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BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

SYNOPSIS, CATALOGUE, AND BIBLIOGRAPHY OF NORTH AMERICAN THYSANOPTERA,

WITH DESCRIPTIONS OF NEW SPECIES.

BY

DUDLEY MOULTON,
Deputy State Commissioner of Horticulture for California.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Entomology,
Washington, D. C., December 13, 1910.

Sir: I have the honor to transmit herewith the manuscript of a bulletin to be entitled "Synopsis, Catalogue, and Bibliography of North American Thysanoptera, with Descriptions of New Species."

During the past few years the order Thysanoptera in America has been the subject of increased study by entomologists, not only on account of the extreme interest attaching to the insects themselves, but also by reason of the considerable importance which several of the species have attained as pests of horticultural and other crops. Mr. Moulton, while in the employ of this bureau, was a part of the time engaged in a study of two very destructive species in California, namely, the pear thrips (*Euthrips pyri* Daniel) and the orange thrips (*Euthrips citri* Moulton), and the present paper is an outgrowth of data and specimens collected during his investigation of these insects for the bureau.

An up-to-date synopsis and catalogue of the Thysanoptera is greatly to be desired and will be of much use to students of this order. I would therefore recommend the publication of this paper as Technical Series No. 21 of the Bureau of Entomology.

Respectfully,

L. O. Howard,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

SYNOPSIS, CATALOGUE, AND BIBLIOGRAPHY OF NORTH AMERICAN THYSANOPTERA, WITH DESCRIPTION OF NEW SPECIES.

INTRODUCTION.

The many recent publications on American thrips, and especially the descriptions of new species with their added notes, have constantly impressed the writer with the need of a catalogue of these already known species, with references to their habitat and food plants and to notes on their life history. The writer is also impressed with the need, for future workers, of a uniform method in describing new species.

Several English and European entomologists have published extensively on European thrips, but it is only within the last decade that American writers have given more than passing notice to these insects. Several species of injurious thrips, in both the East and West, have been carefully studied, and these economic problems, it seems, have been largely the incentive for the other, the systematic work. The grass thrips (*Anaphothrips striatus* Osborn), the strawberry thrips (*Euthrips tritici* Fitch), the onion thrips (*Thrips tabaci* Lindeman), the tobacco thrips (*Euthrips fuscus* Hinds), the greenhouse thrips (*Heliothrips hæmorrhoidalis* Bouché), the bean thrips (*Heliothrips fasciatus* Pergande), the orange thrips (*Euthrips citri* Moulton), and lastly the pear thrips (*Euthrips pyri* Daniel) are all examples of what serious pests this group includes. Already many agents of the Bureau of Entomology of the United States Department of Agriculture and various State and county workers have spent much time and money in learning the habits of these several injurious forms. California, unfortunately, harbors all of the above-mentioned species except, so far as we know, the tobacco thrips.

Messrs. Hood, Shull, Franklin, and D. L. Crawford have published extensively on these insects since the monograph by Dr. W. E. Hinds appeared. The writer also knows of others who are collecting thrips and preparing manuscript on description of new species. It seems opportune, therefore, for the sake of future workers, that a uniform method of describing species be adopted. The writer, therefore, includes an outline,[1] which has been found most satisfactory in his own work.

Thrips are such minute insects that it is necessary for accurate study that they be mounted on slides. The writer has been able to get the best results by treating them in the following way: The thrips should be collected and killed by dropping them directly into 75 or 80 per cent alcohol; they should be dehydrated by passing them successively through 90 per cent, 95 per cent, and absolute alcohol, and then cleared in xylol or cedar oil, and mounted in balsam. One specimen only should be placed under a cover glass; but by using small cover glasses, two can be placed side by side on a single slide. Glycerin jelly mounts are not to be desired.

The present paper includes 118 species of known American thrips, which are variously divided among 40 genera. Descriptions of 2 genera, 10 species, and 1 variety are herewith presented. The bibliography includes only references to recent publications.

CLASSIFICATION OF NORTH AMERICAN THYSANOPTERA.

KEY TO THE SUBORDERS AND FAMILIES.

I. SUBORDER TEREBRANTIA.

Female with a sawlike ovipositor. Terminal abdominal segment of female conical and of male broadly rounded. Wings usually present; fore pair strongest, with more or less well-developed veins; membrane of wings with microscopic hairs.

a. Antennæ with nine segments. Fore wings broad and rounded and with prominent ring veins and cross veins. Ovipositor upcurved.
(*A.*) Family ÆOLOTHRIPIDÆ.

a′. Antennæ with seven, eight, nine, or ten segments. Wings present or wanting; when present usually narrow and pointed at tips. Ovipositor downcurved .... (*B.*) Family THRIPIDÆ.

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[1] ORDER FOLLOWED IN DESCRIBING THYSANOPTERA.

Name.

Measurements: Head length, width; prothorax length, width; mesothorax width; abdomen width; length of tube in the Phlœothripidæ; total body length; antennæ, length of segments in microns, total length. Note any variations.

General color, with variations.

Head: Comparative size, shape (frons, cheeks), markings, spines.

Eyes: Size, shape, position on head, color; shape and size of facets; presence or absence of pilosity.

Ocelli: Present or wanting, size, position, color.

Mouth-cone: Comparative size, shape; maxillary palpus, shape, segments; labial palpus, shape, segments.

Antennæ: Number of segments, total length compared with head, color, markings including spines, sense cones and areas.

Prothorax: General shape, size, angles, number and position of spines, color.

Mesothorax: Shape, comparative size, color.

Metathorax or *pterthorax:* Ditto.

Legs: Shape, markings of claws or spines, color.

Wings: Fore wings, size, shape, veins, spines or hairs, fringe, color; hind wings, ditto.

Abdomen: Shape, markings, spines; shape of tube in Phlœothripidæ.

Number of specimens from which described.

Habitat.

Food plants.

Notes: Including time of year when adults are taken.

Descriptions of males should follow the same outline as for females.

Notes on larval stages.

II. SUBORDER TUBULIFERA.

Female without sawlike ovipositor. Terminal abdominal segment tubular in both sexes. Wings usually present; fore pair only with a rudimentary median longitudinal vein; membrane of wings without microscopic hairs. Antennæ with eight segments, or sometimes only seven.
(*C.*) Family PHLŒOTHRIPIDÆ.

KEY TO THE GENERA.

A. Family ÆOLOTHRIPIDÆ.

1. All segments of antennæ freely movable and diminishing in size gradually toward the tip.
   a. Maxillary palpi with seven or eight segments; wings with bands.
   b. Wings with dark cross-bands; maxillary palpi with seven segments.
   (1) *Orothrips* Moulton.
   b′. Wings with dark longitudinal bands along posterior margin; maxilliary palpi with eight segments........... (2) *Erythrothrips* new genus.
   a′. Maxillary palpi three-segmented, labial palpi two-segmented; wings without dark cross-bands.................(3) *Ankothrips* Crawford.
2. Last four segments of antennæ closely united and together shorter or a little longer than the fifth; maxillary palpi three-segmented, labial palpi four-segmented....................(4) *Æolothrips* Haliday.

B. Family THRIPIDÆ.

1. Antennæ with seven segments.
   a. Body with deeply reticulated structure; wings broad, reticulated, and without front fringe........................(5) *Parthenothrips* Uzel.
   a′. Body without reticulated structure; wings pointed, front fringe present.
   b. Maxillary palpus with two segments.................(6) *Baliothrips* Haliday.
   b′. Maxillary palpus clearly with three segments...........(7) *Thrips* Linnæus.
2. Antennæ with eight segments (with six segments in *Aptinothrips rufus* var. *connatticornis*).
   a. Body with reticulated structure, wings present.
   b. Last segment of antenna long and slender and very much longer than segment 7.
   c. style longer than segment 6; prothorax much shorter than head; spines on veins pointed.......................(8) *Heliothrips* Haliday.
   c′. style shorter than segment 6; prothorax about as long as head; spines on wings long, strong, and with dilated tips.
   (9) *Echinothrips* new genus.
   b′. Last segment of antenna not noticeably long and slender and only a little longer than segment 7; style shorter than segment 6.
   (10) *Dictothrips* Uzel.
   a′. Body without reticulated structure (except in *Sericothrips reticulatus*).
   b. Abdomen having a silky luster (when living or in dried condition), because of covering of extremely small hairs.
   (11) *Sericothrips* Haliday.
   b′. Abdomen without small hairs giving it a silky luster.
   c. Last two antennal segments longer than the sixth....(12) *Raphidothrips* Uzel.
   c′. Last two antennal segments shorter than the sixth.
   d. Terminal segment of abdomen with a pair of extremely stout, short spines near the tip above................(13) *Limothrips* Haliday.
   d′. Terminal abdominal segments without stout spines.

e. Antennæ with second segment drawn out into an acute process on outer angle; fore femora usually broad and with small tooth at end on outside....................(14) *Chirothrips* Haliday.

e'. Antennæ with second segment normally symmetrical· fore femora smaller and without tooth.

f. Ocelli and wings wanting; hairs upon the end of the abdomen short and as a rule very weak.........(15) *Aptinothrips* Haliday.

f'. Ocelli and wings present; hairs upon the end of the abdomen moderately long and proportionately stout.

g. With a long spine at the middle of each side of prothorax; spines on body and wings very strong.........(16) *Scolothrips* Hinds.

g'. Without a spine at the middle of each side of prothorax.

h. Ovipostor long and extending considerably beyond tip of abdomen................................(17) *Scirtothrips* Shull.

h'. Ovipostor not unusually long and not extending beyond tip of abdomen..................(18) *Euthrips* Targioni-Tozzetti.

3. Antennæ with apparently nine segments.

a. Head only slightly wider than long; wings not regularly set with spines; spines weak and not conspicuous. ....(19) *Anaphothrips* Uzel.

a'. Head fully one and one-half times as wide as long; wings set regularly with spines.........................(20) *Pseudothrips* Hinds.

4. Antennæ with clearly nine segments, sometimes apparently ten. (21) *Heterothrips* Hood.

C. Family PHLŒOTHRIPIDÆ.

1. Head about as long as wide and either shorter or only a little longer than the prothorax.

a. Antennæ with seven segments.

b. Antennæ one and one-half times as long as head; head rounded in front and about as wide as long; basal segments of antennæ subapproximate ....(22) *Allothrips* Hood.

b'. Antennæ two and one-half times as long as head; head rectangular; basal segments of antennæ widely separated and placed on the prominent anterior angles of the head. (23) *Rhaptothrips* Crawford.

a'. Antennæ with eight segments and one and one-half to twice as long as head.

b. Width of abdomen of females not nearly equal to one-half its length; wings constricted in the middle.

c. Mouth-cone not longer than its breadth at base; labrum narrowed toward the tip but not sharply pointed; fore femora but slightly thickened; fore femora of males without large curved tooth on inner side......................(24) *Anthothrips* Uzel.

c'. Mouth-cone reaching nearly to hind edge of prosternum; labrum blunt; fore femora of females thickened, of males greatly enlarged and with a large curved tooth on inner side. (25) *Aleurodothrips* Franklin.

b'. Width of abdomen of females equal to about one-half its length.

c. Head narrowed in front............................(26) *Eurythrips* Hinds.

c'. Head not narrowed in front.

d. Third antennal segment very short and narrow.....(27) *Lissothrips* Hood.

d'. Third antennal segment normal.

e. Segment 8 of antenna shorter than segment 7....(28) *Trichothrips* Uzel.

e'. Segment 8 of antenna very slender and noticeably longer than segment 7. (29) *Plectothrips* Hood.

2. Head considerably longer than wide and longer than the prothorax.
   a. Head less than twice as long as wide.
      b. Fore femora each with a tooth on the inner side near the end. (30 *Acanthothrips* Uzel.
      b′. Fore femora unarmed.
         c. Wings wanting or reduced to pads (or very short and weak if fully developed).
            d. Mouth-cone shorter than its width at base, labrum not narrowed in the middle and with a blunt tip.......(31) *Cephalothrips* Uzel.
            d′. Mouth-cone as long as its width at base, labrum sharply pointed.
               e. Cheeks with spine-bearing warts...............(32) *Malacothrips* Hinds.
               e′. Cheeks without spine-bearing warts.................(33) *Neothrips* Hood.
         c′. Wings fully developed.
            d. Wings constricted in the middle.
               e. Mouth-cone broadly rounded at the end; wings only slightly narrowed in the middle.......................(34) *Cryptothrips* Uzel.
               e′. Mouth-cone constricted at the end; wings considerably narrowed in the middle and having somewhat the shape of a sole.
                  f. Head nearly twice as long as wide; mouth-cone reaching nearly across prosternum.........................(35) *Leptothrips* Hood.
                  f′. Head only a little longer than broad; mouth-cone reaching only to middle of prosternum.................(36) *Zygothrips* Uzel.
            d′. Wings of equal width throughout.
               e. Cheeks with a few very small warts, each of which bears a small spine. (37) *Phlœothrips* Haliday.
               e′. Cheeks without such warts.........................(38) *Liothrips* Uzel.
   a′. Head more than twice as long as wide; individuals very large.
      b. Antennæ one and one-sixth to one and one-half times as long as head; fore tarsi of females unarmed, of males each armed with a tooth; without prominent spines along fore margin of prothorax. (39) *Idolothrips* Haliday.
      b′. Antennæ twice as long as head; color brown to dark brown; fore tarsi not armed; four prominent spines along fore margin of prothorax, two of which stand on the outer angles. (40) *Megalothrips* Heeger.

KEY TO THE SPECIES.

(1) Genus Orothrips Moulton.

1. Segment 2 of antenna quite uniform brown; segment 3 not constricted in the middle; sense areas on segments 3 and 4 elongate. (1) *Orothrips kelloggii* Moulton.
2. Segment 2 of antenna brown at base, yellow at tip; segment 3 constricted in the middle; sense areas on segments 3 and 4 ovoid. (2) *Orothrips kelloggii yosemitii*, new variety.

(4) Genus Æolothrips Haliday.

1. Fore wings with dark cross-bands.
   a. White band around abdominal segments 1 and 2; last four segments of antennæ much longer than fifth.
      b. Segments 2 and 3 of abdomen white; wings with cross-veins. (5) *Æolothrips bicolor* Hinds.
      b′. Segments 1, 2, and posterior half of 3 white; wings without cross-veins. (6) *Æolothrips vespiformis* Crawford.

a. Without white band around first two abdominal segments; last four segments of antennæ approximately as long as the fifth alone.
(7) *Æolothrips fasciatus* Linnæus.

2. Each fore wing with dark longitudinal band along posterior margin.
a. With veins in anterior wings normal as in most species of this genus.
(8) *Æolothrips kuwanaii* Moulton.
a′. Without veins in anterior wings..............(9) *Æolothrips longiceps* Crawford.

(7) Genus Thrips Linnæus.

1. Head considerably wider than long.
a. Body color dark brown, thorax and other parts orange-tinted, inner crescents bordering ocelli orange-red; individuals large, about 1.25 mm. in length.
b. Wings light brown, with lighter colored area near base.
(12) *Thrips madronii* Moulton.
b′. Wings uniform dark brown to brown.........(13) *Thrips magnus*, new species.
a′. Body color light yellow to light brown or brown; inner crescents bordering ocelli light brown; body length about 1 mm.
b. Ocelli subapproximate; posterior longitudinal vein of fore wing with about fourteen to seventeen regularly placed spines.
(14) *Thrips tabaci* Lindeman.
b′. Ocelli widely separated, anterior one on frons and directed forward; posterior longitudinal vein bearing about seven spines.
(15) *Thrips abdominalis* Crawford.

2. Head about as long as wide.
a. Color uniform light lemon-yellow................(16) *Thrips bremnerii* Moulton.
a′. Color of head brown, of thorax reddish orange-brown, of abdomen pale yellow to gray-brown...........................(17) *Thrips perplexus* Beach.

(8) Genus Heliothrips Haliday.

1. All tibiæ yellow.
a. Antennæ nearly three times as long as head; wings shaded brown, with two more or less distinct whitish cross-bands and whitish at tip.
(18) *Heliothrips femoralis* Reuter.
a′. Antennæ about twice as long as head; wings almost white, shaded light brown along veins..................(19) *Heliothrips hæmorrhoidalis* Bouché.

2. Middle and hind tibiæ brown.
a. Antennæ two and one-half times as long as head, segments 3 and 4 modioliform, maxillary palpi three-segmented...(20) *Heliothrips fasciatus* Pergande.
a′. Antennæ twice as long as head, segments 3 and 4 fusiform; maxillary palpi two-segmented......................(21) *Heliothrips fasciapennis* Hinds.

(11) Genus Sericothrips Haliday.

1. Wings fully developed or rudimentary.
a. Wings fully developed.
b. Fore wings dusky or gray-brown and more or less distinctly marked with whitish cross-bands; general color yellowish to dusky gray.
(24) *Sericothrips variabilis* Beach.
b′. Fore wings black, with two broad white cross-bands, and white at tip; general color blackish.....................(25) *Sericothrips pulchellus* Hood.
a′. Wings reduced or fully developed; body dark brown to nearly black, except segments 4, 5, and 6 of abdomen, which are almost white.
(26) *Sericothrips cingulatus* Hinds.

2. Wings wanting.
   a. Body very dark brown, nearly black; pterthorax yellow to yellow-brown; legs brown..............................(27) *Sericothrips apteris* Daniel.
   a′. Body uniform brown; surface of body strongly reticulated; legs yellow.
   (28) *Sericothrips reticulatus* Moulton.
   a″. Body and legs uniform brown; four stout spines on dorsal side of segment 9.
   (29) *Sericothrips stanfordii* Moulton.

(14) Genus Chirothrips Haliday.

1. With two moderately long spines at each hind angle of prothorax; two longitudinal veins in each fore wing; fore wings gray-brown.
   (31) *Chirothrips manicatus* Haliday.
2. With one moderately long spine at each hind angle of prothorax; one median longitudinal vein in each fore wing, five spines on apical part of wing where second vein should be.....(33) *Chirothrips mexicanus* Crawford.
3. Without spines at hind angle of prothorax.
   a. Abdomen light yellow..........................(34) *Chirothrips obesus* Hinds.
   a′. Abdomen light brown..........................(35) *Chirothrips crassus* Hinds.

(18) Genus Euthrips Targioni-Tozzetti.

1. Without prominent spines on fore angles of prothorax, longitudinal veins not regularly set with spines.
   a. Head noticeably wider than long; general color white to light yellow or orange.
      b. Last two segments of antennæ rather long and slender, and together about two-thirds as long as segment 6; wings shaded brown, with transparent whitish areas near base and at tip; ring vein and longitudinal veins not conspicuous......................(39) *Euthrips orchidii* Moulton.
      b′. Last two segments of antennæ not noticeably elongate and slender and together about one-half as long as segment 6.
         c. Ring vein and at least a part of fore vein conspicuous; color of body orange-yellow.
            d. Wings shaded brown; fore part of longitudinal vein alone conspicuous.
            (40) *Euthrips parvus*, new species.
            d′. Wings not shaded brown; both longitudinal veins present, with three or four scattered spines on each, one of which stands at the abrupt ending of each vein..........................(41) *Euthrips citri* Moulton.
         c′. Ring vein and longitudinal veins not conspicuous; group of six spines on basal part of wing where anterior vein should be and nine on outer half where posterior vein should be; color of body and wings clear white, outer half of antennæ dark brown...(42) *Euthrips albus*, new species.
   a′. Head about as long as wide; general color brown, thorax sometimes orange-brown.
      b. Basal segment of antennæ concolorous with head and with segment 2; wings brown, with an irregular, somewhat triangular transparent area near base; two long prominent spines between posterior ocelli; without prominent spines along posterior margin of prothorax; legs brown, concolorous with body, except tarsi, which are lighter.
      (43) *Euthrips pyri* Daniel.
      b′. Basal segment of antennæ lighter colored than head and segment 2; wings uniform light brownish-gray, without whitish area near base.
      (44) *Euthrips ehrhornii* Moulton.
2. With spines on fore angle of prothorax; longitudinal veins set regularly with spines.

a. Fore tibiæ armed at end with tooth. Females dark brown; wings brown, with whitened area near base; antennæ concolorous with head, except segment 3, which is light yellow.
(45) *Euthrips ulicis californicus* Moulton.

a′. Fore tibiæ not armed with tooth.

b. Postocular spines wanting; row of spines along anterior margin of prothorax either wanting or at least not conspicuous, except often the third from the outer margin.

c. Antennæ uniformly brown to dark brown, concolorous with body; wings light brown, veins prominent; spines brown, twenty-three on fore vein, sixteen on hind vein, short and comparatively stout; white longitudinal area near base of wing. .(46) *Euthrips minutus* Moulton.

c′. Antennæ with segment 3 yellowish, 4 and 5 light gray-brown, yellowish at base; wings gray-brown, veins not prominent, spines on wings normally long and stout, fourteen on fore vein, ten on hind vein. (Wings may be reduced to pads)........(47) *Euthrips fuscus* Hinds.

b′. Postocular spines conspicuous.

c. General color uniformly brown to dark brown, no shading of orange; antennæ with segments 3, 4, and 5 light brown to yellow and shaded.

d. Uniformly dark brown; fore wings shaded dark brown, with a large whitened area extending across wing near base; spines on wings all dark brown......................(48) *Euthrips insularis* Franklin.

d′. Color yellowish brown; fore wings uniformly shaded with gray.
(49) *Euthrips nervosus* Uzel.

c′. General color whitish to yellow or yellowish to brown, no shading or orange.

d. Second segment of antennæ with a double spine-bearing tubercle; vertex of head depressed; anterior ocellus directed forward.

e. Color uniformly yellow; surface of body without reticulation.
(50) *Euthrips cephalicus* Crawford.

e′. Color uniformly brown; surface of body reticulated.
(51) *Euthrips cephalicus reticulatus* Crawford.

d′. Second segment of antennæ without double spine-bearing tubercle; vertex of head not depressed; anterior ocellus directed upward; color yellowish, shaded with dusky brown.
(52) *Euthrips helianthi* new species.

c″. General color light yellow to yellowish brown; thorax or other parts decidedly tinted with orange.

d. Head pale lemon-yellow to light yellowish brown; thorax orange-yellow; abdomen brownish yellow to brown; segment 1 of antenna whitish to light brown; segment 2 dark brown.
(53) *Euthrips occidentalis* Pergande.

d′. General color brownish yellow, not uniform; thorax orange-yellow; segment 1 of antenna pale yellow, 2 light brown, base sometimes yellowish................................(54) *Euthrips tritici* Fitch.

d″. General color brown to dark brown; thorax orange-brown.
(55) *Euthrips tritici californicus*, new variety.

(19) Genus Anaphothrips Uzel.

1. Without spines on posterior angles of prothorax; cheeks straight; surface of abdomen not faintly cross-striated; crescents of ocelli bright orange-yellow........................(56) *Anaphothrips striatus* Osborn.
2. With one stout spine on posterior angle of prothorax; cheeks arched; surface of abdomen distinctly cross-striated; crescents of ocelli light brown.

a. Head about as long as wide; wings shaded gray-brown; segments 5, 6, 7, and 8 of abdomen without comblike arrangement of spines along posterior margin; color uniformly yellow to gray-brown.
(57) *Anaphothrips hesperus* new species.

a'. Head noticeably wider than long; wings transparent; segments 5, 6, 7, and 8 of abdomen with conspicuous comblike arrangement of spines; color of head and prothorax yellowish or orange-yellow, abdomen brown.
(58) *Anaphothrips tricolor* new species.

(21) Genus Heterothrips Hood.

1. Prothorax twice as long as head; antennæ with apparently nine segments.
   a. Antennæ without circles of distal sensoria on segment 4; segment 3 light yellow, palest at base; segment 4 brownish, palest toward base; articulation of segments brown, not clear. Wings brown, paler at base. Anterior femora shading to yellow at apex, fore tibiæ yellow, shaded with brown laterally; tarsi yellow.........(60) *Heterothrips salicis* Shull.
   a'. Antennæ without distal circles on segment 4; segments 1 and 2 slightly lighter than body, shaded laterally with black; segment 3 light yellow, with a narrow subbasal white band; distal one-third clouded with brown; segments 4 to 9 uniform light blackish-brown except band of sensoria on segment 4. Wings blackish brown, with a broad white band near base. Legs concolorous with body, except tarsi and distal part of fore tibiæ, which are yellow.
   (61) *Heterothrips arisæmæ* Hood.
2. Prothorax less than twice as long as head; antennæ with apparently 10 segments; circles of sense areas on segments 4 and 5 (corresponding to segments 3 and 4 of other species of *Heterothrips*); segments 3 and 4 (corresponding to segment 3 of other species) light yellow; all others dark brown. Wings light brown, basal one-sixth clear.
   (62) *Heterothrips decacornis* Crawford.

(24) Genus Anthothrips Uzel.

1. Postocular spines wanting; antennæ almost uniformly brown, except segment 3 and base of 4, which are light brown....(65) *Anthothrips niger* Osborn.
2. Postocular spines well developed.
   a. Segments 3 and 6 of antennæ, eyes, fore tibiæ, all tarsi, and other lighter parts of body shaded with orange-yellow... (66) *Anthothrips verbasci* Osborn.
   a'. Intermediate segments of antennæ and other light parts of body light brown.
   (67) *Anthothrips variabilis* Crawford.

(26) Genus Eurythrips Hinds.

1. Width of abdomen about one and two-thirds times that of prothorax; antennæ twice as long as head..........(69) *Eurythrips ampliventralis* Hinds.
2. Width of abdomen about one and one-fourth times that of prothorax; antennæ two and one-half times as long as head.(70) *Eurythrips osborni* Hinds.

(28) Genus Trichothrips Uzel.

1. Prominent spines on body with blunt or dilated tips; most forms very dark brown or nearly black (except *T. angusticeps*), usually with short wings (except *T. longitubus*).
   a. Each fore tarsus armed with a tooth; antennæ about one and two-thirds times as long as head; total body length about 1.4 to 1.7 mm.

b. Postocular spines very short and not conspicuous.

c. Color brown, with conspicuous red pigment blotches; mouth cone pointed and reaching beyond posterior margin of prosternum; segments 1 and 2 of antennæ brown, unicolorous with body. (72) *Trichothrips dens* Moulton.

b′. Postocular spines prominent.

c. Postocular spines acute; color of body black; mouth cone blunt, short, reaching but slightly past middle of prosternum; segments 1 and 2 of antennæ black, segment 2 shading to lighter. (73) *Trichothrips brevicuralis* Shull.

c′. Postocular spines prominent and nobbed at ends.

d. Color of body brownish yellow, shaded with brownish black, with maroon-colored hypodermal pigmentation; mouth cone considerably surpassing base of prosternum; segments 1 and 2 of antennæ paler than body color..................(74) *Trichothrips angusticeps* Hood.

d′. Color of body brown to deep brown, with maroon-colored pigmentation; mouth cone not surpassing base of prosternum; segments 1 and 2 unicolorous with body..........(75) *Trichothrips ruber* new species.

a′. Fore tarsi not armed; body length about 1.8 mm.; antennæ about twice as long as head.

b. Wings fully developed; tibiæ, tarsi, and intermediate segments of antennæ bright lemon-yellow; prothorax two-thirds as long as head; tube fully as long as head.............(76) *Trichothrips longitubus* Hood.

b′. Wings short; antennal segments 1 to 3 yellowish-brown, segments 4 to 8 black; prothorax about as long as head; tube slightly shorter than head..................................(77) *Trichothrips buffæ* Hood.

2. Prominent spines on body acute; most forms yellow-brown (except *T. ilex* which may be almost black); antennæ about twice as long as head; all rather large individuals, about 1.7 mm. or more in length, and with wings usually fully developed (except *T. smithii*, which is without wings and very small, about 1 mm. in length).

a. Individuals small and without ocelli or wings....(78) *Trichothrips smithi* Hood.

a′. Individuals large; wings usually fully developed (they may be rudimentary in *T. americanus.*)

b. Each fore tarsus armed with a small tooth.

c. Small stout spines on head borne upon small warts; tube fully as long as head. (79) *Trichothrips beachi* Hinds.

c′. Spines on head not borne on small warts; tube shorter than head.

d. Antennæ one and three-fourths times as long as head; tube two-thirds as long as head; total length about 2 mm.; fore tarsus with a short, stout tooth; wings clear white, except a slightly clouded band at one-third the wing's length........(80) *Trichothrips ambitus* Hinds.

d′. Antennæ twice as long as head; tube three-fourths as long as head; total body length about 1.7 mm.; fore tarsi with a very small tooth; wings clear white...............(81) *Trichothrips femoralis* Moulton.

d″. Antennæ slightly more than twice as long as head; tube slightly shorter than head; total body length about 1.7 mm.; fore tarsi with a small acute tooth; wings light gray-brown, spotted with darker. (82) *Trichothrips americanus* Hood.

b′. All tarsi armed each with a small tooth.

c. Color very dark brown, almost black; all tarsi, tips of fore tibiæ, and segments 3 and 4 of antennæ shading to yellow; sides of head slightly arched.............................(83) *Trichothrips ilex* Moulton.

c'. General color similar to that of *T. ilex*; all tarsi gray-brown to brown; antennæ brown, with base of segment 3 yellow.
(84) *Trichothrips ilex dumosa* Moulton.

c''. Color brown to light brown; tarsi light brown; antennæ concolorous with body, except segment 2 and base and top of 3, which are yellowish; sides of head nearly parallel......(85) *Trichothrips tridentatus* Shull.

(30) Genus Acanthothrips Uzel.

1. Postocular spines wanting; back of head with spine-bearing tubercles; antennæ hardly twice as long as head; body without latero-dorsal white stripes.

a. General color yellowish brown; antennæ, legs, and segments 8 and 9 of abdomen banded with nearly transparent or yellowish white; tube bearing a circlet of eight very long hairs.
(87) *Acanthothrips magnafemoralis* Hinds.

a'. General color dark brown, without white bands and without long hairs at end of tube.

b. A distinct white fleck, by reflected light, on dorsal anterior corners of all abdominal segments except the two basal and the two apical.
(88) *Acanthothrips nodicornis* Reuter.

b'. Without whitish markings................(89) *Acanthothrips doanei* Moulton.

2. Postocular spines long and pointed; back of head without spine-bearing tubercles; antennæ about one and one-fourth times as long as head; body with latero-dorsal white stripes extending from posterior margin of eyes to base of eighth abdominal segment.
(90) *Acanthothrips albivittatus* Hood.

(31) Genus Cephalothrips Uzel.

1. General color yellowish brown; antennæ yellow, shaded with brown; all femora and middle and hind tibiæ brown; all tarsi and fore tibiæ (except at base outside) pale yellow; body length 1.48 mm. (1.40 mm. to 1.56 mm.)..........................(91) *Cephalothrips yuccæ* Hinds.
2. General color dark brown; antennæ dark brown, except segment 3, which is yellowish brown at tip; all femora and bases of all tibiæ brown; tips of all tibiæ and all tarsi yellow; body length 1.16 mm. (1.86 mm. in winged forms when bodies are distended).
(92) *Cephalothrips errans* new species.

(34) Genus Cryptothrips Uzel.

1. Color brown to blackish brown, with conspicuous purplish pigmentation; segments 1 and 2 of antennæ concolorous with head, 3 and base of 4 yellow, others shading to brown toward tip; postocular spines not long and prominent...........(93) *Cryptothrips californicus* Daniel.
2. Color uniformly coal-black, except tarsi, which are blackish brown.

a. Antennæ uniformly black; body length about 2.22 mm.; two pairs of prominent postocular spines..........(96) *Cryptothrips carbonarius* Hood.

a'. General color of antennæ black, segment 2 paler at apex, segment 3 with two transverse brownish-yellow bands, one at base and the other in the middle; body length about 2.7 mm.; without prominent postocular spines.........................(97) *Cryptothrips rectangularis* Hood.

(37) Phlœothrips Haliday.

1. Postocular spines long and conspicuous.
   a. General color dark brown, with tibiæ and tarsi bright yellow; cheeks nearly straight; antennæ one and three-fourths times as long as head. (100) *Phlœothrips uzeli* Hinds.
   a′. General color yellowish brown, with considerable irregular red hypodermal pigmentation; legs grayish brown; cheeks slightly arched; antennæ twice as long as head...........(101) *Phlœothrips pergandei* Hinds.
   a″. General color brown; fore tibiæ and all tarsi light brown; cheeks strongly arched; antennæ one and one-half times as long as head. (102) *Phlœothrips raptor* Crawford.
2. Postocular spines wanting; general color dark mahogany brown, with many smaller white pigment markings along head, thorax, and abdomen, and on legs...........................(103) *Phlœothrips maculatus* Hood.

(38) Genus Liothrips Uzel.

1. Head about one and three-tenths or less times as long as wide.
   a. Fore wings brownish at extreme base; head about one and fifteen one-hundredths times as long as wide; marginal abdominal bristles yellowish; tube eight-tenths as long as head...........(104) *Liothrips ocellatus* Hood.
   a′. Fore wings nearly black in basal half; head about one and three-tenths times as long as wide; marginal abdominal spines nearly black; tube six-tenths as long as head........(105) *Liothrips umbripennis* Hood.
   a″. Fore wings brownish in basal half. (106) *Liothrips umbripennis mexicanus* Crawford.
2. Head about one and five-tenths times as long as wide.
   a. Antennæ lemon-yellow; spines on prothorax large and prominent; mid laterals present, fully as long as anterior marginals; tube two-thirds as long as head.........................(107) *Liothrips citricornis* Hood.
   a′. Antennal segments 1 and 2 concolorous with head; spines on prothorax not prominent; mid laterals wanting.
      b. Antennæ with segments 1 and 2 almost black, 3 light yellow to light brown, others brown; tube one-half as long as head.
         c. Head converging anteriorly...........(108) *Liothrips fasciculatus* Crawford.
         c′. Head distinctly converging posteriorly. (109) *Liothrips fasciculata stenoceps* Crawford.
      b′. Antennæ one and two-thirds times as long as head; segments 1 and 2 dark brown, concolorous with body, others yellow. (110) *Liothrips bakeri* Crawford.
      b″. Antennæ one and one-fourth times as long as head; segment 1 and base of 2 concolorous with body, apical half of 2 and of 5 and 6 to 8 light brown; 3, 4, and basal half of 5 yellow; tube one-half as long as head..........................(111) *Liothrips mcconnelli* Crawford.

(39) Genus Idolothrips Haliday.

1. Wings wanting or reduced to pads; all tibiæ and tarsi bright yellow; tibiæ often clouded with brown at base.........(112) *Idolothrips flavipes* Hood.
2. Wings fully developed but short.
   a. Average length 5.28 mm.; color deep black; entire body surface, including femora and tibiæ, finely reticulated; tarsi yellow. (113) *Idolothrips angusticeps* Crawford.
   a′. Average length about 4 mm.; color coal-black, without markings; tarsi dark brown.......................(114) *Idolothrips coniferarum* Pergande.

a''. Average length about 3.3 mm.; color black, antennal segments 3 to 5 yellow at bases; tarsi blackish brown........(115) *Idolothrips armatus* Hood.

3. Wings large, powerful, brown at base; median vein brown, prominent, and extending to middle of wing; fore wings double fringed behind for about 40 hairs.......................(116) *Idolothrips tuberculatus* Hood.

(40) Genus MEGALOTHRIPS Heeger.

1. Color dark brown, with orange or red pigment; all tibiæ and tarsi shaded with yellowish; bases of antennal segments 3–6 lemon-yellow.
(117) *Megalothrips hesperus* Moulton.
2. Color nearly uniformly black, excepting tarsi, which are blackish brown.
(118) *Megalothrips spinosus* Hood.

CATALOGUE OF NORTH AMERICAN THYSANOPTERA.

1. Genus OROTHRIPS Moulton, 1907.

(1) **Orothrips kelloggii** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 45, figs., 1907.

Habitat: Santa Cruz Mountains, central California.

Taken in blossoms of manzanita (*Manzanita manzanita*) and madroña (*Arbutus menziesii*) in March and April.

(2) **Orothrips kelloggii yosemitii** new variety. (For description see p. 34.)

Habitat: Yosemite Valley, Cal.

Taken in blossoms of wild lilac (*Ceanothus* sp.?) at an altitude of 6,000 feet, in June and July.

2. Genus ERYTHROTHRIPS new genus.

(Described on page 34.)

(3) **Erythrothrips arizonæ** new species. (For description see p. 35.)

Habitat: Phoenix, Ariz.; Oroville, Cal.

Taken in orange and olive blossoms in Arizona, by Mr. J. Eliot Coit, and on *Rhamnus purshiana* at Oroville, Cal., by Mr. B. B. Whitney.

3. Genus ANKOTHRIPS Crawford.

(4) **Ankothrips robustus** Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 100, figs., 1909.

Habitat: Claremont and Los Gatos, Cal.

Taken on California laurel (*Umbellularia californica*) and California lilac (*Ceanothus* sp.?) at an altitude of 5,000 feet.

4. Genus ÆOLOTHRIPS Haliday.

(5) **Æolothrips bicolor** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 130, figs., 1902.

Habitat: Amherst, Mass.

Food plants: Brunella vulgaris, Panicum sanguinale, bindweed, and various grasses in mowings.

(6) **Æolothrips vespiformis** Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 109, figs., 1909.

Habitat: Managua, Nicaragua.

Food plant not known.

(7) **Æolothrips fasciatus** Linnaeus, 1758. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 127, figs., 1902.

Habitat: England; Vienna, Austria; Finland; Germany. In the United States—Connecticut; Massachusetts; New York; Indiana; Iowa; Michigan; New Mexico; San Jose and Chico, Cal.; Corvallis, Oreg.

Food plants: As listed by Hinds—alfalfa, buckwheat, celery, clover, Compositæ, oats, onion, tansy, wheat, various grasses and weeds. In California in blossoms of California buckeye (*Æsculus californica*) and monkey flower (*Diplacus glutinosus*), and on sugar beet foliage. In Oregon on *Chrysanthemum leucanthemum*, specimens collected by J. C. Bridwell. Taken in California from April to July.

(8) **Æolothrips kuwanaii** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 47, figs., 1907.

Habitat: Santa Cruz Mountains, California.

Food plants: California lilac (*Ceanothus thyrsiflorus*), elderberry (*Sambucus glauca*), chamisal (*Adenostoma fasciculatum*), purple lupine (*Lupinus* sp.?), April to July.

NOTE.—Specimens of *Æolothrips kuwanaii* collected from the blossoms of *Ceanothus thyrsiflorus*, at La Honda, Cal., have a variation in the shape of the dark longitudinal band on the wing. This band is widened at its anterior end and often extends across the entire wing. Segment 3 of the antenna is also often brown instead of lemon-yellow, shading to light brown at the tip.

Æolothrips kuwanaii, variety *robustus* Moulton (Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 48) is withdrawn and included in the species.

(9) **Æolothrips longiceps** Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 101, figs., 1909.

Habitat: Claremont, Cal.

Food plant: Artemisia.

NOTE.—Described from one male.

5. Genus PARTHENOTHRIPS Uzel.

(10) **Parthenothrips dracænæ** Heeger, 1854. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 176, figs., 1902.

Habitat: Vienna; Finland; St. Petersburg; Germany; Bohemia. United States—Washington, D. C.; Amherst, Mass.; San Francisco and Sacramento, Cal.

Food plants: After Hinds—*Dracæna, Ficus elastica, Kentia belmoreana.* In California on *Aralia* (?) and sago palm (*Cycas revoluta*).

6. Genus BALIOTHRIPS Haliday.

(11) **Baliothrips basalis** Shull, Ent. News, vol. 20, p. 224, figs., May, 1909.

Habitat: Huron County, Mich.

On leaves of millet grass (*Milium effusum*) in August.

7. Genus THRIPS Linnæus.

(12) **Thrips madronii** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 57, figs., 1907.

Habitat: California; Oregon.

Food plants: California lilac (*Ceanothus thyrsiflorus*), mountain laurel (*Umbellularia californica*), *Solanum umbelliferum, Arbutus menziesii*, western azalea (*Rhododendron occidentale*), lemon blossoms; taken from April to July.

(13) **Thrips magnus** new species. (For description see p. 36, Pl. II, figs. 10, 11.)
Habitat: Visalia, Cal.
On monkey-flower (*Mimulus* sp.?). Specimens collected by Mr. P. R. Jones.

(14) **Thrips tabaci** Lindeman, 1888. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 179, figs., 1902. (The onion thrips.)
Habitat: After Hinds—Russia; England; Italy; Bohemia; Heligoland; Bermuda. In United States, generally distributed from Maine to California.
Food plants: Almost all wild and cultivated flowers, grasses, fruit blossoms, and truck crops.

(15) **Thrips abdominalis** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, page 157, March, 1910.
Habitat: Guadalajara, Mexico.
Taken in various Compositæ, *Solanum*, *Daucus* sp.?, and others.

(16) **Thrips bremnerii** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 59, figs., 1907.
Habitat: San Jose, Cal.
From inside of ripe figs, July.

(17) **Thrips perplexus** Beach, 1895. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 184, figs., 1902.
Habitat: Ames, Iowa; Amherst, Mass.
Food plants: After Hinds—*Cyperus* sp.?, corn, various grasses.

8. Genus HELIOTHRIPS Haliday.

(18) **Heliothrips femoralis** Reuter, 1891. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 172, figs., 1902.
Habitat: Helsingfors, Finland. United States—District of Columbia; Amherst, Mass.
Food plants: As listed by Hinds—*Amarillis* sp., *Aralia*, *Arum*, *Cestrum nocturnum*, *Chrysanthemum*, *Crinum*, cucumber, *Dracæna* sp., *Eucharis grandiflora*, *Ficus elastica*, *F. grandiflora*, *Gardenia*, *Gossypium*, *Hydrangea*, *Mina lobata*, moonflower, *Pandanus*, *Phœnix*, *Richardia æthiopica*, tomato, *Vitis*.

(19) **Heliothrips hæmorrhoidalis** Bouché, 1833. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 168, figs., 1902. Ref.: Russell, Bul. 64, Pt. VI, Bur. Ent., U. S. Dept. Agr.; Proc. U. S. Nat. Mus., vol. 33, p. 719, 1908. (The greenhouse thrips.)
Habitat: England; Germany; Vienna; Finland. United States—District of Columbia; Iowa; Massachusetts; Michigan; California. Mexico; St. Vincent and Barbados Islands; Hongkong, China.
Food plants: *Aspidium*, azaleas, croton, dahlias, ferns, liliaceous plants, *Pellea hastata*, phlox, pinks, verbenas, vines, laurestinas.
Note.—This insect is usually a hothouse pest, but lives out of doors on such plants as laurestinas and azaleas in the milder California climate. Mr. Franklin records it from the Barbados and St. Vincent Islands, in the West Indies group, where it feeds on cacao, kola, and date palms; and numerous shipments of mangoes from Mazatlan, Mexico, which arrive in the port of San Francisco, indicate that this insect is a serious pest on these fruits.

(20) **Heliothrips fasciatus** Pergande, 1895. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 174, 1902.
Caliothrips woodworthi, Ent. News, vol. 15, p. 297, November, 1904.
Habitat: Widespread throughout California.

Food plants: Oranges, wild vetch, burr clover; foliage of beets, radishes, pea vines, and lettuce; pear blossoms and foliage.

NOTE.—This insect is a serious pest on oranges, alfalfa, pear trees, and various garden crops.

(21) **Heliothrips fasciapennis** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 171, figs., 1902.

Habitat: Amherst, Mass.

Food plants: Grasses.

9. Genus ECHINOTHRIPS new genus.

(Described on page 37.)

(22) **Echinothrips mexicanus** new species. (For description see p. 37.)

Habitat: Acapulco, Mexico.

Specimens taken from a small potted plant on shipboard in San Francisco, Cal.

10. Genus DICTOTHRIPS Uzel.

(23) **Dictothrips reticulatus** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 155, figs., 1910.

Habitat: Guadalajara, Mexico.

"Taken on blossoms of native acacia-like tree" (Crawford).

11. Genus SERICOTHRIPS Haliday, 1836.

(24) **Sericothrips variabilis** Beach, 1895. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 143, figs., 1902.

Habitat: Iowa; Massachusetts; Yosemite Valley and San Jose, Cal.

Food plants: Cucumber, grass, smartweed; in blossoms of buckthorn and mountain lilac (*Ceanothus* sp.?) in Yosemite Valley in California at an altitude of 5,000 ft. The California specimens should probably rank as a distinct new variety of this species.

(25) **Sericothrips pulchellus** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 363, 1908.

Habitat: Muncie, Ill.

Food plants: Hop-tree (*Ptelea trifoliata*).

NOTE.—Mr. Hood notes that "this species is very close to *Sericothrips variabilis* Beach, but the coloration is distinctive. In living specimens examined under a hand lens, the head and prothorax are velvety black and without luster, due no doubt to the microscopic reticulation."

(26) **Sericothrips cingulatus** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 141, figs., 1902.

Habitat: Amherst, Mass.; Nebraska City, Nebr.

Food plants: Various grasses. The writer has collected specimens of this insect from grass at Nebraska City, Nebr., which have fully developed wings. These are broader and clear white in the basal fourth and slender and uniform gray-brown in the outer three-fourths.

(27) **Sericothrips apteris** Daniel, Ent. News, vol. 15, p. 295, November, 1904. Redescribed by Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 49, 1907.

Habitat: Counties about San Francisco Bay, California.

Food plants: Various grasses and weeds.

NOTE.—Many specimens of this thrips collected recently indicate a close relationship to *S. stanfordii* Moulton. Some specimens are almost uniformly brown.

(28) **Sericothrips reticulatus** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 50, figs., 1907.
Habitat: Santa Clara Valley, Cal.
Food plant: Grass and weeds.

(29) **Sericothrips stanfordii** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 51, figs., 1907.
Habitat: Stanford University, California.
Food plants: Grasses and various weeds.

12. Genus RAPHIDOTHRIPS Uzel.

(30) **Raphidothrips fuscipennis** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26. p. 159, figs., 1902.
Habitat: Massachusetts.
Food plants: Grasses.

13. Genus LIMOTHRIPS Haliday.

(31) **Limothrips cerealium** Haliday, 1852, Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 139, figs., 1902. (*Limothrips avenæ* Hinds.)
Habitat: England; Germany. United States—Pennsylvania; Massachusetts.
Food plants: Oats, *Festuca pratensis.*

14. Genus CHIROTHRIPS Haliday.

(32) **Chirothrips manicatus** Haliday, 1836. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 134, figs., 1902.
Habitat: England; Germany; Finland; Russia; Bohemia. United States—Manchester, Iowa; Amherst, Mass.; Nebraska City, Nebr.; Corvallis, Oreg.
Food plants: Flowers of various grasses and cereals, clover, wild carrots.

(33) **Chirothrips mexicanus** Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 114, figs., 1909.
Habitat: Guadalajara, Mexico.
Food plants: Tobacco flowers (*Nicotiana tabacum*).

(34) **Chirothrips obesus** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 137, figs., 1902.
Habitat: Amherst, Mass.
Food plants: *Festuca ovina, Poa pratensis.*

(35) **Chirothrips crassus** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 136, figs., 1902.
Habitat: Amherst, Mass.
Food plants: "Old witch grass," *Panicum capillare.*

15. Genus APTINOTHRIPS Haliday.

(36) **Aptinothrips rufus** Gmelin, 1788, and variety *connaticornis* Uzel, 1895. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 166, figs., 1902.
Habitat: England; Russia; Sweden; Bohemia; Germany; Heligoland; Finland. United States—Amherst, Mass.; Nebraska City, Nebr.; San Jose and Oakland, Cal.
Food plants: Various grasses and in turf.

16. Genus SCOLOTHRIPS Hinds.

(37) **Scolothrips sexmaculatus** Pergande. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 157, figs., 1902.

Habitat: Missouri; Ames, Iowa; Lincoln, Nebr.; Baraboo, Wis.; Honolulu, Oahu, Hawaiian Islands.

Taken on beans, blackberry, elm, and hop (Beach).

NOTE.—"Found on many plants infested with red spiders, on which it has repeatedly been observed to feed" (Pergande). "Feeding on mites in fold of cottonwood leaf" (Bruner). Specimens of thrips sent by Mr. David Fullaway from the Hawaiian Islands are larger and darker in color than as given in Hinds's description and all of the dark spots on the wings are enlarged to bands.

17. Genus SCIRTOTHRIPS Shull.

(38) **Scirtothrips ruthveni** Shull, Ent. News., vol. 20, p. 222, figs., May, 1909.

Habitat: Huron County, Mich.

Food plants: Terminal clusters of dogwood (*Cornus stolonifera*).

18. Genus EUTHRIPS Targioni-Tozzetti.

(39) **Euthrips orchidii** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., figs., 1907.

Habitat: Fruitvale, Alameda County, Cal.; Brussels, Belgium (Bagnall).

Taken in flowers of orchids in greenhouse in California and on *Chamædorea fragrans*, *Ficaria*, and palms in Belgium, by Mr. Bagnall.

(40) **Euthrips parvus** new species. (For description see p. 38, Pl. IV, figs. 23–25.)

Habitat: San Francisco, Cal.

Food plants: Various hothouse plants.

(41) **Euthrips citri** Moulton, Tech. Ser. 12, Pt. VII, Bur. Ent., U. S. Dept. Agr., ills., 1909. (The orange thrips.)

Habitat: Orange districts on eastern foothills of San Joaquin Valley, southern California; Phoenix, Ariz.

Taken from citrus trees and thistle (?) in San Joaquin district; from orange in southern California; from nightshade (by Mr. P. R. Jones) in Phoenix, Ariz.

NOTE.—This is a very destructive pest in some of the orange districts of California, the injury being done in the retarding and deforming of the new growth of foliage and in the marking (scabbing) of the oranges.

(42) **Euthrips albus** new species. (For description see p. 39, Pl. III, figs. 20–22.)

Habitat: Red Bluff, Cal.

Taken on peach-tree foliage.

(43) **Euthrips pyri** Daniel, Ent. News, vol. 15, p. 294, November, 1904. Redescribed by Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 53, figs., 1907; Bul. 68, Pt. I, Bur. Ent., U. S. Dept. Agr., figs., ills., 1907; Bul. 80, Pt. IV, Bur. Ent., U. S. Dept. Agr., figs., ills., 1909. (The pear thrips.)

Habitat: Counties around San Francisco Bay, central California, north to Sacramento, south to Hollister; Berkhamsted, Hertford County, England.

Food plants: Deciduous fruits, including almond, apple, apricot, cherry, fig, grape, peach, pear, plum, prune, English walnut. Blossoms of wild plum in England.

(44) **Euthrips ehrhornii** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 54, figs., 1907.

Habitat: San Jose and Saratoga, Cal.

Taken on grass and on foliage of prune trees.

(45) **Euthrips ulicis californicus** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 55, figs., 1907.

Habitat: Wrights Station, Santa Cruz Mountains, Cal.

Taken from wild vetch sweepings.

(46) **Euthrips minutus** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 56, figs., 1907; Pomona College, Journ. Ent., vol. 1, no. 4, figs., 1909.

Euthrips minutus setosus Crawford.

Habitat: Santa Clara Valley, Yosemite Valley (altitude 5,000 ft.), Suisun, Newcastle, Loomis, Lindsay, East Highlands, La Honda, Cal.

Food plants: Prune and cherry foliage, pear and cherry blossoms, grass, yarrow, chamisal, buttercups, sunflowers.

NOTE.—This insect is also found to be usually much larger than in the original description. A new typical specimen has: Head, length 0.105 mm., width 0.135 mm.; prothorax, length 0.12 mm., width 0.18 mm.; mesothorax, width 0.240 mm.; abdomen, width 0.270 mm., and total body length 1.30 mm.

Antennæ: 1, 15μ; 2, 33μ; 3, 37μ; 4, 39μ; 5, 36μ; 6, 45μ; 7, 9μ; 8, 15μ; total 0.23 mm.

The back of the head is cross-striate, the ocelli have orange-brown crescents, and the fore and middle tibiæ are light brown. The costa has twenty-six to twenty-eight spines, the fore vein twenty to twenty-one spines, and the hind vein fifteen to sixteen spines.

(47) **Euthrips fuscus** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 154, figs., 1902. *Euthrips nicotianæ* Hinds, Proc. Biol. Soc. Wash., vol. 18, p. 197, 1905; Cir. 68, Bur. Ent., U. S. Dept. Agr., figs., 1906; Bul. 65, Bur. Ent., U. S. Dept. Agr., figs., ills., 1907. (The tobacco thrips.)

Habitat: Massachusetts; Florida; Georgia; Texas.

Food plants: Grass (?), tobacco.

(48) **Euthrips insularis** Franklin, Proc. U. S. Nat. Mus., vol. 33, p. 715, figs., 1908. *Euthrips insularis reticulata* Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 116, 1909.

Habitat: Guadalajara, Mexico; Barbadoes and West Indies Islands.

Food plants: Lupinus, Convolvulus, Compositæ, *Rhamnus* in Mexico at an elevation of from 1,000 to 2,500 ft.; black willow, legumes, yams, beans, roses, grass, potato, papaw, pepper, tobacco, white wood, woolly pyrol, *Convolvulus*, ground nut, arrowroot, flamboyant in the Barbados and West Indies Islands.

(49) **Euthrips nervosus** Uzel, 1895. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 155, figs., 1902.

Habitat: Bohemia; Ames, Iowa; Amherst, Mass.

Taken on corn, various grasses, and spring flowers.

(50) **Euthrips cephalicus** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 153, March, 1910.

Habitat: Guadalajara, Mexico.

Food plants: "Several compositæ, a small native acacia-like tree, a *Solanum*, and several other plants" (Crawford).

(51) **Euthrips cephalicus reticulatus** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 155, March, 1910.

Habitat: Guadalajara, Mexico.

Taken on certain Rosaceæ and Labiatæ.

(52) **Euthrips helianthi** new species. (For description see p. 40, Pl. IV, figs. 26–29.)

Habitat: Visalia, Cal.

Taken in wild sunflower blossoms.

(53) **Euthrips occidentalis** Pergande, 1895. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 152, 1902.

Habitat: California.

Food plants: Blossoms and foliage of numerous trees and weeds.

(54) **Euthrips tritici** Fitch, 1855. (For description, life-history notes, and references, see Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 149, 1902.)

Habitat: Generally distributed throughout the United States.

Taken in flowers of almost all wild and cultivated plants.

NOTE.—This is undoubtedly the commonest and the most widely distributed of all American species of thrips. The variation within the species will probably lead some later writer to divide the group into several distinct varieties. The insect varies from very light colored, almost white individuals (which for the most part are collected in white or light colored flowers) to very dark brown, and from individuals with no shading of orange to those colored to a deep red-orange. The writer is here erecting one new variety, to include the very dark brown specimens in this group. These can not possibly be included within the species as Mr. Hinds's description now stands. The variety is called *Euthrips tritici californicus*.

(55) **Euthrips tritici californicus** new variety.

Habitat: California, Oregon, and Washington.

Taken in company with *Euthrips tritici*, in the blossoms of almost all wild and cultivated plants. The variety is distinguished from the species by the following characters: General color uniformly dark brown, thorax orange-brown; segment 1 of antennæ brown, unicolorous with head, segment 2 uniformly darker brown.

19. Genus ANAPHOTHRIPS Uzel.

(56) **Anaphothrips striatus** Osborn, 1883. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 160, figs., 1902. Ref.: Ent. News, vol. 20, p. 224, May, 1909 (males found).

Habitat: Illinois; Iowa; Maine; Massachusetts.; New York; Ohio; Ontario; Nebraska; California.

Food plants: Poa pratensis, Phleum pratense, and other grasses; in California on leaves and ears of corn, and on alfalfa.

(57) **Anaphothrips zeæ** new species. (For description see p. 41, Pl. IV, figs. 31–34.)

Habitat: Visalia, San Jose, and Red Bluff, Cal.

Taken on leaves and ears of corn, on grasses, and on foliage of orange.

(58) **Anaphothrips tricolor** new species. (For description see p. 41.)

Habitat: Tulare County, Cal.

Taken on goldenrod and on orange nursery stock by Mr. P. R. Jones.

20. Genus PSEUDOTHRIPS Hinds.

(59) **Pseudothrips inequalis** Beach, 1896. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 146, figs., 1902.

Habitat: Ames, Iowa.

Food plant: Aster.

21. Genus HETEROTHRIPS Hood.

(60) **Heterothrips salicis** Shull, Ent. News, vol. 20, p. 220, figs., May, 1909.

Habitat: Huron County, Mich.

Taken on the outside of catkins of a willow (*Salix fluviatilis*).

(61) **Heterothrips arisæmæ** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 362, August, 1900.

Habitat: Urbana, Ill.

Taken in flowers of jack-in-the-pulpit (*Arisæma triphyllum*).

(62) **Heterothrips decacornis** Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 110, 1909.

Habitat: Guadalajara, Mexico.

Taken on a low native tree with small yellow flowers, common in the barrancas near Guadalajara; also on a shrub belonging to the family Malpighiaceæ.

22. Genus ALLOTHRIPS Hood, 1908.

(63) **Allothrips megacephalus** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 372, figs. 1908. Ref.: Ent. News, vol. 20, p. 228, May, 1909 (males found).

Habitat: Urbana and Springfield, Ill.

Taken from under bark of various trees in winter.

23. Genus RHAPTOTHRIPS Crawford.

(64) **Rhaptothrips peculiaris** Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 116, figs., 1909.

Habitat: Guadalajara, Mexico.

Food plant: "A certain spiny solanaceous plant" (Crawford).

24. Genus ANTHOTHRIPS Uzel.

(65) **Anthothrips niger** Osborn. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 188, figs., 1902.

Habitat: Iowa; Michigan; Massachusetts; Oregon; California.

Food plants: Achillea millefolium, oxeye daisy, red and white clover, various grasses.

(66) **Anthothrips verbasci** Osborn. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 189, figs., 1902.

Habitat: Ames, Iowa; Amherst, Mass.

Food plant: Mullein.

(67) **Anthothrips variabilis** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 166, fig., March, 1910.

Habitat: Santiago de las Vegas, Cuba; Managua, Nicaragua; Guadalajara, Mexico.

Food plants: "Celosa, Dodder and native creeping vine" (Crawford).

25. Genus ALEURODOTHRIPS Franklin.

(68) **Aleurodothrips fasciapennis** Franklin (described as *Cryptothrips fasciapennis*), Proc. U. S. Nat. Mus., vol. 33, p. 727, figs., 1908; as *Aleurodothrips fasciapennis* in Ent. News, vol. 20, p. 228, figs., May, 1909.

Habitat: Newstead, St. Peters, Barbados Islands; Florida.

Taken on flower of La France rose and commonly in Florida feeding on the eggs, larvæ, and pupæ of the citrus white fly (*Aleyrodes citi* R. & H.).

26. Genus EURYTHRIPS Hinds, 1902.

(69) **Eurythrips ampliventralis** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 202, figs., 1902.

Habitat: Amherst, Mass.

"Taken in turf in fall" (Hinds).

(70) **Eurythrips osborni** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 203, figs., 1902.

Habitat: Amherst, Mass.

Food plants: Grasses.

27. Genus LISSOTHRIPS Hood, 1908.

(71) **Lissothrips muscorum** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 265, 1908.
Habitat: Illinois.
Taken in moss.

28. Genus TRICHOTHRIPS Uzel, 1895.

(72) **Trichothrips dens** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 60, figs., 1907.
Habitat: Santa Clara Valley, Cal.
Taken on apricot foliage.

(73) **Trichothrips brevicuralis** Shull, Ent. News, vol. 20, p. 227, figs., May, 1909.
Habitat: Huron County, Mich.
Taken among leaves of pine-cone gall on willow (*Salix fluviatilis*).

(74) **Trichothrips angusticeps** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 367, figs., 1908.
Habitat: St. Joseph and Urbana, Ill.
Taken under bark of rotten stumps.

(75) **Trichothrips ruber** new species. (For description see p. 42.)
Habitat: San Jose, Cal.
Taken in azalea blossoms.

(76) **Trichothrips longitubus** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 368, 1908.
Habitat: Carbondale, Ill.
Taken in sweepings.

(77) **Trichothrips buffæ** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 369, figs., 1908.
Habitat: Decatur, Homer, and Urbana, Ill.
Taken under bark of soft-maple trees.

(78) **Trichothrips smithi** Hood, Ent. News, vol. 20, p. 29, figs., January, 1909,
Habitat: Boskydell, Ill.
Taken on hard maple (*Acer saccharum*).

(79) **Trichothrips beachi** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 192, figs., 1902.
Habitat: Amherst, Mass.
Taken under quince bark.

(80) **Trichothrips ambitus** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 191, figs., 1902.
Habitat: Amherst, Mass.
Food plant: Grass.

(81) **Trichothrips femoralis** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 61, figs., 1907.
Habitat: Newcastle, Cal.
Food plant: Wild mullein.

(82) **Trichothrips americanus** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 366, figs., 1908.
Habitat: Carbondale, Homer, and Urbana, Ill.
Taken under bark on rotten stumps.

(83) **Trichothrips ilex** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 62, figs., 1907.
Habitat: Coast region of California.
Food plant: Christmas berry (*Heteromeles arbutifolia*).

(84) **Trichothrips ilex dumosa** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 63, 1907.
Habitat: Saratoga, Cal.
Taken on scrub oak (*Quercus dumosa*).

(85) **Trichothrips tridentatus** Shull, Ent. News, vol. 20, p. 226, figs., May, 1909.
Habitat: Huron County, Mich.
Taken under the scales of the bark of white oak (*Quercus alba*).

29. Genus PLECTOTHRIPS Hood, 1908.

(86) **Plectothrips antennatus** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 370, 1908.
Habitat: Urbana, Ill.
Taken on a window of a woodshed, in June.

