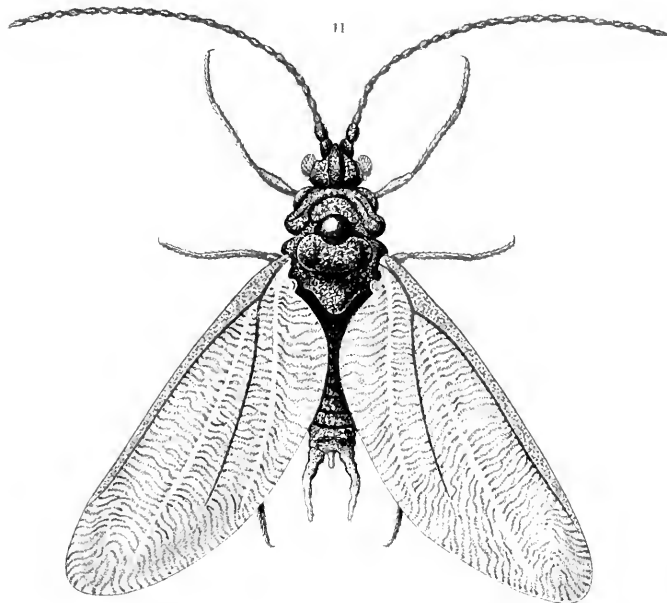
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LABIOPROCTUS POLEI ♀.

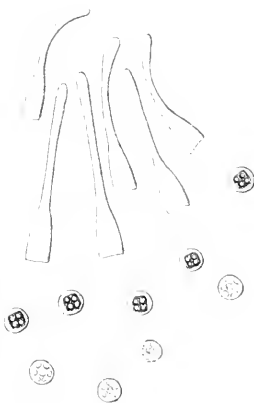




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PLATE 11

LABIOPROCTUS POLEI.



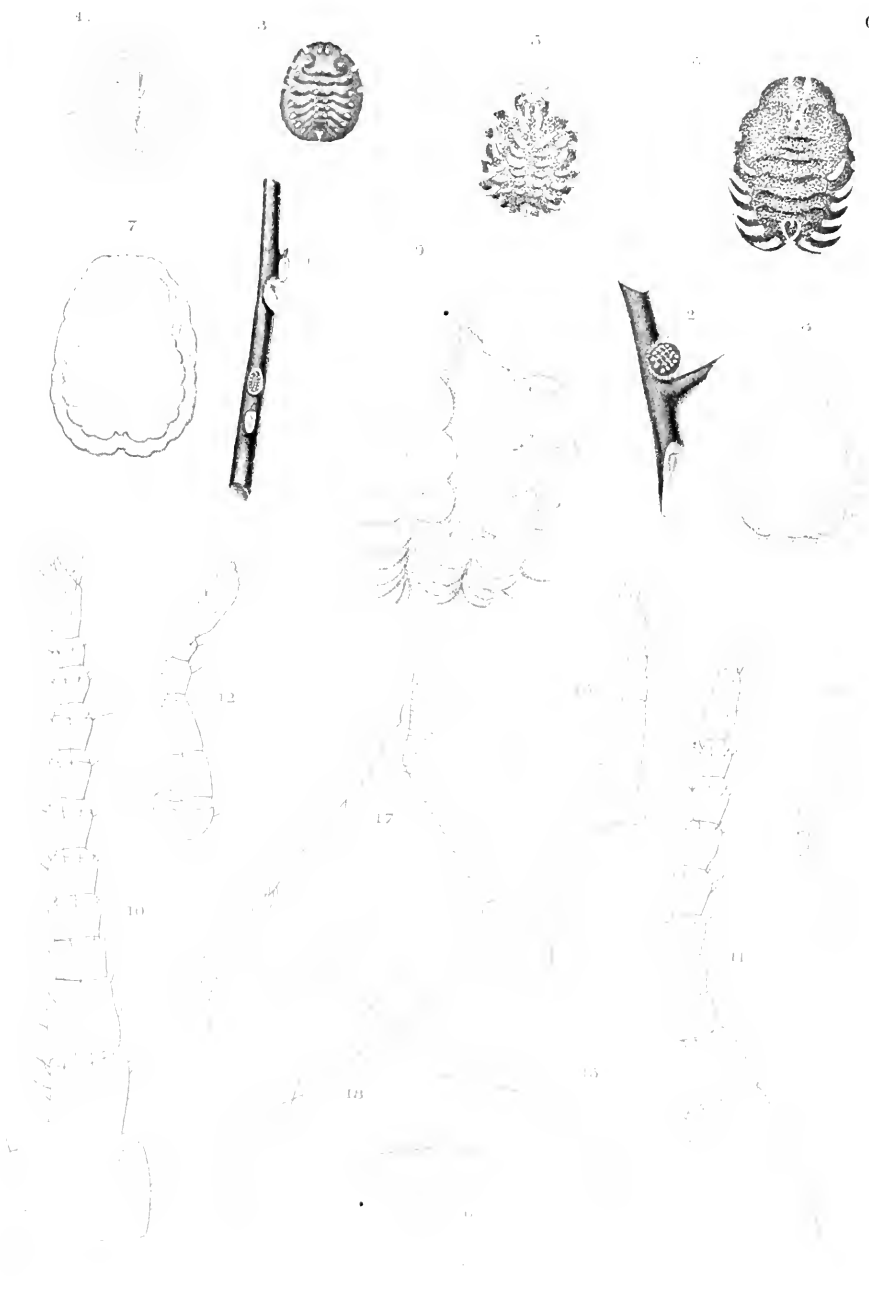
EXPLANATION OF PLATE CXCI.