30. Genus ACANTHOTHRIPS Uzel, 1895.

(87) **Acanthothrips magnafemoralis** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 199, figs., 1902. Ref.: Psyche, vol. 10, p. 221, October–December, 1903.
Habitat: Miami, Fla.; Amherst, Mass.
Food plant: Under loose bark on a sycamore tree.

(88) **Acanthothrips nodicornis** Reuter, Uzel's Monograph, p. 260, figs., 1895. Ref.: Psyche, vol. 10, p. 222, October–December, 1903.
Habitat: Germany; Finland; Bohemia; Amherst, Mass.
Taken under the bark of a sycamore tree in Massachusetts.

(89) **Acanthothrips doanei** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 64, figs., 1907.
Habitat: Alum Rock Canyon, San Jose, Cal.
Food plant: Grass.

(90) **Acanthothrips albivittatus** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 374, 1908.
Habitat: Bloomington, Ill.
Taken on the trunk of a Carolina poplar.

31. Genus CEPHALOTHRIPS Uzel, 1895.

(91) **Cephalothrips yuccæ** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 194, figs., 1902.
Habitat: Amherst, Mass.; Washington, D. C.
Food plants: *Yucca filamentosa*, goldenrod.

(92) **Cephalothrips errans** new species. (For description see p. 43, Pl. VI, figs. 42–44.)
Habitat: San Jose, Cal.
Food plants: Wild mustard, apricot, and pine foliage. Taken during June and July.

32. Genus MALACOTHRIPS Hinds, 1902.

(93) **Malacothrips zonatus** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 200, figs., 1902.
Habitat: Amherst, Mass.
Taken in turf.

33. Genus NEOTHRIPS Hood, 1908.

(94) **Neothrips corticis** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 372, figs., 1908.
Habitat: Urbana and Hillery, Ill.
Taken under bark in winter.

34. Genus CRYPTOTHRIPS[1] Uzel, 1895.

(95) **Cryptothrips californicus** Daniel, Ent. News, vol. 15, p. 293, November, 1904. Redescribed by Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 66, figs., 1907.
Habitat: California, Oregon, and Washington.
Often taken under the old shells of the brown apricot scale (*Lecanium corni* Bouché (*armeniacum* Craw)) and black scale (*Saissetia oleæ* Bern.).
Taken on foliage of peach, French prune, and Bartlett pear, also on leaves of chamisal (*Adenostoma fasciculatum*) and tanbark oak (*Quercus densiflora*) and other plants.

(96) **Cryptothrips carbonarius** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 376, figs., 1908.
Habitat: Pulaski, Ill.
Taken in sweepings from grass and weeds.

(97) **Cryptothrips rectangularis** Hood, Can. Ent., vol. 40, no. 9, p. 307, figs., 1908.
Habitat: Urbana, Ill., and Harrisburg, Pa.
Taken under dead bark in peach tree in Illinois and "In burrow of lepidopterous or coleopterous larva in dead willow stem."

35. Genus LEPTOTHRIPS Hood, 1909.

(98) **Leptothrips asperus** Hinds, Ent. News, vol. 20, p. 249, June, 1909.
Cryptothrips asperus Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 205, figs., 1902.
Phyllothrips asperus Hood, Can. Ent., vol. 40, no. 9, p. 305, 1908.
Habitat: Amherst, Mass.
Taken on grape.

36. Genus ZYGOTHRIPS Uzel, 1895.

(99) **Zygothrips longiceps** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 364, figs., 1908.
Habitat: Carbondale, Ill.
Taken in a gall on *Solidago*.

37. Genus PHLŒOTHRIPS Haliday, 1836.

(100) **Phlœothrips uzeli** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 196, figs., 1902.
Habitat: Amherst, Mass.
Taken on various grasses and clover and on *Ulmus montana* var. *pendula*.

(101) **Phlœothrips pergandei** Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 197, figs., 1902.
Habitat: Amherst, Mass.
Taken on grass.

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[1] For *Cryptothrips asperus* Hinds, see *Leptothrips asperus*, No. 98.

(102) **Phlœothrips raptor** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 159, March, 1910.
Habitat: Guadalajara, Mex.
Taken in sweeping shrubbery.

(103) **Phlœothrips maculatus** Hood, Ent. News, vol. 20, p. 250, figs., June, 1909.
Habitat: Baldwin, Mich.
Taken under rotting poplar bark.

38. Genus LIOTHRIPS Uzel, 1895.

(104) **Liothrips ocellatus** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 375, 1908. Ref.: Ent. News, vol. 20, p. 249, June, 1909.
Habitat: Hillery, Ill.
Taken in moss.

(105) **Liothrips umbripennis** Hood, Ent. News, vol. 20, p. 30, figs., January, 1909. (Described as *Phyllothrips umbripennis.*)
Habitat: Illinois and Michigan.
Taken on various species of oak.

(106) **Liothrips umbripennis mexicanus** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 161, March, 1910.
Habitat: Guadalajara, Mex.
Taken in oak galls, at an elevation of 10,000 feet.

(107) **Liothrips citricornis** Hood, Can. Ent., vol. 40, no. 9, p. 305, fig., 1908. (Described as *Phyllothrips citricornis.*)
Habitat: Dubois, Duquoin, Odin, and Pulaski, Ill.; Harrisburg and Rockville, Pa.
Food plants: "On hickory leaves," in Illinois and "on wild grape" in Pennsylvania, April 28 to July 16.

(108) **Liothrips fasciculatus** Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 105, figs., 1909. (Described as *Phyllothrips fasciculata.*)
Habitat: Claremont and Suisun, Cal.
Food plant: Wild buckwheat (*Eriogonum fasciculatum*).

(109) **Liothrips fasciculatus stenoceps** Crawford, Pomona College, Journ. Ent., vol. 1, no. 4, p. 108, 1909.
Habitat: Claremont, Cal.
Specimens taken with *Liothrips fasciculatus* on wild buckwheat.

(110) **Liothrips bakeri** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 161, March, 1910.
Habitat: Havana, Cuba.
Taken on "galls on leaves of *Ficus nitida* and flowers of *Ficus religiosa*" (Crawford).

(111) **Liothrips mcconnelli** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 163, March, 1910.
Habitat: Guadalajara, Mex.; Chico and Suisun, Cal.
Taken from "stems and leaves of a certain bignoniaceous shrub, and also from sweepings on other shrubs" (Crawford); prune foliage and apple blossoms in California.

39. Genus IDOLOTHRIPS Haliday, 1852.

(112) **Idolothrips flavipes** Hood, Bul. Ill. State Lab. Nat. Hist., vol. 8, art. 2, p. 377, fig., 1908.
Habitat: Illinois.
Specimens taken among fallen oak leaves.

(113) **Idolothrips angusticeps** Crawford, Pomona College, Journ. Ent., vol. 2, no. 1, p. 168, figs., March, 1910.

Habitat: "Belize; Havana, Cuba; San Marcos and Chivandega, Nicaragua; Guadalajara, Mex." (Crawford).

(114) **Idolothrips coniferarum** Pergande, 1896. Redescribed by Hinds, Mon. Thys. N. Amer., Proc. U. S. Nat. Mus., vol. 26, p. 206, figs., 1902.

Habitat: Washington, D. C.; Amherst, Mass.

Taken on *Pinus inops, Juniperus virginiana,* and *Abies* sp.

(115) **Idolothrips armatus** Hood, Ann. Ent. Soc. Amer., vol. 1, no. 4, p. 285, figs., December, 1908.

Habitat: Carbondale, Havana, Pulaski, and Urbana, Ill.

Taken in galls of *Gnorimoschema gallæsolidaginis* on *Solidago canadensis* in miscellaneous and woodland sweepings; on *Plantago rugelii.*

(116) **Idolothrips tuberculatus** Hood, Ann. Ent. Soc. Amer., vol. 1, no. 4, p. 287, figs., December, 1908.

Habitat: White Heath and Boskydell, Ill.

Taken on white oak.

40. Genus MEGALOTHRIPS Heeger.

(117) **Megalothrips hesperus** Moulton, Tech. Ser. 12, Pt. III, Bur. Ent., U. S. Dept. Agr., p. 65, figs., 1907.

Habitat: Stanford University, California.

Food plant: Not known.

(118) **Megalothrips** (?) **spinosus** Hood, Can. Ent., vol. 40, p. 306, figs., 1908. Ref.: Ent. News, vol. 20, p. 231, May, 1909.

Habitat: Harrisburg, Pa.; St. Anthony Park and St. Paul, Minn.

Taken "in burrows of lepidopterous or coleopterous larvæ in dead willow stem," and "under the bark of dead limb of white birch."

DESCRIPTIONS OF NEW GENERA AND NEW SPECIES.

[The numbers correspond to the list numbers in the catalogue.]

(2) **Orothrips kelloggii yosemitii** new variety. (Pl. II, fig. 9.)

Measurements: Head, length 0.16 mm., width 0.20 mm.; prothorax, length 0.16 mm., width 0.25 mm.; mesothorax, width 0.35 mm.; abdomen, width 0.45 mm.; total body, length 1.75 mm. Antennæ: 1, 30 μ; 2, 54 μ; 3, 99 μ; 4, 96 μ; 5, 63 μ; 6, 48 μ; 7, 45 μ; 8, 33 μ; 9, 33 μ; total, 0.50 mm.

Color dark brown to blackish-brown; cheeks not strongly arched. Segment 2 of antennæ yellow, dark brown at base; segment 3 yellow, but dark brown in outer half; segment 3 noticeably constricted in the middle; sense areas on segments 3 and 4 ovoid (in *O. kelloggii* elongate). Spines on hind margin of prothorax short but quite stout; those on mesonotum likewise small. Trochanters not noticeably yellow. Darkened bands in center and at tip of wings smaller and lighter colored and more irregular than in *Orothrips kelloggii.*

2. Genus ERYTHROTHRIPS new genus.

Head almost one-third longer than wide. Ocelli present in both sexes. Antennæ nine-segmented, the last two segments closely joined and together somewhat shorter than segment 7. Maxillary palpi geniculated and with eight segments. Labial palpi with three segments. Prothorax about as long as head and only a little wider, without large bristles. Legs long and slender; fore femora somewhat thickened in both sexes. Wings present in both sexes; fore wings very slightly narrowed before the middle; fore part of ring vein and fore longitudinal vein furnished with a few sparse, inconspicuous hairs; fore wings white, with dark-brown longitudinal band along posterior margin.

(3) **Erythrothrips arizonæ** new species. (Pl. I, figs. 1–7.)

Measurements: Head, length 0.24 mm., width 0.19 mm.; prothorax, length 0.24 mm., width 0.23 mm.; mesothorax, width 0.38 mm.; abdomen, width 0.49 mm.; total body, length 2.66 mm. Antennæ: 1, 45 μ; 2, 63 μ; 3, 126 μ; 4, 111 μ; 5, 6, 72 μ; 7, 69 μ; 8, 30 μ; 9, 18 μ; total length, 0.64 mm.

Color dark brown, with red pigmentation; connecting tissue of abdominal segments light brown to brown.

Head about one-fourth longer than wide, rounded in front and elevated only a little between basal segments of antennæ; cheeks slightly arched, converging but very slightly posteriorly; back of head cross-striated; without prominent spines. *Eyes* prominent, not protruding, black; eyes with large facets, pilose. *Ocelli* present. *Mouth-cone* short, pointed; maxillary palpi geniculate, eight-segmented; labial palpi four-segmented; basal segment small. *Antennæ* nine-segmented, two and one-half times as long as head; brown, unicolorous with body except basal part of segment 3, which is light brown. All segments thickly clothed with short spines. A long slender sense area on each of segments 3 and 4.

Prothorax about as wide as long and only a little larger than the head; with several inconspicuous spines; all angles broadly rounded. *Legs* uniformly dark brown in females, but fore tibiæ and tarsi shading to light brown in males. Fore femora slightly enlarged; tibiæ each with a stout spine at tip; all legs thickly set with short, dark spines. *Fore wings* of about even width for entire length, very slightly narrowed before the middle, broadly rounded at tip; with ring vein and two longitudinal veins that unite with ring vein near tip; with five cross veins; fore part of ring vein and fore longitudinal vein with small, white, inconspicuous spines; second longitudinal vein with about twenty-seven dark spines. Posterior margin of wing only with fringe. Wings clear white, with dark-brown longitudinal band extending from base, including scale, to tip, this band broadest at middle of wing and somewhat narrowed before the middle. Hind wings clear white, margined with fringe only along posterior side.

Abdomen large, fourth and fifth segments widest and from them tapering gradually to the bluntly pointed tenth segment. Without long spines except on last three segments. Eighth abdominal segment of males covered with many long hairs.

Described from four females and ten males.

Habitat: Phoenix, Ariz., type specimens collected and forwarded by Mr. J. Eliot Coit; California, specimens collected by Mr. B. B. Whitney at Oroville.

Food plants: Orange and olive blossoms in Arizona; *Rhamnus purshiana* in California.

The larva of this species is uniformly light brownish-yellow and has conspicuous red pigment bands across the dorsal plates of mesothoracic and metathoracic segments and all segments of abdomen.

(13) **Thrips magnus** new species. (Pl. II, figs. 10, 11.)

Measurements: Head, length 0.13 mm., width 0.18 mm.; prothorax, length 0.16 mm., width 0.23 mm.; mesothorax, width 0.35 mm.; abdomen, width 0.40 mm.; total body, length 1.70 mm. Antennæ: 1, 24 μ; 2, 36 μ; 3, 56 μ; 4, 51 μ; 5, 42 μ; 6, 54 μ; 7, 24 μ; total length 0.30 mm.

General color very dark brown, head blackish brown.

Head considerably wider than long, broadest near back; cheeks very slightly arched, roughened; front of head broadly rounded; back of head transversely striate. A small spine on front of each posterior ocellus and a row of several smaller spines back of each eye. *Eyes* large, occupying about two-thirds the width of the head, not unusually protruding, pilose. *Ocelli* subapproximate, with dark-brown crescents. *Mouth-cone* short, reaching hardly past middle of prothorax, pointed; maxillary palpi three-segmented; labial palpi two-segmented. *Antennæ* seven-segmented, slightly more than twice as long as head, uniform dark brown, with segments 1 and 2 often blackish-brown; forked sense cones on dorsal side of segment 3 and ventral side of segment 4.

Prothorax somewhat larger than head, all angles rounded; two long prominent spines on each posterior angle, several smaller ones along posterior margin, the inner one being the longest; other spines present but not conspicuous. *Mesothorax* largest, sides of *pterthorax* broadly and evenly rounded. *Legs* dark brown, tips of tibiæ and tarsi shading to lighter or yellowish brown; hind tibiæ alone armed with spines. *Wings* present; fore wing large, uniform brown, with spines arranged as follows: Costa, thirty-one; fore longitudinal vein with eight at base and three scattered on outer half; hind vein with thirteen.

Abdomen subovate, third and fourth segments largest; longest spines on last two segments.

Described from numerous females. Males much larger.

Habitat: Visalia, Coyote, and San Francisco, Cal.

Food plant: *Mimulus* sp.

9. Genus ECHINOTHRIPS new genus.

Head and thorax with a deeply reticulated structure (sides of abdomen may also be reticulated). Head about as long as wide and not longer than the prothorax. Eyes large, oval, prominent. Ocelli present. Antennæ with eight segments, long, slender, last four segments united evenly and diminishing in size gradually. Prothorax angular at sides. Legs slender, unarmed. Wings present, strong, broadest at base and tapering gradually to a pointed tip, without prominent veins except fore part of ring vein. Spines on fore margin and where fore longitudinal vein should be, long, strong, and with blunt tips.

This genus has many of the characters of both *Heliothrips* and *Dictothrips*. It is readily determined from the former by the shape of the antennæ, inasmuch as the segments are all rather slender and quite evenly united; segment 6 is longest; the style not longer than segment 6. It is readily separated from *Dictothrips* by the character of the wings, which have two rows of long, strong, blunt spines along the anterior margin.

(22) **Echinothrips mexicanus** new species. (Pl. III, figs. 16–19.)

Measurements: Head, length 0.10 mm., width 0.15 mm.; prothorax, length 0.10 mm., width 0.18 mm.; mesothorax, width 0.23 mm.; abdomen, width 0.23 mm.; total body, length 0.92 mm. Antennæ: 1, 9 μ; 2, 30 μ; 3, 45 μ; 4, 39 μ; 5, 45 μ; 6, 60 μ; 7, 15 μ; 8, 27 μ; total, 0.27 mm.

General color uniform dark brown, with red pigmentation. Bases of femora, tips of tibiæ, all tarsi, outer half of segments 3 and 4, and base of segment 5 of antennæ yellow.

Head noticeably wider than long, retracted into the prothorax, angular in front, with basal joints of antennæ subapproximate; vertex depressed and bearing the anterior ocellus on its anterior surface; strongly reticulate; cheeks roughened and with spines. *Eyes* large, oval, prominent, slightly protruding, reddish black with yellowish inner and outer margins; facets large, protruding, strongly pilose. *Ocelli* present, subapproximate, placed near center of head, anterior ocellus directed forward, posterior ones distinctly separated from inner margins of eyes; yellow-orange, with deep orange-red crescents. *Mouth-cone* pointed, reaching past base of prosternum. *Antennæ* with eight segments, two and one-half times as long as head, slender; segment 6 longest; segments 1 and 2 deep brown, unicolorous with head, terminal segments brown, intermediate segments yellow. (Segments 5 to 8 united evenly, antennæ tapering gradually from base of segment 6 to tip.)

Prothorax about as long as head, widest at middle; sides angular, roughened and with curved spines; strongly reticulate. *Mesothorax* largest, with notch on either side near posterior margin, uniting evenly with metathorax. *Legs* slender, with numerous hairs but without claws. *Fore wings* strong, broadest at base, tapering gradually from base to point at tip; anterior part of ring-vein prominent, posterior part and other longitudinal veins wanting. With a row of thirteen long, brown, blunt spines along anterior margin, and ten other similar spines close to anterior margin where fore longitudinal vein should be; fore fringe long and wavy, especially on outer half of wing; posterior fringe also well developed. Wings uniform dark brown, with elongate whitened area near base. Posterior pair of wings each with single, median, dark brown, longitudinal vein extending from base to near tip; wing membrane brown, fringe well developed.

Abdomen widest across third and fourth segments and from them tapering gradually to a blunt tip; with numerous spines along sides and on dorsum; a single pair near anterior margin on each segment most conspicuous.

Described from a single female.

Habitat: Acapulco, Mexico.

Specimens taken from a small potted plant on shipboard in San Francisco from Acapulco, Mexico. One adult with numerous larvæ and pupæ.

(40) **Euthrips parvus** new species. (Pl. IV, figs. 23–25.)

Measurements: Head, length 0.09 mm., width 0.126 mm.; prothorax, length 0.096 mm., width 0.144 mm.; mesothorax, width 0.16 mm.; abdomen, width 0.21 mm.; total body, length 0.95 mm.

Antennæ: 1, 15 μ; 2, 30 μ; 3, 45 μ; 4, 39 μ; 5, 36 μ; 6, 45 μ; 7, 9 μ; 8, 12 μ; total length 0.225 mm.

General color orange-yellow; forewings, as also segments 3 to 8 of antennæ, light brown.

Head angular in front, with depression to receive basal segments of antennæ; frons depressed, broadest across eyes; sides of head constricted posteriorly, not retracted into prothorax; back of head faintly cross-striated; two small spines in front of anterior ocellus and one in front of each posterior ocellus; a pair bordering the posterior inner side of each eye. *Eyes* large, ovoid, prominent and protruding; facets large, pilose. *Ocelli* located in central part of head, closely placed but not contiguous, yellow, with orange-red crescents; anterior ocellus in depression on fore part of head and directed forward. *Mouth-cone* short, blunt, tipped with black; maxillary palpi with three segments, labial palpi with two. *Antennæ* with eight segments, two and one-half times as long as head; segment 1 pale yellow, 2 orange-brown, others uniformly brown; spines and sense cones present but not conspicuous.

Prothorax only a little wider than head, sides arched, all angles rounded; with scattering spines, three on either side along posterior margin, brown and conspicuous, the central one of each group largest; sides of prothorax constricted in middle. *Legs*, especially posterior pair, rather long and slender, covered with numerous hairs, unicolorous with body. *Fore wings* broadest in basal one-third, pointed at ends; ring vein prominent, fore longitudinal vein conspicuous only at base; with about twenty spines along anterior margin; five or six spines on basal part of fore longitudinal vein, the outer two separated from the others; three spines on outer half of wing where fore vein should be and three spines near posterior margin where posterior longitudinal vein should be. Fringe on wing on both anterior and posterior margins long only on outer half of wing. Wings brown, with inconspicuous, light, longitudinal area extending from base to tip. *Abdomen* rather long and slender, spines conspicuous only on last two segments; a comblike structure on posterior margin of segment 8.

Described from numerous specimens.

Habitat: San Francisco, Cal.

Food plants: Taken on various hothouse plants, especially on *Cathartica* sp?

Adults and larvæ collected during June and July.

(42) **Euthrips albus** new species. (Pl. III, figs. 20–22; Pl. IV, fig. 30.)

Measurements: Head, length 0.12 mm., width 0.12 mm.; prothorax, length 0.12 mm., width 0.16 mm.; mesothorax, width 0.23 mm.; abdomen, width 0.25 mm.; total body, length 1 mm.

Antennæ: 1, 15 μ; 2, 30 μ; 3, 48 μ; 4, 45 μ; 5, 33 μ; 6, 54 μ; 7, 9 μ; 8, 12 μ; total length 0.25 mm.

Color translucent whitish, segments 4 to 8 of antennæ brown.

Head about as wide as long, noticeably square, cheeks straight and very slightly arched; front angular; spines, except a pair between eyes, weak. *Eyes* prominent, black, with light outer borders, coarsely faceted. *Ocelli* wanting. *Mouth-cone* long, pointed, tipped with black; maxillary palpi three-segmented. *Antennæ* eight-segmented, about twice as long as head, segments 1 to 3 inclusive whitish, 4 brown, whitish at base, others brown. Forked sense cone on dorsal side of segment 3, and a similar one on ventral side of segment 4.

Prothorax somewhat wider than long. A very weak spine at each anterior angle. A pair of prominent ones on each posterior angle. *Mesothorax* largest; front angles rounded. *Legs* unicolorous with body. Spines prominent only on hind tibiæ, each tarsus with a black spot at end. *Wings* present, rather broad, and tapering gradually from base to distal end; not sharply pointed at tip; costa of fore wings set rather sparsely with about twenty spines; fore vein with six spines near base of wing and two near tip. Hind vein with nine regularly placed spines, these beginning immediately below where the group of six spines on fore vein ends. Spines brown.

Abdomen elongate-ovate, tapering rather gradually from third segment to near tip; with prominent spines on outer posterior angles of all abdominal segments except first.

Described from one female taken on peach foliage, Red Bluff, Cal.

(52) **Euthrips helianthi** new species. (Pl. IV, figs. 26–29.)

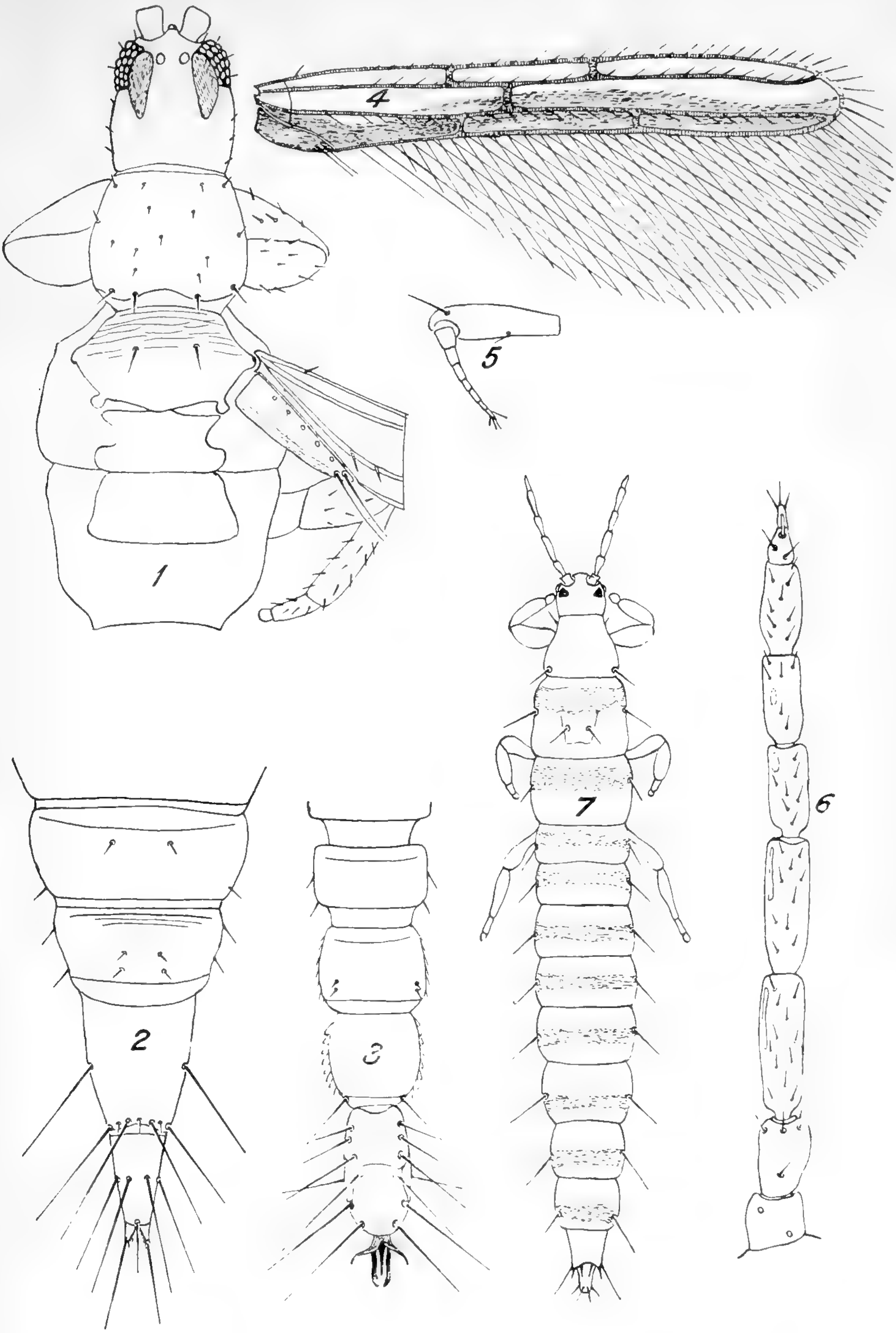
Measurements: Head, length 0.135 mm., width 0.16 mm.; prothorax, length 0.150 mm., width 0.20 mm.; mesothorax, width 0.28 mm.; abdomen, width 0.28 mm.; total body, length 1.25 mm.

Antennæ: 1, 21 μ; 2, 39 μ; 3, 60 μ; 4, 51 μ; 5, 42 μ; 6, 54 μ; 7, 9 μ; 8, 15 μ; total length 0.300 mm.

General color transparent yellowish-gray, shaded with brown.

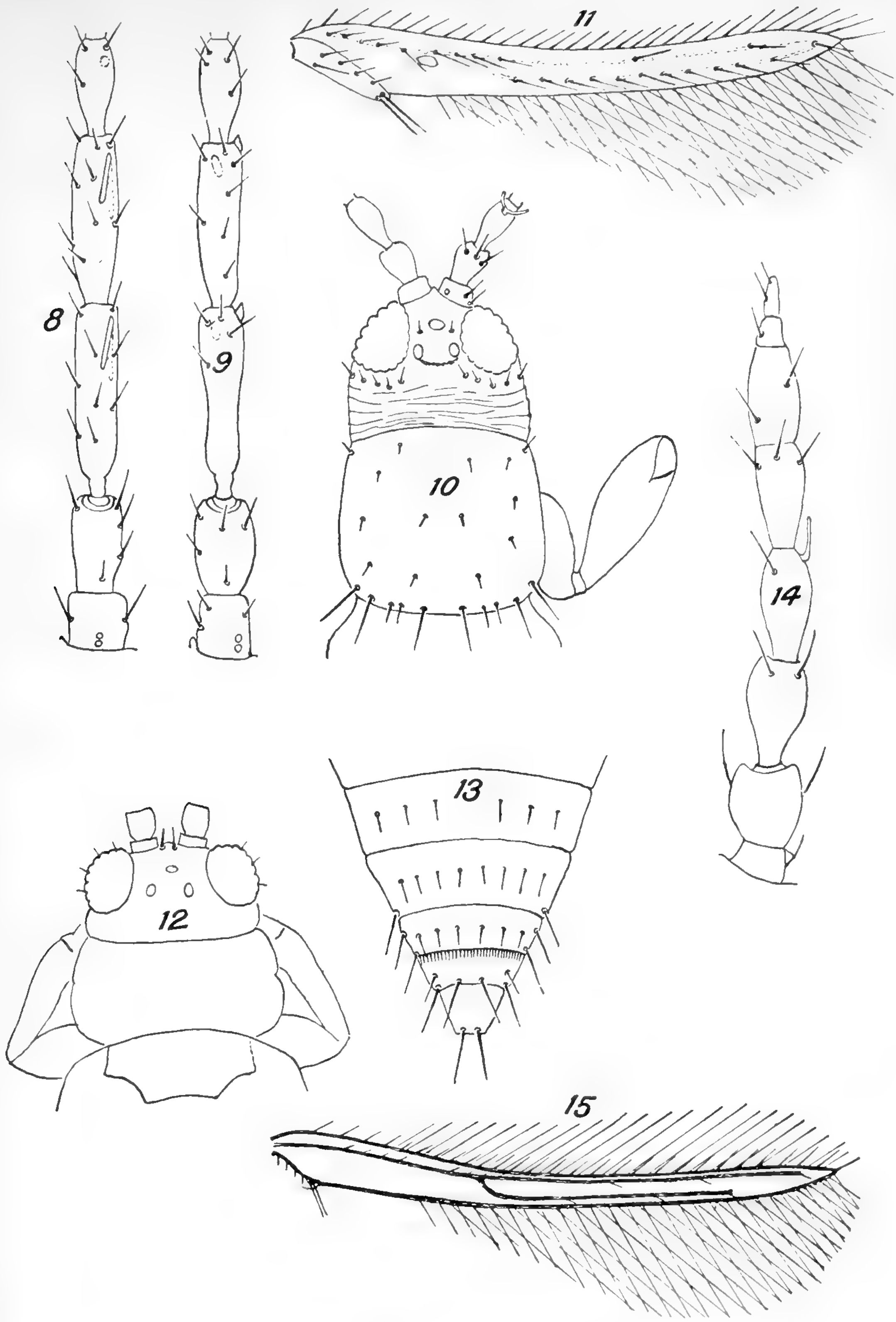
Head only a little wider than long, cheeks straight and parallel; anterior margin only slightly elevated and rounded in front, back of head very faintly cross-striated. Head retracted into prothorax. Large, brown, conspicuous spines in front of posterior ocelli and back of eyes; other smaller spines present, also dark brown and conspicuous. *Eyes* rather small, occupying about one-half the width of the head, not prominent, with purple-black pigment, pilose. *Ocelli* present, translucent whitish, separated, and posterior ones not contiguous to eyes, with light orange-yellow pigment blotches which are only irregularly crescent-shaped. *Mouth-cone* pointed, dark brown, nearly black at tip. Maxillary palpi three-segmented, labial palpi two-segmented, basal segment very short. *Antennæ* eight-segmented, only slightly more than twice as long as head, segment 1 light yellowish gray, unicolorous with head; 2 dark brown; 3, 4, and 5 brown, yellowish at base; 3 also sometimes yellowish at tip; 6 and style uniform dark brown. A forked sense cone on dorsal side of segment 3 near tip, and a similar one near tip on ventral side of segment 4. All spines dark brown and conspicuous.

Prothorax about one-fourth wider than long, with a long, conspicuous, dark-brown spine at each anterior angle, two at each posterior angle, one on either side of anterior margin about halfway between center and side, a medium-sized dark spine on posterior margin on either side near center, and many other smaller spines, also brown and conspicuous. *Mesothorax* with angles broadly rounded in front, uniting almost evenly with metathorax, the sides of which converge posteriorly. *Legs* with fore femora somewhat thickened, light brownish gray; all tibiæ armed; all tarsi with a dark-brown spot near tip. *Wings* uniform translucent whitish. Veins set regularly with spines; costa with about twenty-seven, fore vein with twenty-one, hind vein with fifteen, scale with six, inner side of scale with one; all spines brown. Microscopic hairs transparent; costal fringe short; posterior fringe long and wavy.



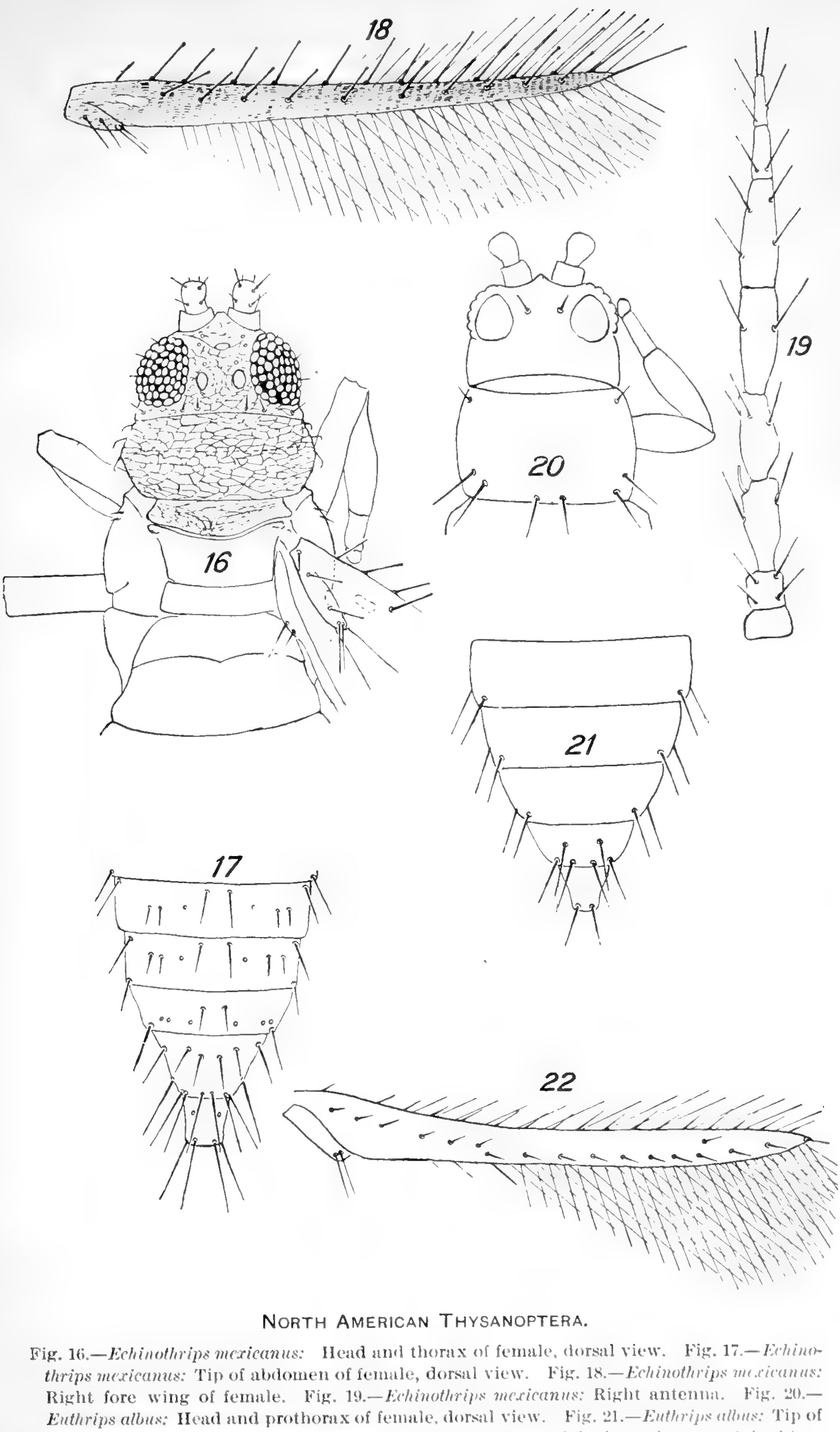
NORTH AMERICAN THYSANOPTERA.

Fig. 1.—*Erythrothrips arizonæ:* Head and thorax of female, dorsal view. Fig. 2.—*Erythrothrips arizonæ:* Tip of abdomen of female, dorsal view. Fig. 3.—*Erythrothrips arizonæ:* Tip of abdomen of male, dorsal view. Fig. 4.—*Erythrothrips arizonæ:* Right fore wing. Fig. 5.—*Erythrothrips arizonæ:* Maxillary palpus. Fig. 6.—*Erythrothrips arizonæ:* Left antenna. Fig. 7.—*Erythrothrips arizonæ:* Larva. (Original.)



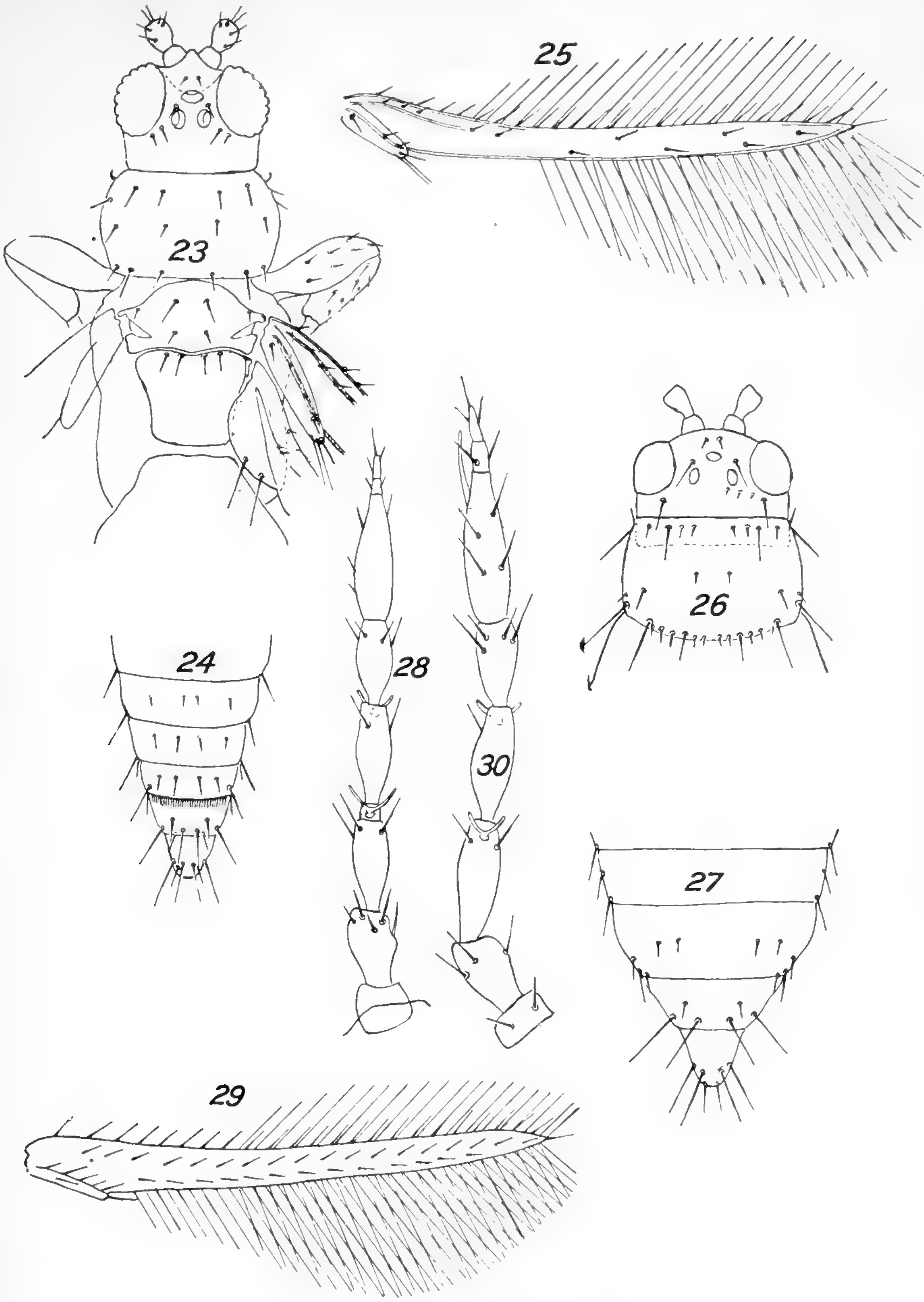
NORTH AMERICAN THYSANOPTERA.

Fig. 8.—*Orothrips kellogii:* Right antenna. Fig. 9.—*Orothrips kellogii yosemitii:* Right antenna. Fig. 10.—*Thrips magnus:* Head and prothorax of female. Fig. 11.—*Thrips magnus:* Right fore wing. Fig. 12.—*Euthrips citri:* Head and prothorax of female. Fig. 13.—*Euthrips citri:* Tip of abdomen of female. Fig. 14.—*Euthrips citri:* Right antenna of female. Fig. 15.—*Euthrips citri:* Right fore wing. (Original.)



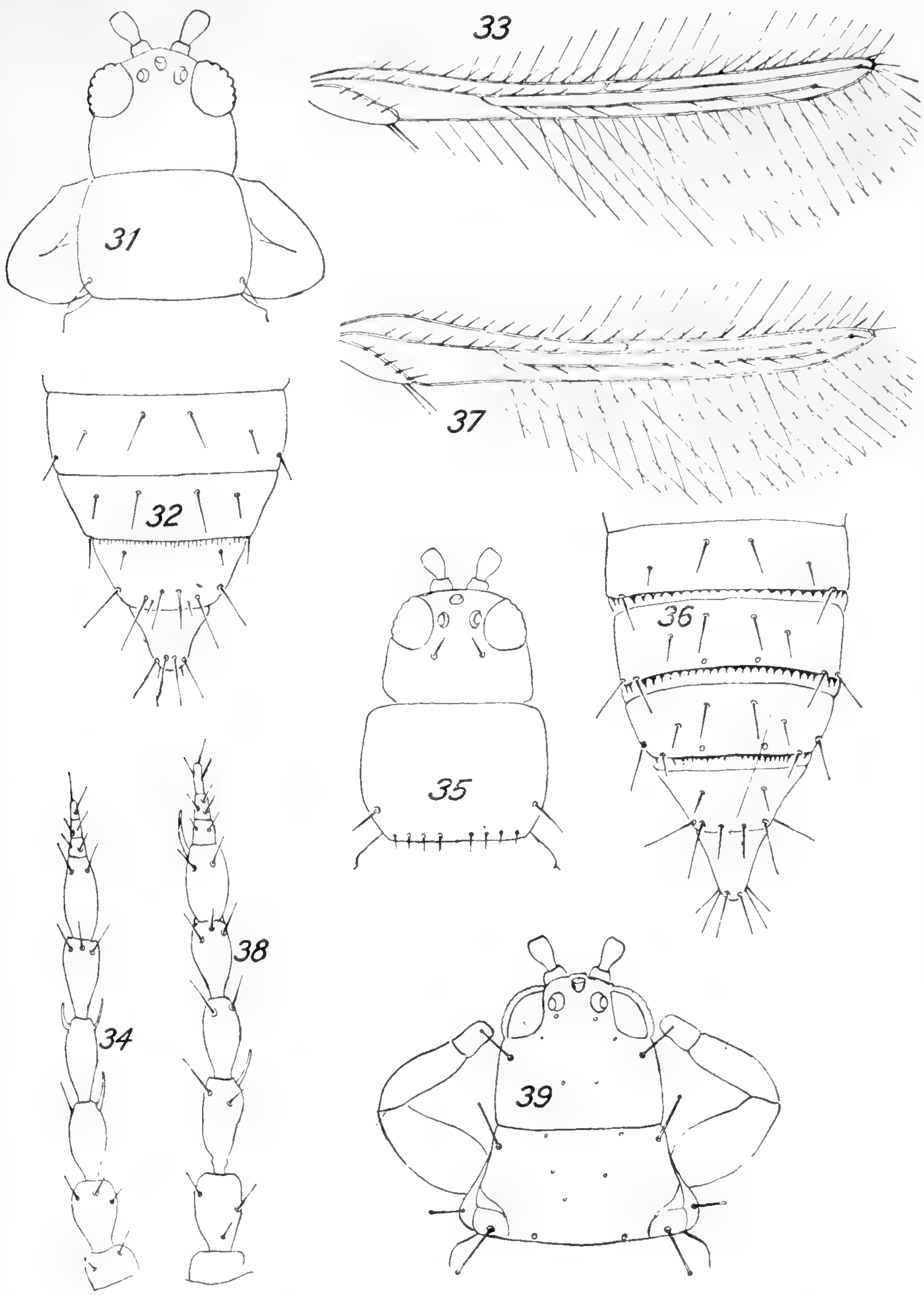
NORTH AMERICAN THYSANOPTERA.

Fig. 16.—*Echinothrips mexicanus:* Head and thorax of female, dorsal view. Fig. 17.—*Echinothrips mexicanus:* Tip of abdomen of female, dorsal view. Fig. 18.—*Echinothrips mexicanus:* Right fore wing of female. Fig. 19.—*Echinothrips mexicanus:* Right antenna. Fig. 20.—*Euthrips albus:* Head and prothorax of female, dorsal view. Fig. 21.—*Euthrips albus:* Tip of abdomen of female, dorsal view. Fig. 22.—*Euthrips albus:* Right fore wing. (Original.)



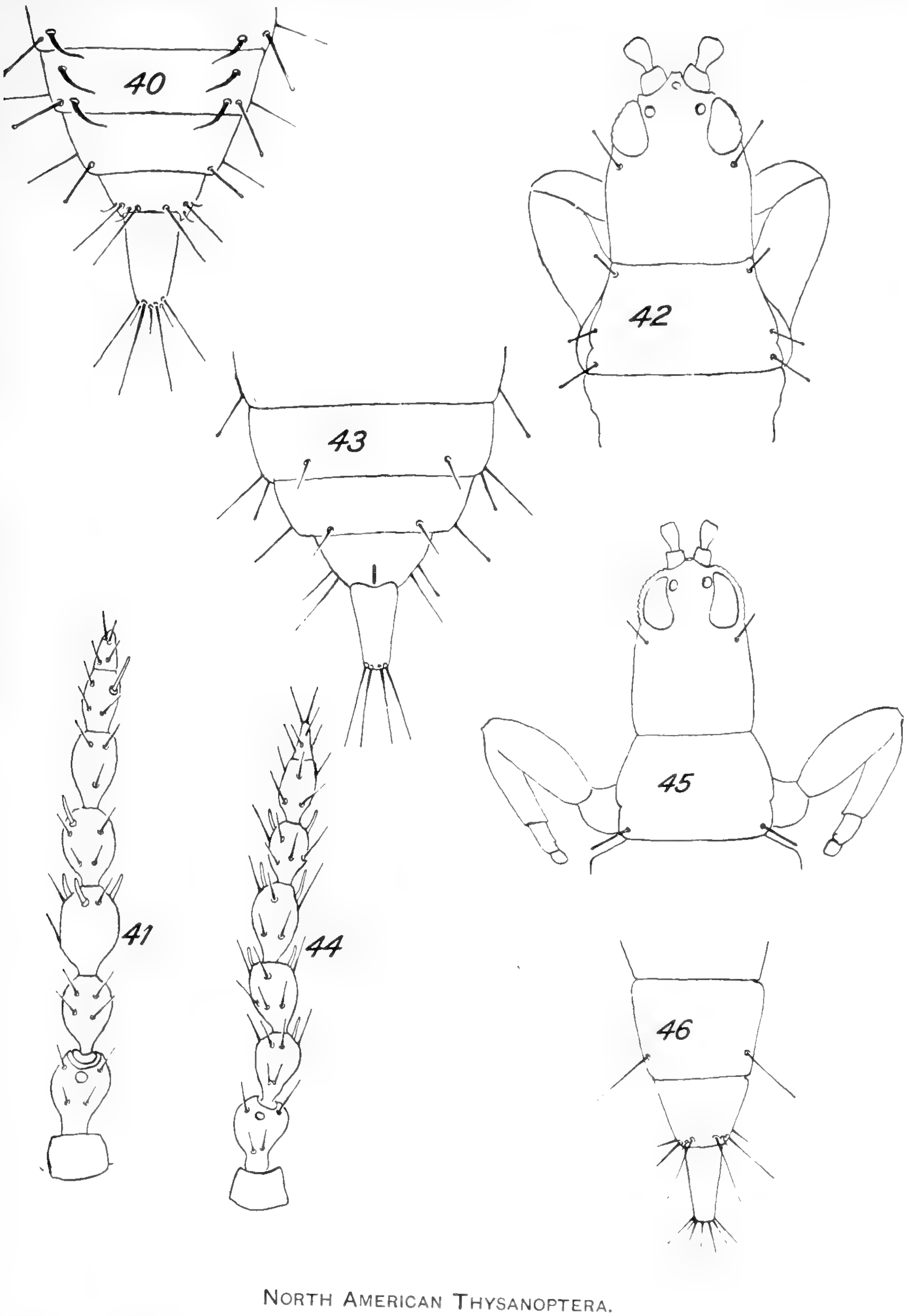
NORTH AMERICAN THYSANOPTERA.

Fig. 23.—*Euthrips parvus:* Head and thorax of female, dorsal view. Fig. 24.—*Euthrips parvus:* Tip of abdomen of female, dorsal view. Fig. 25.—*Euthrips parvus:* Right fore wing of female. Fig. 26.—*Euthrips helianthi:* Head and prothorax of female, dorsal view. Fig. 27.—*Euthrips helianthi:* Tip of abdomen of female, dorsal view. Fig. 28.—*Euthrips helianthi:* Right antenna of female. Fig. 29.—*Euthrips helianthi:* Right fore wing. Fig. 30.—*Euthrips albus:* Right antenna of female. (Original.)



NORTH AMERICAN THYSANOPTERA.

Fig. 31.—*Anaphothrips zeæ:* Head and prothorax of female, dorsal view. Fig. 32.—*Anaphothrips zeæ:* Tip of abdomen of female, dorsal view. Fig. 33.—*Anaphothrips zeæ:* Right fore wing. Fig. 34.—*Anaphothrips zeæ:* Right antenna of female. Fig. 35.—*Anaphothrips tricolor:* Head and prothorax of female, dorsal view. Fig. 36.—*Anaphothrips tricolor:* Tip of abdomen of female, dorsal view. Fig. 37.—*Anaphothrips tricolor:* Right fore wing of female. Fig. 38.—*Anaphothrips tricolor:* Right antenna of female. Fig. 39.—*Trichothrips ruber:* Head and prothorax of female, dorsal view. (Original.)



NORTH AMERICAN THYSANOPTERA.

Fig. 40.—*Trichothrips ruber:* Tip of abdomen, dorsal view. Fig. 41.—*Trichothrips ruber:* Right antenna of female. Fig. 42.—*Cephalothrips errans:* Head and prothorax of female, dorsal view. Fig. 43.—*Cephalothrips errans:* Tip of abdomen of female, dorsal view. Fig. 44.—*Cephalothrips errans:* Right antenna of female. Fig. 45.—*Cryptothrips californicus:* Head and prothorax of female, dorsal view. Fig. 46.—*Cryptothrips californicus:* Tip of abdomen of female, dorsal view. (Original.)

Abdomen cylindrical ovate, with conspicuous brown spines on outer margin of each segment, six along the posterior ventral margin of each ventral plate, and longer, stronger ones at tip on segments 9 and 10.

Habitat: Visalia, Tulare County, Cal.

Food plant: Wild sunflower.

(57) **Anaphothrips zeæ** new species. (Pl. V, figs. 31–34.)

Measurements: Head, length 0.12 mm., width 0.13 mm.; prothorax, length 0.12 mm., width 0.16 mm.; mesothorax, width 0.23 mm.; abdomen, width 0.26 mm.; total length 1.10 mm.

Antennæ: 1, 18 μ; 2, 30 μ; 3, 42 μ; 4, 39 μ; 5, 33 μ; 6, 30 μ; 7, 8, 9, 33 μ; total length 0.225 mm.

Color yellow to grayish brown, wings gray.

Head about as long as wide, broadly rounded in front, cheeks arched. *Eyes* prominent, slightly protruding, with coarse facets. *Ocelli* present, widely separated, with light-brown crescents. Head with prominent spines. *Mouth-cone* broad at base, pointed at tip. Maxillary palpi large, three-segmented, labial palpi very small, with two segments, mouth-cone dark brown at tip. *Antennæ* about as long as head, segment 1 yellowish gray, segment 2 light brown, segment 3 light brown, transparent yellowish at basal half, segment 4 and others light brown, shading to darker toward the tip, without conspicuous spines or sense cones. Antennæ sometimes almost uniformly light brown, with segment 2 darker.

Prothorax about as long as head and only slightly wider, with one transparent but rather prominent spine on each posterior angle. *Mesothorax* largest, sides rounded; *metathorax* with sides almost parallel but constricted abruptly at the posterior margin. *Pterthorax* somewhat darker than rest of body. *Legs* uniformly grayish brown, only hind tibia armed. *Wings* uniformly brownish gray, with small, semitransparent, elongate area near base with veins and spines prominent, although all veins are transparent. *Costa* with twenty-seven spines, fore vein with nine regularly placed spines near base and other scattered spines along outer part. Hind vein arising from fore vein at about one-fourth the wing's length from the base and ending abruptly near tip of wing with ten more or less regularly placed spines. Fringe on fore vein weak.

Abdomen cylindrical ovate, uniformly brownish gray, without prominent spines except on terminal segments; all spines transparent.

Habitat: San Jose, Fresno, Lindsay, Tulare County, Cal. Taken on grasses, leaves, and ears of corn.

(58) **Anaphothrips tricolor** new species. (Pl. V, figs. 35–38.)

Measurements: Head, length 0.10 mm., width 0.15 mm.; prothorax, length 0.13 mm., width 0.18 mm.; mesothorax, width 0.23 mm.;

abdomen, width 0.25 mm.; total length 1.16 mm. Antennæ: 1, 12 μ; 2, 30 μ; 3, 39 μ; 4, 30 μ; 5, 30 μ; 6, 30 μ: 7, 8, 9, 33 μ; total length 0.21 mm.

Color: Head and prothorax grayish yellow; pterthorax orange; abdomen brown, shading to darker toward tip.

Head considerably wider than long, cheeks almost straight and diverging behind. Front of head broadly rounded; back of head very faintly cross-striated, without prominent spines. *Eyes* prominent, black, occupying almost two-thirds of width of head. *Ocelli* present, with light-brown inner crescents. *Mouth-cone* long and slender, reaching almost to posterior margin of prothorax, tipped with black. Maxillary palpi three-segmented, labial palpi two-segmented, basal segment very short, second segment very long. *Antennæ* apparently with nine segments, only slightly more than twice as long as head, segments 1, 2, 3, and base of 4 unicolorous with head, segment 2 shaded with brown, tip of 4 and others shading quite uniformly to dark brown, all spines transparent.

Prothorax with angles broadly rounded, unicolorous with head, with one prominent spine on each posterior angle; other smaller spines are present but all are transparent. *Mesothorax* and *metathorax* united evenly at sides and conspicuously orange-colored. *Legs* slender, grayish yellow, unicolorous with head, all tibiæ armed. *Wings*, including veins and spines, transparent. Veins prominent. Costa with twenty-five regularly placed spines, fore vein with a group of about eight spines on basal half and two or three scattered spines near tip. Posterior longitudinal veins arising from fore veins at about one-third the wing's length from the base and ending abruptly near tip of wing with about ten regularly placed spines; fringe on anterior pair of wings slight.

Abdomen with segments 2 to 6, inclusive, almost equal and with sides parallel. Segments 8, 9, and 10 with sides abruptly converging to meet the smaller pointed tenth segment. Surface of abdomen cross-striated. Posterior margins of dorsal plates of segments 5 to 8, inclusive, with arrangement of short, sharp spines; these are most conspicuous on segments 7 and 8. Abdomen dark brown, shading to darker toward tip, all spines of abdomen dark brown.

Habitat: Tulare County, Cal. Taken on goldenrod and orange foliage. Specimens collected by Mr. P. R. Jones.

(75) **Trichothrips ruber** new species. (Pl. V, fig. 39; Pl. VI, fig. 40.)

Measurements: Head, length 0.18 mm., width 0.19 mm.; prothorax, length 0.14 mm., width 0.28 mm.; mesothorax, width 0.33 mm.; abdomen, width 0.33 mm.; tube length 0.12 mm.; total body, length 1.42 mm. Antennæ: 1, 18 μ; 2, 42 μ; 3, 36 μ; 4, 48 μ; 5, 42 μ; 6, 39 μ; 7, 33 μ; 8, 21 μ; total 0.28 mm.

General color uniform dark brownish-red. Antennæ dark brown, legs brown, tips of fore tibiæ and fore tarsi yellow.

Head about as long as wide, broadly rounded in front, cheeks slightly arched, back of head cross-striated; postocular spines long and with blunt tips. *Eyes* large, semitriangular in shape, slightly protruding, black, with bright-yellow outer borders, pilose. *Ocelli* present, situated far forward, anterior one on vertex; posterior ocelli contiguous with inner anterior margins of eyes, red, with reddish-black crescents. *Mouth-cone* short, pointed, not reaching across prosternum, maxillary palpus with two segments. *Antennæ* with eight segments, one and five-tenths times as long as head, dark brown, except segment 3, which is lighter; segments increasing in size gradually until the fourth, which is largest, and then gradually diminishing toward the tip; all spines and sense cones transparent, three sense cones on segment 4, two smaller ones on segment 5.

Prothorax with sides diverging posteriorly, widest near the back. The fore coxæ are broadly rounded and prominent and form what appear to be the posterior angles of the prothorax; long blunt spines on anterior and posterior angles, on sides and on prominent coxæ; other spines not conspicuous. *Pterthorax* largest. *Legs* rather slender, without conspicuous spines or markings; only a very small claw on each fore tarsus. *Wings* long, slender, transparent except where light brown at extreme base above.

Abdomen with segments 2 to 6, inclusive, about equal, after which they decrease gradually until the tube. Segments 2 to 8 each with two long, blunt hairs on posterior angles. Segments 2 to 7 each with a pair of strong, brown, inwardly curved spines on either side half way from center to margin; other spines smaller and not conspicuous. Hairs on terminal segments long and slender.

Described from a single female.

Habitat: San Jose, Cal.

Taken in blossoms of azalea, in May.

(92) **Cephalothrips errans** new species. (Pl. VI, figs. 42–44.)

Measurements of two wingless females: Head, length 0.18 mm., width 0.13 mm.; prothorax, length 0.12 mm., width (including prominent fore coxa) 0.22 mm.; mesothorax, width 0.20 mm.; abdomen, width 0.28 mm.; tube length 0.10 mm.; total body, length 1.16 mm. Antennæ: 1, 18 μ; 2, 39 μ; 3, 39 μ; 4, 45 μ; 5, 45 μ; 6, 39 μ; 7, 39 μ; 8, 24 μ; total length 0.28 mm.

Three specimens of the winged male of this species show the following variations: Prothorax, length 0.14 mm., width 0.26 mm.; mesothorax, width 0.25 mm.; total length 1.86 mm. when the body is distended. Antennæ: 1, 21 μ; 2, 45 μ; 3, 45 μ; 4, 48 μ; 5, 42 μ; 6, 39 μ; 7, 45 μ; 8, 30 μ.

General color uniform dark brown except tips of all tibiæ and all tarsi, which are yellowish. Wings (in the forms which have wings) transparent.

Head about four-tenths longer than wide, broadly rounded in front except at vertex, which projects forward between basal segments of antennæ; cheeks almost straight, without markings and without spines other than the long, transparent, blunt, postocular ones. *Eyes* somewhat triangular in shape, prominent but not protruding, black, with lemon-yellow outer margins, not pilose. *Ocelli* present, situated far forward on head, each posterior one contiguous with inner anterior margin of eye, slightly reddish-brown, with darker crescents; anterior ocellus smaller and with pigment, elongate and not crescent shaped. *Mouth-cone* a little shorter than its width at base; maxillary palpus two-segmented, basal segment very small, second segment long; labium broadly rounded. *Antennæ* with eight segments, one and one-half times as long as head, uniform dark brown except segment 3, which is light brown and somewhat yellowish at base; spines and sense cones present but not conspicuous; segments 7 and 8 closely joined.

Prothorax about seven-tenths as long as head; sides (including prominent coxa) diverging rapidly from the anterior margin to about three-fourths the length and then abruptly constricted, the outer angles thus formed broadly rounded. With three pairs of long, blunt spines on fore and hind angles and one midway along sides; also similar spine on each prominent fore coxa. *Pterthorax* with sides almost even and parallel, a little narrower than prothorax but much wider than head; almost as wide as prothorax in winged forms. *Legs* short, stout, each fore tibia with a small tooth. *Wings* (in winged forms) very weak, hardly attaining half the length of the abdomen, transparent, and hardly to be seen except for very light brownish area at extreme base.

Spines on sides of *abdomen* long and transparent, those on tip of tube brown.

Described from two wingless and three winged females.

Habitat: San Jose, Cal.

Food plants: Wild mustard, apricot, and prune foliage.

Adults taken from April to July.

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INDEX.

[New genera and species and pages on which they are described are given in black-faced type.]

TECHNICAL SERIES, No. 22.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY.
L. O. HOWARD, Entomologist and Chief of Bureau.

THE STRUCTURE OF CERTAIN DIPTEROUS LARVÆ WITH PARTICULAR REFERENCE TO THOSE IN HUMAN FOODS.

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Rolla P. Currie, *in charge of editorial work.*
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., September 1, 1911.

SIR: At frequent intervals and for many years the Bureau of Entomology has been appealed to by medical men and others to determine insects said to have been passed by sick people. The majority of these insects have been maggots (larvæ of Diptera). The characteristics distinguishing these larvæ have not been well understood, and the accompanying manuscript is the result of a competent effort by Mr. Banks to assist workers in the study of internal myiasis. I recommend that it be published as No. 22 of the Technical Series of this bureau.

Respectfully,

L. O. HOWARD,
Entomologist and Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

PLATES.

10039°—No. 22—12——2

TEXT FIGURE.

THE STRUCTURE OF CERTAIN DIPTEROUS LARVÆ WITH PARTICULAR REFERENCE TO THOSE IN HUMAN FOODS.

INTRODUCTORY.

There is a considerable number of flies whose larvæ either regularly or occasionally live in substances used by man as food. The great majority pass through the intestinal tract without our knowledge, for most of them cause little or no trouble. But sometimes with patients in hospitals or asylums, or in private practice, the physician discovers these maggots, and often suspects them of causing the malady or weakness of his patient.

Many such specimens have been sent to entomologists, but owing to the fact that no one had studied these forms, their characters were little understood, and the identifications have not been of much value. Most of these larvæ belong to a few closely related families of flies that were formerly covered by the name Muscidæ. The arrangement of the flies has been the subject of much diverse opinion, while the knowledge of the larvæ is very fragmentary.

For these reasons Dr. Howard, Chief of the Bureau of Entomology, suggested that the writer make a study of larvæ belonging to these groups in the collections of the Bureau of Entomology and the National Museum, so that in the future a more correct determination might be made of the larvæ that are quite frequently sent to this bureau.

OCCURRENCE.

When we consider that these dipterous larvæ occur in decaying fruits and vegetables and on fresh and cooked meats; that the blowfly, for example, will deposit on meats in a pantry; that other maggots occur in cheese, oleomargarine, etc., and that pies and puddings in restaurants are accessible and suitable to them, it can readily be seen that a great number of these maggots must be swallowed by persons each year, and mostly without any serious consequences.[1] Besides

[1] "Taking everything into consideration, we doubt whether, out of ten thousand cases, where the larvæ of two-winged flies have existed in considerable numbers in the human intestines, more than one single case has been recorded in print for the edification of the world by competent entomological authority." Walsh, Amer. Ent., vol. 2, p. 141, 1870.

these there are the fruit-flies, whose larvæ live in apples, cherries, gooseberries, and oranges, and the pomace-flies that hover around grapes, pears, and other fruits.

There are also other Diptera which do not occur in the intestinal canal, but which may deposit eggs in wounds, or in the nose or ears. The screw-worm is a notable insect of this class, and each year one or more cases reach the bureau of this species affecting the nose or ears. The larva of the ox warble or bot-fly (*Hypoderma lineata* Villers) also sometimes occurs in man. The eggs of this species are deposited upon the hairs of cattle and licked off by the animal, develop in the stomach, and the larvæ bore upward to the back, there to cause the "warble." If some of these eggs drop into the milk pail there is a chance that they will be swallowed by a person. So there are various cases recorded, mostly of children, where, in the winter time, a larva is observed under the skin, usually in the neck or shoulders, and upon removal proves to be the larva of the bot-fly in its second stage.

Many of the muscid and sarcophagid larvæ deposit eggs or larvæ upon dead animals. Although these animals are usually too far along in decomposition to serve as food, yet in some cases these eggs are deposited in time to be taken when the flesh is eaten. In most cases, however, such flesh is cooked enough to kill the contained maggots.

The larvæ of the Muscidæ often occur in manure as well as on decaying vegetable and animal matter. Prof. Portchinski, of Russia, has studied a number of Russian species of these coprophagous and necrophagous Diptera, and his several papers are the most valuable heretofore produced upon them. Unfortunately for us these papers are published in the Russian language. The late Baron von Osten Sacken gave a summary of one of them in English; and of another, most valuable from the systematic point, the writer has been able to secure a translation of several portions. In this paper[1] he gives descriptions of the larvæ, as well as their habits, and tells how to distinguish the allied forms. He has used several of the characters which will be used in this paper, especially the posterior stigmata and the anal tubercle. He has not touched on the fruit-flies, however, nor has he given any generalizations for the separation of the larvæ of the various families.

Several other naturalists have studied individual species of the Muscidæ or Sarcophagidæ, and in some cases published extremely valuable papers upon them. Thus Lowne has worked up the blowfly, Hewitt the house fly, Blanchard the screw-worm, Portchinski the *Sarcophila wohlfahrti*, and Newstead the stable fly. In the Annales

[1] Biologie des mouches coprophagues et necrophagues. <Hor. Soc. Ent. Ross., vol. 26, pp. 63-131. 1891.

de la Société Entomologique de France there are good figures by Laboulbène of *Teichomyza* and some other species.

Interest in the larvæ and the life history of these species of flies arises also from their medical and sanitary importance. The famous tsetse flies (*Glossina* spp.) of Africa are related to the stable fly. One of these flies distributes the Nagana disease of cattle, while another species disseminates the sleeping sickness of man. The Congo floor-maggot is also related; this species inhabits the huts of the natives, and at night crawls from the cracks to attack and suck blood from sleeping persons. The Bengalia fly is also related; it deposits eggs or larvæ on the skin of man and dogs in Africa. But the house fly is by far the most injurious species, since its habits are such that the germs taken up by its proboscis from sputum and dejecta are scattered over food about to be eaten by man.

There are also various species of these flies injurious to domestic animals; notably the horn fly, which is a serious pest to cattle. The stable fly annoys cattle, and the sheep maggot (*Lucilia sericata*) injures both the sheep and the wool. The screw-worm, or heel fly, is a serious pest of cattle, and also attacks man.

The occurrence of dipterous larvæ in man is known as "myiasis." Various divisions are given; as "myiasis externa" or "myiasis dermatosa," for those in the skin or wounds; "myiasis intestinalis," for those in the alimentary canal; "myiasis narium," for larvæ in the nose; etc. The occurrence of larvæ in the nose in this country is rather accidental, and usually due to the screw-worm. In tropical countries such cases are much commoner, and in the East Indies a disease known as "Peenash" is due to larvæ in the nose.

A great number of papers has been published on the medical side of myiasis, often with some description of the maggot, but it is not necessary to list them here.

These maggots, as previously stated, usually do not cause any trouble, but Alessandrini has shown in a study of the cheese skipper that these larvæ may cause intestinal lesions in a dog. The vitality of these larvæ is such that they are not readily affected by the digestive fluids, and in fact are resistant to many chemical substances that one would suppose fatal to them. It is therefore perfectly possible for these larvæ to continue their development in the intestine, especially in cases of constipation.

No other group of insects affects human health and human interests more seriously or directly than the flies of the Muscidæ and Sarcophagidæ. It is therefore of the greatest importance that the larvæ of these flies should be studied in order that it may be possible to distinguish them with accuracy.

LIFE HISTORY.

The life history of these flies presents many remarkable and peculiar phenomena. The females of a number of them deposit eggs which hatch, and the larva pursues the normal line of development. With other species the larva hatches within the body of the parent and is deposited in the first stage or sometimes in the second or even third stage. In *Mesembrina* the larva is deposited in the second stage, in *Dasyphora* in the third stage. Upon what food the larva develops within the body of the parent is not yet known; Portchinski thought that they might feed on undeveloped eggs which he observed near the larvæ. It seems difficult, however, to believe this possible. In the allied tsetse flies the larva, when deposited, is fully grown. The various stages of larval development at deposition serve to lessen the differences between the Pupipara and other Diptera.

In the number of eggs deposited these flies vary greatly, some species, like *Musca corvina*, *Myospila meditabunda*, and *Mesembrina mystacea*, deposit only 24 eggs or less; these, however, are quite large. *Pyrellia* and *Graphomyia* lay about 50 eggs; *Musca domestica* and *Cynomyia* deposit between 100 and 200 smaller eggs, while *Calliphora erythrocephala* lays from 400 to 600 eggs, all extremely small.

Similarily those larvæ deposited alive vary in number and size. *Hylemyia strigosa* deposits but one or two large larvæ in the first stage, while *Sarcophaga hæmatodes* deposits 40 to 60 smaller larvæ.

After deposition there is sometimes a variance in development. In *Musca domestica* there are the usual three larval stages; the first with a heart-shaped aperture to the posterior spiracles, the second with two slits, and the third with three winding slits. In the allied *Myospila meditabunda*, according to Portchinski, the eggs are much larger and fewer in number than in the house fly, the larva upon hatching has the usual simple heart-shaped aperture to the posterior spiracles, but from this first stage the larva transforms directly to the third stage with three slits in each stigmal plate, thus omitting the second stage. This enables the fly to pass through all stages quickly, and to breed during hot weather and in small patches of manure that are apt to dry up too quickly for use by some other flies.

Portchinski has shown that the coprophagous habit induces viviparity. *Mesembrina meridiana* is coprophagous and viviparous; the other species, *Mesembrina resplendens*, lays eggs and is not coprophagous. The coprophagous *Dasyphora pratorum* is viviparous, while *D. lasiophthalma* lays eggs; *Hylemyia strigosa* is coprophagous and viviparous, while most other species of the genus deposit eggs.

Portchinski also claims that the same species may vary in these habits; according to him *Musca corvina* in northern Russia lays about 24 rather large eggs, while in southern Russia this fly deposits a large larva in the first stage, which passes into the third stage omitting the second stage. It may be that he has made a wrong identification, but he claims to have been particularly careful in this matter.

With the fruit-flies the eggs are deposited on or in the immature fruit, the larvæ feeding on the pulpy substance till full grown, and then crawling from the fallen fruit into the soil for pupation.

CLASSIFICATION.

The dipterous larvæ that may be swallowed by man belong to several families included in the old group of Muscidæ. These families are the true Muscidæ, Sarcophagidæ, Anthomyiidæ, and Trypetidæ. Other groups, as Drosophilidæ, Sepsidæ, and Ortalidæ, are of much rarer occurrence. The flies of the Ortalidæ, Trypetidæ, and Sepsidæ are quite different from those of the other groups, but the adults of the three other families are very similar in structure, and the limits of the groups or the number of groups is not constant with different specialists in Diptera. Some would separate a group known as the Calliphorinæ from the Muscidæ; others make a special family for the biting Muscidæ (Stomoxyidæ). It is not the writer's purpose to make any choice of the different plans, nor does he consider that families should be defined by larval characters, but after the descriptions of the several species a few words will indicate what sort of a classification would result from a study of these larvæ. The groups used in the tabulation of the larvæ are used only for the larvæ and do not indicate any opinions about the arrangement of the flies.

There are other flies whose larvæ are sometimes reported as swallowed by persons, particularly the rat-tailed larvæ of *Eristalis,* which sometimes get into drinking water.

GENERAL CHARACTERS.

(See fig. 1.)

The larvæ of all these forms are broadest near the tip of the body, and taper forward, more so in the true Muscidæ than in the other groups. The surface of the body may be smooth or scabrous, provided with minute, acute granules or teeth, or with short, stiff hairs. With many forms there is on the anterior border of most of the segments a swollen ring or girdle; sometimes only on the ventral side. In some cases there are other swollen areas, or pads, usually fusiform in shape.

The first segment, or head, commonly appears bilobed when viewed from above, and each lobe bears a minute, cylindrical tubercle or papilla (fig. 1, *a*). Below is the mouth aperture; at one side and above it is the pair of mandibles or great hooks (fig. 1, *b*), sometimes fused into one. At the base and to one side of the mouth orifice is a striated semicircular flap or lobe, called the stomal disk. These are more or less distinct according to the amount of distension and varying with the species. Below the mouth is a short transverse piece, the labium. Behind the head segment there is another segment which is only clearly seen when the head is greatly protruded; this hidden segment is known as "Newport's segment," and the writer has not counted it in treating of the number of segments, since it was not considered by Portchinski and others in describing these larvæ. The second (apparent) segment bears on each side, in the full-grown larvæ, a short fan-shaped process, the anterior spiracle (fig. 1, *c*); each spiracle shows at its tip a number of lobes, varying, with the species, from four or five to forty or more. Some of the segments show fusiform areas on the venter and on the sides; those on the venter are called ventral fusiform areas (fig. 1, *d*) and those on the sides, lateral fusiform areas (fig. 1, *e*). The last segment of the body has a large area (fig. 1, *h*) on the end containing two chitinized subcircular plates, the posterior stigmata. These, in the adult, have

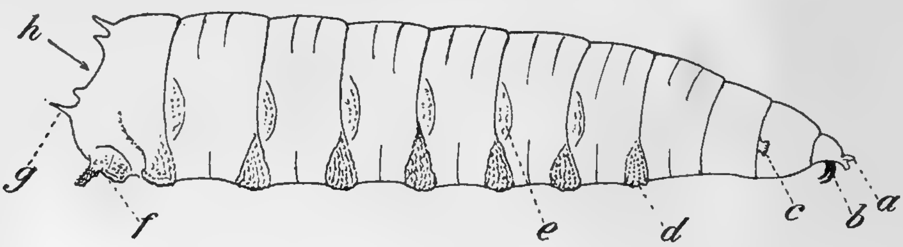

FIG. 1.—Larva of a muscid: *a*, Papilla of head; *b*, great hooks; *c*, anterior spiracles; *d*, ventral fusiform area; *e*, lateral fusiform area; *f*, anal tubercle; *g*, apical spines; *h*, stigmal field (containing posterior stigmal plates). Enlarged. (Original.)

each three slits or sinuous apertures and sometimes a rounded mark, or button, at their base. In some forms the area or field around the stigmal plates is sunken, forming a deep cavity, with the plates at the bottom. The margin or lips of the cavity often bear conical processes (fig. 1, *g*), normally 12 in number. At the lower base of the last segment is the anal field. Each side of the anus is a smooth, convex area or lobe, whose size depends upon the extent of protrusion, and above is a transverse swollen area, often spinulate, and sometimes with a cone at each corner (fig. 1, *f*).

Within the head or, rather, anterior part of the body is a chitinous framework, consisting of several articulated parts, called the cephalopharyngeal skeleton. The outer part is the hypostomal sclerite, to which are articulated the mandibles or great hooks; behind the hypostomals is a pair of large sclerites, nearly divided to their base; one branch is very thin and broader and longer than the other, which is more chitinized, and rounded at tip; they have been called the lateral plates. From their base, near the origin of the hypostomals, there projects forward and upward a pair of slender pieces, the parastomal sclerites. The shape and proportion of these parts vary with the different species and are quite different in the newly-hatched larva than in the full-grown maggot.

The anterior spiracles do not appear on the larva while in its first stage, but usually appear in the second stage, although sometimes deferred till the third or full-grown stage.

The posterior stigmal plates in the larvæ of the first stage are quite small and generally have a simple heart-shaped aperture; in the second stage, the plates become more elongate and each has two short slits. In the third stage, there are always three slits of varying shapes according to the species.

The number of segments in the body of a larva is a disputed question. Apparently there are 12; with the hidden Newport's segment, this would make 13, a number accepted by several investigators. Others, however, claim there are really 14 or 15 segments.

SYNOPSIS OF THE GROUPS.

1. Body with lateral and dorsal spinose processes .... *Homalomyia.*
   Body without such processes 2
2. Body ending in two fleshy processes; rather small species 3
   Body truncate or broadly rounded at end 4
3. Processes bearing the stigmal plates; body about 5 mm. long .... *Drosophila*
   Processes not bearing the stigmal plates; body 10 mm. in length or longer .. *Piophila.*
4. But one great hook; posterior stigmal plates with winding slits; no distinct lateral fusiform areas; tip of body with few if any conical processes .... Muscinæ.
   With two great hooks; slits in the stigmal plate not sinuous 5
5. No tubercles above anal area; no distinct processes around stigmal field 6
   Distinct tubercles above anal area; often processes around stigmal field; lateral fusiform areas usually distinct 7
6. Stigmal plates on black tubercles; lateral fusiform areas distinct ...... Ortalidæ.
   Stigmal plates barely if at all elevated; lateral fusiform areas indistinct; stigmal plates often contiguous or nearly so; slits long and subparallel ...... Trypetidæ.
7. Slits in stigmal plates rather short, and arranged radiately 8
   Slits slender, and subparallel to each other 9
8. Two tubercles above anal area; stigmal field with distinct processes around it. Anthomyiidæ.
   Four or more tubercles above anal area; slits of stigmal plates usually pointed at one end .... *Muscina.*
9. A button to each stigmal plate; slits rather transverse to body ...... Calliphorinæ.
   No button to stigmal plates, slits of one plate subparallel to those in opposite plate; plates at bottom of a pit .... Sarcophagidæ.

SARCOPHAGIDÆ.

In the Sarcophagidæ the hooks are two in number and the posterior stigmal plates have three straight slits as in the Calliphorinæ. However, these slits are not directed toward those of the opposite plate but are subparallel to them. Moreover, the stigmal field is strongly depressed to form a deep stigmal pit, at the bottom of which are situated the stigmal plates. The segments of the body bear complete rings of spinose areas, and often supplementary pads on the sides.

Sarcophaga larvæ prefer animal matter, and have been found in cheese, oleomargarine, pickled herring, dead insects, and human feces.

Sarcophaga incerta Walk.

(Plate IV, fig. 75.)

Body mostly scabrous, each little wrinkle or stria giving rise to a very short, appressed, stout, spinelike bristle. Head deeply bilobed, each lobe tipped with a very short papilla; mandibles two, well separated. About seven lobes in the anterior spiracle. The basal two-thirds of segments 3 and 4 is scabrous; beginning with segment 5 there is a scabrous fusiform pad each side, and the ventral area of the scabrous basal ring is much broadened and transversely divided by a furrow. Behind this is another longer transverse furrow rather behind the middle of the segment. The dorsum of these segments shows four transverse areas, the posterior one rather broader than the others. The last segment is short, scabrous; the anal area not very prominent, scabrous, and with a small conical tubercle at each outer corner. Stigmal pit about one and one-half times as long as broad, its upper lip with three large, scabrous tubercles each side, the intermediate one rather smaller than the others, the lower lip with two large tubercles, and a median pair of smaller ones slightly back from the margin. Stigmal plates about one-half their diameter apart, each with three slits, subparallel to those in the opposite plate; no button.

Sarcophagid *A*.

(Plate IV, figs. 73, 74, 78.)

Body broad and rather flattened. Head small, bilobed, and a minute antenna on each lobe; two well-separated mandibles. Apex of second segment roughened; the anterior spiracles hemispherical, and occupying a depression at base of the second segment, provided with a number of small tubercles; third segment at base with swollen ring, showing striæ and punctures; surface of the following segments minutely, transversely striate and punctate. Each segment transversely divided, both above and below, into three regions, as shown in the figures; all more or less swollen, and a swollen area on each side; last segment striate and punctate as other segment; anal area hardly prominent, with a rounded spinulose tubercle at each upper corner; stigmal pit one and one-half times broader than long, rather deep, its lips each with three minute cones or tubercles each side; the stigmal plates hardly their diameter apart, each with three straight slits, rather divergent from those of the opposite plate.

From *Sarracenia flava* from Florida.

Sarcophagid *B*.

(Plate IV, figs. 72, 76, 79, 80.)

Body moderately stout. Head small, seen from above truncate and slightly emarginate in middle; two approximate mandibles. Anterior spiracles of about 12 lobes; anterior margin of segment 3 and following with a spinulose, elevated ring, widest on the ventral part; also on the posterior margin of segment 4, and following segments, on each side of venter, a short fusiform, elevated, spinulose area pressing against the basal ring of the next segment; much of the general surface of segments also minutely spinulate, but on the venter are some transverse, slightly elevated smooth spots; on segments 3 and 4 are two each side, on segment 5 and following is a transverse elongate area, each side of which bears three more elevated spots, two at the median end, approximate, the other at the lateral end; outside of this is still another, less distinct, smooth, elevated spot; on the median line before these is another elevated area, transversely striate. On the pleuron of each segment, about where one might expect spiracles, there is a smooth, rounded, elevated spot, faintly double on some of the posterior segments. On the dorsum of segments 3, 4, 5, and 6 there is a transverse, anterior row of small, smooth tubercles. From the fifth the following segments, from above, appear divided transversely into three subequal rings, all spinulose. At tip the anal area is prominent, spinulose, and bears at each outer corner an outwardly directed spinulose cone. The stigmal pit is elliptical, one and two-thirds times as long as broad, its upper lip with three subequal, spinulose cones each side; its lower lip with two similar cones each side, and a median pair smaller, and situated more toward the anal area. The stigmal plates, as usual, have three elongate, simple slits; those of one plate subparallel to those of the other.

These larvæ were taken from Limburger cheese on two occasions, and an extremely similar form was received as having been passed in feces.

Sarcophaga sarraceniæ? (so labelled).

Body pitted over almost the entire surface, and from each pit arises a tiny stiff bristle; sometimes the surface is minutely wrinkled, and near the tip more spinulose. The anterior spiracles show about 12 lobes. The posterior ventral half of segments 3 and 4 is smooth, but the posterior ventral area of the others is crossed by a broad band of these pits and bristles. Around each segment is the usual basal ring, and on the posterior sides is the usual fusiform area pressing against the ring of the following segment, all with pits and bristles. On the pleuron of each segment, about where one might expect spiracles, is a minute tubercle, on the penultimate segment rather large. Above, the segments from 5 on are transversely divided into four parts; the second part from in front is narrower than the others. At the tip the anal area is prominent, with the two outwardly projecting spinulose cones rather larger than in the *Sarcophaga* from Limburger cheese; the upper lip of the stigmal pit has three spinulose cones each side, the outer one the largest, the intermediate one the smallest; the lower lip shows two cones each side as large as the inner of the upper lip, and a median pair smaller and situated back from edge of lip; the stigmal plates have the usual six simple subparallel slits. The penultimate segment shows above a subapical transverse row of small tubercles.

Sarcophagid *C.*

(Plate IV, figs. 70, 77.)

Head rather deeply emarginate from above. Anterior spiracles with about twelve lobes. Each segment has the usual basal elevated, spinulose ring, which is very prominent; from the fifth segment on there is on each side the usual apical fusiform, swollen, spinulose area pressing against the ring of the next segment; the rest of the surface of the segments, both above and below, is smooth, or faintly striate; on the venter of each segment are two small indistinct, smooth tubercles each side. The anal area is prominent, spinulose, and with the usual two outer spinulose cones; beneath there is a smooth, blackish area, crossed by a furrow, perhaps ordinarily covered by the anal tubercle. The stigmal pit is about once and a half longer than broad; its upper lip with three very small cones each side, the intermediate so very minute as to be almost absent; the lower lip has two small cones each side, and a median pair below, and away from the margin.

Reared from decaying vegetables.

Sarcophagid *D.* (From grasshopper, *Melanoplus.*)

(Plate IV, figs. 64–66.)

Body rather stout; second segment seen from above broad, smooth; anterior spiracles short, of about eight lobes. Other segments with a basal, swollen ring, which is covered, but not very closely, with short, acute spinules, stouter than those in some of the other species. Beginning with segment 5 there is the usual fusiform area pressed against the ring of the next segment, also with the stout spinules; the general surface of all the segments (except 2) is also provided with these spinules, but not so abundantly. Around the middle of each segment, from 4 on, there is a row of about 22 tubercles, mostly smooth; on each side of the ventral line are three of these on a slightly swollen area, like that seen in the *Sarcophaga* from Limburger cheese. On most of the ventral segments is a transverse area in front and one behind the row of tubercles which does not have the spinules, but is transversely striated. On the dorsum the segments from 5 on appear to be divided into three transverse portions, the middle one bearing the row of smooth tubercles. Anal tubercles not very prominent, with a short, stout cone at each corner, all spinulose. The stigmal pit is small, nearly egg-shaped, about one and one-fourth times as long as broad; its upper lip with the usual three cones each side, all short, the intermediate one very small; the lower lip has also the usual two cones each side, small, and a median pair still smaller, and remote from edge of lip. The stigmal plates and slits are as usual in the genus.

Chrysomyia macellaria Fab.

(Plate IV, figs. 67, 68, 69, 71.)

The head from above is distinctly bilobed; there are two distinct mandibles; the anterior spiracles are very short, and contain only 7 lobes. The posterior upper part of segment 1 is swollen and spinulose. Each of the following segments (except 2) has a basal, swollen ring, armed with reclinate teeth, the teeth of the anterior row always the larger. Beginning with segment 6 the ventral part of each ring is much broadened and divided transversely by a narrow smooth space. On segments 5 to 10 there is each side behind a fusiform swollen area pressing against the swollen ring of the next segment; this area is also spinulose. The tip of the body shows on the dorsal part a great cavity, in the bottom of which are the stigmal plates, each with three straight slits, those of one subparallel to those of the other; no button. Behind the cavity is a high, transverse, spinulose crest; and the ventral part of tip shows a spinulose area bearing two rather widely separated, prominent, smooth tubercles. The dorsal edge of the tip shows four small conical tubercles.

The "screw-worm", as the larva of this insect is called, occurs in sores and wounds of domestic animals, and also in man. There are various records of its presence in the ears and nose, or nasal cavities, of people, from swelling near the nose, from a boil under the arm, under the skin of a child, and in the navel of a child. It is therefore hardly a possible factor in internal myiasis, and most of such recorded cases probably belonged to some species of *Sarcophaga* whose larvæ are very similar in appearance to those of the screw-worm.

Chrysomyia (?)

(Plate III, figs. 39, 47, 52.)

Head showing a lobe each side, each tipped by a distinct antenna; mandibles two, well separated; base of second segment a swollen ring, finely obliquely striated; each of the following segments with a basal swollen ring, and furnished with spinules; beginning with the fifth segment there is an apical, fusiform, spinulose area each side, pressing against the ring of the next segment; elsewhere the surface is smooth and shining, each segment with two faint grooves around its middle; anterior spiracle with about 10 lobes. The last segment shows below at base a transverse spinulose area; the anal area is not very prominent, spinulose, and with a prominent conical tubercle at each outer corner; the posterior stigmal area occupies the dorso-caudal surface, but hardly forms a pit, with six small tubercles on each lip, those on upper lip rather larger; the stigmal plates are rather close together, have no button, and each shows three straight slits, subparallel to those in the other plates.

Various specimens taken from fish, at the Barbados, West Indies.

CALLIPHORINÆ.

In the Calliphorinæ there are two hooks or mandibles, and the posterior stigmal plates have each three straight slits directed more or less toward those of the opposite plate. The stigmal field is usually outlined by conical tubercles, but not especially depressed. The anal tubercles are usually spinose, and the prothoracic spiracles rarely, if ever, have more than 15 lobes. The segments usually show a more or less complete ring or spinose area on the segments beyond the fifth. This group is very close to the Sarcophagidæ, and some species of *Lucilia* are nearly as well placed there as here.

Calliphora erythrocephala Meig.

(Plate III, figs. 62, 63.)

Head distinctly bilobed from above, each lobe with a minute papilla; two well-separated mandibles; anterior spiracles with from nine to twelve lobes. Beginning with the third, each segment shows an apical swollen ring or girdle, whose surface is scabrous; these rings are broader below than above, and are here emarginate on the posterior middle. Each ventral segment, beginning with the fifth, is divided by a transverse groove near the middle. The anal area shows a smooth median process, divided in middle, and at each outer corner is a cone. The stigmal field is rather concave, the upper lip with three small tubercles each side, the lower lip with two larger tubercles each side, and a median pair smaller and lower down; the stigmal plates are about once and a fourth their diameter apart, each with three simple, straight slits, directed slightly downward, but mostly toward those of the opposite plate; the button is distinct.

The blow-fly deposits eggs on dead animals, and also on fresh and cooked meat. As such meats are often accessible to them in pantries, it is readily seen that many larvæ are swallowed by people each year; we have, however, comparatively few records, probably because the food causes no trouble.

Protocalliphora chrysorrhœa Meig.

(Plate III, figs. 56–58.)

Body rather short, thicker than usual behind. Head plainly bilobed from above, each lobe bearing a distinct papilla, two separate bifid mandibles; posterior margin of first segment with a broad reflexed margin, bearing a fringe of black hair. Surface of body closely, minutely scabrous; beginning with the third segment there is below a median, transverse, apical, elevated, smooth lobe; on segments 4 and 5 there is a lateral lobe at each side; each segment from below also shows a transverse, median furrow, and above most of the segments show a broad, transverse depression. The anal area is smooth, and shows an oblique lobe at each side; a median depression, partly covered by a median lobe from above. Stigmal plates small, about two to three diameters apart; each with three straight slits directed obliquely downward and slightly toward those of the other plate.

Pawnee on Delaware, Pa., attached to young bluebirds in nest, July; Wellesley Hills, Mass., on nestling bluebirds, June. It also occurs in Europe, and is there known to feed on young birds.

Lucilia sericata Meig.

(Plate III, figs. 54, 55, 60, 61.)

Body rather stout, not slender in front. Head very distinctly bilobed, with distinct antennæ; mandibles two, well-separated. Anterior spiracle with about eight lobes. Surface of body mostly smooth; pleura of segments 3, 4, and 5 bilobed; beginning with segment 6 there is a basal ring or girdle, roughened; these girdles on segments 6 to 9 are widened on middle of venter; these pleura are also swollen, but not plainly bilobed, except those near tip. The ventral segments are transversely divided by a line or furrow in the middle. Last segments short, stigmal field occupying most of the tip, slightly depressed, upper lip with three sharp tubercles each side, the intermediate one hardly smaller than the others; lower lip with two large, sharp tubercles each side, and a median pair more remote from the margin. Anal area rather sunken, with a small rounded tubercle at each outer corner. Stigmal plates about one-half their diameter apart, each with three straight slits, directed somewhat toward each other, but also downward.

This species has been recorded in Holland and other parts of Europe as very injurious to sheep. The larvæ, feeding in matted parts of the wool, start sores on the skin, which they invade and feed on the matter, producing ugly, ulcerated patches.

Mr. W. W. Froggatt has recorded a species of *Calliphora* (*oceanica*) as causing similar sores on sheep in New South Wales.

Meinert has reared another *Lucilia* (*L. nobilis*) from larvæ taken from the ears of a sailor.

Lucilia sylvarum Meig.

(Plate III, figs. 48–51.)

In general similar to *L. sericata.* A bilobed head, two mandibles, about eight lobes to the anterior spiracle, surface of body mostly smooth. A roughened ring around each segment; beginning with the sixth segment this ring is broadened below, and traversed by a narrow smooth space; the dorsal part of these rings for the last few segments is very weak and obscure. The last segment is rather short, with the stigmal field hardly concave; the upper lip with three small, subequal tubercles each side, smaller than in *L. sericata,* lower lip with two tubercles each side, and a median pair, removed from edge of lip. Anal area rather prominent, roughened, with two small, rounded, approximate, smooth tubercles below, and one pointed and roughened at each outer corner. Stigmal plates about one-half their diameter apart, each with three straight slits, pointing somewhat toward each other, but not so much as in *Calliphora;* an approach to the condition of *Chrysomyia.*

Myospila and *Auchmeromyia.*

Portchinski has figured *Myospila,* showing that it goes in the Calliphorinæ, and Newstead has figured the Congo floor-maggot, *Auchmeromyia luteola* Walk., which also belongs here.

Gedoelst has figured larvæ of *Cordylobia,* which is considered to be a calliphorine, but these larvæ appear to be much nearer to the Œstridæ.

MUSCINÆ.

According to the larval characters the Muscinæ form a very sharply restricted group. There is but one great hook, and the posterior stigmal plates have three sinuous slits; characters not found (as far as known) in any of the allied forms. The anterior part of the body is more slender than in *Calliphora* and *Sarcophaga.* The spinose parts of the segments are confined to the ventral surface; the anal tubercles are smooth, and there are no prominent tubercles outlining the stigmal field. The prothoracic spiracles have only a few lobes.

Musca domestica L.

(Plate I, figs. 1–4, 16.)

The larva of the house fly has been described by several authors, and very fully by Dr. Hewitt. The body is slender and tapering in front; large and truncate behind. The head has a tiny papilla each side and there is but one great hook, apparently the union of the pair seen in other forms. The prothoracic spiracles show six or seven lobes; on the ventral base of the sixth and following segments there is a transverse, fusiform, swollen area provided with minute teeth. The anal area is but slightly prominent and shows two approximate processes. The stigmal area is barely if at all concave and not outlined by tubercles; the spiracles are prominent, less than their diameter apart, each with three sinuous slits, and a button at the base. In some cases two of the winding slits are apparently connected. The second stage has but two straight slits in each stigmal plate, while in the first larval stage there are two smaller slits on a tubercle each side of the middle, and in this stage there are no prothoracic spiracles.

The larva of the house fly is rarely swallowed, but there are records to that effect, and it sometimes breeds in decaying fruits and vegetables.

Pseudopyrellia cornicina Fab.

(Plate I, figs. 11–15.)

Body rather slender in front, broad and truncate behind. Head from above distinctly bilobed, each with a distinct papilla; one large mandible or hook. Anterior spiracle ,six or seven lobed. Surface generally smooth at junction of segments; there are on sides usually a few short, longitudinal tubercles or striæ. Beginning with the sixth segment each has on the ventral base a transverse, swollen, fusiform area or pad which is provided with two rows of tubercles or longitudinal teeth. Each ventral segment also shows a transverse groove before the middle. The penultimate segment has a fusiform area at apex below with tubercles upon it. The last segment has the anal area not very protuberant, above is a slender median process, and at each side a larger, slender, lateral process; from them a row of small teeth extends upward and toward base. The posterior stigmal plates are large, close together, and each has the three winding slits characteristic of the true Muscidæ.

The specimens were taken from cow dung, which harbored larvæ of *Lyperosia irritans* L.

Muscid *B*.

(Plate III, figs. 40–43.)

This larva is plainly larger than that of the house fly, and less tapering in front; the head is blunt and rounded, and the papillæ are not distinct; there is but one mandible; the anterior spiracles are six-lobed. The fifth segment has below on base a slightly swollen area which is transversely striate; the sixth and following segments have on the ventral base the usual fusiform area, but little swollen, faintly divided on the median line, and with many longitudinal teeth or short ridges; the dorsum is smooth. The anal area is sunken, but the upper margin shows a median lobe with three smaller lobes each side; surface of last segment smooth; stigmal plates small, deep black, about their diameter apart and each with three sinuous slits, similar to those of *Musca*.

Several specimens sent from New York that were passed by an epileptic patient in December and January. This species is closely related to the house fly, but to what genus it belongs is yet uncertain—perhaps to *Graphomyia*.

Lyperosia irritans L.

(Plate I, figs. 5–7.)

The body of the horn fly larva is very slender, especially in front. Head bilobed, each lobe with a tiny papilla; one mandible, not very large. The anterior spiracles have six lobes. The general surface of the body is smooth or very minutely striate; the fourth ventral segment at base shows an area with tubercles or small teeth; beginning with the sixth, each segment has on the ventral base the transverse, fusiform, swollen area, with two rows of longitudinal teeth or tubercles, and also each ventral segment shows a transverse groove before the middle, and the penultimate segment has at base beneath a spinulose fusiform area. The last segment is rather evenly rounded above, the stigmal plates close together, and each with three winding slits, as in allied forms. The anal area is moderately protuberant, mostly black, and shows below a smooth submedian lobe each side, and laterad of this a larger smooth lobe; above is a pair of more prominent, smooth, black tubercles; each side of these is a smaller cone and above is a transverse row of teeth.

Specimens came from cow manure containing also the larvæ of *Pseudopyrellia cornicina*.

Stomoxys calcitrans L.

(Plate I, figs. 8–10.)

The larva has been described and figured by Newstead and later by Hewitt. It is similar in shape to that of the house fly, with a single great hook or mandible; the anterior spiracles have five lobes; the sixth and following segments have each a ventral basal fusiform area provided with tubercles; the anal area has two submedian tubercles and three lobes each side of these; above them is a row of minute granules, ending each side in a larger granulate tubercle; there are no tubercles outlining the stigmal area; the stigmal plates are subtriangular, about one and one-half times their diameter apart, black, and each with three pale areas containing a sinuous or S-shaped slit, but these slits are not near each other at the end as in *Musca*, and there is no apparent button.

It commonly breeds in manure of various kinds, but also in decaying matter, and is not often passed by people, but there is one record. It is recorded that in parts of Africa *Stomoxys* attacks dogs so viciously that the ears are often seen raw and bleeding from their bites.

Mesembrina and *Dasyphora*.

Portchinski has described and figured the larvæ of *Mesembrina* and *Dasyphora*.[1] His figures show the posterior spiracles with the winding slits as in *Musca*, and in *Mesembrina* he figures the single great hook, so that these genera also belong in the Muscinæ as here restricted. Both genera have the posterior spiracular plates semicircular, but in *Mesembrina* they are very faintly trilobed; in both genera the plates are very close together.

Glossina.

The tsetse fly normally deposits a full grown larva, although specimens in captivity have sometimes deposited partly grown larvæ. This larva is short, subcylindrical, of a yellowish-white color, and at the truncate posterior end are two large, rounded, black processes, which have finely granulated surfaces. At the ventral base of each of the segments 4 to 10 is a narrow, transverse, fusiform ridge. Austen, in his account (Brit. Med. Journ., 1904, pt. 2, p. 659) says that "in the larger larvæ the tips of the mouth hooks can be seen, slightly protruding from the cephalic end." It would therefore appear that they had two separate mouth-hooks, and not one as in *Stomoxys* and *Musca*. If this be the case *Glossina* is not closely related to *Stomoxys*.

MUSCINA GROUP.

The larvæ of the Muscina group are in general related to the true Muscidæ, but differ at once in the simple, short, pointed slits in the posterior stigmal plates. The great hooks lie close together so that they approach the azygos condition seen in *Musca*. Most of the classifications keep *Muscina* in the true Muscidæ, but from the larval standpoint it must be separated.

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[1] Hor. Ent. Soc. Ross., vol. 26, pp. 91, 118, 1891.

These forms infest overripe fruit, and since such fruit is apt to cause sickness, these larvæ are frequently reported by physicians.

Muscina stabulans Fall.

(Plate II, figs. 17, 18, 19, 27, 28, 36.)

Head bilobed from above, no distinct antennæ; two closely approximate mandibles; anterior spiracles of about six lobes. Surface of segments mostly smooth; beginning with fifth segment there is on the venter a long, basal, transverse, fusiform swollen area, furnished on the crest with rows of teeth; each of these areas is divided on the median line. On the penultimate segment there is a similar area at tip, but not divided; the segments below also show a transverse line before the middle. The last segment has the anal basal area spinulose, but not very prominent, and with a median and three lateral spinulose tubercles in a nearly transverse row; the rounded tip of the segment shows, across the middle, faint traces of four low cones. The stigmal plates are scarcely elevated, black, less than their diameter apart, and each with three very short slits pointing toward those of the opposite plate.

The larva of this species is common in decaying vegetable matter; and it has been reared from rotten apples, pears, squash, mushrooms, and dead insect larvæ. In one case a considerable number was passed by a child suffering from summer complaint.

Laboulbène records larvæ of this species vomited by a person suffering from bronchitis.

Muscina assimilis Fall.

(Plate II, figs. 20–22.)

Head bilobed, each lobe with a prominent papilla; mandibles two, well-separated. Anterior spiracles with about nine lobes. Surface smooth; the rings or girdles to segments distinctly outlined, but little swollen; they are faintly scabrous, and on the ventral surface broadened and transversely divided by a furrow; there is also on most of the ventral segments a short, median, transverse line; the anal area appears extruded as a broad, rather flattened lobe, traversed by median and transverse grooves; the tubercle above has a small cone at each outer corner. The stigmal field is margined on each upper side by three very small conical tubercles, and behind by a transverse row of four large conical tubercles close together, and laterad of them is a minute tubercle. The stigmal plates are rather more than their diameter apart, and each shows three short, straight slits directed toward those of the opposite plate; the button is distinct.

Larvæ in roots of a melon vine.

Near *Muscina*.

(Plate II, figs. 23–26.)

Body slender, especially so in the anterior part; segments 3, 4, and 5 with a ridge around near tip, and faintly spinulate. Beginning with the fifth segment the ventral area is swollen, and with two bands of spinules. At the ventral base of the last segment there is a row of seven rounded tubercles, all nearly smooth, the median smaller than the others; the middle one of each side is at the end of a curved swollen area which extends under the submedian tubercle. The tip of body is truncate, and with four tubercles on the upper edge and four below; those above are rather prominent, but those below are small, and the outer ones scarcely visible. The stigmal plates are elevated, and each has three straight slits, directed toward those of the opposite plate; the button is distinct. The anterior spiracles have six long lobes. The head, seen from above, shows a truncate lobe each side.

This has been sent in two cases as passed in feces, both localities in the South.

Muscid *A*.

(Plate II, figs. 33, 37, 38.)

Head from above bilobed; two closely approximate mandibles; anterior spiracles short, with four lobes. Segments generally smooth; beginning with the fifth each has a transverse line on middle of venter; beginning with the sixth each has a basal, transverse, fusiform, spinulose area on the venter; on the penultimate segment there is one at tip, and on last segment one at base surrounding the anal area, which is not prominent, but shows two smooth brown areas on the middle, and each side a small tubercle. The fourth segment shows above and on sides a raised line near the posterior edge, also a finer line on basal part of last segment; the segments at their juncture are usually contracted. The last segment is rather flat on top, but evenly rounded below, and without tubercles; the stigmal plates elevated, scarcely one-half their diameter apart, each with a button and three short straight slits pointing toward those of the opposite plate.

Sent in from the South as passed in feces.

Muscid *C*.

(Plate II, figs. 29–32.)

The bilobed head has a papilla each side; two separate great hooks; the anterior spiracles are semicircular and with many (about 20) lobes; segment 5 and those beyond have each a swollen, fusiform area on the ventral base, each with transverse ridges; lateral fusiform areas not prominent, a transverse line on ventral middle of most segments; the anal area shows four hispid tubercles in a transverse row; stigmal plates black, a little elevated, each with three short pointed slits, and a button; a pair of cones above and a pair of smaller cones below stigmal plates.

In orange from Mexico, with *Trypeta ludens*, No. 4242.

Muscid *D*.

(Plate II, figs. 34, 35.)

Body long and slender, the bilobed head with small papilla; two great hooks; anterior spiracles with about six lobes; a narrow, fusiform, swollen area on the ventral base of the segments beyond 4, each with transverse ridges; a transverse line on ventral middle of these segments; lateral fusiform areas distinct; tip of body large and truncate, no distinct tubercles but two low humps above and less distinct ones below the stigmal plates; latter small, about their diameter apart, each with three rather short, subparallel slits, and directed toward those of opposite plate, the button distinct. Anal area with three smooth, rounded tubercles each side, and a less distinct median one, each tubercle with a few fine grooves on tip; a transverse granulated ridge in front of the anal tubercles.

From Alaska, probably taken on cabbage.

HOMALOMYIA GROUP.

The larva of Homalomyia has long been known because of its peculiar appearance, and the frequency with which it is associated with human food. These larvæ are flat and fusiform, each segment provided with long bristly processes. The mouth parts are obscure, and the stigmal plates occupy a dorsal position on the last segment of the body.

So very different are these larvæ from the ordinary anthomyiid larvæ that they should stand in a group by themselves.

Homalomyia sp.

(Plate VI, fig. 106.)

The larva of the genus Homalomyia is entirely different in general appearance from any of the other forms considered in this paper. The body is flattened, and bears above a pair of long spinous processes on each segment, forming two submedian rows; there is a row of similar processes on each upper and lower side, making six rows of these processes on the body; on the head is a pair of anteriorly-directed processes, and the last segment, whose posterior surface is apparently turned upward, has two of these processes on each side, and a pair of longer ones on the hind margin. These processes, and the general surface of the body, are usually scabrous. Near the upper base of the last segment is a small trilobed process each side; these are the posterior spiracles, and each has three short, straight slits. Each ventral segment is transversely divided by a narrow furrow or line which terminates each side in a slight tubercle. The last segment has behind the usual transverse line another much curved, and with a double median forward extension.

There is a number of species of *Homalomyia*, differing in the proportions of the processes, and Walsh described three species from the larval stage. There are many records of the passage of *Homalomyia* larvæ, and we have others in the office. Since they feed on fruit and vegetables that are just beginning to decay one can readily see that they are often swallowed by people. They also breed, at least some species, in human feces, and as the flies occur in houses they are, in a lesser way than the house fly, the possible conveyors of disease.

ANTHOMYIIDÆ.

(Plate VI, in part.)

The larvæ of Anthomyiidæ are of the general shape of the larva of the house fly, but hardly so slender in front; the head shows distinctly a pair of papillæ; there are two separate great hooks; the anterior spiracles have not many lobes, often but 6 to 10 (13 are figured for one species); segment 5 and others beyond have each a swollen fusiform area on the ventral base, which is provided with roughened ridges; the lateral fusiform areas are well developed. The caudal end is truncate, but barely if at all sunken, and margined with a number of short, fleshy tubercles, about eight to fourteen in number, according to the species, some rather larger than others, and often with four of them in a transverse row; there are, usually at least, two tubercles above the anal area; the stigmal plates are not far apart, and each has three short slits arranged more radiately than in the other groups; sometimes the button is absent.

A few notes on some of the common species occurring on foods and elsewhere will serve to show the range of form in the family.

In *Pegomya fusciceps* Zett. (figs. 111, 116) there are four simple, conical tubercles in a transverse row below the stigmal plates; the stigmal plates do not show a button; and the anterior spiracles have about six lobes.

In *Pegomya cepetorum* Meade (fig. 119) there are four simple slender tubercles in a row and the stigmal plates are similar to those of *P. fusciceps*, but the anterior spiracles are larger and have about ten lobes.

In *Pegomya brassicæ* Bouché (figs. 107, 113, 114) and *P. planipalpis* Stein the median tubercles of the four in a row are broader than the others and bifid at tip, more deeply so in *P. brassicæ* than in *P. planipalpis*, and the stigmal plates show a distinct button; the anterior spiracles have about 10 lobes. In a *Pegomya* from Alaska, taken from cauliflower, the median tubercles of the four in a row are very broad and trifid at tip.

In *Pegomya ruficeps* Stein the body is shorter and stouter, and with many swollen areas and transverse lines; the anterior spiracles have about 12 lobes; the median tubercles of the four in a row are much smaller than the others; the stigmal plates are slightly elevated, each with the three radiating slits, but no distinct button.

The larva of *Pegomya bicolor* Wied. (figs. 110, 112) has all the tubercles at tip of body small; the four in a row are all equally small; the stigmal plates as shown in figure 112; the anterior spiracles rather large, and with about 12 small lobes; there is a swollen area of ridges all around each segment from the fourth backward. A larva, supposedly an anthomyiid, on roots of roses, shows at tip (fig. 117) four large processes; the stigmal plates being on the inner base of the smaller processes.

Carpenter has figured in *Pegomya betæ* Curtis two prominent teeth on the great hooks; the anterior spiracles with eight lobes, and the stigmal plates far apart.

Hewitt has published a fine account of *Anthomyia radicum* L.; no teeth on the great hooks; anterior spiracles with 13 lobes; stigmal plates near each other, and with three rather long slits; the median tubercles of the four in a row are smaller than others and situated a little nearer the stigmal plates; each is bifid at tip; no button is shown on the stigmal plates.

In *Phorbia floccosa* Macq. (figs. 108, 109) the stigmal field is margined by 12 conical processes, and the anal tubercle is in the form of two similar conical processes; the anterior spiracle has but six lobes.

TRYPETIDÆ.

In the few forms of Trypetidæ examined, those that feed in fruits and soft tissue, there are two mandibles or hooks, the tip of the body is destitute of pointed tubercles, and there is one pair of rounded anal tubercles. The posterior spiracles are similar to those of the Calliphorinæ—three simple slits, those of one plate directed toward those of the other. The prothoracic spiracles have numerous lobes, often over twenty, always more numerous than in the Muscidæ or Sarcophagidæ. There are no complete bands of spinules around the body, only fusiform areas on the ventral segments; the stigmal area is not noticeably depressed.

Ceratitis capitata Wied.

(Plate V, figs. 87, 88, 89, 100.)

Body moderately tapering in front, not particularly slender; two distant mandibles; head from above bilobed; anterior spiracles long, with about 15 lobes. The segments show on the venter the usual transverse, fusiform, spinulose areas, and between them on the middle of each segment are two low ridges, which in the median area are connected as in the figure, one of them being broken in the middle. On the posterior border of each segment where it joins the next is a row of pits, and also less distinct a longitudinal row, or two of them, on the side of each segment; on some segments these are more like a line or groove. Elsewhere on the segments there are a few longitudinal grooves and ridges. At apex of body the stigmal area is slightly elevated, the plates long, and each has three short, straight slits. Above them on the upper edge is a pair of distant, conical tubercles; below the plates is a transverse, elevated crest, and on the lower slope is an elliptical, medial area, spinulose around the edge, and containing the two anal tubercles, elongate, and pear-shaped, but not much elevated.

This is the peach maggot of tropical countries.

Acidia fratria Loew.

(Plate V, figs. 91–93.)

Body very pale; not very slender; two approximate mandibles; head from above rounded at tip; anterior spiracles long, with concave upper edge, and about 24 lobes. No part of body spinulose; the swollen parts of segments not very prominent, and striate or wrinkled, not spinulose. At the tip there are below two smooth, approximate tubercles on the anal area, which is not prominent. At dorsal tip is a large process, apparently bilobed from the side, and also from above, bearing in its middle the flat-topped stigmal eminence; the stigmal plates are fully their diameter apart, each with three short slits directed toward those of opposite plate, no apparent button, and no other tubercles.

This species mines the leaves of the parsnip.

Dacus ferrugineus Fab.

(Plate V, figs. 90, 103, 105.)

Body rather thick, anterior part not slender; two widely separated mandibles; anterior spiracles long and of about 38 lobes. Anterior margins of segments 3, 4, and 5 minutely transversely striated above. The ventral region, beginning with segment 4, shows the scabrous elevated areas. The last segment shows beneath a large scabrous flattened elevation bearing two approximate smooth tubercles. The tip has a faint conelike process each side below the stigmata; the latter are slightly elevated, each showing three straight slits, wide apart and directed toward those of the opposite plate.

Dacus curcurbitæ Coq.

(Plate V, figs. 101, 102, 104.)

Head bilobed from above, each lobe bearing a distinct antenna; mandibles two, distant; anterior spiracles long, with about 20 lobes. Ventral segments 6 to 12 with swollen spinulose areas. The last segment shows below a transversely elliptical spinulose area, rather depressed, and containing two approximate, flat, rounded tubercles; tip of body rounded, with a low, broad swelling at each lower corner; the stigmal plates are approximate, each with three short slits, pointing toward those of the opposite plate.

From melons in Hawaii; No. 8478.

Rhagoletis suavis Loew.

(Plate V, figs. 94–96.)

Body much the largest near the tip; head small, bilobed, each lobe with minute antenna; two stout, blunt mandibles, and laterad of them is a horny crest; anterior spiracles hemispherical, with about 25 lobes; surface of body smooth; beginning with the fifth segment there is a basal, fusiform, much swollen area on the venter of each segment, each transversely ridged and punctate; on the middle of these segments is a transverse line extending down on the sides; dorsum of segments indistinctly divided into three transverse areas; last segment with the anal area near the tip, not very prominent, but with two prominent, approximate, smooth lobes; above the anal area are two minute depressions; the stigmal field is slightly depressed, the plates close together, each with three narrow, straight slits directed toward those of the opposite plate.

From shuck of a butternut, Plummers Island, Md.

Rhagoletis pomonella Walsh.

(Plate V, figs. 83, 84.)

Body rather stout, tapering but little in front; head broad, papilla very small; two great hooks; anterior spiracles broad, with about 15 lobes; each dorsal segment from the third has a basal area of ridges; each ventral segment from the fifth has a broad, basal, fusiform, swollen area, which is very minutely ridged; a transverse line on middle of each ventral segment, and the apex of each segment with an area of several transverse ridges; the lateral fusiform areas are fairly distinct; the anal tubercle is moderately prominent, and strongly bilobed; the stigmal plates are fully their diameter apart, each with three straight, parallel slits; between the stigmal plates and the anal tubercle are two pairs of distinct, rounded, fleshy tubercles; the two nearer the anal tubercle are closer to each other than are the other two.

Locally common in northern apples.

Rhagoletis cingulata Loew.

(Plate V, figs. 97, 98.)

Head broad, papilla barely visible, two prominent great hooks; anterior spiracles broad, concave above, with about fourteen lobes. Ventral segments from 5 onward each with a broad, basal, fusiform, swollen area, with many transverse ridges; each ventral segment has also in the middle a transverse line or furrow; the lateral fusiform areas indistinct; on the dorsal base of segments 3, 4, and 5 is an area of transverse ridges, barely distinct on the following segments; anal tubercle small, slightly roughened, divided by a longitudinal line; stigmal plates not their diameter apart, each with three short, barely curved slits; between the stigmal plates and the anal tubercle, at the extreme tip of the body, are two low elevations or swellings each side, each with a minute central tubercle, the four forming a curved line.

Common in cherries.

Epochra canadensis Loew.

(Plate V, figs. 81, 82.)

Body subcylindrical, tapering only a little in front; papilla of head very minute; two well-separated great hooks; anterior spiracles broad, broadly emarginate in the middle, with about eighteen to twenty lobes. Ventral segments from the fifth backward with a very narrow, basal, fusiform area, only slightly protuberant, and finely ridged; each of these segments with a ventral, median, transverse line; no lines or furrows on dorsum; no lateral fusiform areas. Apex of body evenly rounded, smooth, no tubercles; the stigmal plates without a button, each with three short, nearly straight slits; anal tubercle distinct, but small, more yellow than the surrounding surface, slightly convex, and divided by a longitudinal line.

From currants; more common in the North.

Anastrepha ludens Loew.

(Plate V, figs. 85, 86, 99.)

Head small, short, bilobed from above; two distinct mandibles; anterior spiracles long, with twenty or more lobes; on the fifth and the following segments is the usual ventral, basal, fusiform area, with transverse striæ, the area on fifth segment smaller than the others; the anal area shows two large, smooth, prominent, submedian tubercles; there are no tubercles outlining the stigmal field; the stigmal plates are contiguous, each with three short, straight slits directed toward those of opposite plate; these slits are much shorter and broader than in *Rhagoletis*.

This species, the orange maggot, is sometimes found in Mexican oranges.

ORTALIDÆ.

The larvæ of the ortalid flies are rather more slender than those of *Musca;* the two great hooks are distinct; the anterior spiracles have about ten lobes; the ventral fusiform areas are distinct, but the lateral rather weak; the tip of body ends in two slight processes bearing the posterior stigmal plates, each with three short slits.

Most of the species occur in places where they are not apt to be swallowed by man, but the onion maggot, and a few other forms, may occasionally be taken in food.

Euxesta thomæ Loew.

(Plate III, figs. 53, 59.)

Body smooth, slender; two great hooks; two distinct papillæ on the bilobed head; segments from 5 on each with distinct fusiform, swollen area on ventral base, each area with several transverse ridges; lateral fusiform areas fairly distinct; anal area not swollen, and no tubercles; tip of body rounded and smooth, without tubercles; each stigmal plate on an elevated black base, each plate with three short slits and a button, but indistinct; nine lobes in the anterior spiracles.

In ear of corn from Texas.

A similar ortalid from tomatoes in Florida has but five lobes in the anterior spiracles, and the slits on the posterior spiracles are more nearly on the outer edge.

Tritoxa flexa Wied (?)

(Plate III, figs. 44–46.)

Slender; head truncate, with two small papillæ; two great hooks; anterior spiracles with ten lobes; segment 5 and beyond each with a swollen, fusiform area on ventral base, each area with several ridges in front and behind, leaving a smooth space in the middle; a faint transverse line on middle of ventral segments; lateral fusiform areas visible, but not prominent; anal area with a low swollen lobe each side, no tubercles; a few fine ridges above and below anal area; last segment rounded, smooth, no tubercles; stigmal plates on low elevations, about their diameter apart, each with three radiated slits, and a button, incomplete on inner side.

From onions, in Pennsylvania. It is probably this species or its close ally, *T. incurva* Loew.

SEPSIDÆ.

The larvæ of the Sepsidæ are of the muscid shape; the fusiform areas are not prominent except on the venter; the anal tubercle is rather inconspicuous; the spiracles are situated on projections at the tip of the body, and also in the pupæ. Each spiracle has three straight slits.

They breed mostly in manures, but sometimes in decaying fruit; one species, the cheese skipper, has long been known because of its occurrence on old cheeses.

Piophila casei L.

(Plate VII, figs. 122–124.)

The body is of the usual shape, tapering in front. The head is emarginate from above, each corner projecting in a papilla; there are two well-separated great hooks. The anterior spiracles are rather prominent and divided into about ten lobes. The sixth and following segments have on the ventral base a narrow, transverse, fusiform area in which the ridges are broken into minute teeth. The last segment has at tip two processes, each about three times as long as broad at base, and rather more than their length apart; this last segment also has a prominent outer angle each side near the base. The posterior spiracles are situated on the inner tip of a slight protuberance, and each has three straight slits. Each main tracheal tube is black for a short distance from the tip.

The cheese skipper not only occurs in cheese, but also in hams, especially the fatty parts, and in oleomargarine; there are several records of its occurrence in people, and we have one such case.

Alessandrini has recently made experiments with this species on dogs and finds that it passes through uninjured, while it may cause intestinal lesions in the dog. He also found that the larva was remarkably resistant to many chemical substances, supposedly destructive to life.

DROSOPHILIDÆ.

Drosophila.

(Plate VIII, figs. 133, 135–137.)

Body rather slender in front; head with distinct papillæ, two well-separated great hooks; anterior spiracles obscure, not much extruded, with eight to ten long branches or lobes; each segment of the body is slightly constricted in the middle, with a basal roughened area encircling each segment; anal tubercle broad, dark colored, bilobed, but not very prominent; around tip of body are several pairs of tubercles; five pairs are described for *D. ampelophila* Loew, four pairs for *D. amœna* Loew; the stigmal plates are on the tips of two approximate cylindrical processes which rest on an elevated part of the tip of the body.

The pupæ are rather barrel-shaped, with a slender projection at each anterior corner of the body, the process varying in size and tubercles with the species; the posterior end of the body is provided with tubercles similar to those of the larvæ, and stigmal plates at the tip of a pair of truncate projections. The pupæ are usually found in the same lot as the larvæ, as evidently but a few days are required for them to develop from the eggs.

Drosophila larvæ and pupæ are quite common in overripe fruit, especially grapes, pears, and apples; they also occur in jellies, jams, vinegar, pickles, etc., and so are frequently swallowed by people.

THE CEPHALOPHARYNGEAL SKELETON.

The structure of the cephalopharyngeal skeleton varies with the species. It is not always feasible to use this structure in identifying material, since it usually necessitates the destruction of the anterior part of the larva, which one does not care to do in unique specimens. Figures have been given of this skeleton as seen in several species; but it can not be used as a diagnostic character for groups until one has examined a larger number of species. In the first larval stage this skeleton is formed of very slender pieces, only narrowly connected, but in the second and third stages the parts broaden, especially the lateral plates.

In the Trypetidæ (figs. 125, 132) the lateral plates are only weakly chitinized, and not black; they are deeply indented from behind, so that the upper and lower limbs are connected only for a short distance. The great hooks have a very prominent spur above at base.

In the Ortalidæ (*Euxesta,* fig. 121) the skeleton is very similar to that of the Trypetidæ.

In the three species of *Sarcophaga* examined the lateral plates are not so deeply indented from behind, and the upper limb shows a slender appendage along its lower edge; the great hooks have a spur above at base (fig. 134).

In the Muscidæ (figs. 115, 120) the lateral plates are still less indented from behind, the lower limb being much larger than the upper limb; the hypostomal sclerites are short and heavy; the great hook (for there is but one) has a rather small spur above at base.

In the Calliphorinæ (figs. 126, 128, 131) the lateral plates are deeply indented from behind, and here it is the upper limb that is the larger. The hypostomal sclerites have a hump or swelling beneath; the great hooks have hardly any spur above at base. In some of the genera, *Calliphora* and *Protocalliphora*, only part of the upper limb of the lateral plates is strongly chitinized.

In *Homalomyia* (fig. 127) there is an approach to the form of *Musca*, the lateral plates only slightly indented, the lower limb the larger, and a basal spur above on the great hooks. In the upper anterior part of the lateral plates, where they unite, is a number of perforations, some round, some elongate; these are not seen in the other families examined, but appear in *Drosophila* (fig. 133).

BEARING OF LARVÆ ON CLASSIFICATION.

The value of larval characters in classification will always be variously estimated by different entomologists, and the writer is far from claiming that any group should be delimited by larval characters. But in view of the diversity of opinion among dipterists as to the divisions of the old family Muscidæ, the bearing of these larval structures may be of interest. Some authors have taken *Stomoxys* and *Glossina* from the Muscidæ and put them in a separate family, the Stomoxyidæ. From the standpoint of the larvæ there is no warrant for this separation, *Stomoxys* being much nearer in structure to *Musca* than is either to the Calliphorinæ. Looking at these groups from the structure of the larvæ, one will notice that both the Muscidæ and the Anthomyiidæ possess two styles of larval structure, and it is very difficult to see why these striking differences in the larvæ should not find some corresponding difference in the flies upon which to found a better classification. The larva of *Homalomyia* differs so greatly from that of *Anthomyia* that one can not but think that this difference should be reflected in the adult. Likewise when one considers the peculiarities of the larvæ of *Musca*, *Stomoxys*, *Lyperosia*, and *Pseudopyrellia*, differing from other muscids by important characters at each end of the body, one can hardly believe that there is not some structure of the flies to distinguish them as a group.