NIETNERA PUNDALUOYA.

Immediately after moult :

- Fig. 1, 2. Nymphs, nat. size.  
3. Early nymph, " × 4.  
4. Nymph, earlier stage, × 4.  
5. Nymph, later stage, × 4.  
6. Adult female, × 4.  
7. " " after maceration, × 4.  
8. " " after death, × 4.  
9. Cast skin of nymph, × 12.  
10, 11. Antenna of adult female, × 50.  
12. Antenna of nymph (in stage shown at fig. 5), × 50.  
13. " " " ( " " " 3), × 50.  
14. Antenna of early nymph, × 50.  
15. Mid leg of nymph (as at fig. 5), × 30.  
16. " " early nymph, × 30.  
17. " " adult female, × 30.  
18. Foot " " " × 135.  
19. Dorsal spines of adult female, × 220.  
20. " " " " " × 450.  
21. Spines of ceriferous tract, × 220.  
22. " " " " " × 450.  
23. Anal area, × 130.  
24. Pores from anal area, × 450.  
25. Abdominal spiracle, × 220.  
26. Setae and pores of venter, × 450.  
27. Dorsal spines of (?) late nymph, × 200.  
28. " " " " " × 450.





NIETNERA PUNDALUOVA.







NIETHNERA PUNDALUOYA



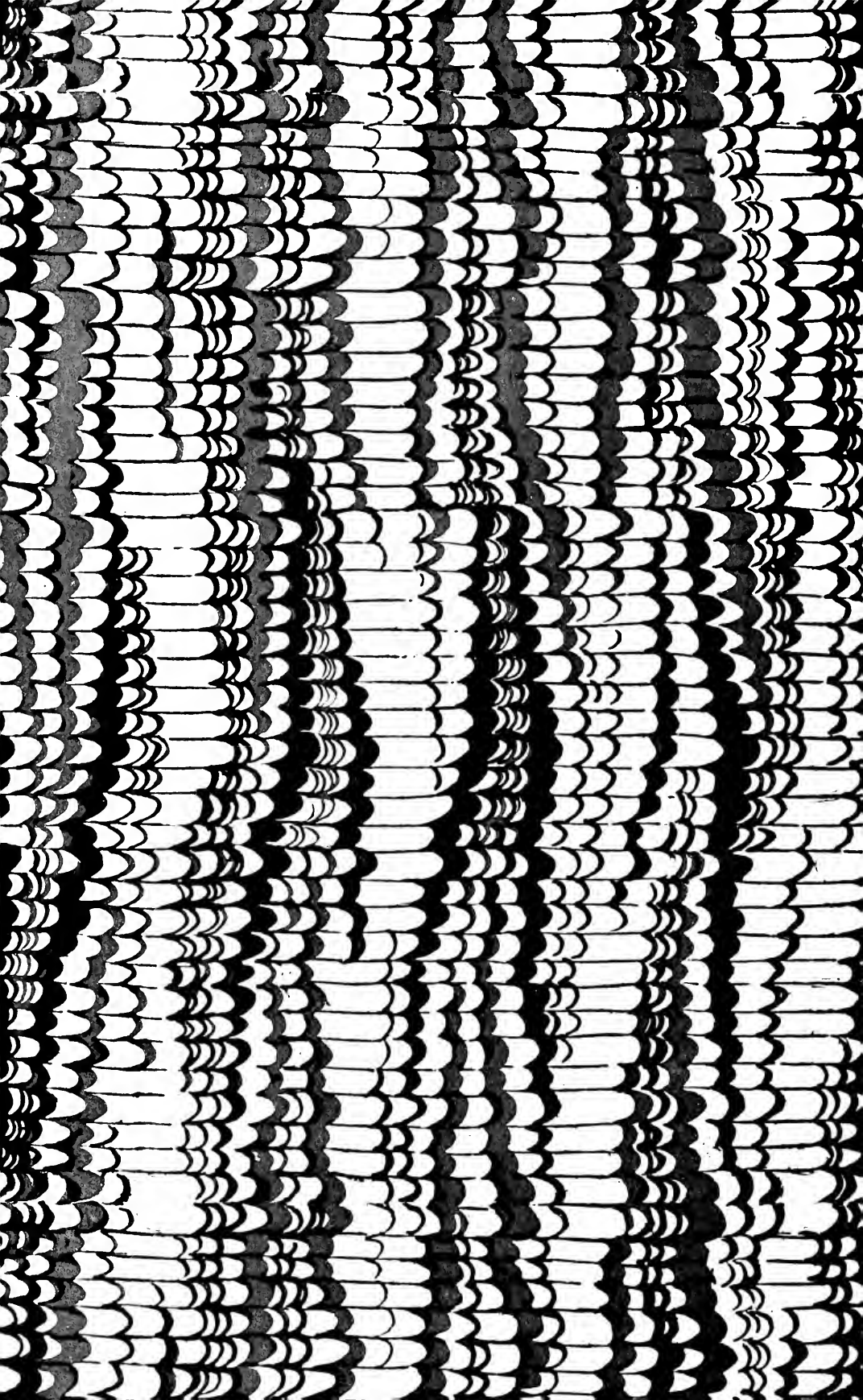














Mr. E. Ernest Green

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