The classifications of the Muscidæ by Pandelle and by Girschner agree much better with the larvæ than the classifications seen in the catalogues. These authors have put the Calliphorinæ remote from the true Muscidæ and near the Sarcophagidæ; Pandelle also has a distinct group in the Anthomyiidæ for *Homalomyia*, and the true Muscidæ are included in his Anthomyiares. However, the larvæ of the true Muscidæ are so different from *Anthomyia* that one would suppose the flies should have a group at least equal in value to that of the Anthomyiidæ or Tachinidæ. This would indicate three families, Muscidæ in the restricted sense—Tachinidæ, to include Calliphorinæ and Sarcophagidæ; and the Anthomyiidæ, to include *Muscina* and *Homalomyia*, the latter to have subfamily rank.

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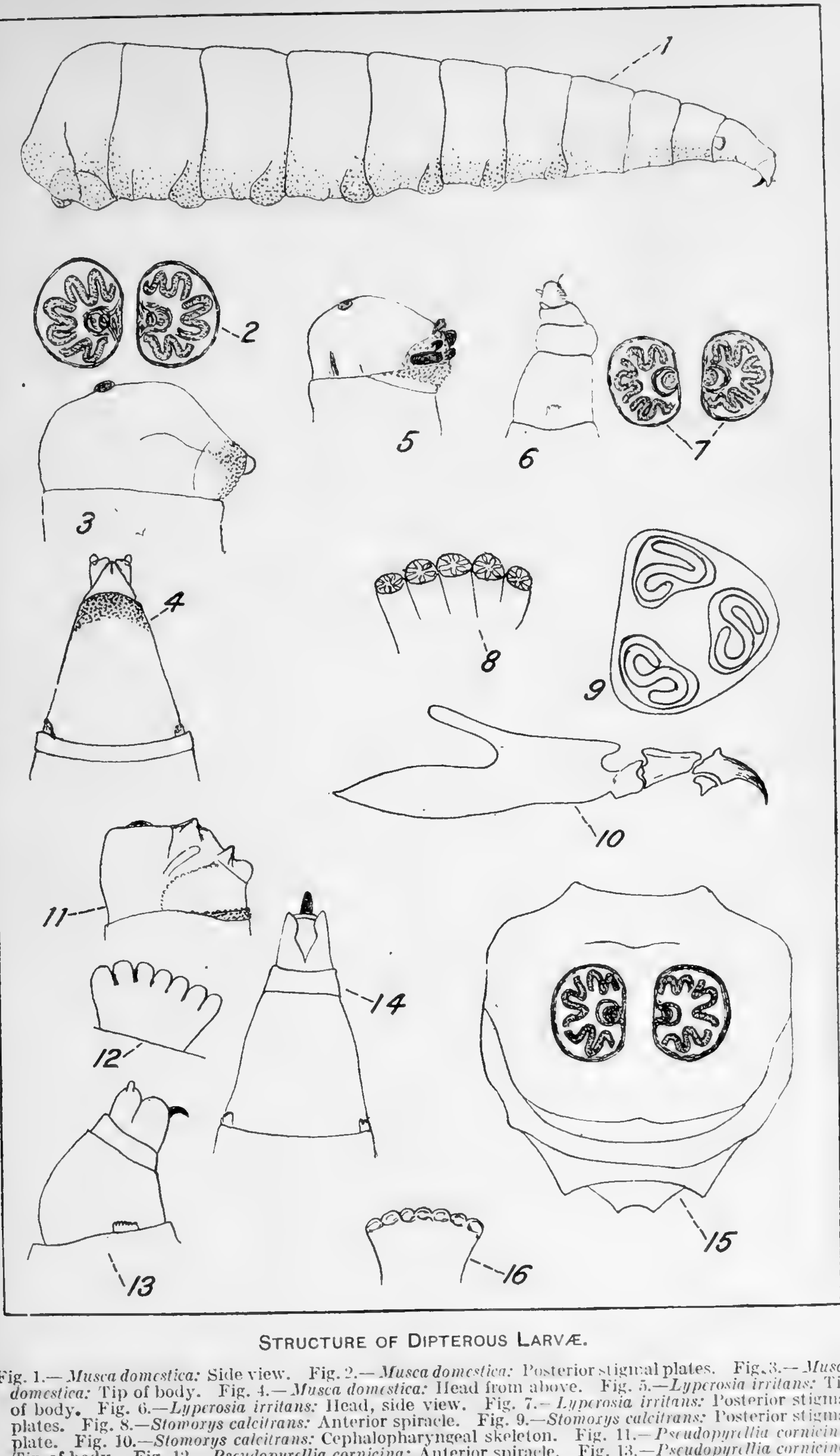
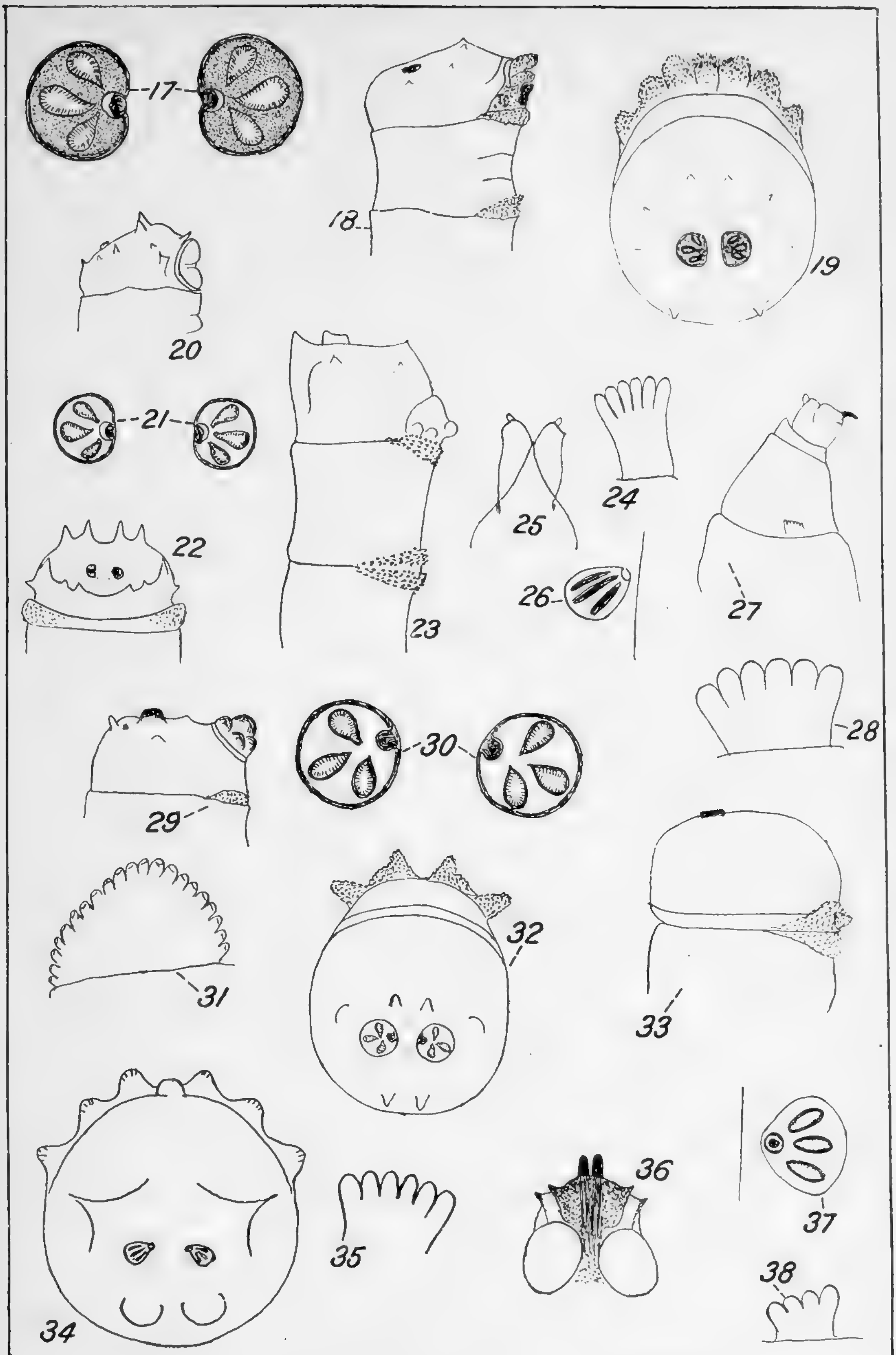


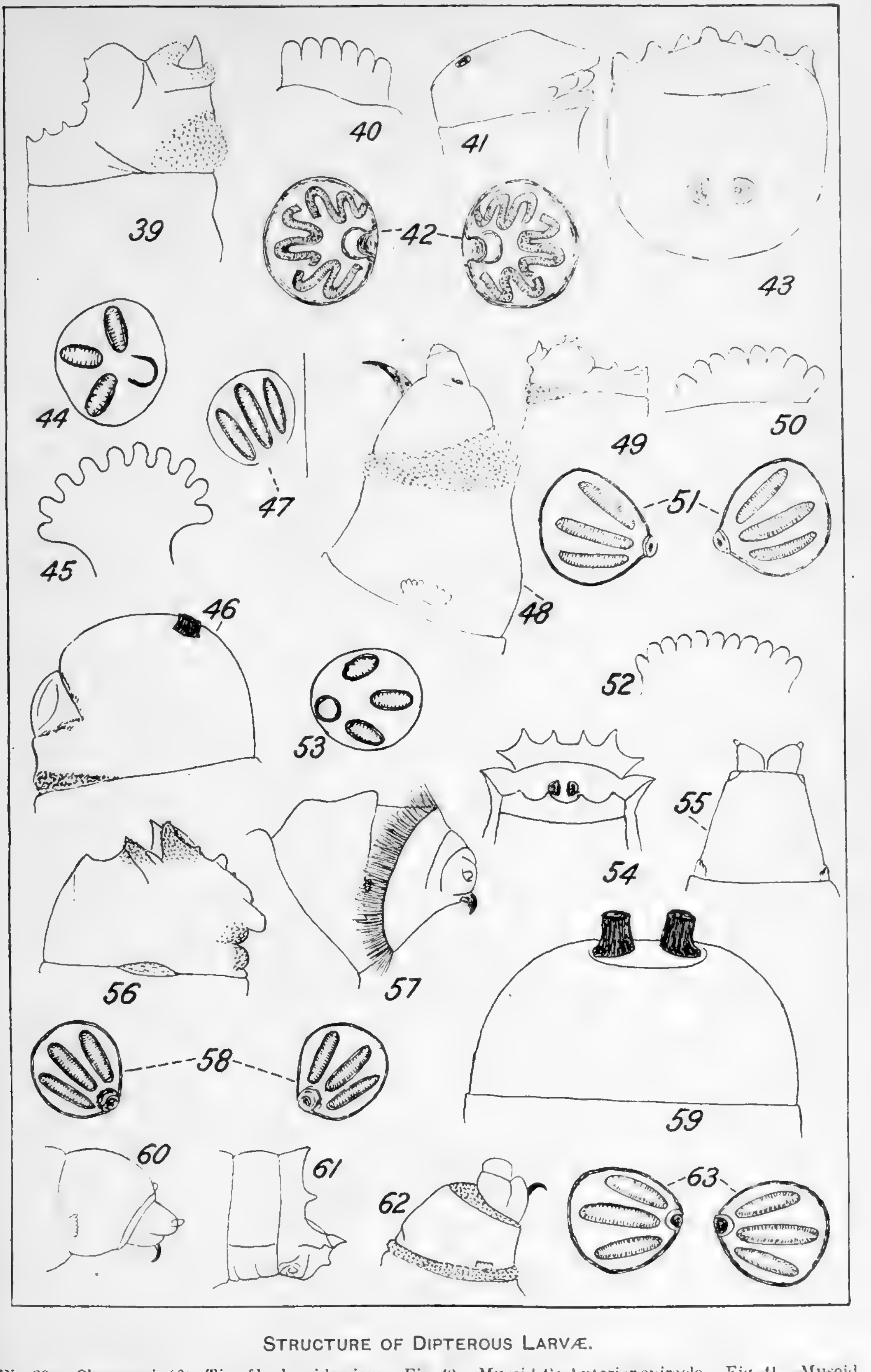
STRUCTURE OF DIPTEROUS LARVÆ.

Fig. 1.—*Musca domestica:* Side view. Fig. 2.—*Musca domestica:* Posterior stigmal plates. Fig. 3.—*Musca domestica:* Tip of body. Fig. 4.—*Musca domestica:* Head from above. Fig. 5.—*Lyperosia irritans:* Tip of body. Fig. 6.—*Lyperosia irritans:* Head, side view. Fig. 7.—*Lyperosia irritans:* Posterior stigmal plates. Fig. 8.—*Stomorys calcitrans:* Anterior spiracle. Fig. 9.—*Stomorys calcitrans:* Posterior stigmal plate. Fig. 10.—*Stomorys calcitrans:* Cephalopharyngeal skeleton. Fig. 11.—*Pseudopyrellia cornicina:* Tip of body. Fig. 12.—*Pseudopyrellia cornicina:* Anterior spiracle. Fig. 13.—*Pseudopyrellia cornicina:* Head, side view. Fig. 14.—*Pseudopyrellia cornicina:* Head, top view. Fig. 15.—*Pseudopyrellia cornicina:* Stigmal area. Fig. 16.—*Musca domestica:* Anterior spiracle. Enlarged. (Original.)



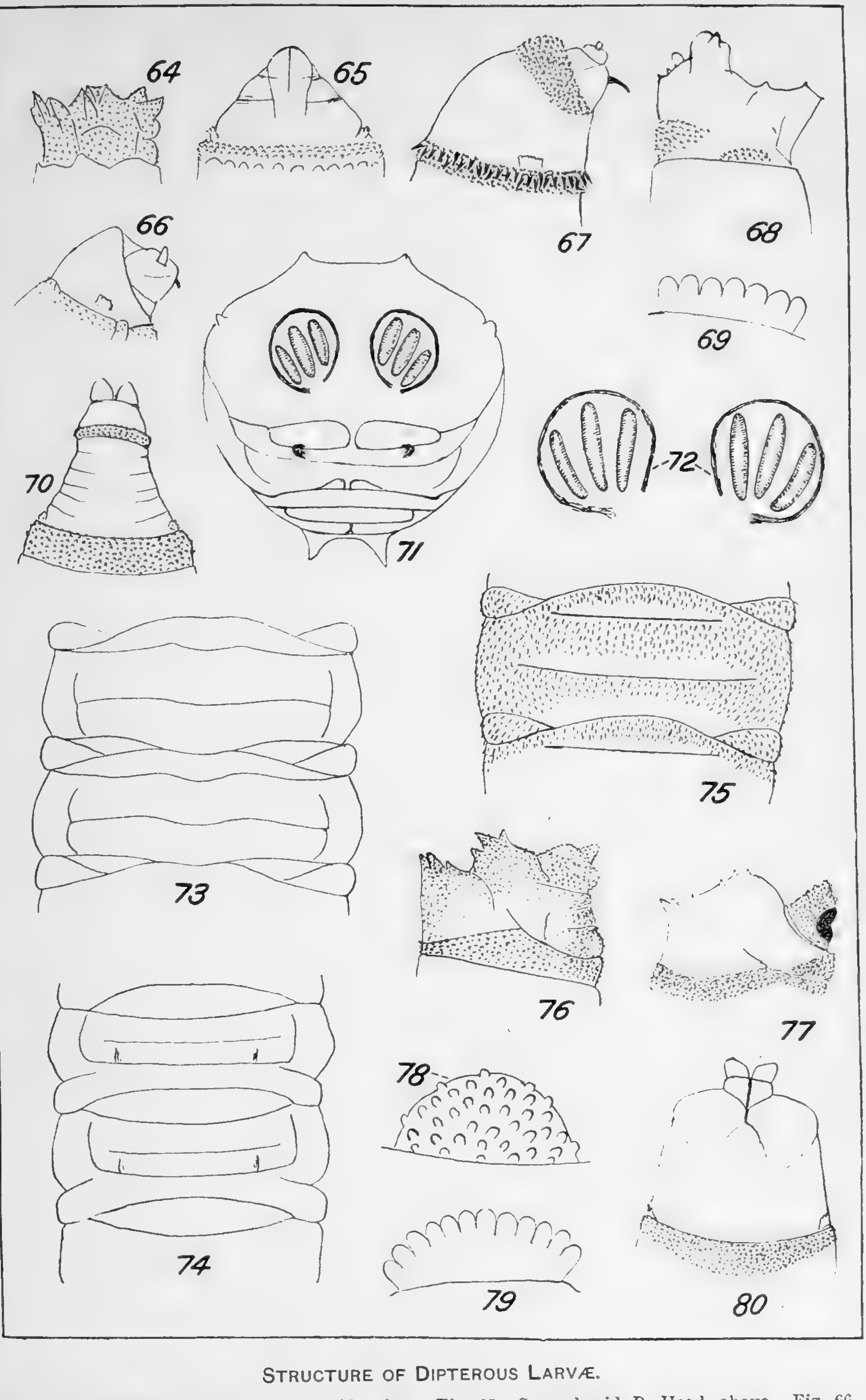
STRUCTURE OF DIPTEROUS LARVÆ.

Fig. 17.—*Muscina stabulans:* Stigmal plates. Fig. 18.—*Muscina stabulans:* Tip of body, side view. Fig. 19.—*Muscina stabulans:* End of body. Fig. 20.—*Muscina assimilis:* Tip of body, side view. Fig. 21.—*Muscina assimilis:* Stigmal plates. Fig. 22.—*Muscina assimilis:* End of body. Fig. 23.—Near *Muscina:* Last two segments. Fig. 24.—Near *Muscina:* Anterior spiracle. Fig. 25.—Near *Muscina:* Head, above. Fig. 26.—Near *Muscina:* Stigmal plate. Fig. 27.—*Muscina stabulans:* Head, side view. Fig. 28.—*Muscina stabulans:* Anterior spiracle. Fig. 29.—Muscid *C:* Tip of body, side view. Fig. 30.—Muscid *C:* Stigmal plates. Fig. 31.—Muscid *C:* Anterior spiracle. Fig. 32.—Muscid *C:* End of body. Fig. 33.—Muscid *A:* Tip of body, side view. Fig. 34.—Muscid *D:* End of body. Fig. 35.—Muscid *D:* Anterior spiracle. Fig. 36.—*Muscina stabulans:* Head, above. Fig. 37.—Muscid *A:* Stigmal plate. Fig. 38.—Muscid *A:* Anterior spiracle. Enlarged. (Original.)



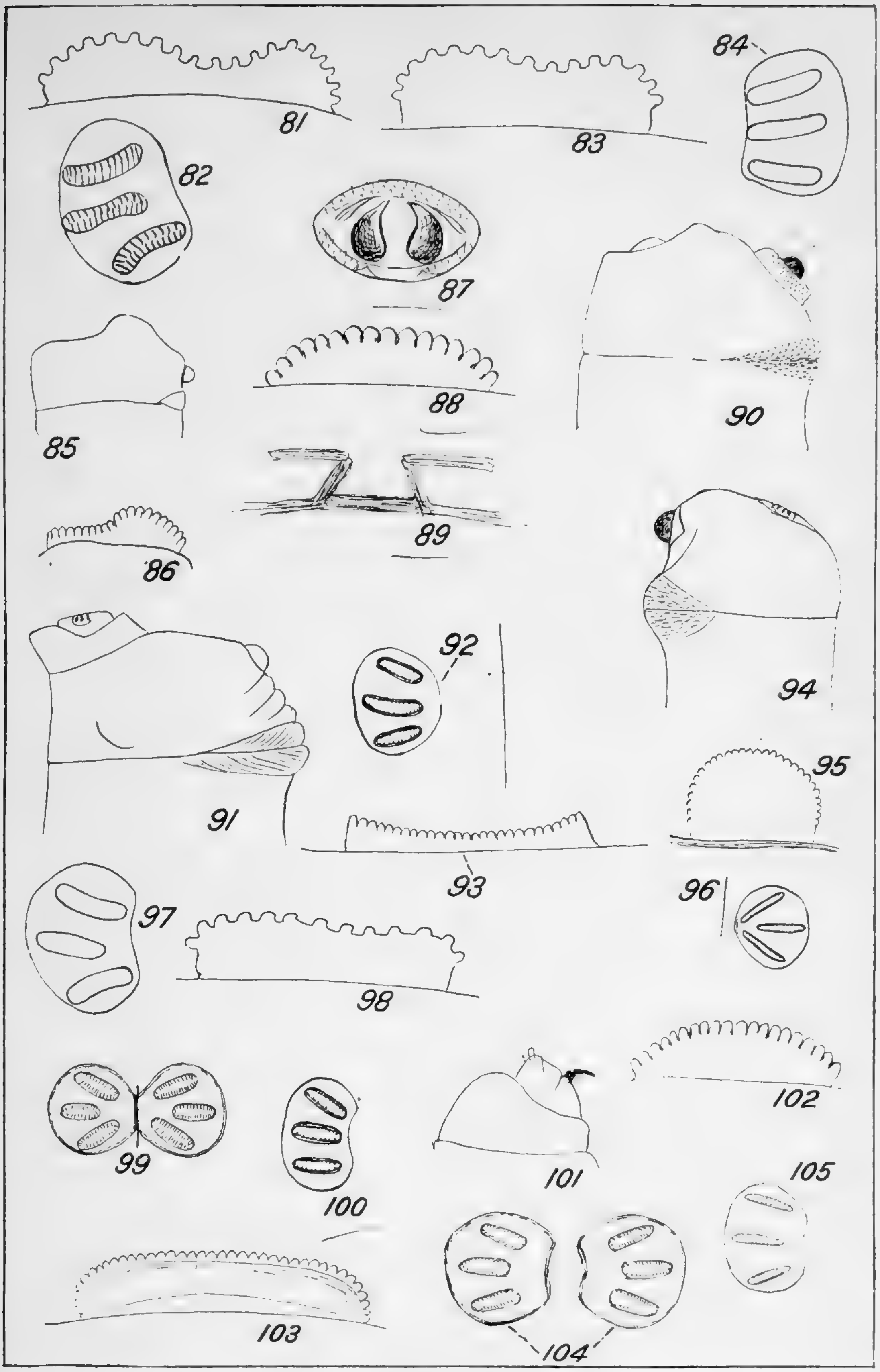
STRUCTURE OF DIPTEROUS LARVÆ.

Fig. 39.—*Chrysomyia* (?): Tip of body, side view. Fig. 40.—Muscid *B:* Anterior spiracle. Fig. 41.—Muscid *B:* Tip of body, side view. Fig. 42.—Muscid *B:* Stigmal plates. Fig. 43.—Muscid *B:* End of body. Fig. 44.—*Tritoxa flexa:* Stigmal plate. Fig. 45.—*Tritoxa flexa:* Anterior spiracle. Fig. 46.—*Tritoxa flexa:* Tip of body, side view. Fig. 47.—*Chrysomyia* (?): Stigmal plate. Fig. 48.—*Lucilia sylvarum:* Head, side view. Fig. 49.—*Lucilia sylvarum:* Tip of body, side view. Fig. 50.—*Lucilia sylvarum:* Anterior spiracle. Fig. 51.—*Lucilia sylvarum:* Stigmal plates. Fig. 52.—*Chrysomyia* (?): Anterior spiracle. Fig. 53.—*Euresta thomæ:* Stigmal plate. Fig. 54.—*Lucilia sericata:* End of body. Fig. 55.—*Lucilia sericata:* Head, top view. Fig. 56.—*Protocalliphora chrysorrhœa:* Tip of body, side view. Fig. 57.—*Protocalliphora chrysorrhœa:* Head, side view. Fig. 58.—*Protocalliphora chrysorrhœa:* Stigmal plates. Fig. 59.—*Euresta thomæ:* Tip of body, above. Fig. 60.—*Lucilia sericata:* Head, side view. Fig. 61.—*Lucilia sericata:* Tip of body, side view. Fig. 62.—*Calliphora erythrocephala:* Head, side view. Fig. 63.—*Calliphora erythrocephala:* Stigmal plates. Enlarged. (Original.)



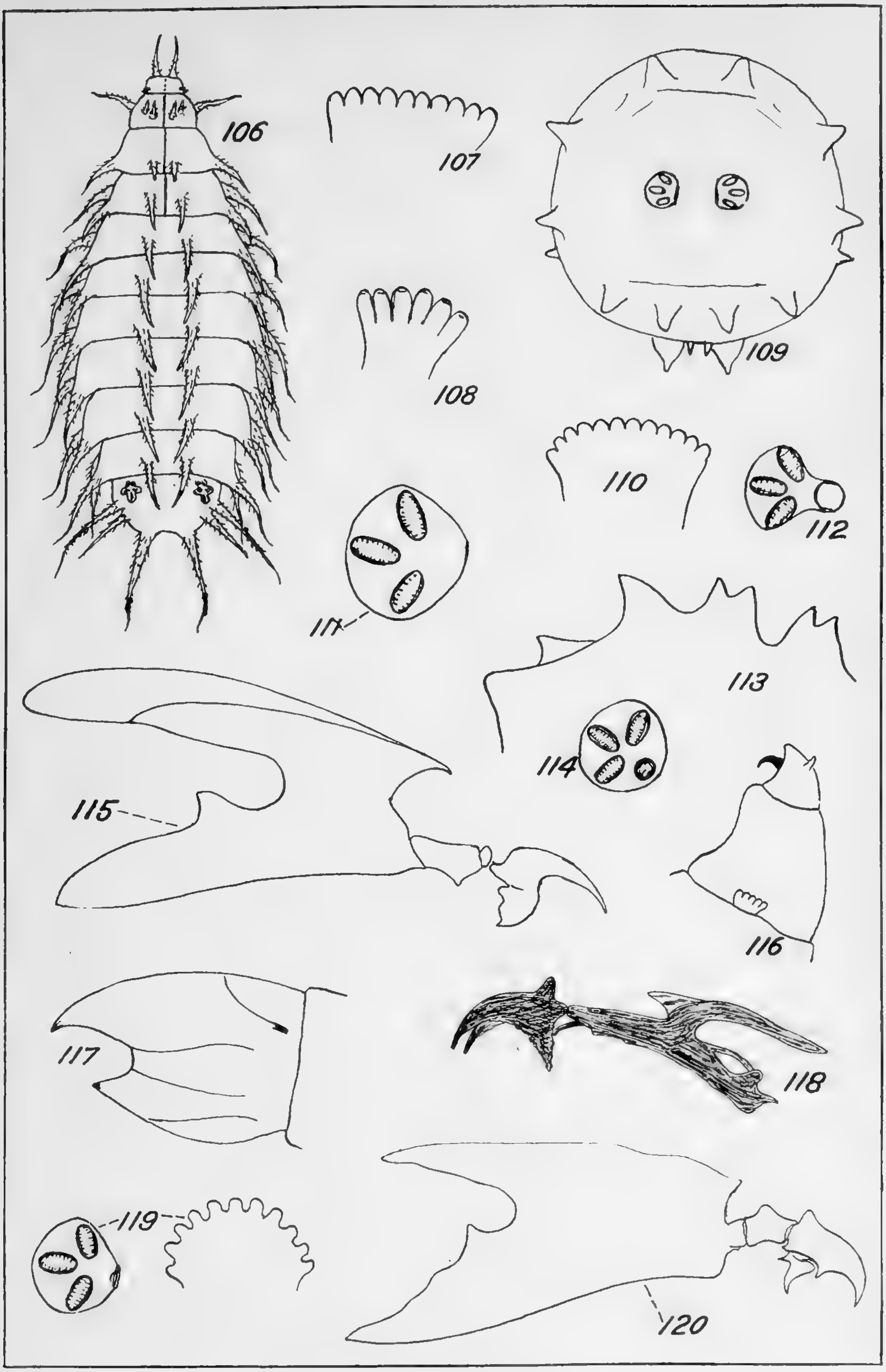
STRUCTURE OF DIPTEROUS LARVÆ.

Fig. 64.—Sarcophagid *D:* Tip of body, side view. Fig. 65.—Sarcophagid *D:* Head, above. Fig. 66.—Sarcophagid *D:* Head, side view. Fig. 67.—*Chrysomyia macellaria:* Head, side view. Fig. 68.—*Chrysomyia macellaria:* Tip of body, side view. Fig. 69.—*Chrysomyia macellaria:* Anterior spiracle. Fig. 70.—Sarcophagid *C:* Head, above. Fig. 71.—*Chrysomyia macellaria:* End of body. Fig. 72.—Sarcophagid *B:* Stigmal plates. Fig. 73.—Sarcophagid *A:* Two segments, venter. Fig. 74.—Sarcophagid *A:* Two segments, dorsum. Fig. 75.—*Sarcophaga incerta:* Segment, venter. Fig. 76.—Sarcophagid *B:* Tip of body, side view. Fig. 77.—Sarcophagid *C:* Tip of body, side view. Fig. 78.—Sarcophagid *A:* Anterior spiracle. Fig. 79.—Sarcophagid *B:* Anterior spiracle. Fig. 80.—Sarcophagid *B:* Head, above. Enlarged. (Original.)



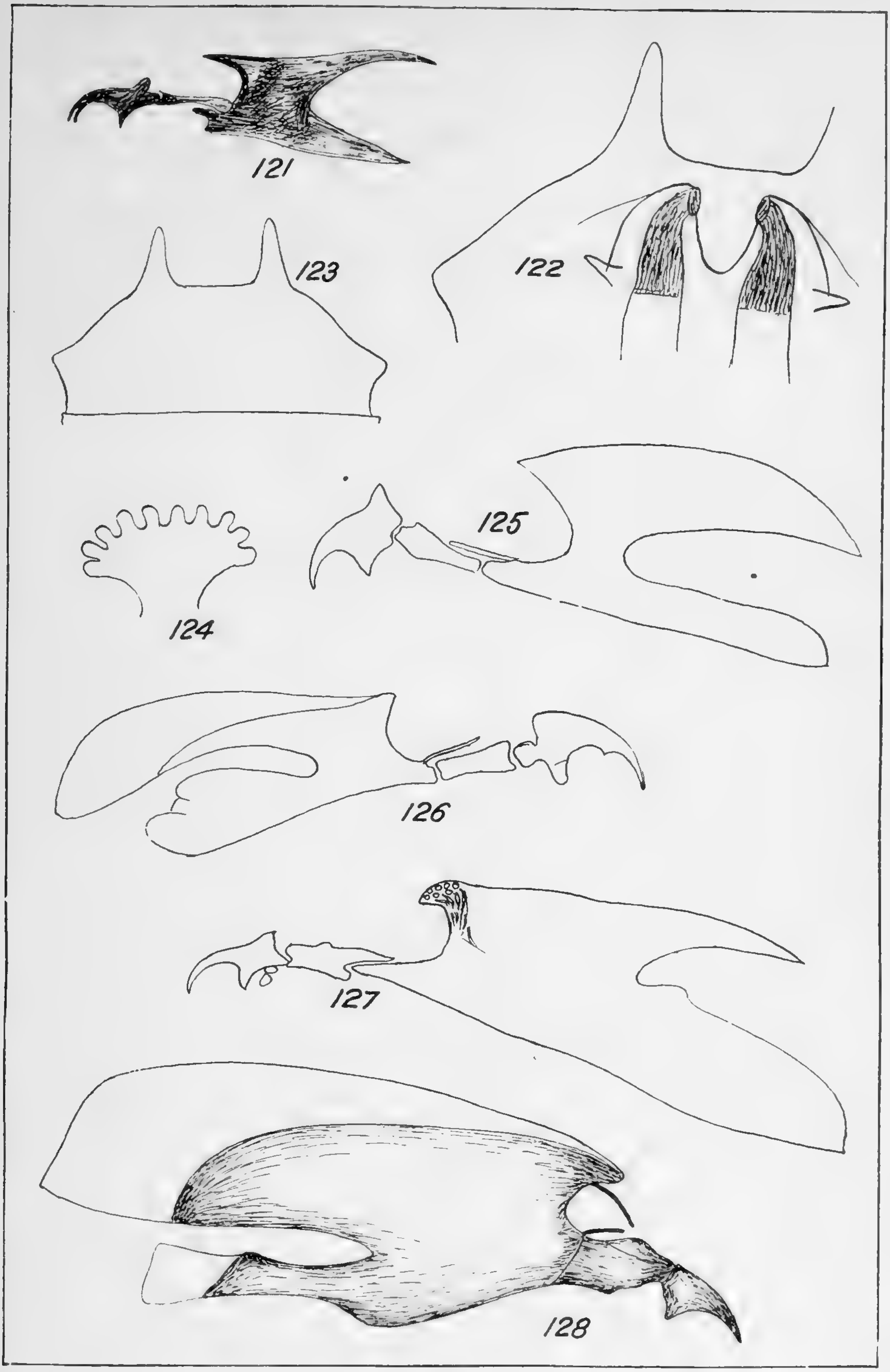
STRUCTURE OF DIPTEROUS LARVÆ.

Fig. 81.—*Epochra canadensis:* Anterior spiracle. Fig. 82.—*Epochra canadensis:* Stigmal plate. Fig. 83.—*Rhagoletis pomonella:* Anterior spiracle. Fig. 84.—*Rhagoletis pomonella:* Stigmal plate. Fig. 85.—*Anastrepha ludens:* Tip of body, side view. Fig. 86.—*Anastrepha ludens:* Anterior spiracle. Fig. 87.—*Ceratitis capitata:* Anal tubercle. Fig. 88.—*Ceratitis capitata:* Anterior spiracle. Fig. 89.—*Ceratitis capitata:* Ridges on ventral segments. Fig. 90.—*Dacus ferrugineus:* Tip of body, side view. Fig. 91.—*Acidia fratria:* Tip of body, side view. Fig. 92.—*Acidia fratria:* Stigmal plate. Fig. 93.—*Acidia fratria:* Anterior spiracle. Fig. 94.—*Rhagoletis suavis:* Tip of body, side view. Fig. 95.—*Rhagoletis suavis:* Anterior spiracle. Fig. 96.—*Rhagoletis suavis:* Stigmal plate. Fig. 97.—*Rhagoletis cingulata:* Stigmal plate. Fig. 98.—*Rhagoletis cingulata:* Anterior spiracle. Fig. 99.—*Anastrepha ludens:* Stigmal plates. Fig. 100.—*Ceratitis capitata:* Stigmal plate. Fig. 101.—*Dacus cucurbitæ:* Head, side view. Fig. 102.—*Dacus cucurbitæ:* Anterior spiracle. Fig. 103.—*Dacus ferrugineus:* Anterior spiracle. Fig. 104.—*Dacus cucurbitæ:* Stigmal plates. Fig. 105.—*Dacus ferrugineus:* Stigmal plate. Enlarged. (Original.)



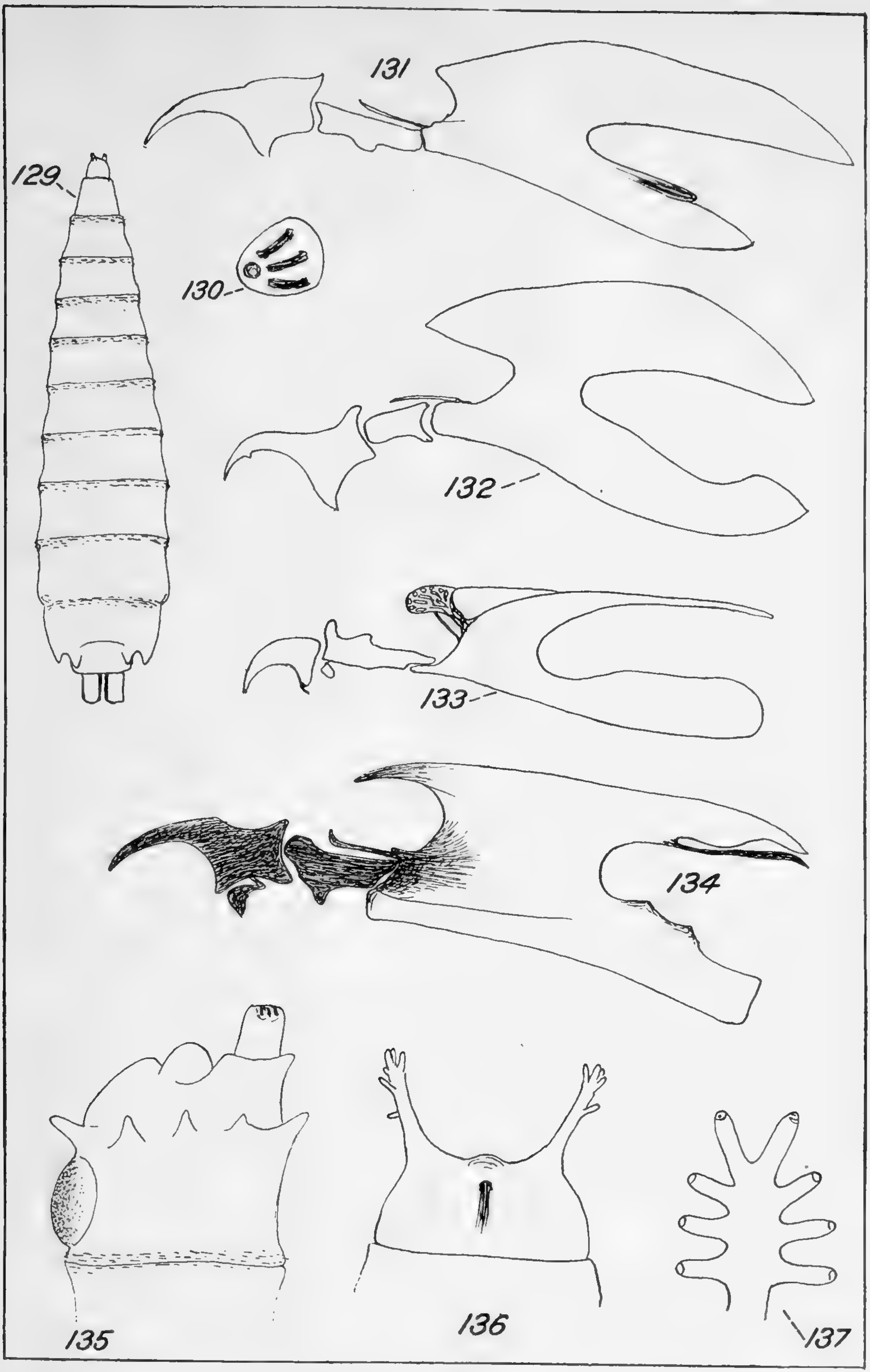
STRUCTURE OF DIPTEROUS LARVÆ.

Fig. 106.—*Homalomyia* sp.: Dorsal view. Fig. 107.—*Pegomya brassicæ:* Anterior spiracle. Fig. 108.—*Phorbia floccosa:* Anterior spiracle. Fig. 109.—*Phorbia floccosa:* End of body. Fig. 110.—*Pegomya bicolor:* Anterior spiracle. Fig. 111.—*Pegomya usciceps:* Stigmal plate. Fig. 112.—*Pegomya bicolor:* Stigmal plate. Fig. 113.—*Pegomya brassicæ:* Margin of stigmal field. Fig. 114.—*Pegomya brassicæ:* Stigmal plate. Fig. 115.—*Muscina stabulans:* Cephalopharyngeal skeleton. Fig. 116.—*Pegomya fusciceps:* Head, side view. Fig. 117.—*Anthomyia* sp.: Tip of body, side view. Fig. 118.—*Pegomya brassicæ:* Cephalopharyngeal skeleton. Fig. 119.—*Pegomya cepetorum:* Stigmal plate and anterior spiracle. Fig. 120.—*Musca domestica:* Cephalopharyngeal skeleton. Enlarged. (Original.)



STRUCTURE OF DIPTEROUS LARVÆ.

Fig. 121.—*Euxesta notata:* Cephalopharyngeal skeleton. Fig. 122.—*Piophila casei:* Tip of body, below. Fig. 123.—*Piophila casei:* Tip of body, above. Fig. 124.—*Piophila casei:* Anterior spiracle. Fig. 125.—*Rhagoletis pomonella:* Cephalopharyngeal skeleton. Fig. 126.—*Calliphora erythrocephala:* Cephalopharyngeal skeleton. Fig. 127.—*Homalomyia* sp.: Cephalopharyngeal skeleton. Fig. 128.—*Protocalliphora:* Cephalopharyngeal skeleton. Enlarged. (Original.)



STRUCTURE OF DIPTEROUS LARVÆ.

Fig. 129.—*Drosophila ampelophila:* Dorsal view. Fig. 130.—*Drosophila ampelophila:* Stigmal plate. Fig. 131.—*Lucilia sericata:* Cephalopharyngeal skeleton. Fig. 132.—*Dacus cucurbitæ:* Cephalopharyngeal skeleton. Fig. 133.—*Drosophila ampelophila:* Cephalopharyngeal skeleton. Fig. 134.—*Sarcophaga incerta:* Cephalopharyngeal skeleton. Fig. 135.—*Drosophila ampelophila:* Tip of body, side view. Fig. 136.—*Drosophila ampelophila:* Head of pupa. Fig. 137.—*Drosophila ampelophila:* Anterior spiracle. Enlarged. (Original.)

INDEX.

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TECHNICAL SERIES, No. 23.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

MISCELLANEOUS PAPERS.

CONTENTS AND INDEX.

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L. O. HOWARD, Entomologist and Chief of Bureau.

MISCELLANEOUS PAPERS.

I. SOME NEW CALIFORNIA AND GEORGIA THYSANOPTERA.

By PAUL R. JONES, *Entomological Assistant, Deciduous Fruit Insect Investigations.*

II. AN INTERNAL PARASITE OF THYSANOPTERA.

By H. M. RUSSELL, *Entomological Assistant.*

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A. F. BURGESS, *in charge of gipsy moth and brown-tail moth investigations.*
ROLLA P. CURRIE, *in charge of editorial work.*
MABEL COLCORD, *in charge of library.*

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

Technical Series, No. 23, Part I.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

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BY

PAUL R. JONES,

Entomological Assistant, Deciduous Fruit Insect Investigations.

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Mabel Colcord, *in charge of library.*

CONTENTS.

ILLUSTRATIONS.

PLATES.

U. S. D. A., B. E. Tech. Ser. 23, Pt. I. Issued January 26, 1912

MISCELLANEOUS PAPERS.

SOME NEW CALIFORNIA AND GEORGIA THYSANOPTERA.

By Paul R. Jones,
Entomological Assistant, Deciduous Fruit Insect Investigations.

INTRODUCTION.

In the present paper Moulton's arrangement of genera has been followed and his key to North American species has been adapted to include the species herewith described. The numbers preceding the genera in the text agree with those in Moulton's paper,[1] to which the present article is supplemental, and will facilitate the use of these two publications.

4.[2] Genus ÆOLOTHRIPS Haliday.

Key to the Species.

1. Fore wings with dark cross-bands.
   - *a.* White band around abdominal segments 1 and 2; last four segments of antennæ much longer than fifth.
     - *b.* Segments 2 and 3 of abdomen white; wings with cross-veins. *Æolothrips bicolor* Hinds.
     - *b′.* Segments 1, 2, and posterior half of 3 white; wings without cross-veins. *Æolothrips vespiformis* Crawford.
   - *a′.* Without white band around first two abdominal segments; last four segments of antennæ approximately as long or a little longer than the fifth alone.
     - *b.* Last four segments of antennæ equal to the fifth alone, third segment one and one-third times as long as 1 and 2 together; wings with cross-veins. *Æolothrips fasciatus* Linnæus.
     - *b′.* Last four segments of antennæ one and one-fourth times as long as segment 5, segment 3 one and one-half times as long as 1 and 2 together; wings without cross-veins........*Æolothrips nasturtii* new species.
2. Each fore wing with dark longitudinal band along posterior margin.
   - *a.* With veins in anterior wings normal as in most species of the genus. *Æolothrips kuwanaii* Moulton.
   - *a′.* Without veins in anterior wings..............*Æolothrips longiceps* Crawford.

Note.—In connection with the bureau's investigation of the pear thrips and the orange thrips in California during the past few years, it has appeared desirable to obtain as much information as possible on the characteristics, life histories, and food habits of related species of Thysanoptera, and as opportunity has offered observations on these insects have been made. In this way many species have been collected, some of which were found to be new to science. Mr. Moulton's paper[1] dealt with specimens obtained by him while connected with the investigation, and in the present paper Mr. Jones presents descriptions of several species which he has obtained in the course of his work during the past two years, and which have not heretofore been recognized.

A. L. Quaintance,
In Charge of Deciduous Fruit Insect Investigations.

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[1] Tech. Ser. 21, Bur. Ent., U. S. Dept. Agr., 1911.

[2] The numbers preceding this and other genera are the same as those used by Moulton in his classification. (See Tech. Ser. 21, Bur. Ent., U. S. Dept. Agr.)

DESCRIPTION OF NEW SPECIES.

Æolothrips nasturtii new species. (Pl. I, figs. 1–4.)

Measurements: Head, length 0.25 mm., width 0.225 mm.; prothorax, length 0.2 mm., width 0.25 mm.; mesothorax, width 0.341 mm.; metathorax, width 0.266 mm.; abdomen, width at distal part of segment 1, 0.216 mm., width of segment 4, 0.483 mm. Antennæ: segment 1, 31μ; 2, 60μ; 3, 135μ; 4, 108μ; 5, 72μ; 6, 42μ; 7, 23μ; 8, 15μ; 9, 12μ; total length antennæ 0.50 mm. Total body length 2.10 mm.

Color uniform dark brown.

Head slightly longer than wide, sides parallel, *transversely striated above, covered with numerous small spines,* retracted within the prothorax, one spine on each outer side and one on each inner side of the antennæ near their base and *five on each side of the head. Eyes large, extending back well on the ventral side nearly one-half the length of the head,* coarsely faceted and *sparsely pilose. Ocelli* present, large, conspicuous, making an equilateral triangle, not situated far forward, the posterior ones contiguous with the inner margins of the eyes and slightly posterior to a line drawn through the middle of the eyes; four small spines on each side of the anterior ocellus. *Mouth-cone* long, bluntly rounded; maxillary palpi 3-segmented, basal joint large, apical very small. *Antennæ* 9-segmented, twice as long as the head, dark brown, concolorous with the rest of the body, except segment 2, which is light brown, and segment 3, which is lemon-yellow, shaded light brown at the tip; all segments thickly and uniformly clothed with short spines, those on segments 1 and 2 stouter; spines on segments 1, 2, 4, and 5 brown, on segment 3 and style white; sense cones inconspicuous; segment 3 one and one-half times as long as segments 1 and 2 together and more slender than the remaining segments.

Prothorax a little wider than long, only slightly larger than the head, slightly emarginate near the center on each side, clothed with a number of short spines above. *Mesothorax* largest, one and one-third times as wide as the prothorax, broadly rounded anteriorly. *Metathorax abruptly narrower than the mesothorax,* slightly wider than prothorax, edges parallel. *Legs* uniformly dark brown; front femora slightly thickened; tibiæ armed at the tip with two strong spines, those on hind tibiæ strongest; each fore-tarsus armed with a long, stout hook and a tooth; all the legs thickly set with small spines, giving them a pitted appearance. *Wings reaching to posterior margin of sixth abdominal segment,* broadly rounded at tip. No cross-veins present; two longitudinal veins uniting with ring-vein at tip; a *large* clear area at the base, *a similar clear area* a little past the middle, and a smaller area at the tip. *Right fore wing:* Anterior longitudinal vein, *one spine on distal part of basal clear area, five spines between* *basal and central clear areas, one spine on basal part and one on distal part of central clear area, four spines between central and apical clear areas, none on apical clear area;* posterior longitudinal vein, *no spines on basal clear area, five spines between basal and central clear areas, one spine on basal and one on distal part of central clear area, five spines between central and apical clear areas, none on apical clear area. Left fore wing:* Anterior longitudinal vein, one spine on distal part of basal clear area, five spines between basal and central clear areas, none on central clear area, four spines between central and apical clear areas, last one on edge of apical clear area; posterior vein, no spines on basal clear area, four spines between basal and central clear areas, one spine on basal part and one on distal part of central clear area, five spines between central and apical clear areas, none on apical clear area. All spines on white areas nearly inconspicuous. *About 37 spines on anterior margin of fore wings,* nearly inconspicuous on the clear areas. Fore wings light brown except above-mentioned clear areas; microscopic hairs on dark areas brown, on clear areas white and inconspicuous; posterior margin with a long, simple fringe. Hind wings white; *anterior margin with a short, spine-like fringe;* posterior margin with a long, simple fringe.

Abdomen uniform brown, *elongate-ovate,* narrow at base, gradually *becoming wider until segment 4, which is equally as wide as the segments 5, 6, and 7,* gradually tapering from segment 7. Segments 1 to 8 without conspicuous hairs or spines except two short, curved spines on each side of segment 7, and two on each side of segment 8 near the posterior margin; segment 9 with a circlet of about eight long spines, several smaller spines near the posterior margin; segment 10 with a circlet of about six long spines near the middle; last three segments forming a sheath for the upturned ovipositor.

Described from one female specimen taken on flowers of water-cress (*Nasturtium officinale*) at San Jose, Cal., May 23, 1910 (P. R. Jones).

Near *A. vespiformis* Crawford, but differing in the italicized characters.

7. Genus THRIPS Linnæus.

KEY TO THE SPECIES.

1. Head considerably wider than long.
   - *a.* Body color dark brown, thorax and other parts orange-tinted, inner crescents bordering ocelli orange-red. Individuals large, about 1.25 mm. in length.
     - *b.* Wings light brown, with lighter colored area near base. *Thrips madronii* Moulton.
     - *b′.* Wings uniform dark brown to brown............ *Thrips magnus* Moulton.

a′. Body color light yellow to light brown or brown, inner crescents bordering ocelli light brown; body length about 1 mm.

b. Ocelli subapproximate; posterior longitudinal vein of fore wing with about fourteen to seventeen regularly placed spines. *Thrips tabaci* Lindeman.

b′. Ocelli widely separated, anterior one on front and directed forward; posterior longitudinal vein bearing about seven spines. *Thrips abdominalis* Crawford.

2. Head about as long as wide.

a. Head much smaller than prothorax, one-half as wide as prothorax; fore femora and tibiæ greatly enlarged............*Thrips femoralis* new species.

a′. Head only slightly smaller than prothorax, about five-sixths as wide as prothorax; fore femora and tibiæ only slightly enlarged.

b. Color uniform light lemon-yellow.............*Thrips bremnerii* Moulton.

b′. Color of head brown, thorax reddish orange-brown, abdomen pale yellow to gray-brown..........................*Thrips perplexus* Beach.

DESCRIPTION OF NEW SPECIES.

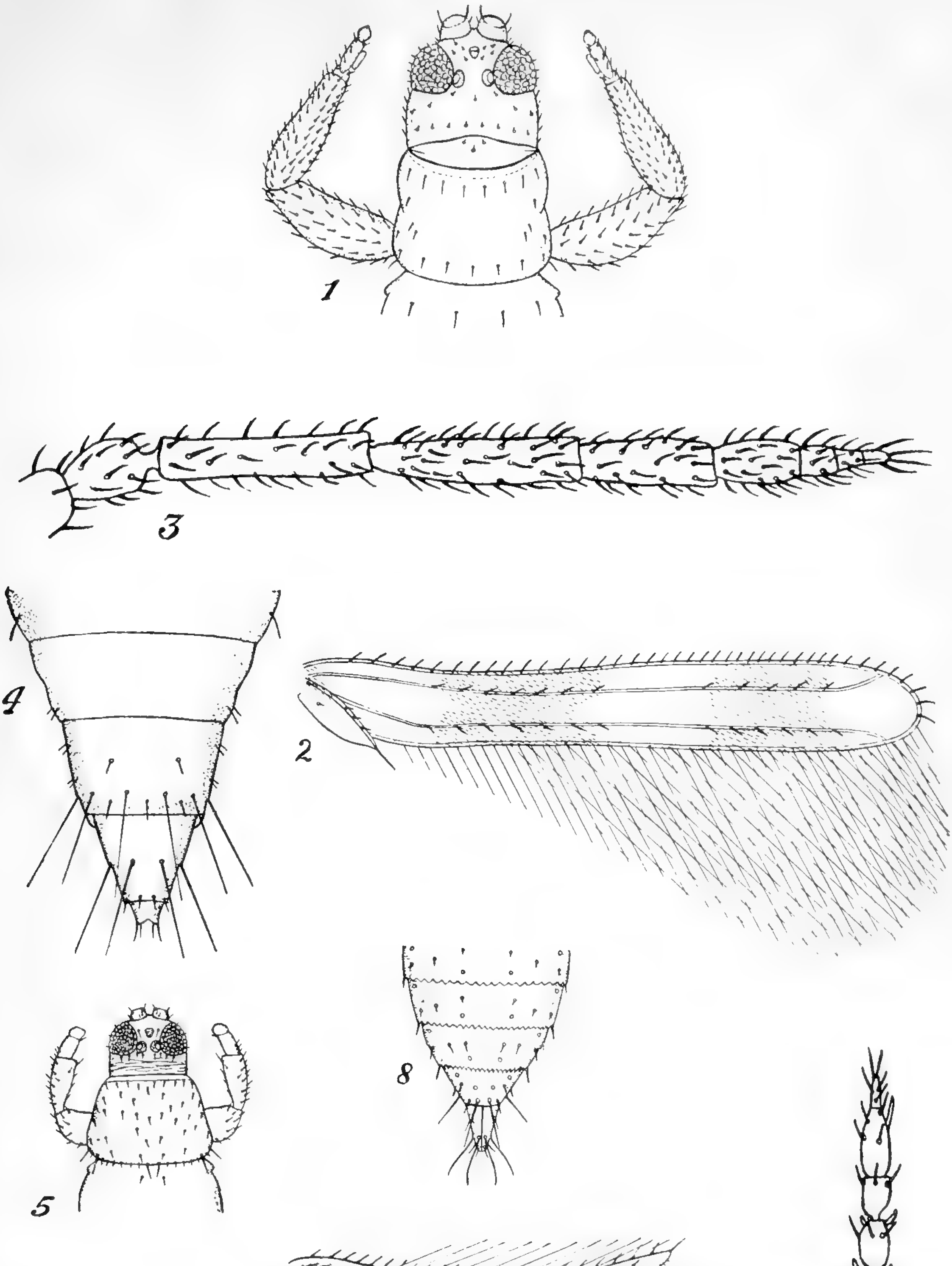
Thrips femoralis new species. (Pl. I, figs. 5–8.)

Measurements: Head, length 0.10 mm., width 0.108 mm.; prothorax, length 0.15 mm., width 0.216 mm.; mesothorax, width 0.266 mm.; abdomen, width 0.283 mm. Antennæ: Segment 1, 21μ; 2, 30μ; 3, 36μ; 4, 36μ; 5, 27μ; 6, 45μ; 7, 21μ; total length antennæ 0.216 mm. Total body length 1.31 mm.

Color of body light grayish brown; head, prothorax, metathorax, and tip of abdomen darker.

Head about as wide as long, very much smaller than prothorax, rounded in front, retracted slightly into prothorax; sides nearly straight; cheeks straight, not arched; back of head transversely striate. A small spine on each side of the anterior ocellus, and four behind each posterior ocellus. *Eyes* large, occupying more than two-thirds the width of head; facets large, inner row light colored, not protruding, sparsely pilose. *Ocelli* subapproximate, situated far backward, posterior ocelli nearly on level with the posterior margin of the eyes. Ocelli yellowish brown with dark-red crescents. *Mouth cone* long, reaching slightly past the middle of the prosternum; maxillary palpi 3-segmented; labial palpi 2-segmented. *Antennæ* 7-segmented, about two and one-tenth times as long as head, uniform light gray-brown except segment 3 and base of segments 4 and 5, which are lighter; base of segment 4 and segment 5 constricted into a broad handle, segment 3 into a longer, narrower handle; a forked sense-cone on the dorsal side of segment 3, one on the ventral side of segment 4, and a long simple sense cone on the lateral side of segment 6.

Prothorax very much larger than the head, one and one-half times as long and twice as wide, all angles rounded; two long spines on each posterior angle and two nearly as long on posterior margin near the



ÆOLOTHRIPS AND THRIPS.

Fig. 1.—*Æolothrips nasturtii:* Head and prothorax of female. Fig. 2.—*Æolothrips nasturtii:* Right forewing of female. Fig. 3.—*Æolothrips nasturtii:* Right antenna of female. Fig. 4.—*Æolothrips nasturtii:* End of abdomen of female. Fig. 5.—*Thrips femoralis:* Head and prothorax of female. Fig. 6.—*Thrips femoralis:* Left antenna of female. Fig. 7.—*Thrips femoralis:* Right forewing of female. Fig. 8.—*Thrips femoralis:* End of abdomen of female. Enlarged. (Original.)

middle; rest of posterior margin set with small spines and whole dorsum of prothorax with numerous slightly longer spines. *Mesothorax* largest, sides of *pterothorax* broadly rounded. *Legs* stout, fore femora and tibiæ greatly enlarged, remaining femora and tibiæ somewhat enlarged. Color of legs brown, fore tibiæ, tips of middle tibiæ, and fore and middle tarsi light yellowish brown. All tibiæ armed with spines. *Wings* present, fore wings large, uniform gray-brown, with spines arranged as follows: Costa with twenty-four; fore longitudinal vein with eight spines at base in groups of five, two, and one, with three scattered spines on apical half of wings; hind vein with six spines, the apical one separated from the rest. *Abdomen* stout, elongate-oval; segments 4, 5, and 6 largest; posterior margin of segments 1 to 7 with distinct sharp serrations, more distinct on apical segments; segment 8 with longer and sharper teeth. Almost no spines on abdomen except on last two anal segments. Segment 10 split above.

Described from two female specimens taken on goldenrod (*Solidago* sp.) at Barnesville, Ga., Aug. 22, 1910. (E. L. Jenne.)

11. Genus SERICOTHRIPS Haliday.

KEY TO THE SPECIES.

1. Wings fully developed or rudimentary.
   - *a*. Wings fully developed.
     - *b*. Fore wings white, no dark cross-bands or shading; general color white. *Sericothrips albus* new species.
     - *b′*. Fore wings dusky or gray-brown and more or less distinctly marked with whitish cross-bands; general color yellowish dusky-gray. *Sericothrips variabilis* Beach.
     - *b″*. Fore wings white, with gray cross-bands; head black; prothorax light yellow-brown; pterothorax black; tip of abdomen black; general color blackish.................... *Sericothrips moultoni* new species.
     - *b‴*. Fore wings black, with two broad white cross-bands and white at tip; head black; prothorax black; pterothorax somewhat lighter; general color blackish........................ *Sericothrips pulchellus* Hood.
   - *a′*. Wings reduced or fully developed; body dark brown to nearly black, except segments 4, 5, and 6 of abdomen, which are almost white. *Sericothrips cingulatus* Hinds.
2. Wings wanting.
   - *a*. Body very dark brown, nearly black; pterothorax yellow to yellow-brown; legs brown............................ *Sericothrips apteris* Daniel.
   - *a′*. Body uniform brown; surface of body strongly reticulated; legs yellow. *Sericothrips reticulatus* Moulton.
   - *a″*. Body and legs uniform brown; four stout spines on the dorsal side of segment 9. *Sericothrips stanfordii* Moulton.

DESCRIPTION OF NEW FORMS AND SPECIES.

Sericothrips apteris Daniel, male. (Pl. II, fig. 1.)

Length 1 mm. Similar to female except that it is usually lighter in color; legs light brown; usually the abdomen, except the last two segments, uniform dark brown; the basal two and the apical two segments sometimes light brown similar to the pterothorax. Segment 9 of abdomen with two very stout, bluntly-pointed, black spines upon the middle above, standing close together.

Described from five specimens collected on grass and weeds during March, April, and June, at San Jose, Cal. (P. R. Jones).

This is a very variable species and I have one specimen with the head dark brown and the remainder of the body uniform light brown.

Sericothrips albus new species. (Pl. II, figs. 2–5.)

Measurements: Head, length 0.1 mm., width 0.18 mm.; prothorax, length 0.13 mm., width 0.23 mm.; mesothorax, width 0.33 mm.; abdomen, length 0.78 mm., width 0.30 mm. Antennæ: Segment 1, 21 μ; 2, 36 μ; 3, 45 μ; 4, 45 μ; 5, 45 μ; 6, 57 μ; 7, 12 μ; 8, 18 μ; total length of antennæ 0.29 mm. Total body length 1.25 mm.

General color very pale, transparent white, devoid of any dark marking, except eyes, ocelli, mouthparts, apical joints of antennæ, and spot upon tarsi.

Head nearly twice as wide as long, retracted within the prothorax, considerably depressed in front where the antennæ are received; cheeks full, converging posteriorly. *Eyes* large, protruding a little, nearly black, coarsely faceted, pilose. *Ocelli* approximate, situated upon a slight raised area between the eyes, very light yellow, with dark reddish-brown crescents; posterior ocelli not contiguous with inner margins of eyes. Spines upon head inconspicuous, but one short, curved spine on each side of fore-ocellus, and two similarly curved spines across the front; sides with several short spines and a number of very small microscopic hairs. *Mouth-cone* very long, tipped with black, extending past posterior margin of prosternum a considerable distance upon the mesosternum. Maxillary palpi slender, three-segmented. *Antennæ* about three times as long as head, well separated by the projection of the head; segment 1 short and thick; segment 2 wider than 1; segments 3 and 4 fusiform; segment 5 fusiform at base, broad at apex where it joins segment 6; segment 6 tapering gradually from base with style to tip of antennæ. Color of antennæ pale transparent white except apex of segments 4 and 5, and segments 6, 7, and 8 which are entirely gray; a forked sense-cone on segments 3 and 4.

Prothorax slightly more than twice as wide as long, angles rounded, striated transversely upon dorsum; one short spine on each anterior angle, and one upon each posterior angle. *Pterothorax* large, about one and one-half times as wide as prothorax, *mesothorax* slightly wider than *metathorax*. *Legs* everywhere transparent white, except dark spot near apex of each tarsus. *Wings* present, reaching to tip of abdomen, transparent white, similar to rest of body. About twenty-four to twenty-six spines upon the costa; about twenty-two on fore vein; one near base and one near apex of wing where hind veins should be. No fringe on anterior margin.

Abdomen cylindrical, tapering sharply from segment 8, thickly clothed with minute white hairs which appear as a fringe upon the posterior margins of the segments. Spines upon segments 1 to 8 weak and inconspicuous; a row of long white spines upon the dorsum of segment 9 near posterior margin, and a similar row on segment 10 near middle of dorsum.

Described from three females taken in May, 1910, at Visalia, Cal., from blossoms of elderberry (*Sambucus* sp.) and from weeds (P. R. Jones).

Structurally, this species is very close to *S. variabilis* Beach. It differs, however, in several details and shows such a constant difference in coloration that I believe it to be a good species.

Sericothrips moultoni new species, female. (Pl. II, figs. 6–9.)

Measurements: Head, length 0.1 mm., width 0.2 mm.; prothorax, length 0.166 mm., width 0.266 mm.; mesothorax, width 0.333 mm.; abdomen, length 0.90 mm., width 0.366 mm. Antennæ: Segment 1, 18 μ; 2, 45 μ; 3, 70 μ; 4, 60 μ; 5, 48 μ; 6, 54 μ; 7, 15 μ; 8, 18 μ; total length of antennæ 0.32 mm. Total length of body 1.35 mm.

Color dark brownish black. Similar to *S. variabilis* Beach, but differing from it as follows:

Head one-half as long as wide, uniformly brownish black. Segments 1, 2, and 3 of the antennæ very light yellowish brown; segments 4 and 5 apically, segments 6, 7; and 8 entirely, grayish brown; a pair of small spines near the inner and outer posterior margins of each eye.

Prothorax not concolorous with head, light yellowish brown, less than one-half as long as wide. *Pterothorax* brownish black, *mesothorax* slightly wider than *metathorax*. Posterior femora uniformly dark brown, except an area at the base. *Fore wings* transparent white, except a small grayish-brown area at base, and one cross-band of similar color about one-third the distance of the wing from the base. About twenty-six spines on costa; about twenty-two spines on fore vein; usually no spines where hind vein should be, but sometimes one spine present near apex of wing.

Abdomen: Segments 1, 2, 7, 8, 9, and 10 brownish black; intermediate segments light yellowish-brown with the anterior margins brownish black, varying in extent. Segments clothed with numerous fine hairs, appearing as a fringe on the posterior margins. Segment

2 often, 7 usually about one-half as long as the remaining segments of the abdomen.

Male: Length about 1.08 mm.; coloration similar to that of female.

Described from numerous specimens, both male and female.

Living specimens, when viewed under a hand lens, appear to be velvety black upon the *head, pterothorax,* and *tip of the abdomen.*

This species was very abundant in 1910, from April to October, upon one plant of a large perennial lupine near San Jose, Cal., and is very active in flying and leaping (P. R. Jones).

The larvæ were abundant also and these, together with the adults, were so numerous as to completely ruin the foliage of the above plant. Very few specimens were in the flowers.

Named for Mr. Dudley Moulton in recognition of his very valuable work on American Thysanoptera.

13. Genus LIMOTHRIPS Haliday.

KEY TO THE SPECIES.

1. Segment 2 of antennæ drawn out into a prominent, acute, triangular process on the outer angle.................................... *Limothrips setariæ* new species.
2. Segment 2 of the antennæ simple.................. *Limothrips cerealium* Haliday. (Synonym, *L. avenæ* Hinds.)

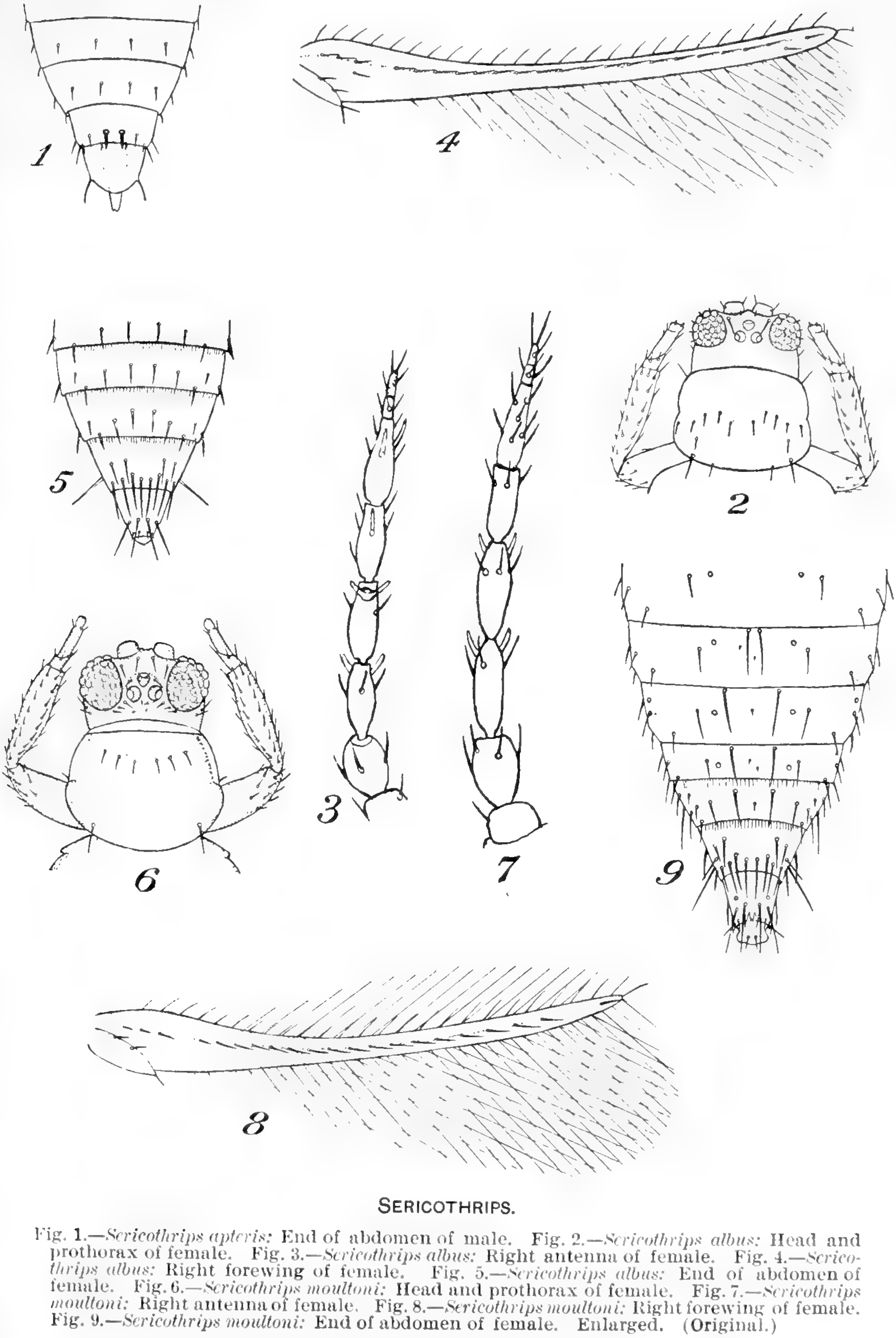
DESCRIPTION OF NEW SPECIES.

Limothrips setariæ new species, female. (Pl. III, figs. 1–5.)

Measurements: Head, length 0.216 mm., width at eyes 0.166 mm., width at back of head 0.2 mm.; prothorax, length 0.183 mm., width 0.233 mm.; mesothorax, width 0.333 mm.; abdomen, width 0.35 mm.; total length of body 2.116 mm. Antennæ: Segment 1, 18μ; 2, 45μ; 3, 51μ; 4, 45μ; 5, 48μ; 6, 60μ; 7, 12μ; 8, 18μ; total length of antennæ 0.30 mm.

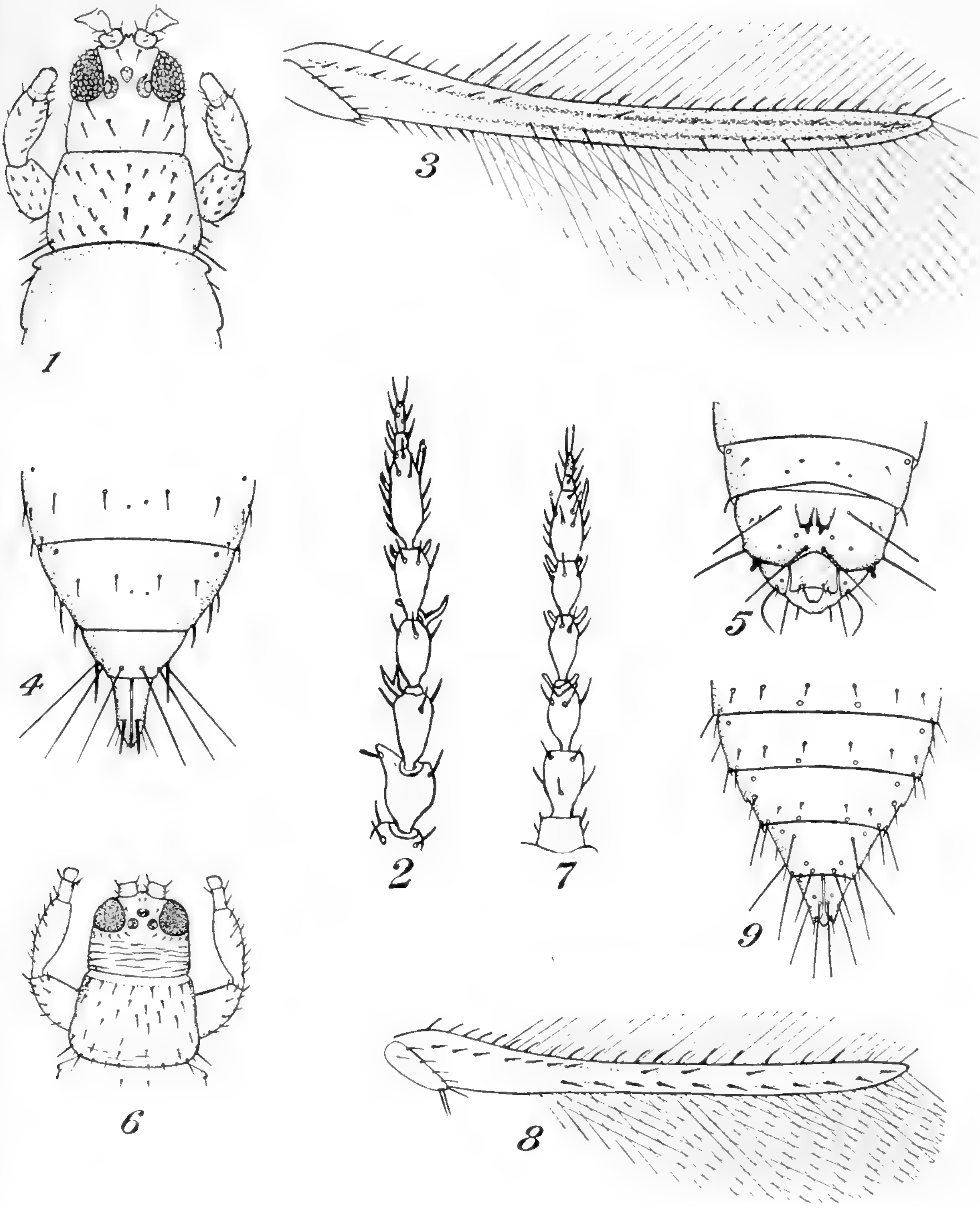
Color dark yellowish brown, ends of tibiæ and tarsi lighter.

Head slightly longer than wide, diverging posteriorly; cheeks very slightly arched; back of head scarcely striated at all; a pair of spines in front of anterior ocellus, one in front of each posterior ocellus, one posterior to each eye, and a row of four spines midway between base of eyes and posterior margin. Front strongly produced anteriorly, considerably so between the bases of the antennæ. *Eyes* moderately prominent, black, with yellow borders, protruding slightly, coarsely faceted, not pilose. *Ocelli* well separated, anterior one smallest, posterior ones contiguous with inner margins of the eyes; brownish yellow, with dark-brown crescents; not situated far forward. *Mouth-cone* obtusely pointed, extending past middle of prosternum; maxillary palpi short, 3-segmented. *Antennæ* 8-segmented, about one and one-half times as long as the head, slender, uniformly dark brown except segments 2, 3, and 4, which are slightly lighter. Segment 1 very short and thick; 2 *large, drawn out into an acute triangular*



SERICOTHRIPS.

Fig. 1.—*Sericothrips apteris:* End of abdomen of male. Fig. 2.—*Sericothrips albus:* Head and prothorax of female. Fig. 3.—*Sericothrips albus:* Right antenna of female. Fig. 4.—*Sericothrips albus:* Right forewing of female. Fig. 5.—*Sericothrips albus:* End of abdomen of female. Fig. 6.—*Sericothrips moultoni:* Head and prothorax of female. Fig. 7.—*Sericothrips moultoni:* Right antenna of female. Fig. 8.—*Sericothrips moultoni:* Right forewing of female. Fig. 9.—*Sericothrips moultoni:* End of abdomen of female. Enlarged. (Original.)



LIMOTHRIPS AND EUTHRIPS.

Fig. 1.—*Limothrips setariæ:* Head and prothorax of female. Fig. 2.—*Limothrips setariæ:* Left antenna of female. Fig. 3.—*Limothrips setariæ:* Right forewing of female. Fig. 4.—*Limothrips setariæ:* End of abdomen of female. Fig. 5.—*Limothrips setariæ:* End of abdomen of male. Fig. 6.—*Euthrips longirostrum:* Head and prothorax of female. Fig. 7.—*Euthrips longirostrum:* Left antenna of female. Fig. 8. *Euthrips longirostrum:* Right forewing of female. Fig. 9.—*Euthrips longirostrum:* End of abdomen of female. Enlarged. (Original.)

process at the outer angle; 3 and 4 fusiform; 5 clavate; 6 fusiform; 7 and 8 slender, cylindrical. A forked sense cone on outer side of segment 3, a similar one on inner side of segment 4, and similar ones on ventral side of segments 5 and 6; all other sense cones simple, short, slender, and inconspicuous.

Prothorax a little shorter than the head, one and one-third times wider than long, diverging from the head posteriorly; one prominent spine on each posterior angle, the other spines short and inconspicuous; sides slightly rounded. *Mesothorax nearly twice as wide as the prothorax; metathorax* abruptly narrower. *Legs* uniform brown, except fore tibiæ, ends of tibiæ, and tarsi, which are brownish yellow; legs moderately long, hind tibiæ alone bearing a fringe of stout spines. *Wings* present, long and slender, *about fifteen times as long as the width in the middle.* Two longitudinal veins in fore wing, branching at about one-fourth its length. Both veins and costa bearing a few short dark brown spines; *costa with about twenty-five to twenty-eight; fore veins with about ten, only three beyond the middle; hind vein with eight more or less regularly placed spines.* Fore wings dark smoky gray; hind wings slightly gray; costal fringes long and prominent.

Abdomen about two-thirds length of body, about as wide as long. Spines on abdomen weak and inconspicuous before segment 7; segment 8 bearing on each side three or four stout, curved, dark-brown spines; segment 9 bearing a circlet of long slender spines and *two very stout spines, one on each latero-posterior edge on the dorsum just in advance of the circlet of spines.* Segment 10 split open above, sharply pointed, and on each side above with a short, very stout, straight, dark-brown spine, reaching slightly beyond the tip. Abdomen yellowish brown, darker toward tip, connective tissue pale yellow.

Described from numerous long-winged females taken on green foxtail grass (*Setaria viridis*), wild oats, and California buckeye (*Æsculus californica*), San Jose, Cal., June-July, 1910 (P. R. Jones).

Near *Limothrips avenæ* Hinds (=*cerealium* Haliday, according to Bagnall) but differing in the italicized characters.

Male: Head, length 0.116 mm., width 0.2 mm.; antennæ, length 0.258 mm.; prothorax, length 0.166 mm.; prothorax, width 0.25 mm.; mesothorax, width 0.175 mm.; abdomen, width 0.341 mm.; total length 1.366 mm.

Color brownish yellow, head grayish brown. Head one and one-half times as wide as long, ocelli wanting, only vestiges remaining in some specimens. *Mouth-cone* longer than in female, extending nearly to posterior margin of the prosternum. *Antennæ* stout, a little more than twice as long as the head, process on second joint not so acute as in the female. *Prothorax* a little longer than the head, one and one-third times as broad as long. No vestiges of wings. *Abdomen* about two and one-half times as long as broad, bluntly rounded;

segment 9 large, bluntly conical; segment 10 small, retracted within 9. Close together on the middle of the dorsum of segment 9 stand two short, very stout spines borne upon broader, black, chitinous projections, the inner and outer edges of which are parallel; on each side of the projections is a long, slender spine; on the latero-posterior edge of segment 9 on each side is another chitinous, black projection supporting a stout, black spine; a much longer, slender, curved spine on each side of segment 9 about one-fourth of the distance from the posterior margin; two long, slender spines projecting on each side of segment 10 from underneath. Segment 9 cut out above over about one-half of segment 10.

Described from six specimens.

18. Genus EUTHRIPS Targioni-Tozzeti.

KEY TO THE SPECIES.

1. Without prominent spines on fore-angles of prothorax, longitudinal veins not regularly set with spines.
   - *a.* Head noticeably wider than long; general color white to light yellow or orange.
     - *b.* Last two segments of antennæ rather long and slender, and together about two-thirds as long as segment 6; wings shaded brown, with transparent whitish areas near base and at tip; ring-vein and longitudinal veins not conspicuous. *Euthrips orchidii* Moulton.
     - *b′.* Last two segements of antennæ not noticeably elongate and slender and together about one-half as long as segment 6.
       - *c.* Ring-vein and at least part of fore-vein conspicuous.
         - *d.* Body color translucent white to yellowish white; spines on costa of fore-wings unusually long; ring vein and both longitudinal veins conspicuous; segments 3 and 4 of antennæ pedicellate; wings shaded dilute yellow. *Euthrips costalis* new species.
         - *d′.* Body color orange-yellow; spines on costa of fore-wings not unusually long; segements 3 and 4 of antennæ not pedicellate.
           - *e.* Wings shaded brown, fore-part of longitudinal vein alone conspicuous.................*Euthrips longipennis* Bagnall.
           - *e′.* Wings not shaded brown; both longitudinal veins present, with three or four scattered spines on each, one of which stands at the abrupt ending of each vein. *Euthrips citri* Moulton.
       - *c′.* Ring vein and longitudinal veins not conspicuous; group of six spines on basal part of wing where anterior vein should be and nine on outer half where posterior vein should be; color of body and wings clear white, outer half of antennæ dark brown..........................*Euthrips albus* Moulton.
   - *a′.* Head about as long as wide or a little wider (except *Euthrips longirostrum*, which is noticeably wider than long); general color brown, thorax sometimes orange-brown and yellow-brown.
     - *b.* Eyes pilose; no postocular spines; two long, prominent spines between posterior ocelli; segments 3 and 4 of antennæ not pedicellate; fore-wings with transparent area near base; hind longitudinal vein of fore-wings with about sixteen spines. *Euthrips pyri* Daniel.

b'. Eyes not pilose; postocular spines present; a prominent spine in front of each posterior ocellus, segments 3 and 4 of antennæ not pedicellate; fore-wings without transparent area near base; hind longitudinal vein of fore-wings with about thirteen spines .... *Euthrips ehrhornii* Moulton.

b''. Eyes not pilose; postocular spines absent; no prominent spines in front of or between posterior ocelli; segments 3 and 4 of antennæ pedicellate; fore-wings without transparent area near base; hind longitudinal vein of fore-wings with about ten spines; mouth-cone very long... *Euthrips longirostrum* new species.

2. With spines on fore-angle of prothorax; longitudinal veins on fore-wings set regularly with spines.

a. Fore tibiæ armed at end with tooth. Females dark brown, wings brown with whitened area near base; antennæ concolorous with head except segment 3, which is light yellow. *Euthrips ulicis californicus* Moulton.

a'. Fore tibiæ not armed with tooth.

b. Postocular spines wanting; row of spines along anterior margin of prothorax either wanting or at least not conspicuous except often the third from the outer margin.

c. Antennæ uniformly brown to dark brown, concolorous with body; wings light yellow-brown, veins prominent; spines brown, twenty-three on fore vein, sixteen on hind vein, short and moderately stout; white longitudinal area near base of wing. *Euthrips minutus* Moulton.

c'. Antennæ with segment 3 yellowish; segments 3 and 4 light gray-brown, yellowish at base; wings gray-brown, veins not prominent, spines on wings normally long and stout, fourteen on fore vein, ten on hind vein (wings may be reduced to pads) .... *Euthrips fuscus* Hinds.

b'. Postocular spines conspicuous.

(1.) General color uniformly brown to dark brown, no shading of orange. Antennæ with segments 3, 4, and 5 light brown to yellow and shaded.

a. Uniformly dark brown, fore-wings shaded dark brown, with a large whitened area extending across wing near base; spines on wings all dark brown .... *Euthrips insularis* Franklin.

a'. Color yellowish brown, fore-wings uniformly shaded with gray. *Euthrips nervosus* Uzel.

(2.) General color whitish to yellow or yellowish to brown, no shading of orange.

a. Segment 2 of antennæ with a double spine-bearing tubercule; vertex of head depressed and anterior ocellus directed forward.

b. Color uniformly yellow, surface of body without reticulation. *Euthrips cephalicus* Crawford.

b'. Color uniformly brown; surface of body reticulated. *Euthrips cephalicus* var. *reticulatus* Crawford.

a'. Segment 2 of antennæ without double spine-bearing tubercule; vertex of head not depressed; anterior ocellus directed upward; color yellowish shaded with dusky brown. *Euthrips helianthi* Moulton.

(3.) General color light yellow to yellowish brown, thorax or other parts decidedly tinted with orange.

a. Head pale lemon-yellow to light yellowish brown; thorax orange-yellow; abdomen brownish yellow to brown; segement 1 of antennæ whitish to light brown; segment 2 dark brown. *Euthrips occidentalis* Pergande.

a′. General color brownish yellow, not uniform, thorax orange yellow, segment 1 of antenna pale yellow, 2 light brown, base sometimes yellowish............*Euthrips tritici* Fitch.

a″. General color brown to dark brown, thorax orange-brown. *Euthrips tritici* var. *californicus* Moulton.

DESCRIPTION OF NEW FORMS AND SPECIES.

Euthrips ehrhornii Moulton, male.

Measurements: Head, length 0.15 mm., width 0.2 mm.; prothorax, length 0.166 mm., width 0.183 mm.; mesothorax, width 0.2 mm.; abdomen, width 0.25 mm.; total body length 1.4 mm.

General color similar to female, light brown, head lighter than rest of body.

Antennæ light gray-brown; segments 1 and 3, base and apex of segment 4, and apex of segment 5, brownish white. *Legs* very light brown, trochanters and underside of all the legs nearly white. *Wings* fully developed, nearly transparent white, lightly tinged with grayish-brown; veins weak; spines on wings not so prominent as in the female, arranged as those in female except that there are five on scale of wing and four scattering spines on distal part of fore vein.

Described from one male taken April 9, 1910, from flowers of large, bushy perennial lupine at San Jose, Cal. (P. R. Jones).

Female, *forma brachyptera:* Similar to *forma macroptera* except larger and longer (1.9 mm. in length); general color darker brown, head not lighter; antennæ similar in color to rest of body, apex of segments 3, 4, and 5, white; head longer than wide, a row of spines on head across the front; wings short, extending to base of abdomen; trochanters similar in color to rest of body; abdomen large in proportion to rest of body, segment 10 split above.

Described from two brachypterous females taken from wild flowers March 31, 1910, at San Jose, Cal. (P. R. Jones).

This species is very close to *Euthrips pyri* Daniel, and is evidently quite variable.

Euthrips longirostrum new species. (Pl. III, figs. 6–9.)

Measurements: Head, length 0.10 mm., width 0.133 mm.; prothorax, length 0.15 mm., width 0.183 mm.; mesothorax, width 0.25 mm.; abdomen, width 0.30 mm. Antennæ: Segment 1, 24μ; 2, 42μ; 3, 48μ; 4, 48μ; 5, 36μ; 6, 48μ; 7, 11μ, 8, 15μ; total length of antennæ 0.267 mm. Total body length 1.08–1.40 mm.

Color of body, brown; head, thorax, legs, and antennæ tinged with yellow.

Head about one and one-third times as wide as long, rounded in front, retracted considerably within the prothorax; cheeks slightly arched; back of head transversely striate, bearing five small spines in a row posterior to each eye; also one on each side and two in front of anterior ocellus. *Eyes* prominent, oval in outline, black, with light borders, finely faceted, not pilose. *Ocelli* subapproximate, light yellow, with reddish brown crescents. *Mouth-cone* very long, pointed, *reaching to middle of mesosternum*, tipped with black; maxillary palpi large, long, 3-segmented, middle segment shortest; labial palpi 2-segmented. *Antennæ* 8-segmented, nearly two and four-fifths times as long as head, uniform light-yellowish gray-brown, except segments 1 and 3, which are lighter, and apex and base of segment 3 broadly, base of segment 4, and segment 5, which are transparent white; segment 3 with a distinct handle, segments 2, 4, and 5 constricted somewhat at the base; a forked sense-cone on dorsal side of segment 3, a similar one on ventral side of segment 4, a short, simple sense-cone on lateral side of segment 5, near apex; spines pale brown.

Prothorax slightly wider than long, one and one-half times as long as head; a very small, weak spine at each anterior angle, two strong ones at each posterior angle, a row of short spines on the posterior margin, and a number on the dorsum. *Mesothorax* largest, angles rounded. *Legs* long, lighter than body, dilute yellowish gray-brown, femora darker; in some specimens the legs are yellowish-white, hind femora darker. Spines at tip of fore and middle tibiæ weak; several strong spines at apex of hind tibiæ. *Wings* present, yellowish-white. Veins usually indistinct and tending to disintegrate in mounted specimens. Wings sometimes extending past tip of abdomen, but usually shorter in proportion to abdomen. Spines arranged as follows: Costa with 21 spines, fore longitudinal vein with eleven spines, seven on basal half of wing, three in one group, four in the other, and four scattered spines on apical half, one of which is near apex; hind longitudinal vein with ten regularly placed spines beginning where basal group ends on fore longitudinal vein.

Abdomen subovate, tapering quite suddenly from segment 7. A number of long, stout spines on last three segments. Last segment split above on dorsum.

Described from four females taken from flowers of a perennial lupine, Los Gatos, Cal., May, 1910 (P. R. Jones). Male unknown.

Euthrips costalis new species. (Pl. IV, figs. 1–4.)

Measurements: Head, length 0.10 mm., width 0.166 mm.; prothorax, length 0.11 mm., width 0.183 mm.; mesothorax, width 0.283 mm.; abdomen, width 0.316 mm. Antennæ: Segment 1, 27 μ; 2, 36 μ; 3, 48 μ; 4, 45 μ; 5, 36 μ; 6, 51 μ; 7, 9 μ; 8, 12 μ; total length of antennæ 0.264 mm. Total body length 1.33 mm.

Color of body very dilute yellowish-white, segments 4 to 8 of antennæ grayish brown.

Head angular in front, depressed to receive basal segments of antennæ; sides straight, about one and one-third times as wide as long; spines on head inconspicuous, except one on inner side of each posterior ocellus. *Eyes* large, black, not protruding, slightly pilose; facets large. *Ocelli* approximate, yellow, with brownish-red crescents. *Mouth-cone* short, blunt, tipped with black; maxillary palpi 3-segmented; labial palpi 2-segmented. *Antennæ* 8-segmented, slender, about two and three-fifths times as long as the head; segments 3 and 4 distinctly constricted into a handle at the base. Color of segments 1, 2, and 3 white, faintly tinged with yellow, outer half of segment 3 darker; remaining segments grayish brown, except apices, which are transparent white. A forked sense-cone on dorsal side of segment 3, a similar one on ventral side of segment 4, and two simple sense-cones on each side of segments 5 and 6, near apex. Spines pale and inconspicuous.

Prothorax only a little wider than the head, constricted in the middle; two long, prominent spines on each posterior angle, no visible spines on posterior margin, but four or five short, slender, inconspicuous spines on lateral margins extending to anterior angles. *Mesothorax* largest, sides of *pterothorax* broadly and evenly rounded. *Legs* long and slender, concolorous with body, very light yellowish-white; spines on hind tibiæ alone visible. *Wings* present; forewings broadest at basal third, pointed at ends, all veins conspicuous to end of wings. Spines arranged as follows: *Costa with about eighteen very long, strong spines, much longer than is usual in this genus;* fore longitudinal vein with eight spines, six at base and two at apex; hind longitudinal vein with eight regularly placed spines, beginning where basal group on fore vein ends; anterior fringe very light; posterior fringe long; both fringes present only on apical half of wing. Wings concolorous with body, very light yellowish white.

Abdomen long and slender; spines conspicuous only on last two segments; a comblike arrangement on posterior margin of segment 8.

Described from one female specimen from flowers of California buckeye (*Æsculus californica*), June 6, 1910, San Jose, Cal. (P. R. Jones.) Male unknown.

19. Genus ANAPHOTHRIPS Uzel.

KEY TO THE SPECIES.

1. Antennæ 9-segmented; no spines on posterior angles of prothorax; cheeks straight; surface of abdomen not faintly cross-striated; crescents of ocelli bright orange-yellow; species apparently not saltatory.
   Anaphothrips obscurus Müll. (Synonym, *A. striatus* Osborn.)
2. Antennæ 9-segmented; one stout spine on each posterior angle of prothorax; cheeks arched; crescents of ocelli light brown; species apparently not saltatory.

a. Head about as long as wide; wings not unusually long, shaded gray-brown, with small transparent area near base; segments 5, 6, 7, and 8 of abdomen without comblike arrangement of spines along posterior margin; color uniform yellow to gray-brown; segment 3 of antennæ not pedicellate. *Anaphothrips zeæ* Moulton.

a'. Head noticeably wider than long; wings not unusually long, transparent; segments 5, 6, 7, and 8 of abdomen with conspicuous comblike arrangement of spines; color of head and prothorax yellowish or orange-yellow, abdomen brown; segment 3 of antennæ pedicellate. *Anaphothrips tricolor* Moulton.

a''. Head noticeably wider than long; wings very long, light brown, with clear area near base; abdominal segments without comblike arrangement of spines on posterior margin of abdominal segments; color brownish yellow to yellowish white; segment 3 of antennæ pedicellate. *Anaphothrips longipennis* Crawford.

3. Antennæ with 8 segments; one stout spine on each posterior angle of prothorax; head noticeably wider than long; species saltatory.

a. Color uniform yellow; first longitudinal vein with ten or eleven spines, hind longitudinal vein with three spines; ocelli subapproximate, with reddish-orange crescents; ovipositor extending past tip of abdomen; segment 3 of antennæ pedicellate....(*Scirtothrips*) *Anaphothrips ruthveni* Shull.

a'. Color translucent white, tinged yellowish brown; first longitudinal vein with nine spines, second longitudinal vein with two; ocelli approximate, crescents light brown; ovipositor not extending past tip of abdomen; segment 3 of antennæ not pedicellate..*Anaphothrips albus* new species.

The genus *Scirtothrips* was erected by Shull [1] for the species *ruthveni* on the characters "*Head is shorter than broad and shorter than prothorax, one spine of moderate length is borne by each posterior angle of the prothorax. Species of this genus have the power of springing.*"

Since then *Anaphothrips zeæ*, *A. tricolor*, and *A. longipennis* have been described and now *A. albus*, all of which have long spines on the posterior angles of the prothorax. In *A. tricolor*, *A. longipennis*, and *A. albus* the head is also noticeably wider than long, while *A. albus* possesses the power of springing; the latter also does not have an oblique division of segment 6 of the antennæ. I am positive that the last four species belong to the genus *Anaphothrips*, and if such is the case the genus *Scirtothrips* can not hold upon the characters for which it was erected.

DESCRIPTION OF NEW FORMS AND SPECIES.

Anaphothrips zeæ Moulton.

Female, *Forma brachyptera:* Length 1.53 mm. Similar to *Forma macroptera* except that it is longer and the abdomen, which is larger in proportion to the rest of the body, is much wider than the pterothorax.

Described from two specimens taken on weeds, May 21, 1910, at Visalia, Cal. (P. R. Jones).

This form of *Anaphothrips zeæ* resembles *Aptinothrips rufus* (Gmelin) superficially.

[1] Ent. News, vol 20, no. 5, p. 222, 1909.

Male: Length 1.16 mm. Similar to female, but more slender in form; antennæ one and one-half times as long as the head, more slender than in the female. Spines on wings as follows: Fore vein with a group of four regularly placed spines near the base, a second group of seven regularly placed spines, a group of two slightly distad of the middle, and two widely separated spines on the outer half; hind vein with ten more or less regularly placed spines.

Genitalia and orange-colored testes very prominent.

One specimen, taken May 21, 1910, on weeds at Visalia, Cal. (P. R. Jones).

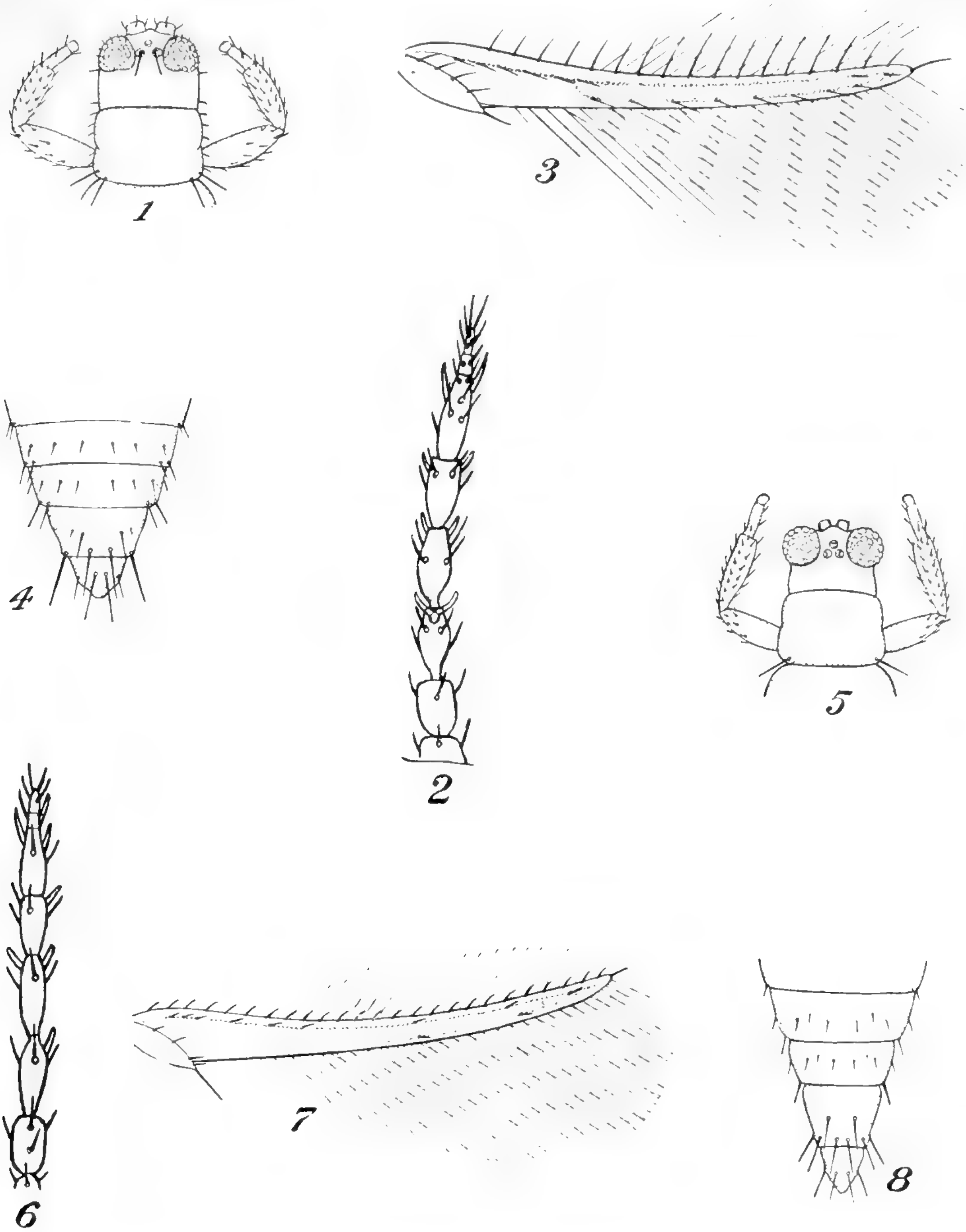
Anaphothrips albus new species. (Pl. IV, figs. 5–8.)

Measurements: Head, length 0.10 mm., width 0.133 mm.; prothorax, length 0.10 mm., width 0.15 mm.; mesothorax, width 0.183 mm.; abdomen, width 0.233 mm. Antennæ: Segment 1, 18μ; 2, 33μ; 3, 45μ; 4, 42μ; 5, 36μ; 6, 42μ; 7, 9μ; 8, 12μ; total length of antennæ 0.247 mm. Total length of body 1 mm.

Color of body translucent white, tinged very lightly with yellowish brown, varying sometimes; head and thorax slightly darker. *Head* considerably broader than long, rectangular, without visible spines, slightly angular in front; cheeks arched. *Eyes* black, prominent, protruding, with coarse facets. *Ocelli* present, approximate, nearly contiguous; crescents light brown. *Mouth-cone* long, broad at base, pointed at tip, which is black, extending to base of prosternum. Maxillary palpi large, 3-segmented; labial palpi 2-segmented, basal segment long. *Antennæ* long, about two and one-half times as long as head, slender, 8-segmented, no oblique line dividing sixth segment; color of segments 1 and 2 very light transparent yellowish white, segment 3 lighter, apex of segment 4, apical half of segment 5, and remaining segments entirely shaded lightly with gray; a forked sense-cone in ventral side of segment 5, and a simple sense-cone on apex of segments 3, 4, 6, and 7, on lateral side.

Prothorax as long as head and only slightly wider; one long, slender, transparent, nearly inconspicuous spine on each posterior angle, no other spines visible. *Mesothorax* largest, sides rounded. *Metathorax* with sides almost parallel but constricted abruptly behind. *Legs* concolorous with body but slightly lighter, hind tibiæ alone armed with spines. *Wings* present, uniformly transparent white, barely discernible. Costa with twenty-six spines; fore longitudinal vein with six spines on basal half in groups of three, then three scattered ones; apical half of wing with three widely scattered spines; hind longitudinal vein with only two widely separated spines on apical half of wing. Anterior fringe very weak, both anterior and posterior fringes not beginning until about the middle of the wing.

Abdomen subovate, lighter translucent white than rest of body, without pronounced spines except on terminal segments, all spines



EUTHRIPS AND ANAPHOTHRIPS.

Fig. 1.—*Euthrips costalis:* Head and prothorax of female. Fig. 2.—*Euthrips costalis:* Right antenna of female. Fig. 3.—*Euthrips costalis:* Right forewing of female. Fig. 4.—*Euthrips costalis:* End of abdomen of female. Fig. 5.—*Anaphothrips albus:* Head and prothorax of female. Fig. 6.—*Anaphothrips albus:* Right antenna of female. Fig. 7.—*Anaphothrips albus:* Right forewing of female. Fig. 8.—*Anaphothrips albus:* End of abdomen of female. Enlarged. (Original.)

transparent. One specimen is more deeply tinged with yellowish brown.

Male: Length 0.833 mm. Smaller and more slender than female but similar in color; orange-colored testes prominent.

Described from two female and one male taken from monkey flower (*Mimulus* sp.) June 6, 1910, San Jose, Cal. (P. R. Jones).

Living specimens are very white and fly readily; they also have the power of springing.

24. Genus ANTHOTHRIPS Uzel.

KEY TO THE SPECIES.

1. Postocular spines wanting; antennæ almost uniformly brown except segment 2 and base of segment 4, which are light brown..*Anthothrips niger* Osborn.
2. Postocular spines well developed.
   - *a*. Postocular spines and most of the spines on postero-lateral margin of abdominal segments knobbed................*Anthothrips flavipes* new species.
   - *a'*. Postocular spines and spines on postero-lateral margin of abdominal segments not knobbed.
     - *b*. Antennæ uniformly brownish black; apex of femora with a small, anteriorly-directed, triangular tooth within.*Anthothrips nigricornis* new species.
     - *b'*. Segments 3 and 6 of antennæ, eyes, fore tibiæ, all tarsi, and other lighter parts of body shaded with orange yellow; femora without tooth at apex..............................*Anthothrips verbasci* Osborn.
     - *b''*. Intermediate segments of antennæ and other light parts of body light brown; femora without tooth at apex.*Anthothrips variabilis* Crawford.

DESCRIPTION OF NEW SPECIES.

Anthothrips nigricornis new species. (Pl. V, figs. 1–4.)

Measurements: Head, length 0.30 mm., width 0.283 mm.; prothorax, length 0.233 mm., width 0.416 mm.; mesothorax, width 0.483 mm.; abdomen, width 0.536 mm.; length of tube 0.15 mm.; total length of body 2.383 mm. Antennæ: Segment 1, 30μ; 2, 48μ; 3, 51μ; 4, 63μ; 5, 60μ; 6, 51μ; 7, 48μ; 8, 30μ; total length of antennæ, 0.381 mm.

General color very dark brown to black with purplish pigmentation.

Head about as long as wide; cheeks nearly straight and parallel; sides of head set with a few minute spines; postocular spines prominent, blunt, but not knobbed. *Eyes* rounded, not protruding, finely and closely faceted. *Ocelli* widely separated, situated far forward, anterior one on extreme vertex; two small spines in front and one behind each posterior ocellus. *Mouth-cone* slightly longer than its breadth at the base, bluntly pointed. *Antennæ* approximate, about one and one-third times as long as the head, uniformly dark brown, segments 1 and 2 sometimes darker; spines pale and weak; three short sense-cones on segment 3 and two short ones on segment 4.

Prothorax slightly more than three-fourths as long as the head; one long, blunt spine on each posterior angle and one on posterior margin just inside of the former pair; one short spine near the anterior angles and one on each side near lateral margin nearly equidistant between the spines on the anterior and posterior angles. Sides of *pterothorax* nearly straight, gradually tapering posteriorly, fore angles oblique. *Legs* long and moderately stout, concolorous with the body, except apex of fore tibiæ and fore tarsi, which are light brown. Fore femora greatly enlarged; all femora with a small, stout, anteriorly directed, triangular tooth at the tip within; all femora with a long spine near the base underneath. Fore coxæ with a short spine. Fore tibiæ with a long spine near the tip underneath. Fore tarsi with a small tooth near the middle within and a stout terminal claw. All legs set with numerous short spines. *Wings* extending to distal margin of sixth abdominal segment, narrowed in the middle, brownish at the base; three spines on anterior margin near the base.

Abdomen gradually tapering from the base; concolorous with the rest of the body, purple pigmentation conspicuous in unmascerated specimens; tube one-half as long as head; a few small spines on dorsum and about six weak, long spines at the tip slightly more than one-half length of the tube; a pair of long, slender, pointed spines on the latero-dorsal margin of each abdominal segment. Males similar to females, except smaller, and fore femora more greatly enlarged.

Described from numerous specimens of both sexes taken in July, August, and September, 1910, on a plant determined by Dr. E. L. Greene, of the Bureau of Plant Industry, as *Eriogonum nudum,* at Alum Rock Creek Canyon, San Jose, Cal. (P. R. Jones).

Anthothrips flavipes new species. (Pl. V, figs. 5–7.)

Measurements: Head, length 0.25 mm., width 0.233 mm.; prothorax, length 0.233 mm., width 0.366 mm.; mesothorax, width 0.40 mm.; abdomen, length 1.41 mm., width 0.444 mm.; length of tube 0.15 mm.; total length of body 2.216 mm. Antennæ: Segment 1, 24μ; 2, 48μ; 3, 57μ; 4, 60μ; 5, 48μ; 6, 45μ; 7, 51μ; 8, 30μ; total length of antennæ, 0.36 mm.

General color dark reddish brown.

Head slightly longer than wide, broadest at the base; sides nearly straight, roughened, set with minute spines; postocular spines prominent, knobbed; hind margin of the head not covered with the front margin of the prothorax. *Eyes* finely faceted, rounded, not protruding, not pilose. *Ocelli* large, well separated, posterior ones the largest, anterior one not situated on the extreme vertex; posterior ocelli contiguous with the light margins of the eyes; two small spines just behind each posterior ocellus and two about twice as far in advance of each posterior ocellus. *Mouth-cone* about as long as its width at the base, pointed. *Antennæ* approximate, about one and one-half times as long as the head, separated at the base by a prolonged vertex; color uniform dark brown except segment 3, which is light brown and yellow at the base; segments 2 and 4 slightly tinged with light brown; segment 1 short, cylindrical; segment 2 urn-shaped, with a long base; segment 3 clavate; segment 4 nearly fusiform; segments 5 and 6 more slender and less fusiform; segment 7 narrow, cylindrical; segment 8 sharply conical. Spines pale and weak; sense-cones short.

Prothorax nearly as long as the head; a stout, knobbed spine on each coxa, one on each fore angle, one in each posterior angle, and a pointed spine just inside of the knobbed ones on posterior angles. Fore coxæ large, forming apparently prominent angles. *Pterothorax* nearly as wide as the abdomen; sides nearly straight, narrowed abruptly in front, gradually behind. *Legs* stout, unicolorous with the body, *fore femora greatly enlarged;* fore tibiæ, distal portion of intermediate and posterior tibiæ, and all the tarsi lemon-yellow; a dark spot on all the tarsi near the apex within; *fore tarsi armed with a large stout tooth near the tip within. Wings* present, narrowed at the middle, fringes long, single, except hind margin of the fore wing where it is double for 10 to 12 hairs.

Abdomen broadly joined to the metathorax and but slightly wider, less than twice as wide as the head and much more than twice as long as wide; first seven segments equally broad; rest gradually tapering; tube about three-fifths as long as the head. Spines inconspicuous on first five segments, several light colored, long, knobbed, and several pointed spines on postero-lateral margin of segments 6, 7, 8, and 9, more numerous on the latter; tube with a whorl of terminal spines *about twice as long as the tube,* which is only slightly wider at the base than at the apex.

Described from one female specimen collected from an "emergence cage" used for the pear thrips (*Euthrips pyri* Daniel) at San Jose, Cal., 1910 (P. R. Jones).

Near *Anthothrips aculeatus* Fab., but differing in the italicized characters.

34. Genus CRYPTOTHRIPS Uzel.

KEY TO THE SPECIES.

a. Color dark yellowish brown, with no conspicuous purplish pigmentation; head slightly more than twice as long as wide; antennæ concolorous with head, except segment 2, which is yellowish brown, segment 3 brownish yellow, segment 4 light brown; postocular spines prominent, knobbed; ocelli not situated far forward .... *Cryptothrips salicis* new species.

a′. Color brown to blackish brown, with conspicuous purplish pigmentation; segments 1 and 2 of antennæ concolorous with head, segment 3 and base of 4 yellow, others shading brown toward tip; postocular spines not long and prominent, blunt, not knobbed.... *Cryptothrips californicus* Daniel.

a″. Color uniformly coal-black, except tarsi, which are blackish brown.

b. Antennæ uniformly black; body length about 2.22 mm.; two pairs of prominent postocular spines.................. *Cryptothrips carbonarius* Hood.

b′. General color of antennæ black, segment 2 paler at apex, segment 3 with two transverse, brownish-yellow bands, one band at the base and the other in the middle; body length about 2.7 mm.; without prominent postocular spines................................ *Cryptothrips rectangularis* Hood.

DESCRIPTION OF NEW SPECIES.

Cryptothrips salicis new species. (Pl. VI, figs. 1–3.)

Measurements: Head, length 0.25 mm., width 0.11 mm.; prothorax, length 0.23 mm., width 0.35 mm. (including coxæ); mesothorax, width 0.33 mm.; abdomen, width 0.41 mm.; total body, length 1.7 mm.; length of tube 0.116 mm. Antennæ: Segment 1, 30μ; 2, 45μ; 3, 59μ; 4, 63μ; 5, 54μ; 6, 45μ; 7, 48μ; 8, 27μ; total length of antennæ, 0.37 mm.

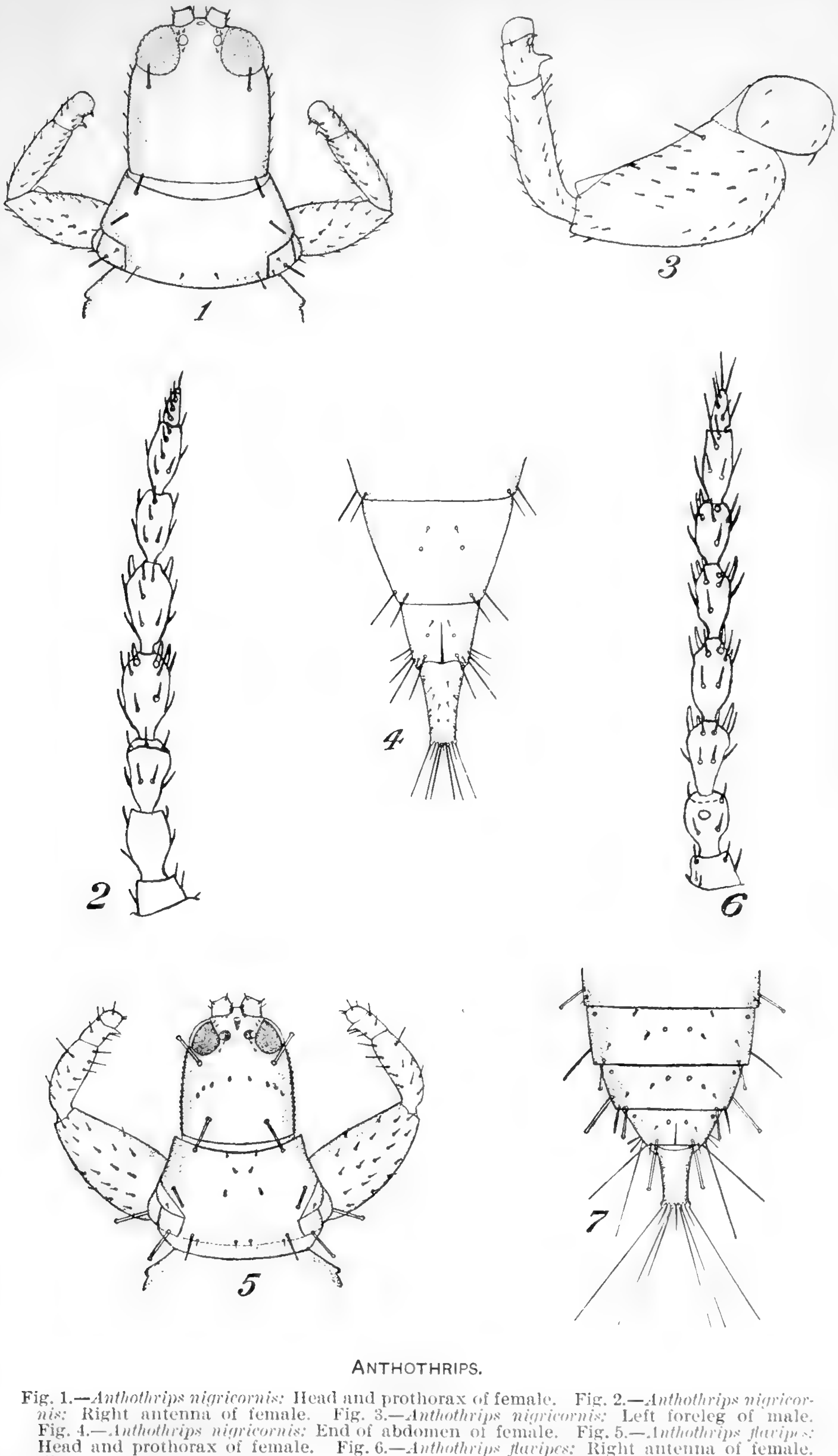
General color dark yellowish brown.

Head cylindrical, about twice as long as wide, somewhat prominent between the basal segments of the antennæ; sides nearly straight, roughened, not pilose, slightly converging posteriorly; head without conspicuous spines except a single prominent knobbed spine posterior to each eye; three small spines in front of and one behind each posterior ocellus. A set of three dark spots just posterior to the ocelli and arranged similarly.

Eyes large, prominent, not protruding, not pilose; facets small, outer ones brownish yellow, remainder of eyes brownish black. *Ocelli* situated far forward; posterior ones contiguous to the inner margins of the eyes, a little proximal to the middle; anterior one not situated on extreme vertex but just distad of a line drawn through the extreme base of the first segments of the antennæ. *Mouth-cone* broad at the base, broadly rounded at the apex, short, extending only to about one-third the length of the prosternum; maxillary palpi quite long and slender. *Antennæ* 8-segmented, separated at the base by a slightly prominent vertex, unicolorous with head, except segment 2, which is yellowish brown, segment 3, which is *brownish yellow,* and segment 4, which is *light brown; segment 3 not noticeably weak.*

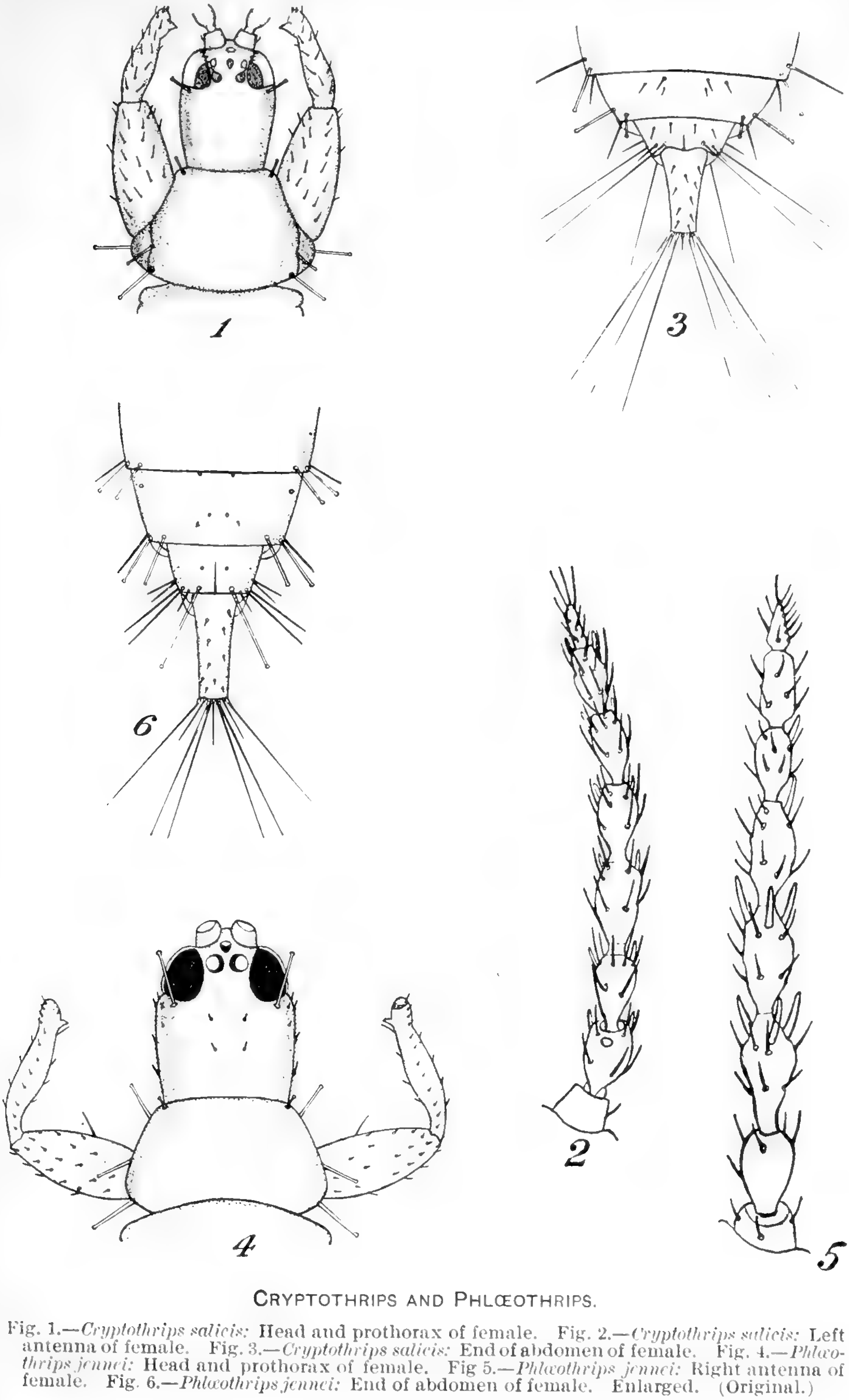
Prothorax large, about one-twelfth shorter than the head; sides straight, extending outward posteriorly; a short, knobbed spine on each anterior angle of prothorax and one long spine on posterior angle of prothorax; also one long spine at the middle of each coxa and one long spine on upper side of each coxa. *Pterothorax* considerably narrower than abdomen; sides almost straight, narrowed abruptly in front, gradually behind. *Legs* dark brown, thickly set with numerous short spines; tibiæ yellowish brown, short and stout; *front femora noticeably thickened;* fore coxæ greatly enlarged. *Wings fully developed,* extending to seventh abdominal segment, slightly narrowed in the middle; both pairs clear and with single fringe except four or five hairs near tip on fore wings, which are double-fringed.

Abdomen long and robust, nearly two and one-half times as long as wide; sides nearly straight to segment 7, which is gradually narrowed; segments 8 and 9 abruptly narrowed; segment 10 (the tube)



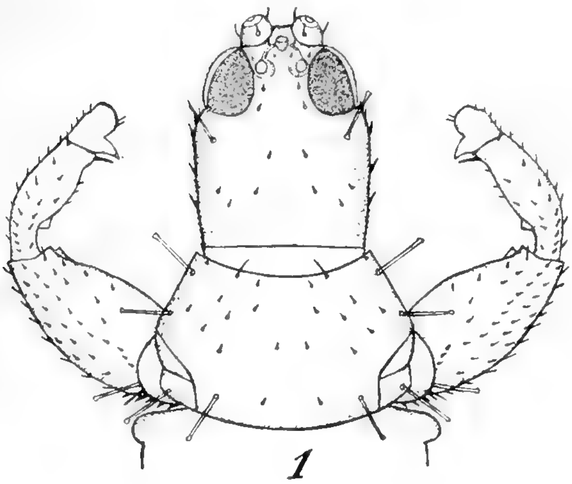
ANTHOTHRIPS.

Fig. 1.—*Anthothrips nigricornis:* Head and prothorax of female. Fig. 2.—*Anthothrips nigricornis:* Right antenna of female. Fig. 3.—*Anthothrips nigricornis:* Left foreleg of male. Fig. 4.—*Anthothrips nigricornis:* End of abdomen of female. Fig. 5.—*Anthothrips flavipes:* Head and prothorax of female. Fig. 6.—*Anthothrips flavipes:* Right antenna of female. Fig. 7.—*Anthothrips flavipes:* End of abdomen of female. Enlarged. (Original.)



CRYPTOTHRIPS AND PHLŒOTHRIPS.

Fig. 1.—*Cryptothrips salicis:* Head and prothorax of female. Fig. 2.—*Cryptothrips salicis:* Left antenna of female. Fig. 3.—*Cryptothrips salicis:* End of abdomen of female. Fig. 4.—*Phlœothrips jennei:* Head and prothorax of female. Fig 5.—*Phlœothrips jennei:* Right antenna of female. Fig. 6.—*Phlœothrips jennei:* End of abdomen of female. Enlarged. (Original.)



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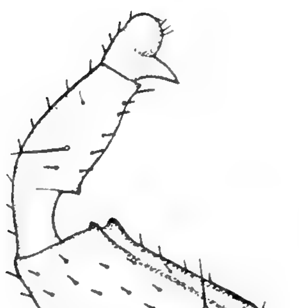

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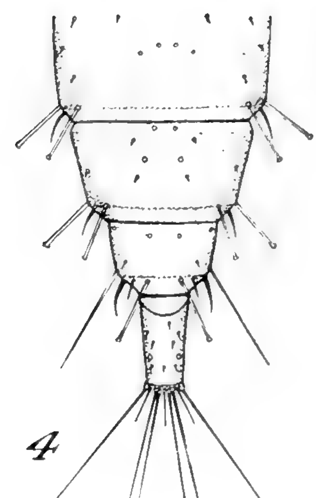

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PHLŒOTHRIPS.

Fig. 1.—*Phlœothrips armatus:* Head and prothorax of male. Fig. 2.—*Phlœothrips armatus:* Right antenna of male. Fig. 3.—*Phlœothrips armatus:* Left foreleg of male. Fig. 4.—*Phlœothrips armatus:* End of abdomen of male. Enlarged. (Original.)

small and slender, only a little narrower at the apex than at the base. A few nearly inconspicuous spines on posterior lateral margin of each segment, knobbed on first eight segments, with small pointed ones on segments 7 and 8; a whorl of six prominent spines on apex of tube.

Described from one female specimen reared from willow galls, San Jose, Cal., September 15, 1910 (J. R. Horton).

Near *Cryptothrips angustus* Uzel, but differing in the italicized characters.

37. Genus PHLŒOTHRIPS Haliday.

KEY TO THE SPECIES.

1. Postocular spines long and conspicuous.
   - *a*. Segment 3 of antennæ longer than segments 1 and 2 together.
     - *b*. Body color dark reddish brown; head nearly one and one-third times as long as wide; antennæ one and one-third times as long as the head. Segment 3 more than one and one-half times as long as segments 1 and 2 together; male unknown........................*Phlœothrips jennei* new species.
     - *b′*. Body color dark reddish brown; head slightly more than one and one-third times as long as wide; antennæ nearly one and one-half times as long as the head. Segment 3 about one and one-ninth times as long as segments 1 and 2 together; males with teeth at apex of fore femora. *Phlœothrips armiger* new species.
   - *a′*. Segment 3 of antennæ shorter than segments 1 and 2 together.
     - *b*. General color dark brown, tibiæ and tarsi bright yellow; cheeks nearly straight; antennæ one and three-fourths times as long as head; males with teeth at apex of fore femora............*Phlœothrips uzeli* Hinds.
     - *b′*. General color brown, fore tibiæ and all tarsi light brown; cheeks strongly arched; antennæ one and one-half times as long as head; males with teeth at apex of fore femora....................*Phlœothrips raptor* Crawford.
     - *b″*. General color yellowish brown, with considerable irregular red hypodermal pigmentation, legs grayish brown; cheeks slightly arched; antennæ twice as long as the head; male unknown........*Phlœothrips pergandei* Hinds.
2. Postocular spines wanting; general color dark mahogany brown, with many small white pigmental markings along head, thorax, abdomen, and legs. *Phlœothrips maculatus* Hood.

DESCRIPTION OF NEW SPECIES.

Phlœothrips jennei new species. (Pl. VI, figs. 4–6.)

Measurements: Head, length 0.31 mm., width 0.25 mm.; prothorax, length 0.18 mm., width 0.36 mm.; mesothorax, width 0.402 mm.; abdomen, width 0.43 mm.; length of tube, 0.2 mm. Antennæ: Segment 1, 22μ; 2, 31μ; 3, 80μ; 4, 80μ; 5, 67μ; 6, 54μ; 7, 52μ; 8, 33μ; total length of antennæ, 0.43 mm. Total length of body, 2.85 mm.

Color dark reddish brown, first seven segments of the abdomen lighter.

Head nearly one and one-third times as long as wide, rounded in front, widest at back of eyes, converging behind; frons protruding quite prominently between the bases of the antennæ; cheeks arched, roughened, set with four spines on each side arising from quite prominent warts, the posterior pair the stoutest. *Eyes* medium in size, not prominent, with small facets; one pair of long, prominent, knobbed postocular spines. *Ocelli* large, distinct, subapproximate, the anterior one directed far forward; all ocelli reddish yellow, with dark red crescents. *Mouth-cone* long, sharply pointed, reaching to the base of the prosternum. *Antennæ* about one and one-half times as long as head; segment 3 about one and one-half times as long as segments 1 and 2 together; segments 3, 4, and 5 subequal in length, the remaining segments appearing smaller. Segments 1 and 2 dark reddish brown; segment 3 brownish white, darker at apex; segments 4, 5, and 6 darker, but lighter than segments 1 and 2, and lighter at the extremities than in the middle; segments 7 and 8 nearly as dark reddish brown as segments 1 and 2; spines long and conspicuous; sense-cones on segments 3, 4, and 5 stout and long.

Prothorax about twice as long as wide and a little more than one-half as long as the head, with long, dark colored, knobbed spines on the posterior and anterior angles, one pair midlatterally; also a pair on the fore coxæ. *Mesothorax* largest, wider than prothorax; *metathorax* tapering gradually to abdomen, which is abruptly wider. *Wings* slender, extending to middle of fifth abdominal segment, lightly infuscated with brown, with three long, knobbed spines on the anterior margin near the base of the fore pair of wings; both wings with a stripe in the center extending past the middle of the wings, the stripes brown in the posterior pair, transparent white in the anterior pair. *Legs* long and stout; fore femora greatly enlarged, with one long spine on the underside near the base; fore tarsi with a large tooth near the middle. Legs nearly uniform, dark reddish brown, except tarsi, which are light brownish white.

Abdomen large and slender, wider than pterothorax, almost equally wide but tapering slightly to the distal margin of the seventh segment; remaining segments tapering more abruptly; first seven segments lighter than rest of body; spines on segments one to eight knobbed, except one pointed spine on the postero-lateral margin of each segment. Tube slightly more than two-thirds as long as the head, with six long spines on the tip as long as the tube itself, and several short ones; several very small spines on the dorsal surface. Ninth abdominal segment with several long, pointed spines on the laterodorsal posterior margin and one pair of knobbed spines.

Near *Phlœothrips minor* Uzel in the shape of the antennæ.

One female, collected May 9, 1910, on peach foliage at Barnesville, Ga. (E. L. Jenne.)

Named for Mr. E. L. Jenne, of the Bureau of Entomology, who collected it.

Phlœothrips armiger new species. (Pl. VII, figs. 1–4.)

Measurements: Head, length 0.30 mm., width 0.23 mm.; prothorax, length 0.25 mm., width 0.41 mm.; mesothorax, width 0.41 mm.; abdomen, width 0.41 mm.; length of tube 0.15 mm. Antennæ: Segment 1, 18 μ; 2, 45 μ; 3, 72 μ; 4, 72 μ; 5, 60 μ; 6, 47 μ; 7, 45 μ; 8, 29 μ; total length of antennæ 0.39 mm. Total length of body 2.46 mm.

General color dark reddish brown, not so deep a reddish cast as in the former species.

Head slightly more than one and one-third times as long as wide; sides nearly straight; five warts on each side from each of which there arises a small spine, the posterior one the largest and stoutest; frons projecting considerably between the basal segments of the antennæ. *Eyes* medium in size, not prominent, with small facets; one pair of long, prominent, knobbed postocular spines. *Ocelli* large, distinct, subapproximate, reddish yellow, with dark-red crescents, the anterior one directed far forward. *Mouth-cone* long, sharply pointed, reaching to the base of the prosternum. *Antennæ* slightly more than one and one-half times as long as head; segment 3 about one and one-seventh times as long as segments 1 and 2 together; segments 1 and 2 dark reddish brown, remaining segments uniformly light brown, lighter at the bases and apices, segment 3 lighter than any of the segments; spines long, prominent, numerous; sense-cones not numerous except on segment 2, where the sense area is large and conspicuous and the sense-cones short and thick; several long sense-cones on segments 3, 4, and 5.

Prothorax about one and two-thirds times as wide as long and about five-sixths as long as the head, with long, dark-colored, knobbed spines on the posterior and anterior angles and one pair midlaterally; also one pair on the posterior margin just inside the pair on the posterior angles. Fore coxæ with a long knobbed spine on each coxa and also *armed with four short, very stout, pointed spines.* *Mesothorax* as wide as the prothorax at its anterior angles, abruptly tapering behind them. *Wings* long and slender, transparent, extending to distal margin of the fifth abdominal segment; three long knobbed hairs on the anterior margin of the fore-wings near the base; a very light brown stripe in the center of the posterior pair of wings extending slightly past the middle. *Legs* long and stout, densely spinose; fore femora greatly enlarged, one-half as wide as long. Fore legs evidently raptorial; fore femora with two sharp, toothlike projections at the tip, within, and a groove between them, evidently a sheath for the tibiæ; fore tibiæ with a small, anteriorly-directed tooth near the base within; fore tarsi with an immense tooth on the inner side; fore femora and fore tibiæ each with a long spine underneath, all other spines very small. Femora and middle and posterior tibiæ concolorous with body; fore tibiæ and all tarsi light brownish yellow.

Abdomen long and slender, tapering gradually from the first segment. First eight segments with knobbed spines; one pair of knobbed spines on the ninth abdominal segment; segments 6, 7, and 8 with several pointed spines in addition to the knobbed spines; segment 9 with several long, pointed, curved spines on the posterior margin. Tube one-half as long as the head, with several small spines on the dorsal surface; 6 long spines, longer than the tube, on the dorsal and latero-dorsal margin; 1 short spine between the two long medio-dorsal spines; no scale at the base of the tube.

One male taken from gall on laurel leaves, Alum Rock Creek Canyon, San Jose, Cal., July 10, 1910 (P. R. Jones).

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TECHNICAL SERIES, NO. 23, PART II.

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BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

MISCELLANEOUS PAPERS.

AN INTERNAL PARASITE OF THYSANOPTERA.

BY

H. M. RUSSELL,
Entomological Assistant.

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W. N. Ord, *collaborator in Oregon.*
Thomas H. Jones, *collaborator in Porto Rico.*
Marion T. Van Horn, Pauline M. Johnson, *preparators.*

CONTENTS

ILLUSTRATIONS.

U. S. D. A., B. E. Tech. Ser. 23, Pt. II. Issued April 27, 1912.

MISCELLANEOUS PAPERS.

AN INTERNAL PARASITE OF THYSANOPTERA.

By H. M. Russell,
Entomological Assistant.

INTRODUCTION.

Although many of the injurious forms of thrips have been the subject of exhaustive research, not only in the United States but throughout the entire world, no internal parasites of importance had been reared until 1911. In July the writer reared a parasite from the prepupa of *Heliothrips fasciatus* Pergande, which Mr. J. C. Crawford has described under the name *Thripoctenus russelli*. At the present time the already-published literature on thrips parasites is not so abundant as to preclude a brief review in this paper. In 1860 Mrs. Charlotte Taylor [1] described a parasite of thrips on wheat under the name *Pezomachus thripites*. This insect was figured and described as a small wingless creature, a little larger than its host. The thorax consisted of 2 nodes, while the antennæ were made up of 40 joints and the palpi of 6. These parasites were observed emerging from thrips larvæ in some numbers. They copulated in a short time, after which the female deposited her eggs in the larvæ of the thrips.

Unfortunately this description is so meager that this insect could hardly be recognized unless actually reared from its host again. It represents, therefore, one of our lost species.

In June, 1911, G. del Guercio published a short note on a chalcidid parasite of *Phlœothrips oleæ* (Costa) Targioni. [2] He gave a short description of the appearance of a parasitized thrips and an excellent figure of the same. According to Del Guercio, the parasitic larva seen within the host is of an oval shape, reddish in color, and resembles a dipterous larva. The adult was mentioned only as "an elegant chalcidid," which he stated he would describe, as soon as he had enough specimens. Nothing was written concerning the biology, habits, or relative abundance of this insect.

Del Guercio, in September, 1911, published a further account of this parasite of the olive thrips, to which he gave the name *Tetrasti-*

[1] American Agriculturist, vol. 19, p. 300, 1860. [2] Redia, vol. 8, pp. 65-68, 1911.

chus gentilii.[1] In this paper he described the adult, of which he stated he had both sexes. According to his observations, these copulate frequently, after which the female seeks out the young larvæ of the host and oviposits in them. The larger larva, prepupa, pupa, and adult stages are passed by in all cases. This insect, he states, passes the winter as larva in its dead host and completes its transformation in the spring. It has been very abundant in Liguria. Del Guercio suggested that by cutting off limbs of the olive infested with parasitized material and shipping the same, this species could be diffused in new localities. It appears from his description of the adult and its habits that he has a larger species than the one referred to in the present paper and with quite different life history and habits.

Dr. L. O. Howard,[2] December 7, 1911, gave a short note on the discovery of the parasite treated in this paper, which is mentioned here as it was the first published note on this insect.

Mr. J. C. Crawford, of the United States National Museum, in December, 1911, described *Thripoctenus russelli* as a new genus and new species.[3] At the same time, the writer gave a brief summary of the life history and habits of this insect.[4]

The present paper, in the light of the information so far obtained on this parasite, aims to present the life history, habits, and economy of *Thripoctenus russelli.* The writer has been ably assisted in the work by Mr. John E. Graf and every point of importance discovered in the life history of this insect has been separately verified by either Mr. Graf or the writer. The writer also wishes to express his appreciation to Dr. L. O. Howard, Dr. F. H. Chittenden, and Mr. J. C. Crawford for their assistance in producing this paper.

HISTORY OF THE DISCOVERY.

The writer, while engaged in the study of truck-crop and sugar-beet insects, at Compton, Cal., began, in May, 1910, an investigation of the life history, habits, and means of control of the bean thrips (*Heliothrips fasciatus* Pergande). From that time until the following fall, frequent collections of the young of this insect were made for study and rearing purposes. On November 10, 1910, the last collection of larvæ of this thrips found that year was made in the yard of the laboratory, for the purpose of determining in what stage this insect passed the winter. These fall-collected larvæ were placed in vials and kept under daily observation and on December 10 four specimens of the prepupal stage of *Heliothrips fasciatus* gave unmis-

[1] Atti Dei Georgofili Di Firenze, 5 ser., vol. 8, pp. 222-227, 1911.
[2] Report of the Entomologist for 1911, U. S. Department of Agriculture.
[3] Proc. Ent. Soc. Wash., vol. 13, p. 233, December 29, 1911.
[4] Ibid., pp. 235-238.

takable signs of parasitism. Two of these died, but on December 13, from the other two, parasitic larvæ had emerged and formed naked pupæ. These parasitic pupæ were sent to Dr. Howard in the hope that the adult could be reared and identified, but unfortunately both died and it was impossible to identify the species. At that time Dr. Howard wrote to the author and advised him of the scientific interest attached to this insect, and requested him to make careful collections of the host larvæ in order to recover the parasite, if possible.

This work was immediately taken up, but it was not until the following year, during February, 1911, that the larvæ of *Heliothrips fasciatus* were again found in the field. From that time until July 1, 1911, large numbers of the larvæ of this thrips were collected and reared to adults, but in no case was there a sign of parasitism. However, on July 3 one prepupa of *Heliothrips fasciatus* gave unmistakable signs of parasitism, but it died before the parasite matured.

While collecting thrips material at Hollywood, Cal., on June 29, 1911, a very minute hymenopteron was observed on the underside of a bean leaf in company with larvæ of this same thrips; and while it was being carefully examined through a small hand lens it appeared to oviposit once in a thrips larva. After this, as the insect was not again observed to come into contact with thrips larvæ, it was captured and put in 50 per cent alcohol. When the minute size of this insect was taken into consideration, it was at once evident that the single case of apparent oviposition must be more or less doubtful, and that it was very essential that the insect be reared to support this observation. This was actually accomplished on July 29, 1911, when an adult of this same species was reared from a larva of *Heliothrips fasciatus*, collected at Hollywood on June 29, 1911. From then until November this parasite has been collected and reared in large numbers.

CLASSIFICATION AND ORIGINAL DESCRIPTION.

Thripoctenus russelli Crawford is a minute insect belonging to the hymenopterous family Chalcididæ and to the subfamily Tetrastichinæ. Mr. Crawford[1] has erected a new genus and species for this insect. He places the genus near *Winnemana*, but separates it from the latter by the absence of two longitudinal grooves on the scutellum.

The following technical description of the genus and species is taken from Mr. Crawford's paper:

Belongs to the tribe Tetrastichini; antennæ with two joints in the funicle, one very small ring joint, club three-jointed, the joints fused; parapsidal furrows indistinct,

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[1] Loc. cit.

incomplete; mesonotum without a median groove; scutellum without longitudinal grooves; propodeum without a median carina; spiracles round; submarginal vein very short, marginal vein long, stigmal short, the knob almost subsessile; postmarginal vein developed though not showing distinctly, as it is, as are the other veins, colorless; marginal fringes of anterior wings almost two-thirds as long as the greatest width of the wings.

Female.—Length about 0.6 mm. Head and thorax black, the abdomen brown, with a large basal flavous spot; head thin anterio-posteriorly, collapsing after death; antennæ testaceous, the pedicel longer than the two joints of the funicle combined; second joint of the funicle longer than the first; hairs on antennæ long; head and thorax smooth, polished; legs including the coxæ testaceous; wings hyaline, the veins colorless.

Male unknown.

LIFE-HISTORY SUMMARY OF THE ORIGINAL HOST.

(*Heliothrips fasciatus* Pergande.)

Heliothrips fasciatus Pergande, the original host of this parasite, is found throughout the entire State of California. In the vicinity of Compton, during the months of July and August, the following life-history notes were obtained.

The eggs are laid in the leaves of the food plant and hatch in from 13 to 19 days. The larvæ immediately begin to feed on the leaves of the host plant, generally on the underside, but when crowded appear to thrive on the upper surface of leaves as well. This stage requires from 10 to 12 days, and as soon as the larvæ are full grown, most of them leave the plant to pupate in rubbish or cracks. The prepupal and pupal stages together occupy from 7 to 12 days, making the total length of the life cycle from 30 to 44 days. The insect is thus exposed to the attack of the parasite during the larval stage only, or for from 10 to 12 days.

METHODS OF COLLECTING FOR EVIDENCE OF PARASITISM.

The small size of both the host and the parasite makes it imperative that special methods be adopted in the rearing of these insects. In making collections for evidence of parasitism the bean leaves badly infested by the host thrips were picked and brought into the laboratory in tin boxes. The thrips larvæ were then removed with camels-hair brushes and placed on freshly picked leaves of the food plant. These were then placed in vials (100 mm. in length by 28 mm. in diameter), which had been lined at the bottom with filter paper. (See fig. 1, at left.) It was found that the filter paper absorbed the surplus moisture and the material transformed better than in cases where the filter paper was omitted. These vials were then tightly closed with cotton plugs, labeled, and put into an outdoor insectary. Each day the material was examined, and the larvæ, when necessary, were removed to fresh leaves by means of the brushes. As soon as full grown the thrips larvæ either pushed in between the vial and edge of the cotton plug or in between the filter paper and the vial, in order to pupate in protected places.

Because of this habit it was very easy to determine parasitism and the amount of material affected. It was found that many of the smaller thrips larvæ died before completing their growth, but this mortality, fortunately, did not retard the investigation.

When it was desirable to discover if material was parasitized or to get adult parasites, the leaves infested with thrips larvæ were put into small wooden boxes with holes bored in the sides for glass tubes.

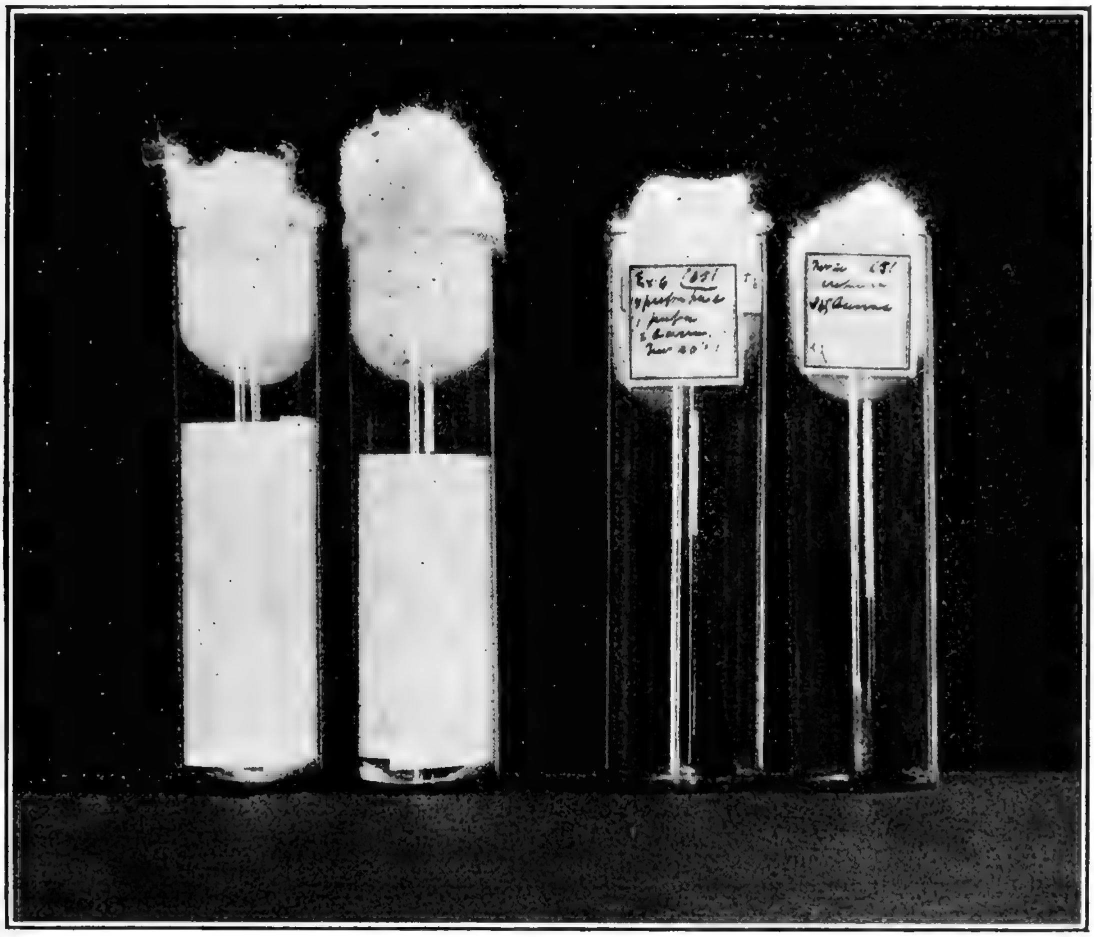

FIG. 1.—Vials used for the study of thrips parasites. (Original.)

(See fig. 2.) These openings were kept closed until the thrips larvæ had all changed, and then the tubes were put in. The parasites upon emerging immediately sought the light and were readily removed from the tubes.

METHODS OF REARING PARASITES FOR LIFE-HISTORY STUDY.

In studying the life history and habits of this parasite, use was made of the large vials described above. In this case, however, the filter paper was left out of the tubes until after the parasite had oviposited in its host. (See fig. 1, at right.) Whenever adults of this parasite emerged they were placed in these vials with fresh leaves heavily infested with healthy larvæ of this species of thrips. In this way oviposition could be carefully watched, and when desired the parasites were removed to fresh vials. The larvæ in which the parasites had oviposited were carefully changed to fresh leaves whenever necessary until they became mature and pupated.

STAGE OF THRIPS SHOWING PARASITISM.

Although hundreds of parasitized thrips have been observed in the laboratory, in no case has the parasitism ever been evident in any stage but that of the prepupa. The larvæ have been carefully examined at regular intervals but until they have changed to prepupæ it is impossible to ascertain which of the larvæ are actually parasitized. In the prepupal stage parasitism develops rapidly, the growth of the host is retarded, and its death follows shortly. In every instance in which a prepupa has changed to a pupa an adult thrips has emerged from this stage, so that, in so far as our present knowledge is complete, the prepupal stage of the thrips is the only one in which parasitism is evident.

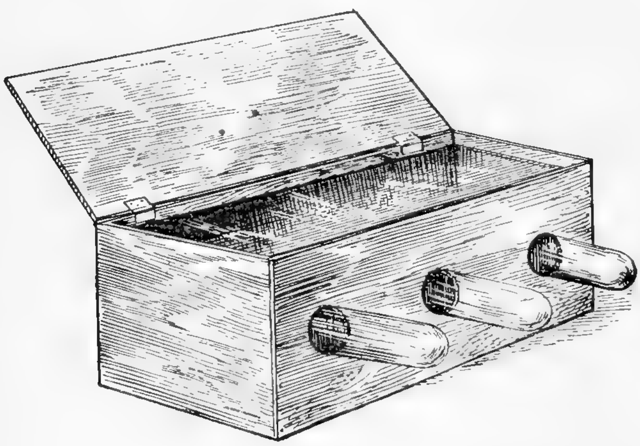

FIG. 2.—Cage for rearing parasites. (From Banks.)

APPEARANCE OF PARASITIZED PREPUPÆ.

Parasitism first becomes evident two or three days after the thrips larvæ have changed to the prepupal stage, and, in case unparasitized prepupæ are in the vial, often after these have further changed to the pupal stage. Parasitism is first indicated in the semitransparent host prepupa when the color contents of the antennæ, head, and anal end of the thrips are removed through the feeding of the internal parasite, leaving the parts hyaline. At the same time there is seen an internal deepening of color in the center of the body. As the feeding of the parasitic larva progresses, the color is more and more directed to the center of the body, and the edges of the body begin to appear hyaline. At about this time the legs of the host larva collapse and sprawl in all directions. A few hours after parasitism is first noticed, the body of the thrips prepupa is swollen and rounded, the original shape being lost. The body is entirely hyaline or colorless except an inner cylinder of deep crimson in *Heliothrips fasciatus* (fig. 3), or yellow in *Thrips tabaci* Lindeman and *Euthrips tritici* Fitch.

BEHAVIOR OF PARASITIZED THRIPS.

The larvæ of thrips that have been parasitized require a few more days for development before changing to the prepupal stage than healthy individuals. It has also been noticed that parasitized larvæ are more apt to change to prepupæ under the paper in the bottom of the vials, while normal larvæ generally crawl up into the edge of the cotton plug before pupating. After parasitism becomes evident in the prepupal stage the doomed insects still have the power of locomotion and will crawl around to some extent. But soon the contents of the limbs are drawn from them and as these collapse all motion in the host thrips ceases.

TIME BETWEEN FIRST INDICATION OF PARASITISM AND FORMATION OF PARASITE PUPÆ UNDER LABORATORY CONDITIONS.

After parasitism becomes evident in the thrips prepupæ, the parasitic larvæ grow very rapidly and within two days, in a few cases, have changed to pupæ of *Thripoctenus russelli;* but the majority change in three and four days. In a few cases this period has taken as long as ten days, but this is unusual and apparently due to some condition unknown at this time. The diagram, figure 4, has been prepared to show the time between the appearance of parasitism and the formation of the parasite pupæ.

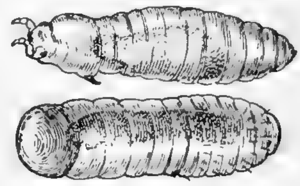

FIG. 3.—Parasitized prepupæ of *Heliothrips fasciatus*, lateral and dorsal views. Greatly enlarged. (Original.)

In a total of 223 specimens, 104, or nearly 50 per cent, changed to pupæ in three days, and 85, or over 38 per cent, in four days.

EFFECT OF COLD ON PARASITIZED PREPUPÆ.

A few experiments were made with parasitized prepupæ of the host thrips to determine the effect of cold on the parasitic larvæ within. On October 19 several parasitized prepupæ were placed in cold storage in a dry atmosphere kept at a constant temperature of 31° F. This material was removed November 27, 1911, and when examined on December 2, by Mr. Graf, all of the parasitic larvæ were found to have emerged and changed to pupæ.

THE PUPA OF THE PARASITE.

FORMATION.

As has been already stated, this parasite invariably completes its growth in the prepupa of its host, and for this reason it changes to the pupal stage in the localities which may have been chosen by its host for pupation. This, of course, will vary with the different species of thrips attacked. Two years constant work with *Heliothrips fasciatus* has shown that, at least in southern California, the majority of the larvæ of this species pupate in rubbish, in cracks, or under clods of earth. Therefore, when *Heliothrips fasciatus* is the host of this parasite the latter will be found to form its pupæ in the same places. *Thrips tabaci* and *Euthrips tritici* both enter the ground and form oval cells in which to pupate, and thus, when either of these thrips is the host, the pupæ of this parasite will necessarily be formed underground.

The parasitic larva, when ready to pupate, splits the skin of the host larva at the anterior end and then gradually works the skin off at the anal end. This molted skin in many cases may be seen lying behind the parasitic pupa.

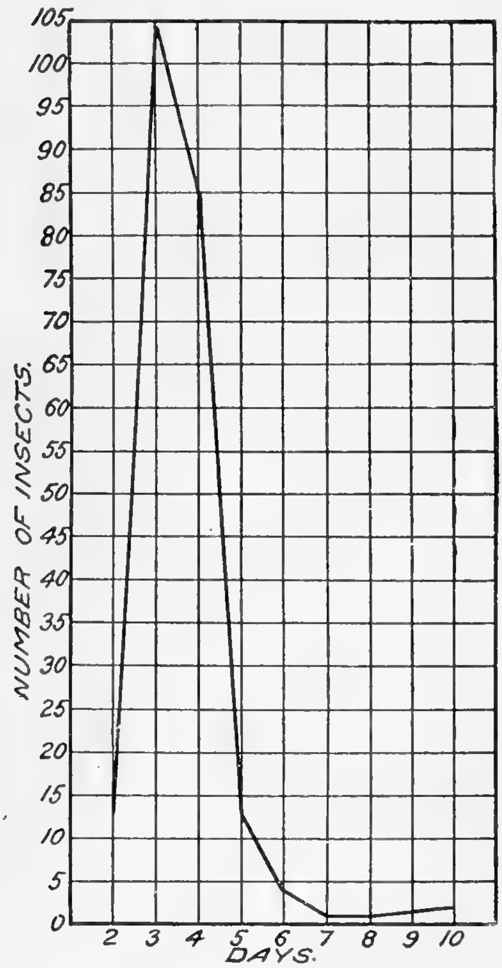

FIG. 4.—Diagram illustrating length of time from appearance of parasitism to formation of parasite pupæ of *Thripoctenus russelli*, July-October, 1911. (Original.)

DESCRIPTION.

When newly formed, the pupa of *Thripoctenus russelli* is almost white, but the intestinal tract in the thorax and anterior part of the abdomen is a bright crimson, similar to the spot in the prepupa of the host that, as stated previously, first indicates parasitism. After a short exposure to the air the edges of the body and appendage cases of the parasitic pupa begin to darken. At first this darker color is of a bluish tint, but it changes more and more to black until the pupa is shining black excepting that portion where the reddish color still shows through. The pupa (fig. 5), which is flattened oval, is rounded in front, but with a slight notch at the center, and is followed by a distinct neck the sides of which are convex. Posterior to this it is abruptly widened to its fullest extent and forms prominent shoulders. The sides then converge very slightly to the beginning of the abdominal segments. The abdomen forms a well-rounded oval, the appendages all being closely appressed to the underside of the pupal shell.

LENGTH OF PUPAL STAGE.

The pupal stage of this hymenopteron requires over one-half of the time of the total life cycle. During the months of July, August, and September, this stage is from 16 to 28 days, but in the majority of cases from 17 to 20 days are required. The diagram, figure 6, has been prepared from the records of 146 individuals, and indicates the length of this stage and the number of individuals for each different length.

EFFECT OF COLD ON PUPAL STAGE.

In order to test the effect of cold, pupæ brought into Washington in September were exposed to outside conditions for over a month. During this time the pupæ remained dormant. About the middle of October these were divided into two lots, one of which was exposed while the other was placed in the greenhouse. After a number of days the adults began to emerge from the pupæ in the greenhouse, in which location the temperature was above the prevailing temperature on the outside, while the lot which had been placed on the outside remained dormant.

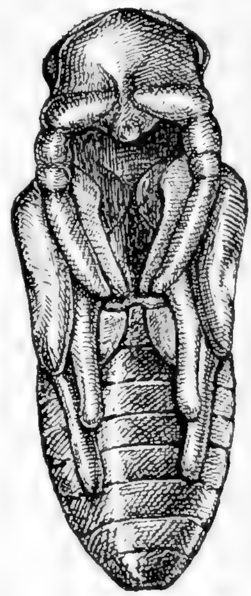

Fig. 5. - *Thripoctenus russelli:* Pupa, ventral view. Greatly enlarged. (Original.)

On October 19 Mr. Graf placed a number of pupæ of this species in cold storage at a temperature of 31° F. in both dry and moist atmospheres. On November 28 he removed some of these pupæ and shipped them to the writer in Washington, D. C. On December 4 these were divided into two lots, one of which was placed in the outdoor insectary while the other was placed in the insectary greenhouse. The temperature maintained in this greenhouse is moderately low and so did not tend greatly to hasten development in the pupæ. However, on February 14 and 17, adults emerged 79 and 82 days after the pupæ were removed from cold storage, in which they had been kept for 41 days. During the three weeks previous to emergence of the adults the average mean temperature in the greenhouse was 65.5° F. February 20 the pupæ in the outdoor insectary were still unchanged.

THE ADULT PARASITE.

EMERGENCE.

The emergence of the adult parasite is best described by Mr. Graf's notes as taken at the time of observation, August 9, 1911.

Several adult parasites were emerging from the pupal cases and were carefully watched. In every case noted, the anterior end of the pupal case, covering the face of the contained parasite, split off and the parasite began to emerge. In addition to the anterior opening, the pupal case, in many instances, split down the back, although this did not hold true with all. In one case the split-off anterior end of the pupal case adhered to the face and antennæ of the newly emerged insect and it required fully an hour from the time the parasite was entirely freed from the pupal case until it was freed from that portion which covered its face.

The longest time in the period of emergence was consumed by the insect in freeing its head and thorax from the pupal case. After this was accomplished the insect rapidly worked the case from its abdomen by the aid of its posterior legs.

The time of emergence noted varied greatly, depending probably upon the strength of the individual and the hardness of the pupal case. The shortest time noted was 4½ minutes from the time the pupal case first began to split until the adult parasite was entirely free. The longest period noted was 1⅓ hours. These both seemed to be exceptional cases, as five others were timed as follows: (1) 21 minutes, (2) 33 minutes, (3) 25 minutes, (4) 28 minutes, and (5) 36 minutes.

For a short time after freeing itself from the pupal case, the adult parasite remains in one position, busily engaged in cleansing its body. The head and antennæ are cleansed by the fore legs and the wings and body by the hind legs. These are then cleansed by drawing them through the mandibles.

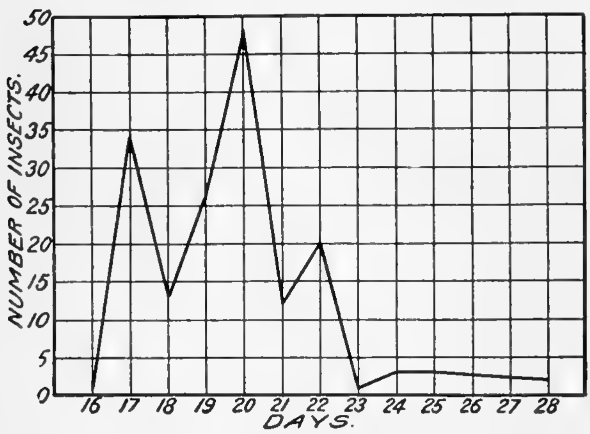

FIG. 6.—Diagram illustrating length of pupal stage in 146 individuals of *Thripoctenus russelli*. (Original.)

When the adult first emerges there is a suggestion of pink color in the abdomen. This is explained by the fact that this parasite in the larval stage does not expel any excrement, and this accumulation of waste matter is of necessity still contained in the abdomen and imparts to it the crimson color so noticeable in parasitized prepupæ. During the change from larva to pupa this waste product still remains and is, in fact, as before stated, in the abdomen of the adult upon emergence. In a short time, however, the adult expels this semiliquid, and it forms several minute red spots on the surface beneath.

DESCRIPTION OF NEWLY EMERGED, LIVE ADULT.

The living adult of *Thripoctenus russelli* is a very minute insect, being about 0.7 mm. long and 0.2 mm. wide. The head is black, with dark red eyes and light yellow antennæ. The thorax is bluish black with the wings hyaline and the legs light yellow, while the abdomen is light yellow with more or less black toward the anal end. The ovipositor is nearly concealed when not in use, but when extended is very long, slender, and light yellow. This insect is shown in figure 7, so that with the technical description on page 35 a more lengthy description at this time is unnecessary.

RELATION AND PROPORTION OF SEXES.

During the course of this investigation hundreds of specimens of this insect have been reared, but among this number it has been impossible to find a single male. Furthermore, up to October 1, 1911, a generation of females had been reared from a female and these in turn had oviposited in their host. Regarding the length of time this insect might continue to multiply without the introduction of the male, or what proportion of males might be produced, it is impossible to determine at the present writing.

PARTHENOGENESIS.

This insect reproduces parthenogenetically to a large extent, for, as the accompanying table indicates, in every one of a number of

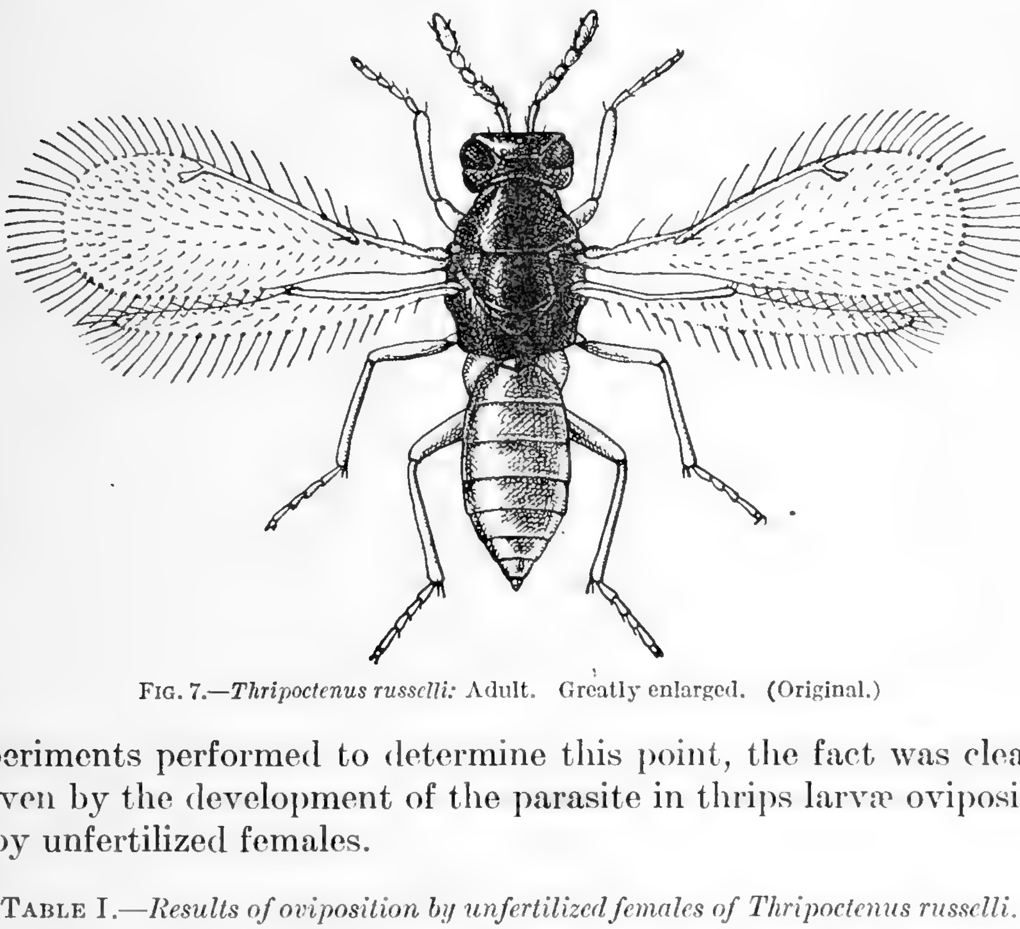

FIG. 7.—*Thripoctenus russelli:* Adult. Greatly enlarged. (Original.)

experiments performed to determine this point, the fact was clearly proven by the development of the parasite in thrips larvæ oviposited in by unfertilized females.

TABLE I.—*Results of oviposition by unfertilized females of Thripoctenus russelli.*

Experiment No.	Date of oviposition by unfertilized female.	First sign of parasitism.	Number of host parasitized.	First adult parasite emerged.	Last parasite emerged.	Number of parasites emerged.
1	Aug. 13	Aug. 20	56	Sept. 11	Sept. 20	44
2	..do	Aug. 21	35	Sept. 12	Sept. 18	25
3	Aug. 14	Aug. 20	10	Sept. 11	Sept. 13	7
4	Aug. 15	Aug. 21	6	Sept. 12	Sept. 15	5
5	Aug. 19	Aug. 26	7	Sept. 18	Sept. 28	5
6	Aug. 20	Aug. 27	31	Sept. 19	Oct. 2	18

These six experiments with six unfertilized females gave a total of 135 parasitized forms, and from these were reared 104 parasite adults.

In many other species of parasitic insects where adults have been reared from eggs deposited by unfertilized females, the offspring have all been males.[1] However, in so far as we have progressed in the rearing of this parasite artificially, the offspring of unfertilized females have been females, for in every case these insects, when placed separately in vials with thrips larvæ, began to oviposit in their host. In one case at least the prepupa of the thrips developed signs of parasitism from the unfertilized egg of the second generation.

Table II shows results of 9 experiments to show effect of parthenogenesis in offspring of the first generation.

TABLE II.—*Effect of parthenogenesis on offspring of first generation of Thripoctenus russelli.*

Exp. No.	Date.	Experiment.	Action.	Result.
1	Sept. 13	Unfertilized parasite, reared from egg deposited by unfertilized female, placed in vial with thrips larvæ.	Insect proved itself to be female by ovipositing immediately.	Sept. 24, 1 parasitized prepupa appeared.
2	...do....	....do	....do	No result.
3	...do....	....do	....do	Do.
4	...do....	....do	....do	Do.
5	Sept. 14	....do	....do	Do.
6	Sept. 15	....do	....do	Do.
7	Sept. 16	....do	....do	Do.
8	Sept. 18	....do	....do	Do.
9	Sept. 23	....do	....do	Do.

METHOD AND PERIOD OF OVIPOSITION.

Oviposition was observed under laboratory conditions in many cases, and in nearly all the operation was identical. The females of this insect, within a few hours after emerging from the pupa, and in all cases under observation, without being fertilized by the males, when placed on a leaf with thrips larvæ began to oviposit as soon as they had located their hosts. The time required for this, of course, varied, as some species of thrips were not as active as others, nor as easily disturbed, so that the parasite had little trouble in finding them. The process is probably best described by the author's notes on oviposition in *Heliothrips fasciatus* taken at the time of observation.

The female, in ovipositing, crawled very slowly over the leaf with her antennæ diverging but horizontal and constantly moving from side to side. In this manner she moved over the leaf more or less in a circle until she came in contact with the larva of *Heliothrips fasciatus*. At this point the antennæ were drawn closely together and moved carefully and slowly over the larva from one end to the other; then, if she

[1] See pp. 257-258, Bul. 91, Bur. Ent., U. S. Dept. Agr. The Importation into the United States of the Parasites of the Gipsy Moth and the Brown-tail Moth. By L. O. Howard and W. F. Fiske.

appeared satisfied, the antennæ were dropped downward, touching the larva. The abdomen was curved under the body and a long, slender, yellowish ovipositor extended from near the anal end of the body. This was quickly thrust into the body of the thrips larva, and as soon as the egg was deposited the ovipositor was withdrawn. Generally this was easily done, but in a few cases a short struggle was necessary before it could be accomplished. The ovipositor was usually inserted into the abdomen near the anal end, but sometimes it is thrust into the side of the thorax. In one instance, where the larva had been approached from in front, the ovipositor was inserted into the front of the body. After the egg was deposited the parasite in some instances would immediately select a new victim or she would rest while cleansing her legs, antennæ, and body and then resume her quest. In other cases, after carefully examining a host larva she would leave it without attempting to oviposit. On some occasions the female was observed to deposit an egg in a larva and after leaving it would shortly return to the same one and oviposit a second or even a third time. In the majority of cases the larvæ of *Heliothrips fasciatus* did not seem to be in the least disturbed by this action. While the writer was engaged in observing oviposition he timed the parasite from its first touching of the host larvæ with its antennæ until the ovipositor was finally withdrawn and in three cases this procedure occupied 20, 50, and 30 seconds each. One female was carefully watched and in 5 minutes oviposited in 4 different larvæ and rejected two others after short examination. During the second 5 minutes this female deposited 2 more eggs. Another female, recently emerged, was placed in a vial with a large number of larvæ of this thrips at 3.15 p. m. At 3.25 p. m. she had deposited her first egg and during the next hour, under the constant observation of the writer, she deposited 20 eggs in 18 larvæ in a period of 35 minutes, and 38 eggs in 36 larvæ in 60 minutes.

Oviposition in the larvæ of *Thrips tabaci* was identical with that in *H. fasciatus*, but the thrips larvæ were more active and more easily alarmed so that they either moved away or violently threw the tip of the abdomen around. In such cases, the parasite retreated but in a short time again approached the larva and in most cases after two or three failures would eventually succeed in ovipositing in the larvæ. The same thing was noticed with the larvæ of *Euthrips tritici*, but in both cases the parasite by returning to the attack generally accomplished her purpose. The same parasite was often placed with one after another of these three species of thrips and would oviposit in each one without appearing to notice the difference. In one case a parasite was observed trying to oviposit in a dead thrips larva that was still more or less soft. Still another adult was observed attempting oviposition in a soft lump of dirt in the vial.

This parasite does not seem to prefer any particular size of larva, as it has been seen to oviposit in all sizes, from larvæ not over a day or two old to larvæ ready to change to prepupæ. If, while examining the leaf for thrips larvæ, it encounters a larva from in front, the parasite generally moves around to the side and then oviposits in the region of the thorax or the abdomen.

HABITS IN THE OPEN.

Oviposition as observed in the field is not very different from that in the laboratory. The following notes were taken while watching the parasite on foliage of turnip infested with *Thrips tabaci:*

The female was observed crawling slowly along with the antennæ in motion and turned first to one side and then to the other; the body also was turned to one side or the other. At other times she ran very rapidly across the leaf. Finally she discovered a larva of *tabaci* and immediately placed her anterior legs on it and lowered her antennæ until they rested on the body. She then oviposited in the host in the same manner that was observed so many times in the laboratory. In nature, however, the thrips larvæ were more scattered, so that this insect succeeding in finding and ovipositing in only 4 larvæ during 40 minutes, and to do this she covered nearly 6 square inches of leaf surface.

In other cases where this insect was observed in the open, a slight jar would frighten her and instantly she would take wing.

EFFECT OF OVIPOSITION IN DIFFERENT STAGES OF HOST.

In the course of the work in rearing the thrips parasite it was found that this insect would oviposit in all stages of the host. In order to determine if the parasite would develop in all stages, a number of experiments were performed in which the parasite was placed in a vial with prepupæ and pupæ of *Heliothrips fasciatus;* and in every case the parasite did not hesitate to oviposit freely in these stages. In spite of this not a single form ever developed the slightest sign of parasitism, and the host adult developed in all cases. From these experiments, it appears, we can safely say that, although this insect will oviposit in all forms of this thrips, it will develop successfully only when the eggs are deposited in the larval stage of the host.

NUMBER OF EGGS AND LENGTH OF OVIPOSITION PERIOD.

Because of the extremely artificial conditions that were necessary in rearing this very minute hymenopteron, it is impossible even to estimate with any degree of correctness the egg-laying capacity of a female under normal conditions. This is due not only to the fact that the parasite is apt to die before the normal number of eggs is deposited, but also largely to the artificial method of rearing, by reason of which many of the host larvæ that have been parasitized die before they show the usual indications of parasitism. In one case a female was observed, under laboratory conditions, to oviposit in 36 larvæ of *Heliothrips fasciatus* 38 times in 1 hour. From the oviposition record of another female, 56 parasitized prepupæ developed, while a third, that undoubtedly parasitized a still larger number, gave a total of 91 parasitized forms that later developed.

The parasites in the vials were observed to oviposit in thrips, as a rule, during a period of 5 days, although in one instance a female was noted that oviposited on the first and eighth day while confined in a vial with larvæ of *Thrips tabaci,* at Washington, D. C. This oviposition period undoubtedly is shorter than that which occurs under conditions which are normal, for, confined in the vials, the parasites were in close contact with many thrips larvæ, their eventual hosts, and so might deposit their eggs faster, while in the open field the parasites were compelled to spend considerable time in searching among the leaves for the thrips larvæ. Undoubtedly this alone would lengthen the normal period of oviposition to at least double that over which oviposition was observed to occur under artificial conditions in the laboratory.

DOUBLE PARASITISM.

Although it has been frequently observed that this parasite would oviposit in the same host two or even three times, only one adult hymenopteron has ever been reared from these doubly-parasitized specimens, and in nearly every case only one parasitic larva has seemed to develop in them. On one occasion, however, Mr. Graf, late in November, 1911, observed a case in which double parasitism had developed and under such conditions that its success was plainly indicated. At that time he took the following notes:

> In the prepupa that was doubly parasitized, the parasitic larva occupying the abdomen of the thrips was about full-sized and no great difference in size could be noted in the alimentary canal of this one as compared with the others. The second parasitic larva occupied the thorax of the host prepupa, with one end of its body against one anterior angle of the thorax of the host, while the other end was against the opposite posterior angle. The colored portion was about one-fourth natural size, and it was more of a yellowish red. It was well shaped however, and not in the least distorted by its position. Under the high-power lens there was a plain division between the two and there was no mistaking the fact that there were two distinct hymenopterous larvæ occupying the body of the prepupal host at the same time. Judging from the appearance under the lens, the larva occupying the abdomen of the host would have been able to develop and pupate, while the one located in the thorax, due to its cramped position and inadequate food supply, would have been unable to reach the pupating stage and would have died.

Unfortunately this host was killed so that no data were obtained as to whether either of the parasitic larvæ would have been able to complete its transformation. However, double parasitism must always result in the death of one of the larvæ and in such a small host undoubtedly in many cases both must die owing to the insufficient nourishment afforded by such a minute host.

ACTIVITY.

While the adult parasite is usually quiet, during the period just after emerging from the pupal case it is, under normal conditions, like most of the Hymenoptera, a very active insect. At times it has been noted to travel over the leaf surface with astonishing speed for so minute a creature, but in the majority of cases which came under observation it seemed to crawl over the leaf in a slow and cautious manner, turning first to one side of the leaf and then to the other, apparently in constant search of its host. Unless disturbed it was seldom noted to take flight, but if jarred or frightened it takes wing at once.

FLIGHT.

This insect is quite capable of sustained flight, as shown by the fact that Mr. Graf captured an adult in the outdoor insectary, on a shelf 5 feet above the ground and about 15 feet from the foliage which held the parasitized thrips. On September 27, 1911, Mr. Graf incorporated in his notes the following:

> On this date two adult parasites were noted in flight. In both instances the parasites flew from the desk to the window, a distance of about 24 inches, and probably could have flown a much greater distance. The characteristic rapidity of their short flights in the vials was lacking and they flew slowly and in a zigzag line. Their flight resembled very much that of a fly in its aimless circuit about a room. During the flight they maintained about the same level, so it is probable that these insects are relatively strong fliers. It is probable that in still air or traveling with an air current they could traverse quite a distance and thus be scattered quite rapidly. This fact is further borne out by the rapidity with which parasitized material of *Thrips tabaci* was taken from all points of a patch of turnips once it had started to show in one place.

SIGHT.

Although this parasite has large eyes, it does not appear to distinguish objects very plainly or at any great distance. In many cases it was observed, while searching for larvæ of its host, to pass near them; so close, in fact, as almost to touch them. In one instance a female, while traveling across a leaf very rapidly, was observed to run halfway over a thrips larva, and then, as if just aware of the presence of its host, to stop, back off, and immediately oviposit in it. It is attracted to light and will travel toward it in the vials so that by turning the bottom toward the window, the cotton plugs may be removed without danger of losing the insect.

BEHAVIOR ON DIFFERENT KINDS OF LEAF SURFACES.

In the course of the laboratory experiments with the thrips parasite it was observed that it experienced considerable difficulty in moving over the surface of a leaf if the latter was hairy or sticky. On leaves with smooth, glaucous surfaces, such as cabbage, turnip, or wild lettuce, this insect moved with rapidity and without apparent difficulty. But on the underside of leaves such as nasturtium and Chinese gourd, the movements were delayed and often ceased while the insect cleaned its legs. Because of this condition oviposition was very slow on leaves of the latter type and the percentages of thrips larvæ parasitized in such experiments were low. Without doubt this same difficulty arises in nature, so that thrips living on plants with spiny or sticky leafage will not be so highly parasitized as those living on plants with smooth leafage.

HOST RELATIONS.

Heliothrips fasciatus Pergande.

The parasite in question, *Thripoctenus russelli* Crawford, was first discovered in the larvæ of *Heliothrips fasciatus* Pergande, and when the adult parasites were first reared they were naturally confined in vials, with the young of this species, and at once oviposited in them. These were carefully manipulated and the parasites later reared in large numbers under laboratory conditions. Collections of this thrips made at various times during 1911 have shown it to be regularly parasitized by this hymenopteron.

Thrips tabaci Lindeman.

As soon as oviposition was noted in larvæ of *Heliothrips fasciatus*, larvæ of the onion thrips (*Thrips tabaci* Lindeman) were substituted for those of *Heliothrips* as a possible host for the parasite, with the result that oviposition took place at once. From these onion thrips larvæ the parasites were successfully reared in large numbers. On September 2, 1911, this parasite was observed actively ovipositing in larvæ of *Thrips tabaci* in the field and from collections of larvæ of this species made at that time the parasite was reared in large numbers. (See Table III.)

TABLE III.—*Parasitism of Thrips tabaci as shown by field collections at Compton, Cal., 1911.*

Lot No.	Date.	Number parasitized.	Lot No.	Date.	Number parasitized.	Lot No.	Date.	Number parasitized.
1	Aug. 30	52	9	Sept. 15	96	17	Sept. 23	23
2	Sept. 2	16	10	Sept. 16	30	18	Sept. 25	14
3	Sept. 5	24	11	Sept. 18	46			
4	Sept. 9	29	12	Sept. 19	40			
5	Sept. 11	45	13	Sept. 20	50			
6	Sept. 12	20	14	Sept. 21	15			
7	Sept. 13	34	15	Sept. 22	23			
8	Sept. 14	28	16	Sept. 23	17	Total number of parasitized forms		602

The percentage of parasitism of this species in September, 1911, ranged in different collections from 15 per cent to 60 per cent, while the average of 7 lots was 33.5 per cent, as shown in Table IV.

TABLE IV.—*Percentage of parasitism of Thrips tabaci by Thripoctenus russelli at Compton, Cal., 1911.*

Lot No.	Date of collection.	Number parasitized.	Per cent of parasitism.
1	Aug. 30	52	35
2	Sept. 2	16	15
3	Sept. 5	24	40
4	Sept. 11	45	30
5	Sept. 13	34	30
6	Sept. 14	28	25
7	Sept. 15	96	60
Total		295	
Average			33.5

In October, from the pupæ of this parasite sent to Washington, D. C., from Compton, Cal., adults were reared which, when placed in vials with larvæ of *Thrips tabaci*, immediately began to oviposit in them. Unfortunately the parasitized larvæ soon died, the parasites perishing with them, and but few data were secured from this experiment. It is possible that this mortality of the host was due to the cool weather which prevailed at the time of the experiment.

These experiments demonstrate the important fact that the parasite *Thripoctenus* will oviposit in the larvæ of *Thrips tabaci*. This later may be an important asset in the control of this destructive insect.

Euthrips tritici Fitch.

Adults of *Thripoctenus*, when confined with larvæ of *Euthrips tritici* Fitch, immediately commenced oviposition. As a result, although the larvæ of this thrips are more difficult to rear, the parasite was successfully reared in a number of experiments. No evidence of parasitism in the open was observed for this species, but as the larvæ were at no time very abundant, sufficient data were not secured to determine whether this insect was being parasitized in the field.

Heliothrips hæmorrhoidalis Bouché.

A series of experiments was conducted in which the larva of *Heliothrips hæmorrhoidalis* Bouché was confined with this parasite and in every case oviposition was noted many times. However, with the exception of one doubtful example, no indication of parasitism ever appeared. To account for this failure is impossible at the present time unless it was that the host larvæ were in a far too advanced state.

Heliothrips femoralis Reuter.

Adults of *Thripoctenus russelli* that emerged in Washington on October 2, 1911, were confined with the larvæ of *Heliothrips femoralis* Reuter and they immediately commenced oviposition. These experiments also failed to give any further results, due no doubt to the fluctuating temperature of the building where the experiments were conducted.

MISCELLANEOUS OBSERVATIONS.

Larvæ of *Trichothrips* n. sp. were confined with the parasite, but whenever the parasite came into contact with the larvæ it at once moved away and upon no occasion did it attempt oviposition. The refusal of the parasite to oviposit was no doubt due to the fact that this thrips was much larger, of an advanced stage, and with a tougher skin.

While observing the oviposition of the parasite in thrips larvæ, one was observed to come into contact with a small red spider (*Tetranychus ?*). The parasite immediately stopped, examined the mite, and then bent under the abdomen and oviposited in it. Undoubtedly this was a case of wasted energy, as the body of the mite was entirely too small to nourish the larva of the parasite.

Young of *Triphleps insidiosus* Say were placed in a vial with the parasite, but no attempt to oviposit was observed. In most cases the young bugs moved so rapidly that the parasite could not get near enough to touch them.

In one experiment Mr. Graf placed very young cabbage aphides (*Aphis brassicæ* L.) in the vial with the thrips parasite, but it refused to oviposit in them.

SUMMARY OF EXPERIMENTS TO DETERMINE HOST RELATIONS.

To briefly summarize the results of the foregoing experiments, this parasite has been reared from *Heliothrips fasciatus* Pergande, *Thrips tabaci* Lindeman, and *Euthrips tritici* Fitch. It has also been observed to oviposit in larvæ of *Heliothrips hæmorrhoidalis* Bouché and *Heliothrips femoralis* Reuter, but without results at the present writing. Upon one occasion, as noted above, it oviposited in a red spider, also without results. Although given the opportunity it refused even to attempt oviposition in *Trichothrips* n. sp., *Triphleps insidiosus*, or *Aphis brassicæ*.

LENGTH OF LIFE IN CONFINEMENT.

Owing to the artificial conditions under which this insect was studied, the normal length of life must have been greatly curtailed. However, adults were often noted in active oviposition for from 3 to 5 days and one was recorded that oviposited on the first and eighth days of its confinement. Adults have been kept alive in the tubes for a period of 10 days. In another case adults were found alive in a shipment of material that was in the mail for 2 days. This insect probably has quite an extended length of life under natural conditions, but its minute size renders it almost impossible to determine this point.

Samuel Doten [1] has recently published some interesting information on the relation of food to the length of life of certain parasites kept in confinement. He found that under favorable conditions some species could be kept alive in confinement for months.

CAUSES OF MORTALITY IN THE OPEN.

Many of the adults of this tiny hymenopteron suffer an untimely death, instances of which have been observed in the present investigation. It was a common sight to see two or three entangled in a spider's web on the underside of a single leaf, and these invariably perished, as they were too frail to extricate themselves. On one occasion the larva of a syrphid was observed to seize one of these parasites and kill it. The larva of *Triphleps insidiosus* was also noted, in one instance, with this insect impaled on its beak.

One female of *Thripoctenus russelli* was observed on a croton leaf, attempting oviposition in the larva of *Heliothrips hæmorrhoidalis*. It was frequently caught by the sticky excrement of its host, and only with great difficulty succeeded in freeing itself. On the next morning this parasite was found fastened to the leaf and dead. Thus the excrement of the larvæ of *Heliothrips* may serve as a protection to the thrips against its natural enemy.

EFFECT OF OVIPOSITION IN DIFFERENT AGES OF HOST LARVÆ.

At the present time our observations show that the degree of maturity of the host larvæ bears some relation to the length of time between oviposition by the parasite and indication of parasitism in the host. In all cases observed where the parasite oviposited in larvæ that were nearly fully grown either the parasitic larvæ did not develop or the length of time required for their development was lengthened a number of days. Also in one experiment where oviposition took place in thrips larvæ only 2 days old the length of time required until there were signs of parasitism was 14 days—considerably more than the average. It appears that the best results are obtained when the parasite selects host larvæ about half grown as its victims.

LIFE HISTORY.

The life history of *Thripoctenus russelli* is taken from records made under artificial conditions, as the material was confined in vials closed by cotton plugs. These were kept in an open-air insectary; hence the other conditions were as nearly natural as it was possible to make them. The fluctuations of temperature were recorded on a

[1] Tech. Bul. 78, Nevada Agr. Exp. Sta., September, 1911.

Freize thermograph. The observations covering the life-history studies of the parasite were made during the months of July, August, and September.

LENGTH OF TIME FROM OVIPOSITION TO FIRST INDICATION OF PARASITISM.

Because of the very minute size of this insect and the internal life led by it in the larval stage, the length of the egg and larval stages was not separately determined. The time required from oviposition by the adult parasite until parasitism becomes evident in the host may be 5 days as a minimum or 17 days as a maximum, but by far the greater number require from 7 to 12 days for this. In Table V this period is recorded for a series of 19 experiments.

TABLE V.—*Time between oviposition and first indication of parasitism, by Thripoctenus russelli.*

Experiment No.	Parasite oviposited in host larvæ.	Number parasitized larvæ observed.																				Total parasitized.
		August.																September.				
		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	
1	Aug. 9				4	8	4	0	4													20
2	...do				1	1	2	1	1	0	1											7
3	Aug. 11	2	1	0	5	0	3	0	0	2	3	5										21
4	Aug. 12				1	2	2	0	3	1												9
5	...do				1	3	2	1														7
6	...do				1	0	0	0														1
7	Aug. 13					3	3	8	16	10	13	3										56
8	...do						2	1	14	7	7	4										35
9	Aug. 14					4	3	2	1													10
10	...do					4	0	1	1	0	1											7
11	...do								1	1												2
12	...do						2	2	1	1	2	2										10
13	Aug. 15						2	5	1													8
14	...do							1	1													2
15	...do						10	14	13	6	4	4	0	6	1	0	0	1	9			68
16	...do						5	0	0	0	0	1										6
17	Aug. 19															9	8	10	8	3	1	39
18	...do											5	2	0	0							7
19	Aug. 20												1	2	2	3	9	3	6	4		30
Total																						345

The diagram, figure 8, gives the length of time between oviposition and indication of parasitism for 353 specimens.

LENGTH OF TIME FROM OVIPOSITION TO PUPATION OF THE PARASITE.

The length of time from oviposition to pupation of the parasite, or the period covered by the egg and larval stages, was carefully determined for 241 specimens and varied from 8 days, as a minimum, to 19 days as a maximum; but 13 or 14 days are required by the greater number of individuals. Figure 9 shows this period.

As the length of the pupal stage was taken up in the discussion of the pupa (p. 33) it is not again referred to here.

LENGTH OF LIFE CYCLE.

The life cycle is shown in Tables VI, VII, and VIII, including the average mean temperature for the period.

TABLE VI.—*Length of life cycle of 44 individuals of Thripoctenus russelli.*

Date of oviposition.	Sign of parasitism.		Parasite larvæ pupated.		Adult emerged.	
	Date.	No.	Date.	No.	Date.	No.
Aug. 13	Aug. 20	3	Aug. 22	1	Sept. 11	1
	Aug. 21	3	Aug. 23	2	Sept. 12	4
	Aug. 22	8	Aug. 24	3	Sept. 13	8
	Aug. 23	16	Aug. 25	7	Sept. 14	7
	Aug. 24	....	Aug. 26	9	Sept. 15	10
	Aug. 25	10	Aug. 27	3	Sept. 16	4
	Aug. 26	13	Aug. 28	3	Sept. 17	....
	Aug. 27	3	Aug. 29	9	Sept. 18	8
			Aug. 31	8	Sept. 19	1
					Sept. 20	1
Total		56		45		44

Total average mean temperature from August 13 to September 20, 65.68° F.
Total life cycle for the 44 specimens, 30 to 39 days.

TABLE VII.—*Length of life cycle of 4 individuals of Thripoctenus russelli.*

Date of oviposition.	Sign of parasitism.		Parasite larvæ pupated.		Adult emerged.	
	Date.	No.	Date.	No.	Date.	No.
Aug. 14	Aug. 20	4	Aug. 22	2	Sept. 11	2
	Aug. 21	1	Aug. 23	2	Sept. 12	....
	Aug. 22	....	Aug. 24	....	Sept. 13	....
	Aug. 23	1	Aug. 25	1	Sept. 14	1
	Aug. 24	....	Aug. 26	....	Sept. 15	1
	Aug. 25	....	Aug. 27	....		
	Aug. 26	1	Aug. 28	....		
			Aug. 29	1		
Total		7		6		4

Total average mean temperature from August 14 to September 15, 65.96° F.
Total life cycle for the 4 specimens, 28 to 32 days.

TABLE VIII.—*Life cycle of Thripoctenus russelli in Thrips tabaci as a host, September and October, 1911.*

Date of oviposition.	Sign of parasitism.		Parasite pupated.		Adult emerged.	
	Date.	No.	Date.	No.	Date.	No.
Aug. 28	Sept. 4	2	Sept. 8	2	Sept. 29	1
	Sept. 5	1	Sept. 9	6	Oct. 2	1
	Sept. 6	3	Sept. 11	2	Oct. 3	2
	Sept. 8	7	Sept. 12	1		
			Sept. 15	1		
Total		13		12		4

Total average mean temperature from August 28 to October 3, 64.7+° F.
Entire life cycle for the 4 specimens, 32 to 36 days.

To summarize all of the rearing experiments conducted during the summer of 1911, the life cycle of this insect required from 28 to 44 days, but the average was between 30 and 34 days. (See fig. 10.)

FIRST APPEARANCE IN THE SPRING.

In 1911 this insect was not observed until June 15, although a very careful lookout had been kept from early in the spring. Undoubtedly future work will show that this insect becomes active considerably before this time and probably as early as the middle of March at least.

LAST APPEARANCE IN THE FALL.

In 1910 parasitized thrips were found as late as November 10 and after that, although thrips larvæ were collected, no signs of parasitism could be found. In 1911 very few adults emerged from the pupæ after October 1, although adults were observed in the field as late as October 21. On November 10, 1911, a large collection of thrips larvæ gave only 9 parasitized specimens, while a later collection, made December 8, gave one parasitized form, which would indicate that this parasite had about ceased its work.

FIG. 8.—Diagram illustrating length of time from oviposition to first evidence of parasitism for 353 individuals of *Thripoctenus russelli*. (Original.)

NUMBER OF GENERATIONS.

The experiments made during 1911 have shown that the female of this insect may begin oviposition in a very few hours after emerging from the pupa. Because of this we can expect a new generation to be begun the same day that the female emerges, provided she finds host larvæ. Therefore, if we take March 15 as a point when this insect becomes active in the spring and November 10 as the date that this insect ceases to oviposit, we might obtain as many as 8 generations, provided each required only 28 days for development, or only 5 generations if the maximum period for development was required.

HIBERNATION.

Thripoctenus russelli passes the winter in the pupal stage, the different individuals evidently hibernating as soon as the temperature drops sufficiently low to check development. Pupæ taken to Washington, D. C., all entered hibernation as early as October 1, while the adults were still emerging at the laboratory in Compton, Cal. At the latter place many entered hibernation as early as October 5, and after that date very few adults emerged.

OCCURRENCE.

The adult of this insect was first observed in a bean field at Hollywood, Cal., on June 29, 1911. At this time one was noted in oviposition and a careful search of the bean foliage for about 3 hours resulted in the capture of 5 more. On July 18, 1911, Mr. Graf and the writer again visited this field and after a very careful examination collected 12 more adults. On August 4, 1911, a visit to this field resulted in the capture of 7 more specimens of this insect, and on August 18 a prolonged examination produced 1 specimen on a leaf of *Lactuca scariola* and 1 on the leaf of a lima bean plant.

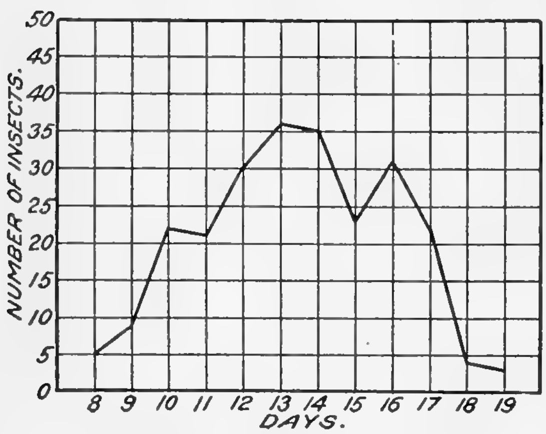

FIG. 9.—Diagram illustrating length of time from oviposition to pupation for 241 individuals of *Thripoctenus russelli.* (Original.)

At Compton, although many parasitized thrips had been collected for over 1½ months, this insect was not found in the adult stage until August 26, 1911, when 1 was taken on a leaf of *Lactuca.* At this time the adults seemed to be very common on turnips in the laboratory yard, for on August 28 Mr. Graf collected 1; on August 29, 1; and on August 30, 2. The writer, on September 1, observed 7 adults crawling over turnip foliage and on September 2, 4 more were observed. Two of these were actively ovipositing in larvæ of *Thrips tabaci.* On September 17 and 23 Mr. Graf observed 4 adults on the turnip foliage.

While Mr. Graf was at Puente, Cal., on October 3, 1911, he found 1 adult of this parasite on a leaf of *Sonchus oleraceus* badly infested by the bean thrips. At the same place on October 21, 1911, Mr. Graf discovered a small bush of *Nicotiana glauca* badly infested by the larvæ of *Heliothrips fasciatus* and careful examination revealed the presence of this insect. On 15 leaves of this plant infested by the bean thrips he found between 40 and 50 adults of this parasite. These were very active and many were observed in oviposition.

DISTRIBUTION.

This insect was first discovered at Compton, Cal., during December, 1910, and during 1911 it has been found to occur very commonly in that locality. During June, 1911, it was found to occur at Hollywood and later it was reared from material collected at Whittier and Puente, Cal. These localities are all situated in Los Angeles County and make up an area of nearly 150 square miles. A few collections of the host larvæ made at Garden Grove and in Los Angeles failed to show parasitism, but probably more extensive collections would have revealed the presence of this insect in both places. Compton, which is near the coast, has a much cooler climate than Puente, which is more inland, so that this insect appears to thrive along the coast and also in the drier and hotter interior valleys.

PERCENTAGE OF PARASITISM IN DIFFERENT LOCALITIES.

The hosts of this parasite are such delicate insects that in all rearing work many have died from the artificial conditions in the vials. Therefore it is impossible to give the exact percentages of the number of thrips parasitized by this insect or the number of normal forms. Nevertheless some idea may be obtained of the work this insect is capable of doing to check its host, *Heliothrips fasicatus*, in Los Angeles County, Cal. Table IX gives the percentage of parasitism at Compton for 1911.

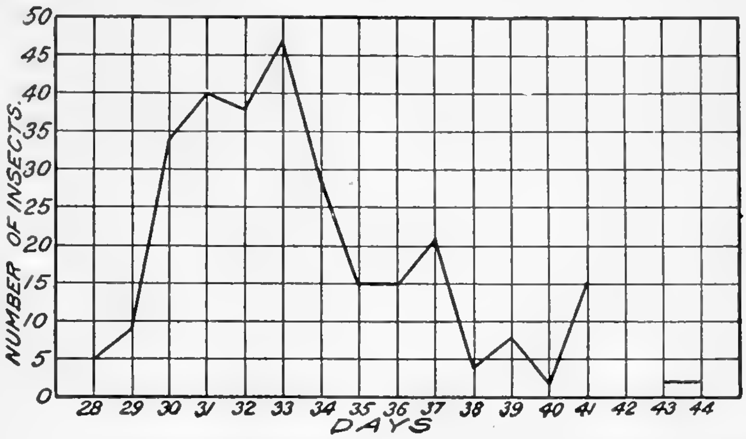

FIG. 10.—Diagram illustrating total number of days in the life cycle of *Thripoctenus russelli;* summary of all rearing experiments. (Original.)

TABLE IX.—*Percentage of parasitism of Heliothrips fasciatus, Compton, Cal., 1910–11.*

Lot No.	Collected.	Number parasitized forms.	Number normal forms.	Per cent parasitized.
	1910.			
1	Nov. 10	4	20	16.66
	1911.			
2	June 15	1	5	16.66
3	June 29	2	26	7.0+
4	July 6	2	8	20.0
5	July 8	....	20-30	....
6	July 10	....	31	....
7	July 12	57	12	70.3
8	July 12	....	5	.0
9	July 14	5	26	16.0+
10	July 17	....	16	....
11	July 18	11	....	10.0
12	July 18	11	....	7.0
13	July 31	21	....	15.0
14	July 31	37	....	25.0
15	Aug. 3	3	....	3.0
16	Aug. 7	65	....	50.0
17	Aug. 8	74	....	45.0
18	Aug. 14	54	....	40.0
19	Aug. 16	147	....	70.0
20	Aug. 21	140	....	[1] 70.0
21	Aug. 26	80	....	(2)
22	Aug. 28	24	....	(2)
23	Aug. 30	35	....	(2)
24	Sept. 2	27	....	(2)
25	Sept. 4	41	....	(2)
26	Sept. 6	9	....	(2)
Total parasitized forms of Heliothrips fasciatus collected at Compton	....	850	....	....

[1] About. [2] Not determined.

In these collections the percentage of parasitism ranged from 0 to 70.3.

Table X gives the percentage of parasitism at Hollywood. The average percentage for that locality was only 0.78+, which seems very strange, as the adult parasite was frequently collected on foliage at that point. However, this low degree of parasitism may have been due to collections made at times when the parasitized material was pupating.

TABLE X.—*Percentage of parasitism of Heliothrips fasciatus, at Hollywood, Cal., 1911.*

Lot No.	Collected.	Number parasitized forms.	Number normal forms.	Per cent parasitized.
	1911.			
1	June 29	2	34	5.55
2	July 8	11	38	22.44
3	July 8		25	
4	July 18		275	
5	July 18		142	
6	July 18		50	
7	July 18		66	
8	July 18		250	
9	July 18		134	
10	July 18		50	
11	July 18		150	
12	Aug. 4	4	(?)	(?)
13	Aug. 4		40	
14	Aug. 18	1	500	.199+
Total		18	1,754	
Average per cent for total				.78+

Table XI gives the percentages of parasitism for a number of collections made during August and September, 1911, at Puente. In this locality the parasite was working about as actively as at Compton, and the percentage of parasitism rose as high as 49.5 in one case that was determined.

TABLE XI.—*Percentage of parasitism of Heliothrips fasciatus at Puente, Cal., 1911.*

Lot No.	Collected.	Number parasitized forms.	Number normal.	Per cent parasitized.
	1911.			
1	Aug. 1	70		35
2	...do....	17	40	29.8
3	Aug. 10	19	(?)	(?)
4	...do....	1	19	5
5	...do....	2	(?)	Very small.
6	Aug. 29	132	(?)	(?)
7	Sept. 1	84	(?)	(?)
8	Sept. 6	89	95	49.5
9	Sept. 12	76	(?)	(?)
10	...do....	71	(?)	(?)
Total		561		

At Whittier the host was not abundant, and the one collection made there on August 29, 1911, of 25 thrips larvæ, developed parasitism in two cases, or about 8 per cent.

MEANS OF COLONIZING THE PARASITE.

Experiments conducted during 1911 between Compton, Cal., and Washington, D. C., have shown that this parasite can be distributed in two ways. Either the material can be collected in the field and shipped direct to the point where its introduction is desired, or the material can be placed in cold storage and thus kept until a more favorable period.

In shipping material direct from the field two methods have been used that give good results. Of these the more promising is to collect material where the parasitism is high and put the thrips larvæ in vials as described under "Methods of collecting for evidence of parasitism" (p. 28). Then, as soon as the parasitic larvæ have

FIG. 11.—Mailing tubes used in shipment of thrips parasites. Original.

transformed to pupæ, they should be packed carefully in cotton, to prevent jarring, and shipped. (See fig. 11.) In the other method the only difference is that the material is shipped as soon as placed in the vials. While this has the advantage of giving more time for shipping, it unfortunately seems to cause greater mortality in the parasitized material. It is also possible to pick leaves of plants infested by parasitized thrips, and pack these in cigar boxes and ship direct. However, this method has not given as good results during the past year as the other two methods.

During the fall of 1911 much material was placed in cold storage in Los Angeles. In these experiments parasitized prepupæ of the thrips were placed in vials or in rubbish and then put in either the egg room or the fruit room. In the same way parasite pupæ were also placed in cold storage. In the egg room the temperature is kept at 31° F. and the air is dry, while in the fruit room, while the temperature is the same, the air is rather moist.

From these experiments it seems that the parasitized prepupæ are able to stand exposure in cold storage for at least 41 days, and when removed at the end of that time the parasites will change to pupæ.

Likewise, when parasite pupæ are placed in cold storage, the period of emergence of the adult may be retarded for a time until conditions are more favorable for its propagation. In these experiments pupæ were left in cold storage for 41 days and then put in a cool greenhouse and in 79 days the adults began to emerge.

The methods of shipping insects and placing them in cold storage just described are at the most very imperfectly worked out, and it is purposed to experiment along these lines until the behavior under these conditions shall be as completely known as is necessary.

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INDEX.

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TECHNICAL SERIES, No. 24.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

THE LIFE HISTORY OF THE ALDER BLIGHT APHIS.

BY

THEO. PERGANDE,

Assistant.

ISSUED APRIL 29, 1912.

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Rolla P. Currie, *in charge of editorial work.*
Mabel Colcord, *in charge of library.*

CONTENTS.

ILLUSTRATIONS.

THE LIFE HISTORY OF THE ALDER BLIGHT APHIS.

INTRODUCTION.

For many years past the writer has spent much time in studying the insects of the family Aphididæ, or plant-lice, in the office and laboratory and in the field. In perhaps no other group of insects is a thorough knowledge of the life histories so necessary to correct conceptions of the species and the differences between them. These life-history studies are often rendered especially difficult from the well-known fact that many of these aphides have a secondary or alternate food plant. In the case of injurious species it sometimes happens that the main injury is to the alternate food plant, and the discovery of the primary food plant furnishes the key to the most effective way of controlling the species. A notable example of this is the hop aphis (*Phorodon humuli* Schrank) which lays its eggs and passes the winter on the plum, and which is best combated by destroying or spraying the wild or cultivated plum trees at the seasons of the year when the aphis is present on this food plant, rather than by measures directed against the insect during the summer when it occurs on the hopvines.

The writer has worked out the life histories of several of the aphides which have alternate food plants. Among these may be mentioned *Hormaphis hamamelidis* Fitch and *Hamamelistes spinosus* Shimer, which inhabit both the witch-hazel and the birch,[1] the hop aphis, just mentioned, and others.

Investigations by the writer of the present species, which has heretofore been confused under various names, were begun in 1878 and have been continued up to the year 1911. They have resulted in straightening out the synonymy of the species and furnished conclusive proof that the *Pemphigus acerifolii* of Riley, described from the maple, and the (*Eriosoma*) *Pemphigus tessellata* of Fitch, described from the alder, are merely forms or series of one and the same species, which should now be known as *Prociphilus tessellata* (Fitch).

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[1] Tech. Ser. No. 9, Div. Ent., U. S. Dept. Agr., 1901.

GENERIC AND SPECIFIC SYNONYMY OF PROCIPHILUS TESSELLATA FITCH.

Eriosoma tessellata Fitch, Cat. Ins. [N. Y.] State Cab. Nat. Hist., p. 68, 1851.

Aphis stamineus Haldeman, Proc. Boston Soc. Nat. Hist., vol. 6, p. 403, 1859.

Schizoneura tessellata Thomas, 8th Rept. Nox. and Ben. Ins. Ill., p. 139, 1879.

Pemphigus tessellata Osborn, Can. Ent., vol. 14, p. 61, 1882.

Pemphigus acerifolii Riley, 8th Rept. Nox. and Ben. Ins. Ill., Suppl., p. 209, 1879.

Pemphigus alni Provancher, Petite Faune Entomologique du Canada, vol. 3, p. 320, 1886.

Prociphilus Koch.

The genus *Prociphilus* was described by C. L. Koch [1] in 1857, and included three species. The following is a translation of his generic diagnosis:

"*Antennæ.*—Short; the two basal joints as usual, short; joint 3 as long as the two following joints combined and somewhat uneven; joints 4 to 6 subequal in length; spur of sixth joint thin and rather short.

"*Nectaries.*—Wanting.

"*Anterior wings.*—Stigma long and narrow; the stigmal vein slightly curved. The first two discoidal veins arising close together, though not from the same point.

"*Legs.*—Rather stout and long."

All of these characters agree well with those of *P. tessellata* Fitch and some other species.

In connection with the above description it seems necessary to add a few points not mentioned by Koch:

Antennal joints 3 to 5 or 6 more or less densely provided with transverse, elongate-oval sensoria, not reaching the lateral margin.

Venation of hind wings like that of *Pemphigus;* the two discoidal veins arising near each other from the subcostal vein about the middle between the base of the wing and the hooklets, at a point where the subcostal bends suddenly toward the front margin of the wing, giving it the appearance of three discoidal veins or of a three-pronged fork.

Last abdominal segment and tail semicircular and fringed with slender hairs.

Prociphilus tessellata Fitch.

This so common species was first described by Dr. Asa Fitch, State entomologist of the State of New York, from apterous specimens found on branches of alder (*Alnus rubra*), in his catalogue of the Homoptera of the State Cabinet of Natural History of the State of New York, 1851, page 68, with the following words:

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[1] "Pflanzenläuse Aphiden," p. 279.

"Alder blight, *E. tessellata.* Dull bluish-black; tergum with the segments marked by strongly impressed lines and covered by white down in square checker-like spots. Length, 0.16. On the underside of branches of the alder (*Alnus rubra*, Marsh.) crowded together and concealed beneath a dense covering of snow-white down. I have searched in vain for winged individuals of this species. No. 863."

A few years later Prof. S. S. Haldeman described the same species[1] as a large species forming follicles on the leaves of the silver-leaved maple, *Acer eriocarpum* (of which *Acer dasycarpum* is but a synonym). He refers to it as follows:

"*Aphis (Pemphigus) stamineus.*

"This name is proposed for a large species of *Aphis* which forms follicles on the leaves of the silver-leafed maple (*Acer eriocarpum*)."

Prof. Haldeman, who mistook the migratory female for the male, gave the following description of the insect:

"*Male.*—Black, feet long, slender, and rufous; tarsi biarticulate; wings slightly deflexed, translucent, pale ferruginous at the base, submarginal nervure conspicuous, black, and ending in a long stigma; disk with four simple nervures; posterior wings with three nervures; mesonotum polished, with a deep Y-shaped impression; abdomen without tubes; promuscis obsolete, antennæ 6-articulate, the first two short, the third long, and the fourth, fifth, and sixth gradually lengthening; length of body, 1½ lines, or, to the end of the wings, 2½ lines.

"*Female and pupa.*—Apterous, dark-reddish brown, feet paler; promuscis twice as long as the head, thickened near the apex; length, 1½ lines."

This is without a doubt the same species as the one described by Prof. C. V. Riley under the name of *Pemphigus acerifolii*, the description of which, for the benefit of those interested in this subject, may be here reproduced.

"*Pemphigus acerifolii* Riley.

"Living in abundant and long cottony excretions on the underside of the leaves of *Acer dasycarpum*, causing them to curl, and exuding an abundance of thick and very glutinous 'honey-dew.'

"*Winged female.*—Alar expanse 16 mm. Head and thorax bluish-black. Abdomen black, covered with long cottony threads. Antennæ reaching the wing insertions; annulations not conspicuous; joints 3, 4, 5, and 6 somewhat contracted at base and apex; apical unguis not perceptible; joints 5 and 6 subequal; 4 distinctly clavate; 3 as long as the two preceding together. Wings subhyaline, of a

[1] Proc. Boston Soc. Nat. Hist., vol. 6, p. 403, 1859.

whitish tinge; subcostal vein and the inner margin of the stigma black; oblique veins whitish, stigma short and broad, not angled at the base of the stigmal vein, which starts from a little behind the middle and is comparatively straight, thereby making the apical cell rather narrow. Terminal distances between the veins subequal, that between second discoidal and cubital somewhat greatest; basal one-third of the cubitus hyaline, but not abortive, as it can usually be traced to its base, which is very close to that of the second discoidal; bases of the two discoidals either approximate or quite contiguous; discoidals of the hind wings proceeding connectedly from the subcostal vein. Larva with 5-jointed antennæ and the promuscis extending beyond tip of abdomen."

Prof. Cyrus Thomas determined the alder blight as *Schizoneura tessellata*, and gave the following short note concerning it:

This species is found on the underside of the branches of the alder (*Alnus rubra*), crowded together and concealed beneath a covering of snow-white down. Wingless individuals, dull bluish-black; the back of the segments are marked with strongly impressed lines and covered with white down in square, checker-like spots. Length to tip of the abdomen, 0.16 inch.

Prof. H. Osborn, on account of the simple venation of the wings, referred the species to the genus *Pemphigus*.

Lastly, it was described under the name of *Pemphigus alni* by the Abbé L. Provancher, who supposed that it was a new species. The following is an English translation of the French original description:

Pemphigus of the alder. *Pemphigus alni*.

Length, 0.8 mm.; to the tip of the wings, 22 mm. Dark brown, including the head and legs, covered entirely with a whitish powder. The abdomen is covered with a long, white, and woolly secretion. The wings are transparent, the veins brown and strong; stigma elongated, narrow; radical cell elongate, inferior veins barely curved.

Found in dense, compact masses, several inches long, on *Alnus*, during September.

Besides the above extracts pertaining to this species, it may be appropriate to mention here also a short report by Dr. Peter Kalm, a Swedish naturalist, of whose "Travels into North America" an English translation has been published. In Volume I, second edition (1772), page 121, there is the following account of an insect on the alder, noticed by him while traveling through Pennsylvania and Delaware, October 3, 1748:

I saw to-day the *Chermes* of the alder (*Chermes alni*) in great abundance on the branches of that tree, which for that reason looks quite white, and at a distance appears as it were covered with mould.

The above lines refer undoubtedly to *P. tessellata*, which Kalm mistook for the European insect which was mentioned by Linnæus in "Fauna Suecica," published in 1746, but which was described in the "Acta" of Upsala in 1736 under the name of *Chermes alni* L. Later, by mistake or oversight, Dr. M. Geoffroy[1] redescribed this latter insect under the name of *Psylla viridis*, and as inhabiting the alder, without recognizing in it the *Chermes alni* L., which may be considered typical of the genus *Psylla*, and a good illustration of which, though without a name, will be found in "Mémoires pour Servir a l'Histoire des Insectes," Volume III (1737), Plate XXVI, figure 1, by M. de Reaumur. Another figure of the same psyllid was published by J. H. Sulzer[2] under the name of *Chermes alni* L. Evidently this psyllid, from a distance, bears some resemblance to our American insect *P. tessellata*, which inhabits the American alders.

Kalm was therefore greatly mistaken when he supposed that our insect was the same as the European *Chermes alni* L., or rather, as it is now known, *Psylla alni*.

Ratzeburg[3] refers to this insect in the following words:

> Auf Erlen [alders], ist die im Puppenzustande sehr sonderbare, kurzborstige, grüne, zuletzt schwarzaftrige, als Fliege, schön grassgrüne 1¼''' lange *P. alni* L., welche meist in der Blattachsel ihren Sitz hat, sehr, ausgezeichnet durch lange weisse Wolle, welche beweglich zu werden scheint, wenn das Insect beunruhigt wird.

An English translation of the above would read as follows:

> On the alders are found very curious, green, short-spined pupæ, the anal end of which in time becomes quite black, which eventually change into the 1¼ lines long, bright, grass-green *Psylla alni* L. They are generally stationed in the angles formed by junctions of the petioles of the leaves and the twigs. The most obvious characteristic about them is the very long, white wool, which appears to move whenever the insect is irritated.

All of the above facts prove that the European *Chermes* or *Psylla alni* L. has nothing in common with the American insect.

FIRST SERIES: PEMPHIGUS ACERIFOLII RILEY.

Observations on the first or original series of *Pemphigus acerifolii* Riley, inhabiting the soft, or silver maple, *Acer dasycarpum*, were commenced by me in 1878 and continued until the year 1911, whereas observations on the alternating, or second series, of *Pemphigus tessellata* Fitch, inhabiting the alders, were started in 1883, or about five years later than those of the former.

Pemphigus acerifolii issues during the early or middle part of April, or as soon as the young leaves appear, from winter eggs deposited the previous fall in cracks or under loose bark on the trunks

[1] Histoire Abrégée des Insectes, vol. 1, p. 486, no. 3, 1799.

[2] Die Kennzeichen der Insekten, Pl. XII, 1761.

[3] Die Forst-Insecten, vol. 3, p. 187, 1844.

of maples, on which return migrants from alders had delivered themselves of the true sexes.

These young stem-mothers, after hatching from winter eggs, travel upward onto the branches and settle on the midrib of the underside of the young leaflets. Usually there is but 1, though frequently there may be 2, 3, or more on the same leaf, in consequence of which, as well as from the increasing irritation, the leaves thus infested exhibit a more or less marked tendency to fold or almost to "double up" from the midrib downward.

Under or within this protection or covering there may be observed numbers of larvæ and pupæ of different stages, up to 100 or more, in company with their mother, all of which, from early in June to the end of July, or until the supply for migrants has been exhausted, develop into winged migrants, without, however, leaving any larvæ behind to continue the series on the maple. These migrants fly then to the alders, which frequently are rather distant from the maples, and settle at once on the underside of the leaves of these shrubs, where they are soon engaged in depositing their larvæ, which surround them in a circle of about 20 to 100. These larvæ, after feeding for about an hour or so, move to the twigs, branches, or stems of the shrubs to start a new cycle of life for the species. Here a number of generations is developed, after which, from about the middle of September to the middle of October, numerous return migrants are developed, which fly back to the trunks of the maples to continue the cycle of life prescribed by nature.

In consequence of these facts, which were gradually obtained, I have been able to prove beyond a doubt that the original host plant of this species is the silver maple, and not, as might be supposed, the alder; the latter is its secondary food plant, and proof of this was established during June of 1903.

In conjunction with the above, it seems proper and just to give some of the observations made through which the life history of the species was definitely ascertained.

Besides the migrants from the maple and return migrants from the alder, I ascertained also that after the departure of the return migrants numbers of mature, apterous females still remain upon the alders and keep on producing additional larvæ, all of which, without casting a skin, crawl down the stems, and frequently to the stouter roots, which are more or less surrounded by cavities made by ants, or hide between or beneath the dead leaves, etc., which surround the base of the shrubs, for hibernation. These form the first hibernating series of larvæ and neither feed nor grow until the sap rises again the following spring, when, after an absorption of sufficient nourishment, they cast their first skin and keep on growing until mature, at which time, like their parents, they also deposit numbers of larvæ, which in turn reach maturity.

Multiplication goes on in this way until a second series of migrants is produced the following fall from the original settlers. However, there remain again enough apterous females to produce a second series of hibernating larvæ, to produce an additional series of migrants. A third series of migrants and hibernating larvæ was also traced.

How long the vitality of the original stock will last it is impossible at present to surmise, though it seems that multiplication may go on indefinitely if the aphides are not exterminated by carnivorous enemies or by parasites.

The most active among the carnivorous enemies are the larvæ of the lycænid butterfly *Feniseca tarquinius* Fabricius; the larvæ of the lacewing fly *Chrysopa sicheli* Fitch [=*C. quadripunctata* Burmeister]; the larvæ and imagos of two ladybirds, *Hippodamia convergens* Guérin, and *Adalia bipunctata* Linnæus; the larvæ and imagos of a hemipteron, (*Nabis*) *Pagasa fusca* Stein, besides the larvæ of various syrphid flies, which generally prove very destructive to these aphides and frequently exterminate whole colonies.

Internal parasites are thus far not known.

Besides these enemies, there are various species of ants which are mainly attracted to these aphides by the honeydew ejected by them, upon which they feed, while some of them even protect the aphides against enemies by constructing tubes or tunnels of earth over and around such colonies, leaving here and there a few exits open to enable the ants to enter and leave. The ants which have been observed to construct tunnels or covers over these aphides are *Tapinoma sessile* Say and *Cremastogaster lineolata* Say; among those which simply gather honeydew, *Camponotus pennsylvanicus* De Geer, *Lasius alienus* Förster, and *Monomorium minimum* Buckley (*minutum* Mayr) have been observed.

EXTRACTS FROM NOTES MADE AT THE TIME.

June 28, 1883.—Migrants from maple leaves, placed in a jar for observation, deposited since yesterday a large number of larvæ. All of them were provided with a long rostrum, which proved that they were not the sexes of this species.

Found to-day two colonies on leaves of maple near Rosslyn, Va., and considered the migrants in these colonies at that time as being identical with those of *Pemphigus tessellata* Fitch, though notwithstanding that migrants were flying, I failed to observe any of them or their larvæ on any of the alders examined. However, after placing infested leaves of maple with a branch of alder I found, later on, that two of the migrants had settled on the alder leaves.

With them were also a few small colonies of larvæ which had settled on the branch, while recently deposited larvæ were also observed on the leaves.

June 7, 1904.—Received to-day from Chatham, Va., some leaves of maple infested with pupæ and migrants of *Pemphigus acerifolii.* A number of these migrants were placed with a potted plant of alder for observation, and I found the following day that quite a number of these migrants had settled on the underside of some of the leaves, and with them were many young larvæ which they had deposited, all of which proved them to be identical in every respect with those of *Pemphigus tessellata.* These larvæ were reddish or brownish red and provided at the anal end of the body with a white and curly or cottony secretion, which gradually spread over the whole insect until it had the appearance of a little lump of cotton.

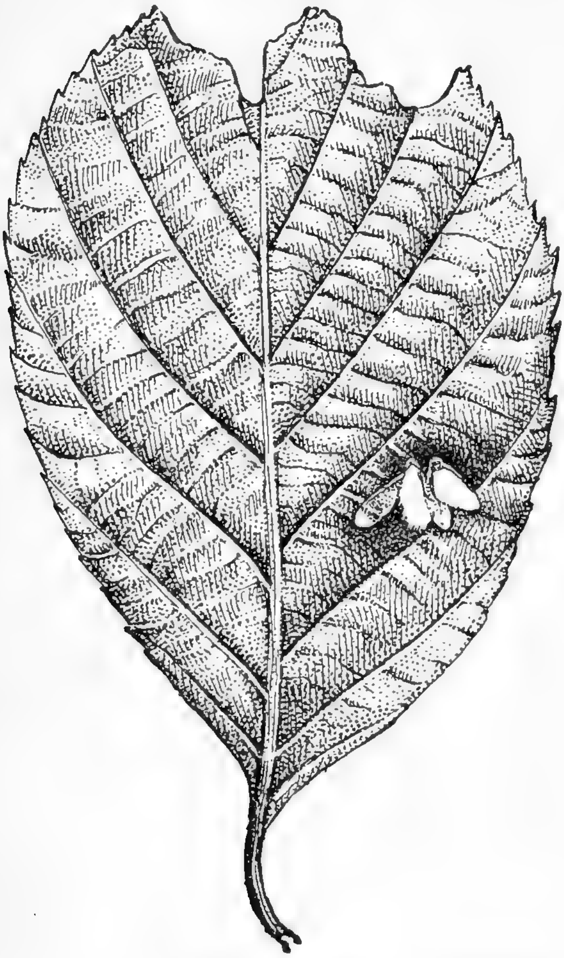

FIG. 1.—*Prociphilus tessellata:* Migrants from maple to alder. (Original.)

Migrants which were placed with a potted maple died without depositing any larvæ.

June 23, 1905.—Observed to-day some migrants of *Pemphigus acerifolii*, on the underside of leaves of alders, *Alnus rugosa*, near the Chain Bridge, District of Columbia. They were each surrounded by a circle of about 28 larvæ, all of which had already cast their first skin, which was adhering to the leaves. These larvæ were orange and their abdomen covered with a long and backward-directed, cottony secretion, whereas that of the thorax was shorter and quite erect, longest along the median line. Sometimes three or four of the migrants had settled on the same leaf; some of them were already dead or barely living. On some of the leaves were several rings of cast skins, varying from 18 to 40 in number, while on the branches of the same shrubs were numerous larger or smaller colonies of larvæ.

April 11, 1905.—While examining trunks of maples near Rosslyn, Va., I found, under the shaggy bark of a tree, numbers of dead and dry return migrants, and with them also some of the young stem-mothers, slowly moving about, all of which would have had to crawl 5 to 10 feet to reach the nearest branches. Young larvæ were not yet present, though the buds were just swelling.

May 11, 1906.—To-day I saw near Rosslyn, Va., a few young stem-mothers on leaves of lower branches of maples stationed near the base of the midrib on the underside of the leaves. Two of them were already fully grown and completely covered with a large amount of woolly secretion, irregularly interspersed with rather long and more or less curly or wavy white threads. These two females deposited a few larvæ till the day following.

May 18, 1906.—Found at Rosslyn, in the same locality as above, six of the stem-mothers on one of the maples. With one of them were 75 and with another one over 100 larvæ, which were already of two stages and of a pale orange color. The smaller larvæ had a brush of white secretions at the end of the body, whereas the whole dorsum of the larger or older larvæ was covered with long, white wool, interspersed with twine-like, wavy strands.

June 6, 1906.—A lot of maple leaves badly infested with *Pemphigus acerifolii* were received to-day from Fredericksburg, Va. Among the aphides were quite a number of migrants, some of which were placed on leaves of a potted alder and soon settled on the underside of these leaves. On examining this tree in the afternoon of the next day I found that one of the migrants had deposited a considerable number of larvæ, which soon after were seen traveling up and down the stem.

June 10, 1906.—Discovered to-day four colonies of *Pemphigus acerifolii* on leaves of maple near the Chain Bridge, District of Columbia. The infested leaves were almost folded, both halves bending down from the midrib. Inside of these folds were numbers of pupæ which at the anal end were provided with about 12 rather stout, twine-like, and somewhat wavy or curly white filaments, about 3 or 4 times the length of the body, spreading out fanlike, intermixed at their bases with shorter, fine wool or secretion. In the immediate neighborhood numbers of migrants were already found on the leaves of alders accompanied by a brood of their larvæ, besides numerous colonies of larvæ on branches and stems.

June 18, 1906.—A large colony of larvæ from migrants of *Pemphigus acerifolii*, which had settled on the stem of a potted alder, was greatly reduced by pupæ of (*Nabis*) *Pagasa fusca* Stein, which fed on the aphides.

June 26, 1906.—Observed to-day numbers of migrants from maple on the underside of leaves of alders near the Chain Bridge, District of Columbia. Many of them were already dead, though all others, still living, were empty and shrunken. Two of the migrants, alive and active, were surrounded by numerous larvæ, and still depositing.

There were also numerous colonies of young larvæ on the branches and stems.

May 28, 1911.—Found to-day one colony of *Pemphigus acerifolii* on a leaf of maple near Rosslyn, Va., containing one stem-mother and 135 of her progeny—mostly pupæ, in various stages of development—besides many quite small larvæ, while the mother appeared to be in a condition to deposit still more.

SECOND SERIES: PEMPHIGUS TESSELLATA FITCH.

Notwithstanding that the insect under this name had been known to me since 1869 as having a range from Canada to Florida and as far west as St. Louis, Mo., occurring upon native and foreign species of alders, the first attempt to learn its life history was begun in June, 1883, when young colonies had established themselves on branches of different kinds of alders on the grounds of the Department of Agriculture at Washington, D. C. The larvæ were apparently the progeny of migrants from maples nearby. They had settled on the underside of the branches in groups of 4 to 8 specimens, arranged in circles, with their heads toward the center. All were covered with rather long, white secretion, so as to resemble a rosette, or a single insect, reminding one strongly of some of the aleyrodids. This secretion issues from 6 rows of transversely oval and rather flat warts.

Early in October of the same year some of the branches were almost completely covered with colonies 12 or more inches in length. Among the great number of apterous females were also many pupæ and large numbers of winged specimens.

EXTRACTS FROM NOTES MADE AT THE TIME.

April 28, 1897.—Observed again small colonies of larvæ on alders on the Agricultural grounds. All of them were densely covered with a white and woolly secretion, intermixed with stout and curly threads. They were closely packed and resembled colonies of large mealybugs, arranged more or less in circles; sometimes they were, however, so much crowded that many were actually standing on their heads. These larvæ had apparently been hibernating since the previous fall.

September 12, 1897.—Found large colonies of this insect on alders at Cabin John, Md., and among them numerous pupæ and migrants. The winged specimens were densely covered with long, white tufts of secretion, which formed a dense mass on the dorsum and around the end of the body, besides projecting in shaggy tufts above the closed wings. This secretion was intermixed at the anal end of the body with longer and stouter threads; along the sides of the abdomen were rather long, delicate, and somewhat curly, erect tufts or streamers, and also long and forwardly directed tufts on the thorax and head, whereas the ventral side of the body was densely covered with a short and white secretion.

September 14, 1897.—A lot of migrants from alders were placed in a tube to obtain their progeny. By the following day they had deposited a number of larvæ which, on examination, proved to be the sexes, or males and females, of this species, both of them without a rostrum. The females were about twice as large as the males and of a bright yellow, whereas the males were greenish or greenish yellow. The antennæ and legs of both were colorless. Each of the females contained only one egg.

Most of the males were dead about 7 days later, whereas most of the females were still alive, active, and mature. These females had cast four skins, which in most cases were still attached, in a continuous string, to the end of the body. None of the females had increased in size, and they looked the same as before. Some had secreted a quantity of rather long and woolly secretion, which covered the posterior half of the body.

September 21, 1897.—On examining the trunks of maples near Rosslyn, Va., I discovered one of the sexual females in a crack of the bark, in the company of a migrant from alder.

September 30, 1897.—Examined the trunk of a European alder on the Agricultural grounds, the branches of which were still covered with this insect; on the trunk were also a few migrants. though I failed to find any of the sexes or the winter eggs; there were, however, on the rough bark and tucked away in cracks or cavities large numbers of hibernating larvæ, while others were still coming down.

November 8, 1897.—Reexamined the same tree, and found again numerous hibernating larvæ in cracks and in empty egg-cases of spiders, but none of the sexes or winter eggs; these larvæ were either covered with a bluish-white secretion or ornamented with 6 dorsal rows of squarish, mealy patches, giving them a pretty, checkered appearance.

After an unavoidable intermission of a number of years, observations on this particular aphis were again taken up in 1903.

January 11, 1903.—While again examining alders on the Agricultural grounds, large numbers of colonies of this species were seen on the shoots, all of them being covered with cottony secretion. On examining these colonies it was found that all of the apterous females were dead, having evidently been killed by the late frosts, but underneath them, and between, were found live and active hibernating larvæ, which evidently had been protected against the wintry blasts by the covering of their dead mothers.

September 27, 1905.—A few colonies on alder were found near the Chain Bridge, District of Columbia, and among them numbers of return migrants.

October 5, 1905.—Large numbers of return migrants were found on the trunks of many of the maples near Rosslyn, Va., while on alders near by some colonies of *Pemphigus tessellata*, composed of apterous females, accompanied by numerous larvæ of the hibernating series and numbers of return migrants, were observed. A comparison of these migrants with those found at the same time on the trunks of maples, or with those of the first series, termed *Pemphigus acerifolii*, proved them to be absolutely alike. These return migrants to the maples were scattered over the trunks of the trees from the bottom to at least 50 feet above the ground, or as far up as the eye could reach, resembling flakes of snow. Frequently as many as 20 or more were counted in some of these batches.

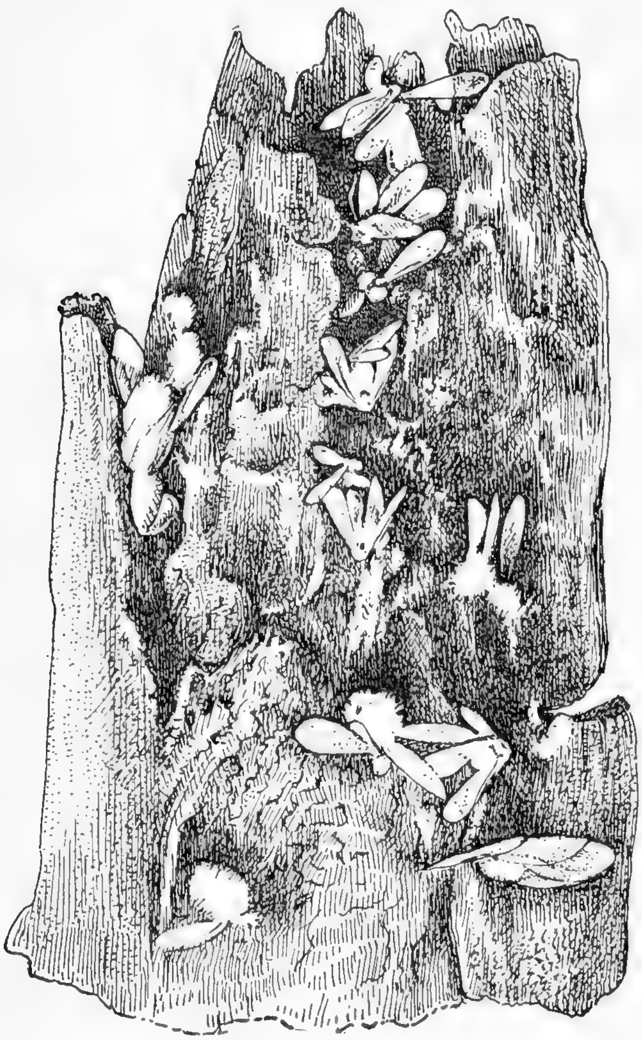

FIG. 2.—*Prociphilus tesselata:* Return migrants on trunk of maple. (Original.)

With the migrants were also numbers of the true sexes, many of them in copula. Some of these females had crowded into such small cracks that it seemed almost impossible for them to do so; 34 specimens of both sexes were found between and under some old spider webs, while near them under a small piece of loose bark were 110 of the sexual females, closely packed. There were also winter eggs in groups of two or more, slightly covered with or embedded in a delicate layer of white wool. The empty females were colorless and generally died some distance from their egg, though sometimes a dead female was found with the egg still attached to it.

July 19, 1906.—Near the Chain Bridge, District of Columbia. Failed to find *Pemphigus acerifolii* on leaves of maple, nor were any migrants observed on leaves of alders. I discovered, however, 3 colonies of the hibernating series, some of which were already mature females, accompanied by hundreds of young larvæ, distributed in patches of 5 to 10 or more, all arranged in circles, with their heads directed toward the center, each specimen being ornamented with six rows of shaggy or threadlike secretion.

October 15, 1906.—After examining thousands of alders near the Chain Bridge, District of Columbia, only three colonies were discovered, composed of apterous females and their larvæ situated near the surface of the ground on the stems, each of which was completely covered with a tube of mud constructed by the small ant *Tapinoma sessile* Say. I saw, however, on the trunks of large maples, thousands of dead return migrants and the sexual generation belonging to them.

November 26, 1907.—Observed again near the Chain Bridge numbers of hibernating larvæ between the dead and decaying leaves which had accumulated around the base of a small shrub. All of them were quite lively, though not feeding. They were very dark greenish or almost black, covered with a mealy secretion, and provided with a cotton-like brush at the anal end of the body.

March 11, 1908.—Numbers of hibernating larvæ were found near Somerset, Md., which had gathered around the base of the shrubs, though still covered with fallen leaves, while smaller colonies had already settled from 1 to 4 feet above the ground, arranged in circles of 5 to 10 specimens. All were covered with a bluish-white secretion and had 4 dorsal rows of small dense and rounded white knobs and a fringe of woolly secretion along the sides and around the anal end of the body.

May 14, 1908.—Found again near Somerset one small colony, about 2 feet above the ground, composed of mature apterous females of the hibernating series, besides numbers of young larvæ deposited by them which had settled near by while others were still crawling about. These young larvæ form the third generation of descendants from migrants of the previous spring.

June 12, 1908.—Numbers of colonies of the hibernating series, each colony being about one-half an inch in length, were seen at Great Falls, Va., on small shrubs. They were about 10 inches above the ground, whereas those on taller trees had located 10 to 25 feet above the ground. All of them were already in the third stage, were closely packed, and covered with a fuzzy secretion. Migrants from maples were not present.

September 24, 1908.—Numerous colonies of this species were again observed on alders near Somerset, Md. Some of the colonies were more than 6 inches in length and were stationed from near the ground to 2 feet above. They were composed of apterous females, numerous larvæ of the hibernating series, pupæ, and some return migrants, while at the same time a considerable number of these return migrants and many of the sexual generation were found on the trunks of maples along a street near by.

October 15, 1908.—Examined some tall alders near Rosslyn, Va., on which migrants from maples had settled in spring, and found four colonies about 10 feet above the ground. These colonies were from 6 to 10 inches long and contained apterous females and numerous larvæ destined for hibernation. They were crawling down the stems to the base, where they congregated in a dense mass, while a great many were already in hiding between the fallen leaves near the base of the trees. There were also many of the return migrants, which were crawling to the tip of the branches or to the terminal leaves, on which they settled, ready for migration.

April 27, 1909.—Examined again the above alders near Rosslyn and found that some specimens of the hibernating series were already in the second and third stages.

In the youngest, or first stage the antennæ are distinctly 4-jointed; in the second stage, after eating a skin, they are 5-jointed; they are also 5-jointed in the third stage, though the divisions between the joints are much more distinct.

June 15, 1909.—Observed some migrants of *Pemphigus acerifolii* and their larvæ on the underside of leaves of alders and numerous colonies of such larvæ on the stems or trunks of such shrubs from 1 to 10 feet above the ground, at Great Falls, Va. (Early in October of the same year large colonies were seen on the same alders, about 4 to 15 feet above the ground, composed of apterous females, accompanied by numerous larvæ of the hibernating series which were swarming down the stems, and numbers of the return migrants.)

June 29, 1910.—Saw again numbers of migrants of *Pemphigus acerifolii*, with recently deposited larvæ near them, on the underside of leaves of alder near Somerset, Md., while numbers of migrants were still flying about. There were also numbers of colonies of apterous females belonging to the hibernating series and numerous larvæ deposited by them.

September 17, 1910.—Numerous colonies of *Pemphigus tessellata*, about 4 feet above the ground, were again found on alders near Somerset. They were composed of apterous females and their larvæ, besides pupæ and return migrants. Many of these colonies were being preyed upon by larvæ of *Feniseca tarquinius*, as well by larvæ of coccinellid and chrysopid insects. Many of the apterous females descended during October to the base of the shoots or stems, even as far down as 1 or 2 inches below the surface, where they were surrounded by numerous hiberating larvæ, constituting a second series. All of these colonies were covered with tunnels of clay constructed by *Cremastogaster lineolata* Say.

DESCRIPTION OF THE PRINCIPAL STAGES OF PROCIPHILUS TESSELLATA FITCH.

In view of the fact, as has already been stated, that the spring migrants from the maple to the alder and the return fall migrants from the alder to the maple are absolutely identical and, as a rule, destined to continue and to conclude the yearly cycle of life for the preservation of the species, the following descriptions of some of the principal stages are herewith included.

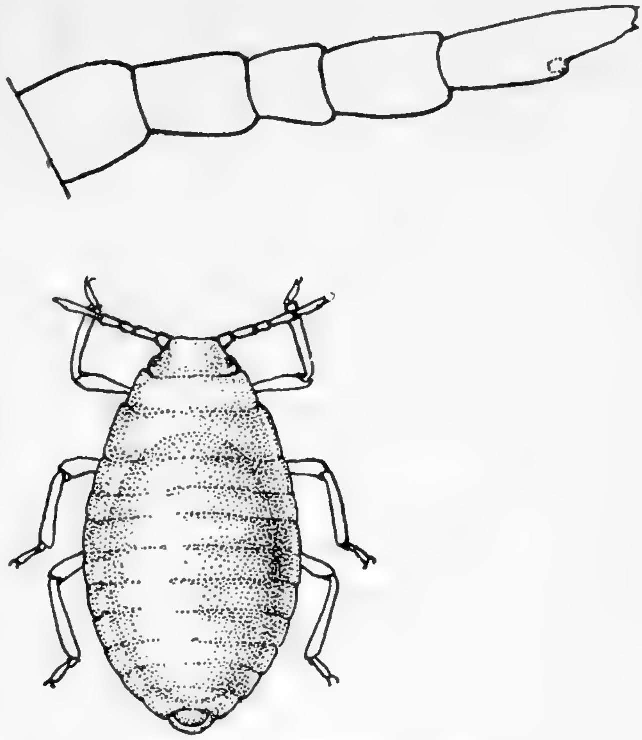

Fig. 3.—*Prociphilus tessellata:* Sexual female and antenna. (Original.)

SEXUAL GENERATION.

The larva-like sexes of the species, which, toward the end of September and early in October, occur on the trunks of maples, are rather small and without a rostrum for the absorption of food.

SEXUAL FEMALE.

The sexual females, as found under loose bark of maple, are of an orange color, with the sides of the body more or less distinctly grayish green. They are elongate-oval and rather plump, and contain only one large orange egg, which reaches to the prothorax. The legs and antennæ are whitish; the eyes small and black. The posterior lateral angles of the prothorax and of the first abdominal segment are rather prominent, while similar though smaller angles are also present on all of the other abdominal segments except the terminal one. The antennæ are rather short and reach for a short distance beyond the anterior margin of the meso-

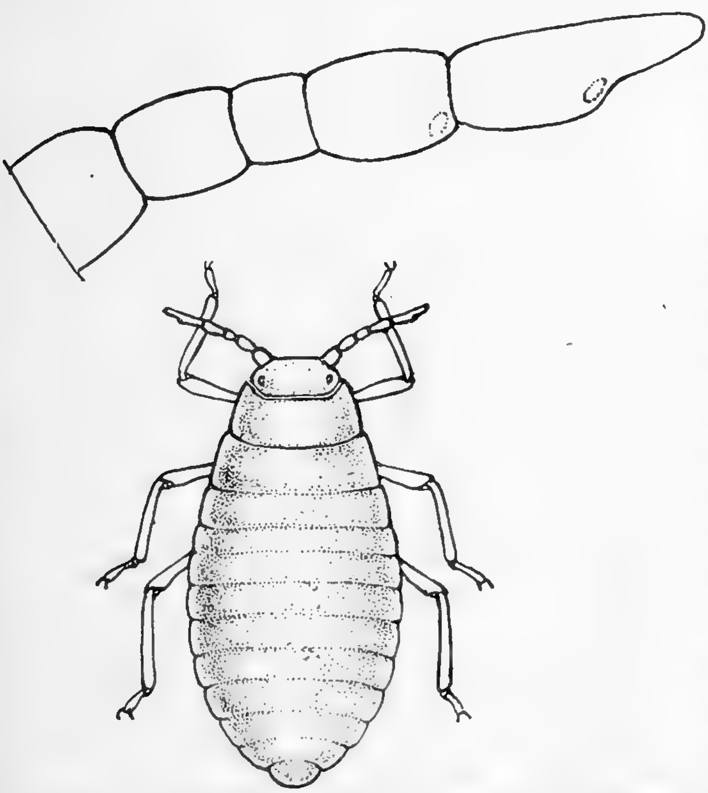

Fig. 4.—*Prociphilus tessellata:* Male and antenna. (Original.)

thorax; they are 5-jointed; joint 3 is shortest and joint 5 longest, or about as long as joints 3 and 4 combined; joints 1, 2, and 4 are somewhat longer than 3, but shorter than 5, and subequal in length. All of the tarsi of both sexes are provided with short, capitate digitules. Length, about 1.2 mm.

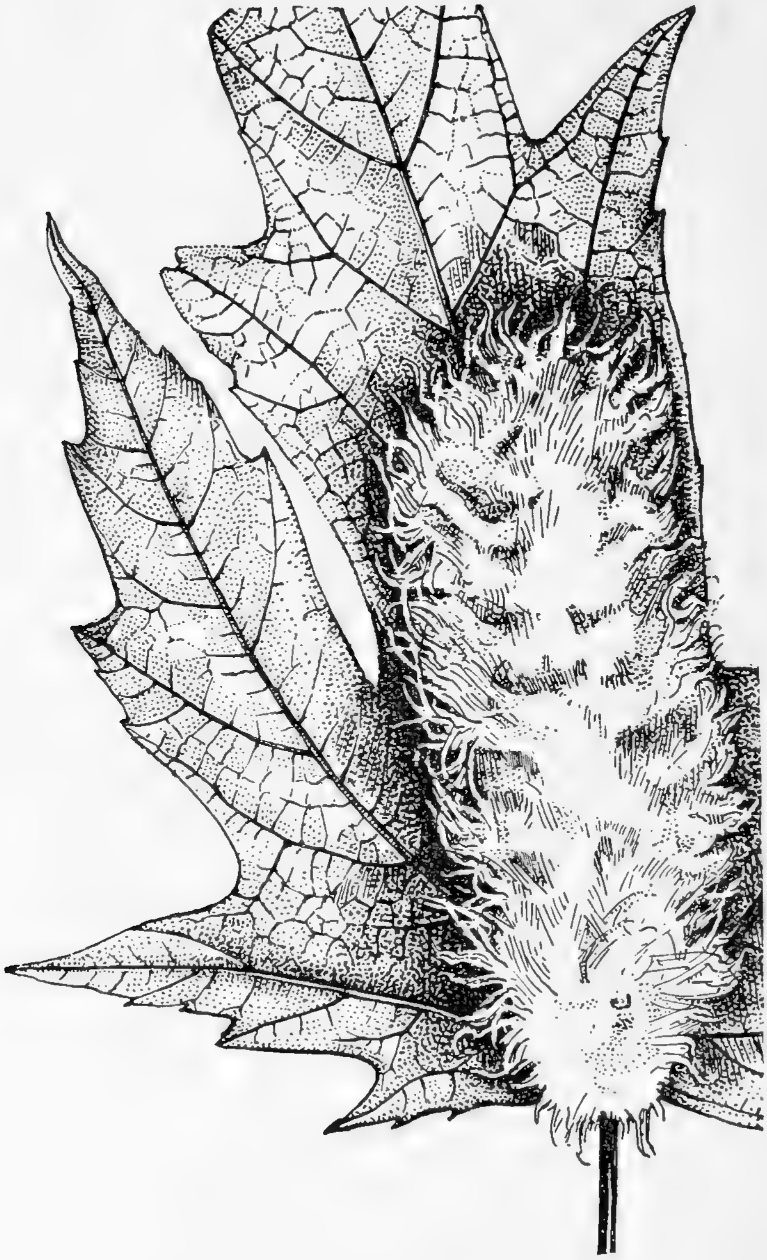

FIG. 5.—*Prociphilus tessellata:* Colony on leaf of maple. (Original.)

MALE.

The male is of a more or less greenish color, with its antennæ and legs somewhat dusky. It is rather small and about one-third or less the size of the female. The antennæ are about as long as those of the female, though stouter, while the proportion of the length of the various joints is the same in both sexes. Length, about 0.8 mm.

WINTER EGG.

The winter eggs, especially in the vicinity of Washington, D. C., are generally deposited during the first half of October, in cracks and under loose bark of the trunks of silver or soft maples, where they are embedded in delicate white wool. They are highly polished and at first of an orange color, with a greenish-gray central spot, though they change gradually to a blackish green. They are elongate-oval and almost twice as long as wide. Their length is about 0.7 mm., and the diameter 0.4 mm.

ASEXUAL GENERATIONS.

COLONY ON LEAF OF MAPLE.

As had been stated before, it has been demonstrated that the infested leaves on maple trees exhibit a more or less distinct tendency to fold or to double downward, so as to protect the insects within this fold, in which frequently there is a large and closely packed colony of aphides, covered with a cottony secretion which gives the entire mass a resemblance to a large white-haired caterpillar.

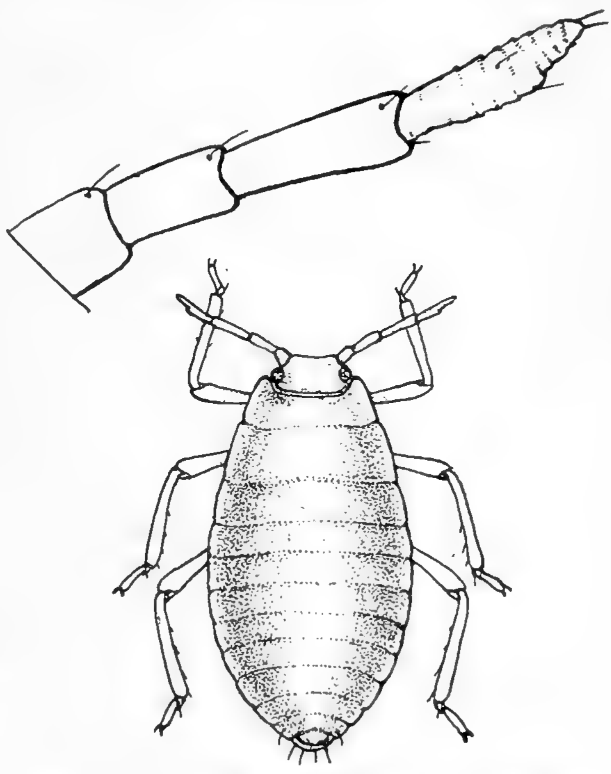

FIG. 6.—*Prociphilus tessellata:* Young stem-mother and antenna. (Original.)

YOUNG STEM-MOTHER.

The general color of the young stem-mother is a dull blackish or brownish green, the head being darkest. The eyes are black and the antennæ and legs dusky. The insects are covered with a delicate bluish-white secretion, and ornamented with four dorsal and a lateral row each side of whitish cottony knobs. The antennæ are 4-jointed and do not reach to the mesothorax; the two basal joints are shortest; joints 3 and 4 are longest and subequal in length, each being about as long as the two basal joints combined; the third is somewhat stoutest at the apex, while the fourth, including its short, blunt spur, appears to be more or less distinctly fusiform. The rostrum is large, and reaches almost to the tip of the abdomen. Length about 0.7 mm.

MATURE STEM-MOTHER.

The mature stem-mother, as seen on the leaves of the maple, is densely covered with white wool, which is interspersed with long, stout, white, and wavy strands. This secretion hides the insects completely from view, in consequence of which they resemble small flakes of cotton. Their natural color is dark yellowish green or olive; the end of the body is black; the legs are of the color of the body, with the apex of the femora and tarsi blackish. The antennæ, including the indistinct spur of the terminal joint, are 5-jointed; they are rather short and reach about to the mesothorax. The first joint is stoutest and slightly the shortest; it is about as long as wide, with the apex truncated; joints 2 and 4 are somewhat longer than the first and subequal in length; joints 3 and 5 are longest and each of them is almost as long as the two basal joints combined; the four basal joints are of the color of the body, while the fifth is blackish. Length of body about 4 mm.; diameter about 3 mm.

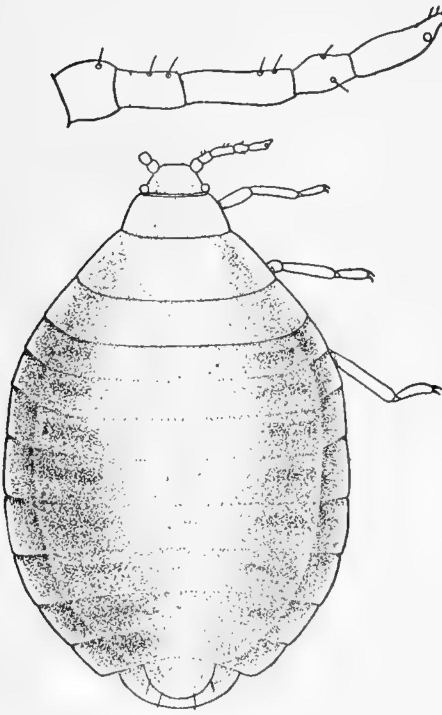

Fig. 7.—*Prociphilus tessellata:* Mature stem-mother and antenna. (Original.)

The mature stem-mother deposits between 100 and 400 larvæ, all of which form the first generation, which may be termed the pupiferous generation, since all of them gradually develop into the winged or migratory form and, after having attained maturity, migrate to the leaves of alders to deposit their larvæ, which, in turn, become the progenitors of the second series, which has been described, by Dr. Asa Fitch under the name of *Eriosoma tessellata.*

MIGRANT.

The migrant, as well as the return migrant, is rather large and stout. The head with its antennæ, the thorax, and the legs are black. The abdomen is of a greenish-brown or almost black color, being palest on the ventral side. The dorsum of the thorax and of the abdomen is densely covered with a whitish woolly or cottony secretion, which generally projects above the closed wings and beyond the end of the abdomen, while most of the secretion of the head is generally rubbed off. The ventral side is covered with a whitish powder, which is most dense on the sternum. The antennæ are rather short and reach to or somewhat beyond the insertion of the front wings; they are provided with only a few fine hairs on joints 3 to 5; there are also 9 to 13 annulations on antennal joint 3, 3 to 5 on joints 4 and 5, and from 5 to 7 on joint 6, all of which annulations are more or less indistinct. The tail and last abdominal segment are short and semicircular, surrounded around the edge with slender fine hairs. Nectaries or nectar-pores are absent. The venation of the wings is similar to that of other pemphiginids. Expanse of wings about 12 mm.; length of body about 4 mm.

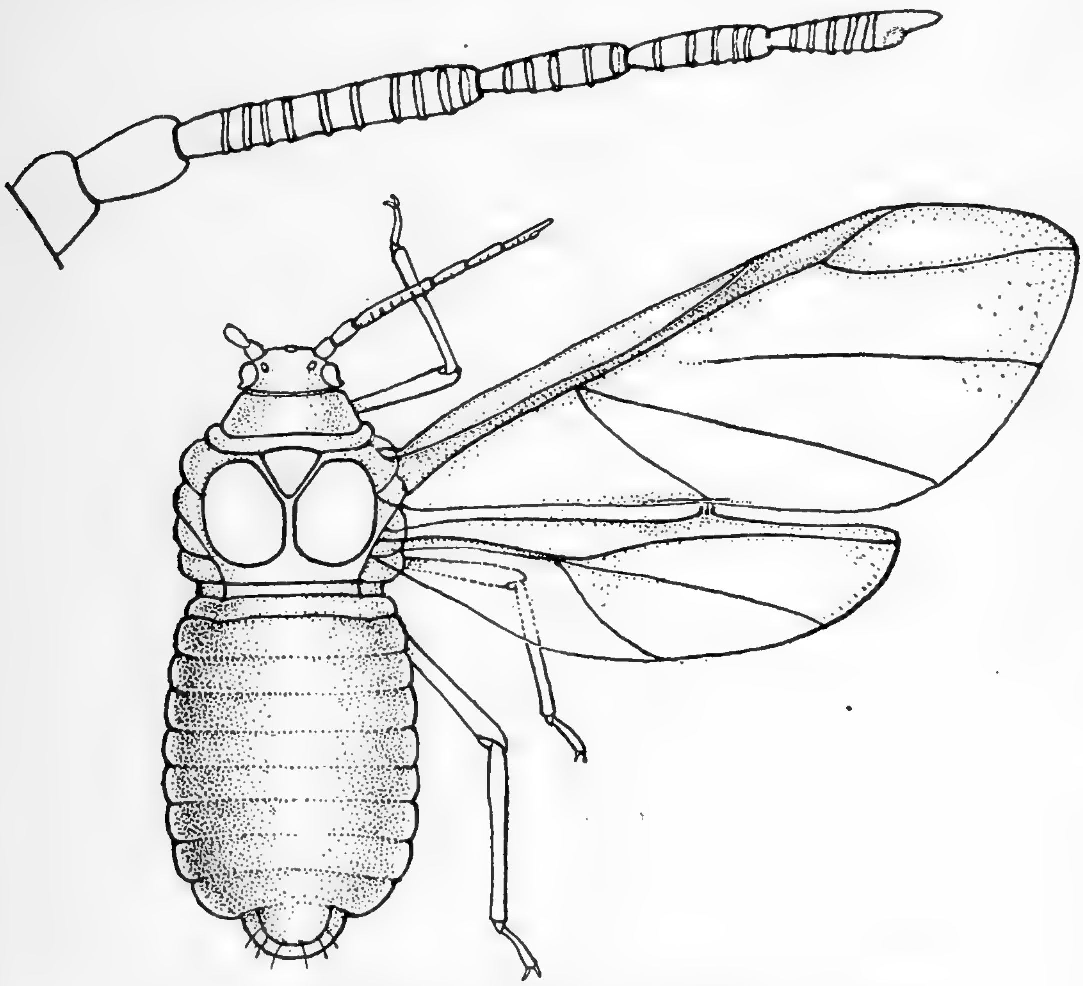

FIG. 8.—*Prociphilus tessellata:* Migrant and antenna. (Original.)

APTEROUS FEMALE ON ALDER.

The apterous females, as found on the stems of alder, are densely covered with white woolly or cottony secretion, which gradually covers a whole colony, though frequently hidden from view by a covering of earth erected over them by *Cremastogaster* and other ants. After having been denuded of their cottony secretion they are found to be of a reddish or dark orange-brown color, with the divisions between the abdominal segments much darker or almost black; the antennæ and legs are the color of the body and the tarsi are blackish. The antennæ are 6-jointed, rather short, and reach at most to the middle of the mesothorax. Antennal joints 3 and 6 are longest and subequal in length, each being about as long as joints 4 and 5 combined; joints 1, 2, 4, and 5 are shortest and subequal in length, with the two basal joints, as usual, stoutest; all of the joints

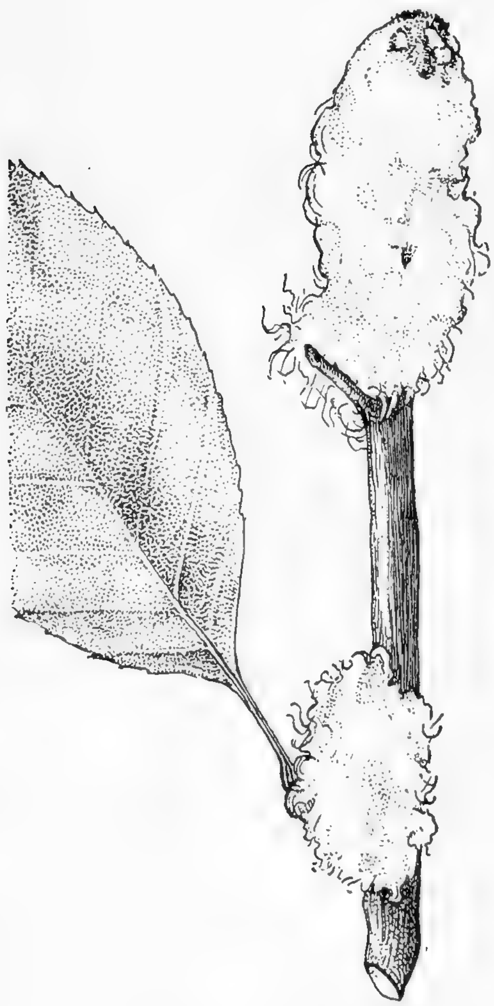

FIG. 9.—Colonies of apterous females on alder. (Original.)

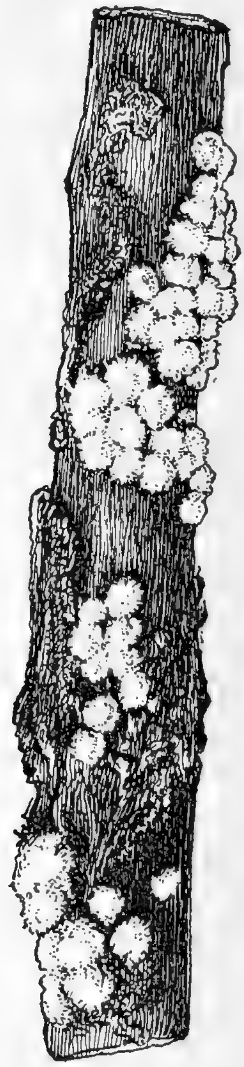

FIG. 10.—Colonies of apterous females on alder. (Original.)

are provided with a few fine and short hairs. The tail and last abdominal segment are as in the migrant. Length about 3 mm.

HIBERNATING SERIES.

The hibernating larvæ, as well as those deposited by migrants and apterous females, are of an orange color, with the eyes and tarsi dark brown or black; all of them are covered with a short and shaggy secretion. The antennæ are 4-jointed in all of them; they are short, as usual, and reach to nearly the middle of the mesothorax.

The first joint is shortest, stoutest at the apex, and about one-half the length of the second; joint 3 is longest, rather slender, though somewhat stoutest at the apex; joint 4 is next in length and about twice as long as the second. The rostrum is almost as long as the body. Length about 1 mm.

ECONOMIC STATUS.

This species may not be considered as particularly injurious, though

FIG. 11.—Tunnel made by the ant *Cremastogaster* to protect colony of *Prociphilus tessellata* on alder. (Original.)

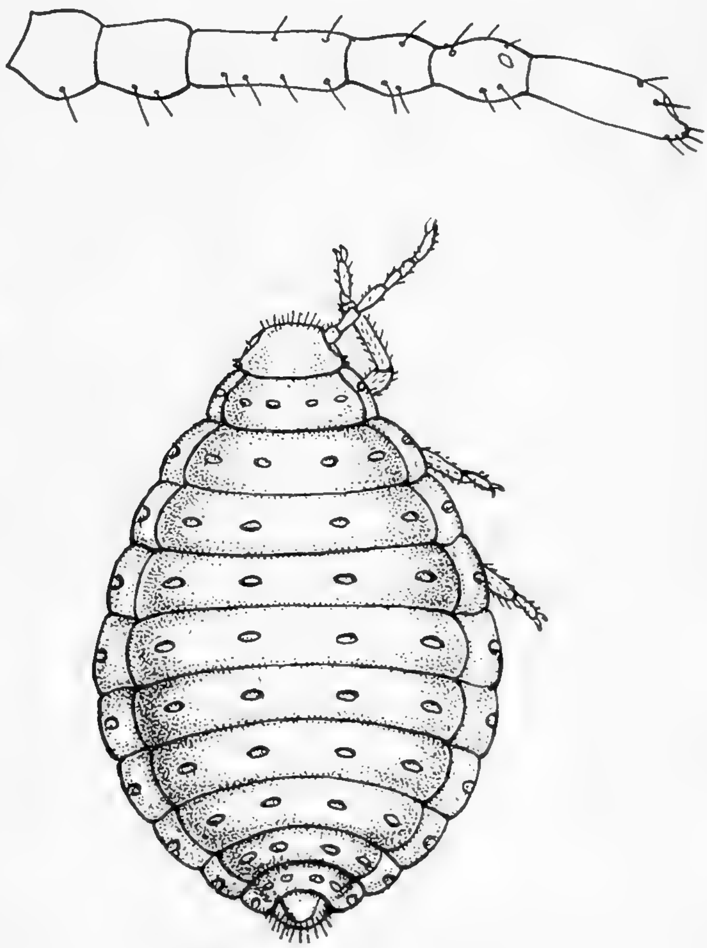

FIG. 12.—*Prociphilus tessellata:* Apterous female and antenna. (Original.)

it may occasionally become quite annoying if present in numerous colonies on the leaves of maple trees, in consequence of which it may be advisable to suggest some method for keeping it down, if not actually exterminating it, in certain localities. To accomplish this result it is advisable to cut down all of the shrubs of alder during the spring and fall to near the surface of the ground and to burn all of the bush as soon as possible, in order to destroy all of the colonies as a measure to prevent the maturing of the return migrants. Still later in the season it is advisable to spray all of the remaining stumps of the shrubs, as well as the accumulated dry leaves and other débris surrounding them, with a dilute solution of kerosene emulsion, in order to destroy the hibernating larvæ. If these shrubs are kept down for a few years there will be no chance for the migrants from maples to deposit their larvæ and consequently no return migrants to fly back to the trunks of maple trees.

INDEX.

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Carl Heinrich

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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

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CONTENTS AND INDEX.

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By W. J. PHILLIPS AND J. J. DAVIS, *Entomological Assistant Cereal and Forage Insect Investigations.*

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W. B. Hall, J. T. Monell, *collaborators.*

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

ERRATA.

Page 15, legend to figure 9, second line, for *aphieds* read *aphides*.
Page 19, line 18, for *sanfoin* read *sainfoin*.
Page 19, line 18, for *Unobrychis* read *Onobrychis*.

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Miriam Welles Reeves, *collaborator.*

CONTENTS.

ILLUSTRATIONS.

PLATE.

TEXT FIGURES.

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INTRODUCTION.

Toxoptera muhlenbergiæ has been under observation since the summer of 1908. On July 24 of that year Mr. V. L. Wildermuth, of this bureau, found this aphis at New Paris, Ohio, on a species of *Muhlenbergia.* It was thought at the time that it was *Toxoptera graminum,* to which species it bears a very close resemblance. The senior author found the same aphis at Richmond, Ind., later in the month, placed it in rearing on *Muhlenbergia,* and obtained the sexes in October. From the sexes it was very evident that the species was not *T. graminum,* as the male is wingless. Since *T. muhlenbergiæ* bore so close a resemblance to the destructive "green bug," a species that the senior author was then studying, he has also kept the former species under observation since that time. The junior author has named and described the species and has also drawn up a key for the identification of the members of this genus. The authors wish to thank Mr. Philip Luginbill, of the Bureau of Entomology, for his assistance in rearing through consecutive generations of this species.

DESCRIPTION OF THE SPECIES.

Toxoptera muhlenbergiæ n. sp.

WINGED VIVIPAROUS FEMALE.

(Fig. 1.)

Head brownish, thoracic plate dark brown, and abdomen pale green. Usually a small pale-yellowish area on the abdomen around each cornicle. Eyes black and ocelli dusky. Antennæ blackish excepting segments I, II, and the extreme base of III, which are pale brownish; slightly imbricate, 3 to 7 circular sensoria in a row on segment III, the usual one near the distal end of V, and several small ones surrounding a larger one at distal end of base of VI; total length about equal to that of the body; segments III and filament of VI longest, the latter being slightly the longer of the two; IV and V subequal, their total length being subequal to III; base of VI about three-tenths the length of the filament or one-third of III. (See fig. 1, *b*.) Beak reaching slightly beyond the coxæ of the first pair of legs. Legs dark brown excepting the basal one-third or one-half of the femora and tibiæ. Wings with the discoidal vein once-branched, the branching being about two-thirds the distance from the base to the tip of the wing, the basal end not contiguous with the costal vein (occasionally one wing with the discoidal unbranched, and in one case the branching was at the extreme tip of the wing);

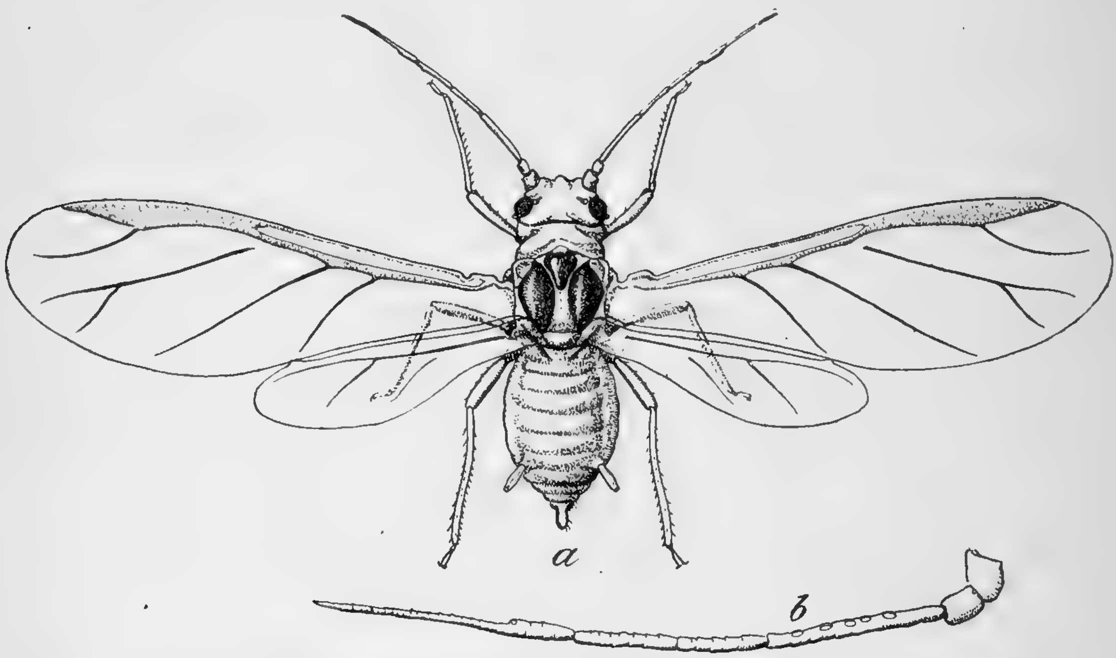


FIG. 1.—*Toxoptera muhlenbergiæ*: *a*, Winged viviparous female, greatly enlarged; *b*, antenna of same, more enlarged. (Original.)

veins dark brown. Lateral abdominal tubercles inconspicuous. Cornicles pale green, very slightly swollen in the middle, subequal in length to the style. Style pale green, and slightly longer than the hind tarsi.

Measurements (from specimens mounted in balsam): Length of body, 0.7999–0.9090 mm., average, 0.8471 mm.; width, 0.2909–0.4181 mm., average, 0.3526 mm.; length of wing, average, 1.88 mm.; width, average, 0.636 mm.; antenna, I, 0.05 mm.; II, 0.041 mm.; III, 0.2119–0.2608 mm., average, 0.23 mm.; IV, 0.0978–0.1385 mm., average, 0.1124 mm.; V, 0.1222–0.1467 mm., average, 0.1325 mm.; VI, base, 0.0652–0.0896 mm., average, 0.0787 mm.; VI, filament, 0.22–0.2689 mm., average, 0.2509 mm.; average total, 0.8955 mm.; cornicles, 0.09–0.12 mm., average, 0.0986 mm.; style, 0.0978–0.1141 mm., average, 0.1048 mm.; hind tarsus, 0.0978 mm.

Described from eight living specimens received from W. J. Phillips collected on *Muhlenbergia* at La Fayette, Ind., September 9, 1909. Types mounted on four balsam slides, in the collection of the Bureau of Entomology, U. S. Department of Agriculture.

WINGLESS VIVIPAROUS FEMALE.

(Fig. 2.)

Head and body entirely pale green, the head being slightly paler than the thorax and abdomen. Eyes black. Antennal segments I, II, and III very pale brownish, IV pale at base and gradually changing to dark brown or blackish; total length slightly more than half that of the body; filament of VI largest, it being about four times the basal portion of VI; III three times the length of IV and three-fourths filament VI; IV and V subequal, V being slightly the longer. Beak reaching the coxæ of the second pair of legs. Legs pale excepting the tarsi and distal ends of the tibiæ, which portions are blackish. Abdominal tubercles as in the winged form. Cornicles and style pale, with a slight greenish tint, and not unlike those of the winged female in form.

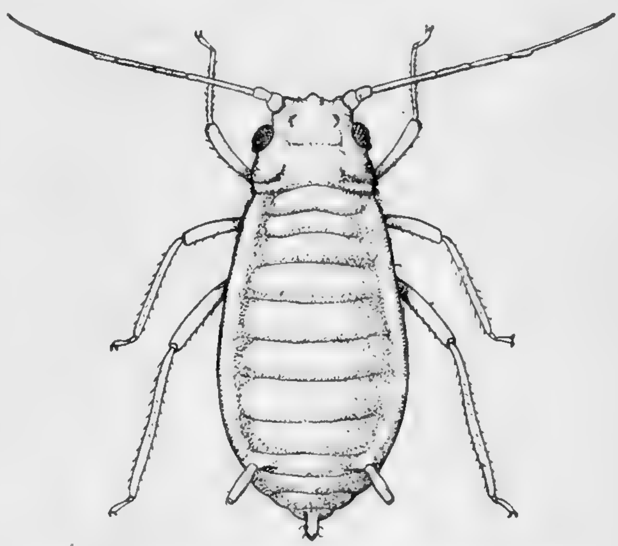


FIG. 2.—*Toxoptera muhlenbergiæ:* Wingless viviparous female. Greatly enlarged. (Original.)

Measurements (from specimens mounted in balsam): Length of body, 1.1308 mm.; width, 0.5198 mm.; antenna, I, 0.0489 mm.; II, 0.04 mm.; III, 0.1548–0.2037 mm., average, 0.1825 mm.; IV, 0.0815–0.1141 mm., average, 0.0994 mm.; V, 0.1059–0.1141 mm., average, 0.1108 mm.; VI, base, 0.0652–0.0815 mm., average, 0.0684 mm.; VI, filament, 0.2119–0.2771 mm., average, 0.2477 mm.; average total, 0.7977 mm.; cornicle, average, 0.1385 mm.; style, 0.1141 mm.; hind tarsus, 0.09 mm.

Described from six living specimens collected at La Fayette, Ind., September 9, 1909. Types mounted on four balsam slides, in the collection of the Bureau of Entomology, U. S. Department of Agriculture.

WINGLESS MALE.

(Fig. 3.)

Head dusky green to blackish, prothorax pale green, thoracic plate dark to blackish green, and the abdomen pale greenish yellow. Eyes black. Ocelli present as in the other forms. Antennæ blackish, excepting the two basal segments, which are pale dusky; irregularly placed circular sensoria as follows: 22–23 on III, 17–24 on IV, 11–17 on V, and the usual ones at the distal end of base of VI; subequal in length to that of the body; III the longest, it being nearly twice as long as IV and four times base of VI; IV and V subequal, and base of VI slightly less than one-third of filament of VI. (See fig. 3, *b*.) Beak reaching just beyond the coxæ of the second pair of legs. Legs pale, excepting the tarsi and distal ends of the tibiæ, which are blackish (in some specimens the basal ends of the femora are pale and the remainder gradually becoming dusky toward the apices, tibiæ dusky excepting the blackish tips, and the tarsi black). Cornicles and style whitish green.

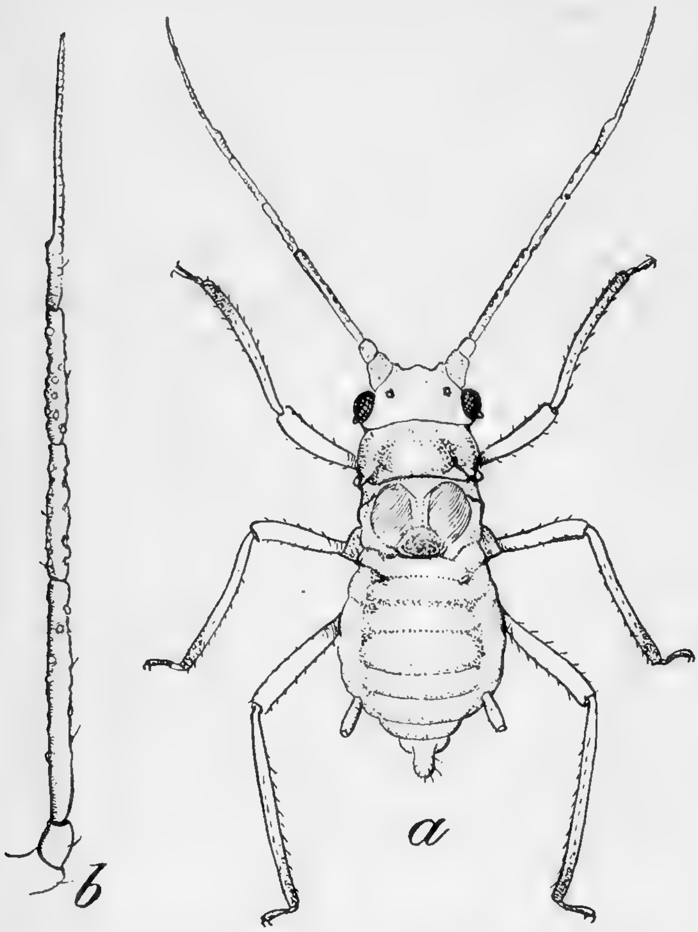


FIG. 3.—*Toxoptera muhlenbergiæ*: *a*, Wingless male, greatly enlarged; *b*, antenna of same, more enlarged. (Original.)

Measurements (from specimens recently mounted in balsam): Length of body, average, 1.127 mm.; width, 0.4143 mm.; antenna, I, 0.057 mm.; II, 0.0489 mm.; III, 0.2934–0.3504 mm., average, 0.3209 mm.; IV, 0.1467–0.22 mm., average, 0.1793 mm.; V, 0.1548–0.1874 mm., average, 0.1712 mm.; VI, base, 0.0733–0.0896 mm., average, 0.0815 mm.; VI, filament, 0.2445–0.3097 mm., average, 0.269 mm.; average total, 1.1278 mm.; cornicles, average, 0.1074 mm.; style, average, 0.1026 mm.; hind tarsus, 0.1074 mm.

Described from seven living specimens. Types mounted in balsam on five slides, October 13, 16, and 18, 1909. In the collection of the Bureau of Entomology, U. S. Department of Agriculture.

WINGLESS OVIPAROUS FEMALE.

(Fig. 4.)

Head pale yellowish and the thorax yellowish green. Abdomen pale greenish, the sides being decidedly pale green and the median dorsum more of a yellowish, this latter being due to the yellow eggs within. Eyes black. Antenna with segments I and II concolorous with the head; III pale but slightly dusky; IV and V pale dusky; VI blackish, slightly more than one-half the length of the body; filament of VI longest, it being one-fourth longer than III; III and IV subequal, and base of VI a little more than one-third of III. (See fig. 4, *b*.) Beak not reaching to the coxæ of the second pair of legs. Legs pale, excepting the distal ends of the tibiæ, which are dusky, and the tarsi, which are black. Hind tibia (fig. 4, *c*) swollen and bearing 15 to 21 rather large but inconspicuous sensoria. Cornicles cylindrical, pale yellow or greenish yellow, and about one-third longer than the hind tarsus. Style concolorous with the cornicles and slightly longer than the tarsus. The position assumed by the oviparous females is similar to that of other species, namely, with the hind tibiæ held back along the abdomen, and the abdomen tilted upward.

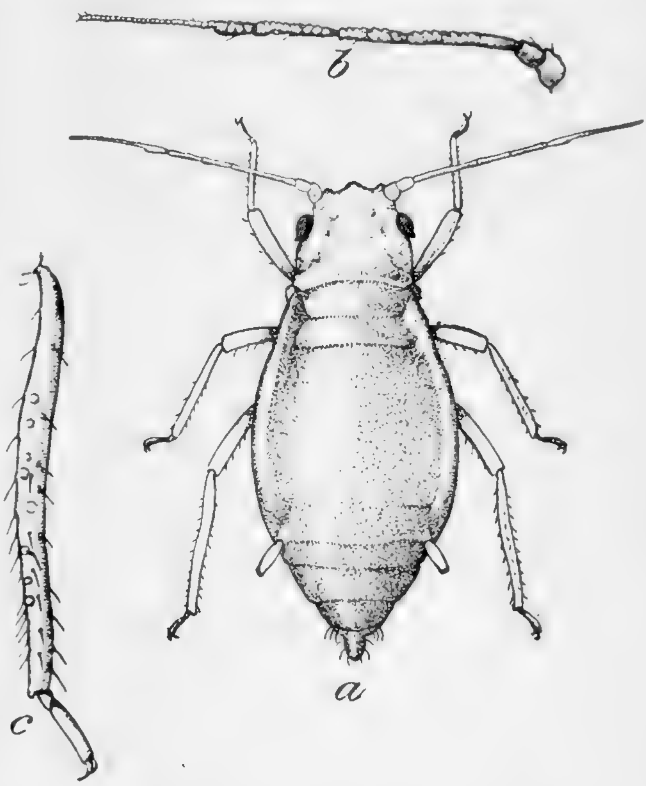


FIG. 4.—*Toxoptera muhlenbergiæ*: *a*, Wingless oviparous female, greatly enlarged; *b*, antenna of same, more enlarged; *c*, hind tibia of same, more enlarged. (Original.)

Measurements (from specimens recently mounted in balsam): Length of body, average, 1.796 mm.; width, average, 0.7855 mm.; antenna, I, 0.057 mm.; II, 0.048 mm.; III, 0.163–0.2363 mm., average, 0.2052 mm.; IV, 0.0978–0.1467 mm., average 0.1254 mm.; V, 0.1141–0.1548 mm., average, 0.1368 mm.; VI, base, 0.0652–0.0815 mm., average, 0.0748 mm.; VI, filament, 0.2282–0.29 mm., average, 0.2589 mm.; average total, 0.9061 mm.; cornicles, average, 0.1596 mm.; style, average, 0.1237 mm.; hind tarsus, average, 0.1042 mm.

Described from 12 living specimens. Types mounted on six slides. October 8, 13, 16, and 18, 1909. In the collection of the Bureau of Entomology, U. S. Department of Agriculture.

EGG.

(Fig. 5.)

Pale yellowish when first laid, gradually changing to pale green, then dark green, and finally to jet black. They are deposited singly on the leaves of *Muhlenbergia*. Form elliptical-oval. Measurements: Length, 0.56 mm.; width, 0.26 mm.

STEM-MOTHER.[1]

First instar (before first molt).—General color dark nile-green; head, beak, antennæ, and legs very dark gray, almost black; cornicles very dark, small, and inconspicuous; eyes black; antennæ 4-segmented.

Measurements (from two specimens in balsam): Length of body, 0.49 mm.; width, 0.20 mm.; antenna, I, 0.0326 mm.; II, 0.0326 mm.; III, 0.0896 mm.; IV, base, 0.0407 mm.; IV, filament, 0.0896 mm.; total length, 0.2851 mm.

Described from two specimens. Types on two balsam slides in collection of the Bureau of Entomology, U. S. Department of Agriculture. La Fayette, Ind., 1910.

Second instar (before second molt).—General color blue-green, the head having somewhat of a grayish cast. Antennæ 5-segmented; the three distal segments very dark, almost black; the basal segments pale gray. Beak black at tip, reaching to coxæ of the third pair of legs. Legs pale, excepting tarsi and distal portions of tibiæ, which are black. Tips of cornicles black, small, and inconspicuous as in the first instar.

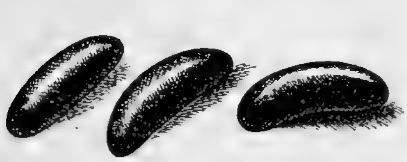


FIG. 5.—*Toxoptera muhlenbergiæ:* Eggs. Greatly enlarged. (Original.)

Measurements (from two specimens recently mounted in balsam): Length of body, 0.54 mm.; width, 0.245 mm.; antenna, I, 0.0326 mm.; II, 0.0326 mm.; III, 0.065 mm.; IV, 0.0489 mm.; V, base, 0.0489 mm.; V, filament, 0.114 mm.; total length, 0.342 mm.; cornicles, 0.0326 mm.; hind tarsus, 0.0733 mm.

Described from two specimens. Types on two balsam slides in the collection of the Bureau of Entomology, U. S. Department of Agriculture. La Fayette, Ind., 1910.

Third instar (before third molt).—General color of body pale green, eyes black. Antennæ 5 segmented, entirely dusky, but darker near the tips, a single sensorium at the end of IV and several at end of base of V. Beak not reaching coxæ of third pair of legs, the tip black. Legs pale greenish gray, excepting the joints and distal portions of tibiæ, which are dusky, and the tarsi, which are black. Cornicles concolorous with body, excepting tips, which are dusky.

Measurements (from two specimens recently mounted in balsam): Length of body, 0.88 mm.; width, 0.40 mm.; antenna, I, 0.0407 mm.; II, 0.0326 mm.; III, 0.125 mm.; IV, 0.0733 mm.; V, base, 0.0652 mm.; V, filament, 0.14 mm.; total length, 0.4768 mm.; cornicles, 0.049 mm.

Described from two specimens. Types on two balsam slides, in the collection of the Bureau of Entomology, U. S. Department of Agriculture. La Fayette, Ind., 1910.

[1] Color notes of the five instars of the stem-mother were made by Mr. Phillips

Fourth instar (before fourth molt).—General color pale green, the head being slightly paler than other parts of the body, and the abdomen having somewhat of a mottled appearance, due to the presence of young within. Beak not reaching coxæ of third pair of legs, black at tip. Eyes black. Antennæ 5-segmented (one specimen showed six segments plainly), segment III with a constriction a little beyond the middle, indicating the point where it divides at the next molt; the two distal segments almost or quite black, the others dusky, shading into greenish gray at the base; sensoria as in the preceding instar. Legs greenish gray, shading into dusky near extremities; tarsi shining black, distal portion of tibiæ and joints quite dusky. Cornicles concolorous with abdomen, excepting tips, which are dusky. Style slightly paler than body.

Measurements (from two specimens recently mounted in balsam): Length of body, 0.90 mm.; width, 0.3912 mm.; antenna, I, 0.049 mm.; II, 0.04 mm.; III, 0.122 mm.; IV, 0.065 mm.; V, base, 0.057 mm.; V, filament, 0.114 mm.; total length, 0.447 mm.; cornicles, 0.049 mm.; hind tarsus, 0.0896 mm.

Described from two specimens. Types on two balsam slides, in the collection of the Bureau of Entomology, U. S. Department of Agriculture. La Fayette, Ind., 1910.

Fifth instar (adult stem mother).—Before the birth of any young the adult is pale green, but gradually the color deepens to apple-green. As in the preceding instar, the young show through the body wall, giving the abdomen somewhat of a mottled appearance. Usually there is a small yellowish area around each cornicle. Head much paler than body, and with a grayish tinge at anterior end. Beak barely reaching coxæ of second pair of legs, black at tip. Eyes jet-black. Antennæ less than one-half the length of body, segments III and filament of VI longest, they being subequal, but filament VI usually slightly the longer of the two; IV about two-thirds or less the length of III; IV and V subequal; base of VI about one-half the length of filament; the two basal segments concolorous with head; III dusky, shading to blackish at apex; the remaining segments black. Legs greenish gray, excepting the joints, which are dusky. Apices of tibiæ very dusky, and tarsi shining black. Cornicles pale translucent, and dusky at tips. Style pale translucent, sometimes dusky, and with a frosted appearance. All stages, including adult, are more or less pruinose.

Measurements (from five specimens recently mounted in balsam): Length of body, average, 1.34 mm.; width, average, 0.69 mm.; antenna, I, 0.057 mm.; II, 0.040 mm.; III, 0.14–0.175 mm., average, 0.155; IV, 0.08–0.1059 mm., average, 0.0945 mm.; V, 0.0978–0.1222 mm., average, 0.10 mm; VI, base, 0.073–0.089 mm., average, 0.08 mm.; VI, filament, 0.14–0.195 mm., average 0.171 mm.; average, total, 0.6975 mm.; cornicles, 0.11 mm.; style, 0.135 mm.; hind tarsus, 0.10 mm.

Described from five specimens. Types mounted on five balsam slides, in the collection of the Bureau of Entomology, U. S. Department of Agriculture. La Fayette, Ind., 1910.

Genus TOXOPTERA Koch.

Seven species of the genus *Toxoptera* have been described, the one described in this paper being the eighth. All, with the exception of this last and *T. caricis* Fullaway, occur in Europe, while only three (*T. graminum, T. aurantii,* and *T. muhlenbergiæ*) are known to America. *T. caricis* was described from specimens collected in Hawaii. The following table may be of service to other workers:

KEY TO THE GENUS.

I. General color of apterous viviparous females black or dark rusty.

a. Apterous females dark rusty; margin of abdomen bearing tuberculate hairs; wing veins pale fuscous, stigma white........................*scirpi* Passerini.

On *Scirpus specierum* and *S. lacustris.*

aa. Apterous females black; margin of abdomen not bearing tuberculate hairs.

b. Sixth antennal segment of winged female equal to one-sixth the terminal filament; wing veins and stigma fuscous; fork of cubital vein arising before the point where the stigmal vein originates.

aurantii Boyer de Fonscolombe.

On orange, citron, and *Camellia.*

Syn. *T. aurantiæ* Koch.

T. camelliæ Kaltenbach.

Ceylonia theaccola Buckton.

bb. Sixth antennal segment of winged female equal to one-fifth the terminal filament; wing veins and stigma not fuscous, pale yellowish; fork of cubital vein arising opposite or beyond the origin of the stigmal vein.

clematidis Del Guercio.

On ornamental *Clematis.*

II. General color green, yellow, or brownish yellow.

a. Body of wingless viviparous female dark green, variegated with shining black. Stigma green..*variegata* Del Guercio.

On *Rhamnus alaternus.*

aa. Body uniformly green, yellow, or brownish yellow.

b. Style black, at least in the winged viviparous female.

c. Body of wingless viviparous female uniformly dark green; style black.

alaterna Del Guercio.

On *Rhamnus alaternus.*

cc. Body of wingless viviparous female brownish yellow, paler at the margins; style darker than body color; cornicles very large, extending beyond tip of style, much constricted at base and apex.............*caricis* Fullaway.

On *Carex* sp.

bb. Style green, yellow, or but slightly dusky.

d. Cornicles uniformly pale greenish or yellowish green; usually a small yellowish area on the abdomen at base of each cornicle; the media (third discoidal) branching at about three-fifths the distance from the base of the vein to the tip of the wing; antennal segments III and "VI filament" subequal. Males wingless...*muhlenbergiæ* n. sp.

On *Muhlenbergia* sp.

dd. Cornicles blackish at tip; the media (third discoidal) branching at about one-half, or less, the distance from the base of the vein to the tip of the wing; antennal segment "VI filament" noticeably longer than III. Males winged........................*graminum* Rondani.

On wheat, oats, rye, barley, and various grasses.

DISTRIBUTION OF TOXOPTERA MUHLENBERGIÆ.

This aphis has been found through northwestern and west-central Ohio and through east-central and northern Indiana. It probably may be found in any location in which *Muhlenbergia* flourishes.

FEEDING HABITS.

Individuals of this species concentrate on the tender shoots and are rarely found on the tough leaves unless the plants are badly infested. They congregate in the curled central growing shoot. As this leaf expands and unfolds, they go to the younger curled leaf just below this. When in great numbers, they cause these tender shoots to wilt and turn yellow.

HOST PLANTS.

Up to the present time *Muhlenbergia* sp. appears to be the normal host, though this aphis often goes to bluegrass (*Poa pratensis*) when first hatched, since the young sometimes appear before *Muhlenbergia* has started growth. Colonies have been established on wheat, though they do not appear to thrive very well on it.

LIFE HISTORY.

As stated previously, the sexes were reared in October, 1908, at Richmond, Ind. A number of eggs was obtained from these females and they were taken to La Fayette, Ind., in March, 1909, but failed to hatch. Later on in the year these aphides were found in abundance and rearings were begun, with the result that a large number of the sexes and an abundance of eggs were obtained in the fall.

CONTINUOUS-GENERATION EXPERIMENTS.

About 1,000 eggs were collected in the fall of 1909 with the hope of getting stem-mothers to start a series of continuous generations. None of these eggs hatched, however. Large numbers of eggs were found in the field and from these the continuous-generation series were started; that is, starting with the stem-mother and isolating her first born and the first born of each successive generation until the sexes appeared; and a second series, consisting of the last born from the stem-mother and the last born of each successive generation until the sexes appeared. By adding the number of first and last born generations and dividing the result by 2 we are able to arrive at the approximate number of generations that would be produced during the year. Much other data would also be accumulated in this way on the daily production of young, the maximum and minimum number of young produced, and the average length of life.

The table following gives in detail the consecutive generations of the first and last born series, starting with a stem-mother that hatched March 28, 1910.

Table of consecutive generations of Toxoptera muhlenbergiæ.

[b=born; d=died or disappeared.]

Date.	Temperature.		First-born generation series.														Last-born generation series.					
	Maximum.	Minimum.	First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.	Ninth generation.	Tenth generation.	Eleventh generation.	Twelfth generation.	Thirteenth generation.	Fourteenth generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.
	°F.	°F.																				
Mar. 28	84	53	b																			
Mar. 29	84	57	0																			
Mar. 30	76	60	0																			
Mar. 31	73	42	0																			
Apr. 1	63	37	0																			
Apr. 2	69	39	0																			
Apr. 3	73	42	0																			
Apr. 4	73	56	0																			
Apr. 5	76	62	0																			
Apr. 6	71	39	0																			
Apr. 7	46	29	0																			
Apr. 8	60	32	0																			
Apr. 9	73	42	0																			
Apr. 10	73	43	0																			
Apr. 11	80	50	0																			
Apr. 12	80	43	2	b																		
Apr. 13	62	32	0	0																		
Apr. 14	69	37	1	0																		
Apr. 15	80	52	3	0																		
Apr. 16	77	59	3	0																		
Apr. 17	71	35	0	0																		
Apr. 18	48	33	0	0																		
Apr. 19	40	32	0	0																		
Apr. 20	47	37	2	0																		
Apr. 21	58	32		0																		
Apr. 22	62	40	0	0																		
Apr. 23	65	30	0	0																		
Apr. 24	31	26	0	0																		
Apr. 25	44	30	0	0																		
Apr. 26	44	34	0	0																		
Apr. 27	43	35	0	0																		
Apr. 28	57	41	1	0																		
Apr. 29	71	46	0	0																		
Apr. 30	82	58	3	0													b					
May 1	66	50	0	7	b												0					
May 2	71	59	d		0												0					
May 3	69	43		1	0												0					
May 4	61	34		0	0												0					
May 5	57	36		3	0												0					
May 6	59	41		1	0												0					
May 7	62	45		2	0												0					
May 8	53	46		3	0												0					
May 9	52	49			0												0					
May 10	72	46		2	0												0					
May 11	73	54		2	0												0					
May 12	55	35		0	0												0					
May 13	57	36		2	0												0					
May 14	55	33		1	0												0					
May 15	59	40		2	0												0					
May 16	64	49			0												0					
May 17	69	54		4	0												0					
May 18	64	48		0	0												0					
May 19	75	50		1	0												0					
May 20	74	59		1	0												0					
May 21	76	59		1	0												0					
May 22	77	62		1	0												0					
May 23	80	65			4	b											0					
May 24	68	54		0	0	0											0					
May 25	69	44		0	1	0											0					
May 26	63	40		0	0	0											5					
May 27	66	38		0	1	0											1					
May 28	68	45		0	0	0											1					
May 29	78	59			0	0											0					
May 30	75	45		1	0	0											0					
May 31	60	41			d	0											0					
June 1	58	39		d		0											0					
June 2	69	41				0											0					

Table of consecutive generations of Toxoptera muhlenbergiæ—Continued.

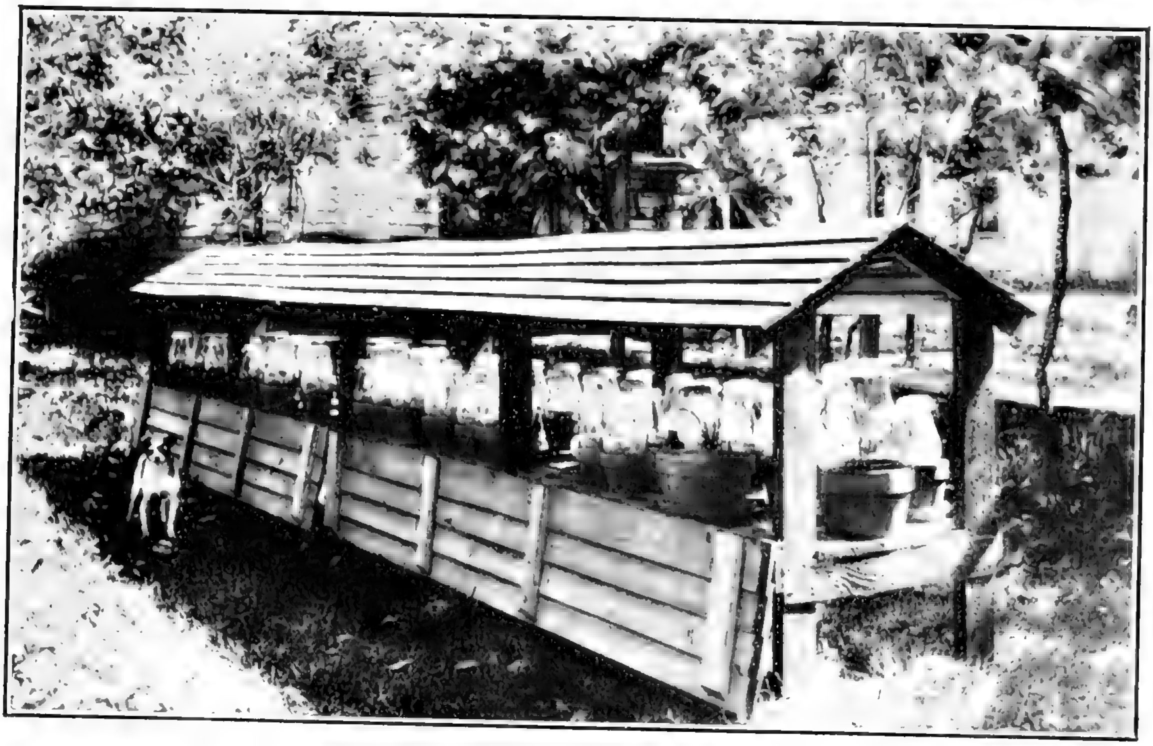
Date.	Temperature.		First-born generation series.														Last-born generation series.					
	Maximum.	Minimum.	First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.	Ninth generation.	Tenth generation.	Eleventh generation.	Twelfth generation.	Thirteenth generation.	Fourteenth generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.
	°F.	°F.																				
June 3	59	39				0											1	b				
June 4	61	44				0											0	0				
June 5	65	54				0											0	0				
June 6	70	46				0											0	0				
June 7	71	40				0											d	0				
June 8	72	51				0												0				
June 9	77	56				0												0				
June 10	70	53				0												0				
June 11	70	50				1	b											0				
June 12	75	45				1	0											2				
June 13	79	52					0															
June 14	83	61				2	0											0				
June 15	81	53				5	0											1				
June 16	87	57				2	0											3				
June 17	90	61				3	0											2				
June 18	91	63				1	0											2				
June 19	92	63				0	0											3				
June 20	94	60				0	0															
June 21	90	65				d	0											0				
June 22	93	65					1	b										0				
June 23	94	68					2	0										2				
June 24	90	69					2	0										2				
June 25	92	63					0	0										1				
June 26	91	62					0	0										3				
June 27	96	68					0	0														
June 28	75	62					0	0										3				
June 29	84	61					0	0										2				
June 30	86	64					0	0										0				
July 1	93	68					4	0										0				
July 2	94	72					3	0										1				
July 3	82	71						0														
July 4	86	64					2	0										3	b			
July 5	75	59						2	b										0			
July 6	85	64					3	1	0									0	0			
July 7	86	66					d	5	0									d	0			
July 8	88	65						0	0										0			
July 9	92	71						4	0										0			
July 10	91	69						1	0										0			
July 11	82	58							1	b									0			
July 12	86	65						1	1	0									0			
July 13	86	60						1	0	0									0			
July 14	83	61						d	1	0									0			
July 15	88	68							1	0									0			
July 16	89	68							2	0									0			
July 17	85	65							2	0									0			
July 18	77	56								0									0			
July 19	77	54							0	0									0			
July 20	80	54							0	0									0			
July 21	83	59							2	0									0			
July 22	83	63							d	0									0			
July 23	86	70								0									3			
July 24	88	73								2	b								1			
July 25	89	70									0											
July 26	91	64								0	0								2			
July 27	90	70								0	0								0			
July 28	94	65								1	0								1			
July 29	86	66								1	0								2	[1] b		
July 30	84	64								1	0								0	0		
July 31	83	54								1	0								0	0		
Aug. 1	80	53									0								0	0		
Aug. 2	86	61								2	0								0	3		
Aug. 3	90	64								3	0								0	2		
Aug. 4	81	60								d	0								d	1		
Aug. 5	83	54									2	b								1		
Aug. 6	82	51									0	0								2		
Aug. 7	86	60									3	0								2		
Aug. 8	74	54										0										

[1] Date of birth uncertain.

Table of consecutive generations of Toxoptera muhlenbergiæ—Continued.

Date.	Temperature. Maximum.	Temperature. Minimum.	First-born generation series. First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.	Ninth generation.	Tenth generation.	Eleventh generation.	Twelfth generation.	Thirteenth generation.	Fourteenth generation.	Last-born generation series. Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.
	°*F*.	°*F*.																				
Aug. 9	86	59									1	0								1		
Aug. 10	77	55									0	0								2		
Aug. 11	85	56									1	0								1		
Aug. 12	85	55									2	0								1		
Aug. 13	87	56									d	0								0		
Aug. 14	87	56										0								2		
Aug. 15	92	67										6	b									
Aug. 16	92	70										3	0							0		
Aug. 17	91	67										2	0							3		
Aug. 18	92	71										2	0							1		
Aug. 19	78	62										5	0							2		
Aug. 20	82	58										0	0							0		
Aug. 21	84	65										0	0							6		
Aug. 22	90	64										0	0									
Aug. 23	86	63										3	0							2		
Aug. 24	82	64										0	5	b						2	b	
Aug. 25	84	74										2	5	0						1		
Aug. 26	80	47										5	2	0						0	0	
Aug. 27	70	47										0	0	0						0	0	
Aug. 28	75	50										0	0	0						0	0	
Aug. 29	80	55										d	0	0						0	0	
Aug. 30	85	59											2	0						d	4	
Aug. 31	90	61											0	0							0	
Sept. 1	80	60											0	0							1	
Sept. 2	70	53											1	0							0	
Sept. 3	77	56											2	0							1	
Sept. 4	86	56											3	0							1	
Sept. 5	84	67												0								
Sept. 6	84	67												7	b							
Sept. 7	82	63											d	0	0						0	
Sept. 8	82	65												2	0						1	b
Sept. 9	85	60												1	0						0	0
Sept. 10	68	46												0	0						0	0
Sept. 11	69	48												1	0						0	0
Sept. 12	80	56													0						0	0
Sept. 13	79	59												0	0						d	0
Sept. 14	64	53												0	0							0
Sept. 15	68	46												0	2	b						0
Sept. 16	73	46												0	0	0						0
Sept. 17	77	48												2	0	0						0
Sept. 18	80	54												0	1	0						0
Sept. 19	85	65												0		0						2
Sept. 20	75	58												0	1	0						1
Sept. 21	79	51												0	2	0						1
Sept. 22	78	54												d	1	0						0
Sept. 23	78	56													0	0						0
Sept. 24	70	63													2	0						1
Sept. 25	74	56													2	0						2
Sept. 26	68	50														0						
Sept. 27	72	51													0	0						0
Sept. 28	65	42													1	0						0
Sept. 29	70	45													0	0						1
Sept. 30	75	49													0	0						1
Oct. 1	80	54													1	0						1
Oct. 2	78	48													2	0						0
Oct. 3	77	57														0						0
Oct. 4	84	65													1	0						1
Oct. 5	72	65													0	0						0
Oct. 6	73	54													0	0						0
Oct. 7	57	35													0	[1] 0						0
Oct. 8	62	38													0							0
Oct. 9	70	43													0							0
Oct. 10	64	40													0							0
Oct. 11	64	42													0							0
Oct. 12	74	45													0							0
Oct. 13	77	46													1							0
Oct. 14	80	47													d							[2] 0

[1] Is adult ♂ now. [2] Died Oct. 31; her young developed into the sexes.



OUTDOOR REARING SHELTERS.

From this table it will be seen that there were 14 generations of the first-born series and 7 of the last born. This would give approximately 10½ generations for the year.

MOLTING.

In 1909 some molting experiments were conducted. Five individuals that had just been born were placed in a specially prepared cage, as shown in figure 7, and observed throughout the molting period. After becoming adult it was found that there were 1 male and 1 oviparous and 3 viviparous females among these 5 individuals. In 1910 observations were also made on a stem-mother to note the number of molts. Of the 6 individuals, all molted 4 times without exception.

FECUNDITY OF THE SUMMER FORMS.

The 19 individuals concerned in the generation series produced 311 young, or an average of 16.3 young each. The maximum number of young produced by a single individual was 35. The maximum number of young produced by any individual in a single day was 5.

AGE WHEN INDIVIDUALS BEGIN REPRODUCING.

The period between birth and reproduction varies greatly, being longest in the spring, when it varies from 15 to 22 days. In summer the shortest period was 6 days, varying from 6 to 13 days. In the fall it varies from 9 to 13 days. The average period throughout the season for the 13 individuals of the series of first born is 13.1 days.

FIG. 6.—*Toxoptera muhlenbergiæ:* Eggs deposited in curled leaf sheath. Greatly enlarged. (Original.)

LENGTH OF LIFE OF THE VIVIPAROUS FORMS.

The length of life, like the period between birth and reproduction, varies greatly. During the spring, when lower temperatures prevail, the viviparous forms will live from 30 to 63 days, while in the summer they live from 16 to 29 days, and in the fall over 30 days. The average length of life throughout the season for the 13 viviparous individuals of the series of first born is 28.9 days.

THE SEXES.

The sexes make their appearance about the first week in October. There does not appear to be any particular generation that consists entirely of the sexes. A viviparous female may produce oviparous and viviparous females and males or she may produce only the sexes.

Males and females reach maturity in from 15 to 23 days. The female will not oviposit without having first been fertilized and will live, under these conditions, for about a month, her abdomen becoming greatly distended with eggs. A female with her abdomen thus distended was dissected after death and found to contain 7 eggs. If a male be placed in a cage with an oviparous female when she reaches maturity she will begin oviposition in about 4 days. The oviparous females, whether in the presence of males or not, apparently always maintain their normal position on the plant, never elevating the tips of their abdomens, as is the case with *T. graminum*.

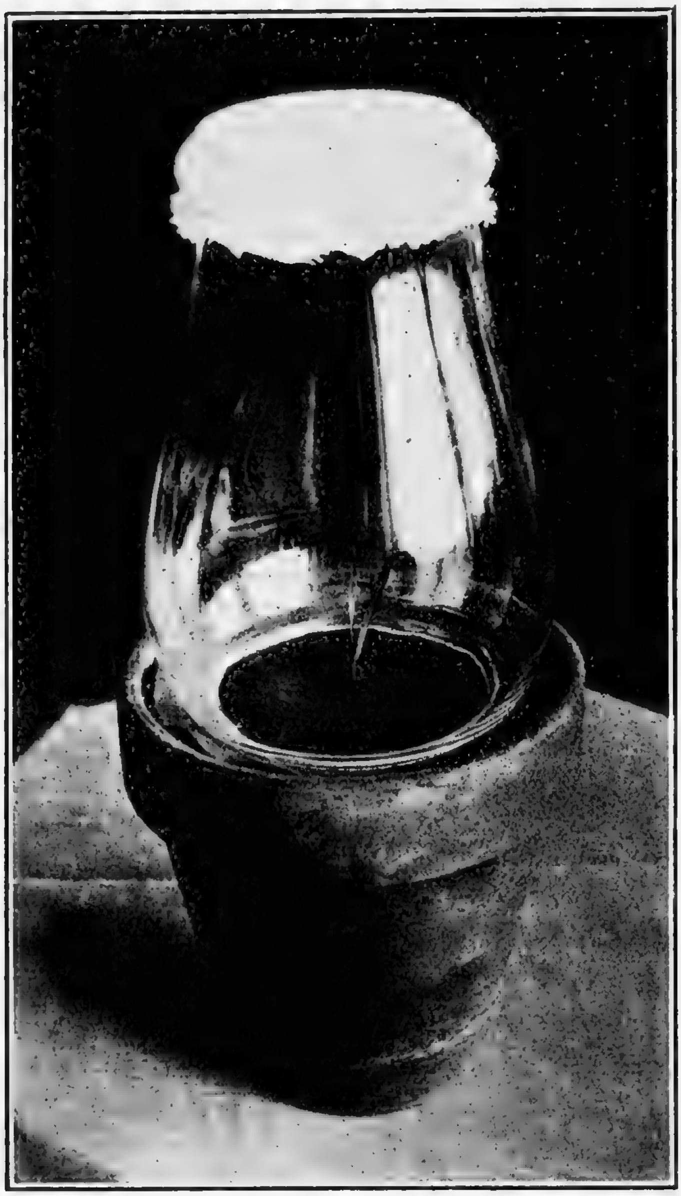


FIG. 7.—Lamp-chimney molting cage used in rearing aphides. (Original.)

PLACE OF OVIPOSITION.

When ready to oviposit, the females crawl down into the leaf sheath, which is usually separated from the plant stem for a part of its length and is somewhat curled, and deposit their eggs in this curled portion. The senior author has counted as many as 200 eggs in such a position. Figure 6 represents such a leaf sheath that has been uncurled and photographed with the eggs in position. In the fall of 1909 eggs were found by the thousands in just such situations.

FECUNDITY OF THE OVIPAROUS FEMALES.

The females of this species do not appear to be quite so prolific as those of its near relative, the destructive "green bug." They produce only from 1 to 5 eggs, though as many as 7 eggs have been taken from the body of a female that had not been fertilized.

MORTALITY OF EGGS.

For some cause or other the eggs appear never to hatch well. During the fall of 1908 from 50 to 100 eggs were collected; and in 1909 fully 1,000 were obtained, but not a single egg hatched, though they were treated in the same manner as eggs of *T. graminum* and other species that stood the winter in good shape. During the spring of 1910 eggs were found by the thousand in the open fields with every evidence that not more than one-half to 1 per cent had hatched, though no unusual circumstances seemed in any way connected with them.

REARING METHODS.

As the Section of Cereal and Forage Insects has been rearing grass and grain infesting aphides for over four years out of doors a brief summary is given of the methods employed, in the hope that future workers on these nsects may find some useful suggestions.

FIG. 8.—Lamp-chimney generation cage used in rearing aphides. (Original.)

FIG. 9.—Lamp-chimney stock cage used in rearing aphieds. Original.)

The rearing stand (Pl. I) consists of a shelf 2 feet wide of tongue-and-groove ¾-inch boards, supported by a frame or base made of 2-inch by 4-inch material. These bases extend up above the shelf 20 inches and support a gable roof of lapped siding. The shelf is 2 feet from the ground. One side is closed by a hinged door that may be raised in case of a storm to prevent the cages from being blown over. This stand should be placed in the shade, preferably of trees, with the hinged side toward the direction from which the prevailing storms come. When it is not storming the hinged door should be let down to permit of free passage of air. It is also well to place a thermograph on the shelf with the cages in order that continuous temperature records may be secured.

The rearing cages used were of three kinds, a cage to observe molting (fig. 7), one for continuous-generation series (fig. 8). and a stock cage (fig. 9).

The cage for the molting observations (fig. 7) consists of a 5-inch flowerpot and the ordinary lantern globe, with a muslin cover over the top. A plant is potted, and a thin piece of black paper is fitted closely about the plant, the paper being the full size of the pot. Absorbent cotton is then pushed down about the plant to fill in completely the space between plant and paper; the cotton is then blackened with carbon ink. In this manner the grayish-white cast skins of the aphides can readily be seen against the black background.

The cage for the consecutive-generation series (fig. 8) is the same as the molting cage minus the paper.

The stock cage (fig. 9) consists of a 10-inch flowerpot and a 6-inch globe. This globe is the same as the one commonly used in villages for street lamps.

All pots should be placed in saucers and irrigated—never watered from the top, as this causes the soil to become very hard and the plants will not grow so well.

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BUREAU OF ENTOMOLOGY.
L. O. HOWARD, Entomologist and Chief of Bureau.

AMERICAN BLACK FLIES OR BUFFALO GNATS.

BY

J. R. MALLOCH,
Entomological Assistant.

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PAPERS ON APHIDIDÆ.

THE YELLOW CLOVER APHIS.

BY

J. J. DAVIS,
Entomological Assistant, Cereal and Forage Insect Investigations.

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W. B. Hall, J. T. Monell, *collaborators.*

CONTENTS.

ILLUSTRATIONS.

PLATE.

TEXT FIGURES.

PAPERS ON APHIDIDÆ.

THE YELLOW CLOVER APHIS.

(*Callipterus trifolii* Monell.)[1]

By J. J. Davis,
Entomological Assistant, Cereal and Forage Insect Investigations.

INTRODUCTION.

The yellow clover aphis, or plant louse (*Callipterus trifolii* Monell), is common and oftentimes abundant throughout the eastern half of the United States, although it has never been considered a pest in this country and consequently little of its life history and habits has been studied. The author takes this opportunity of gratefully acknowledging the assistance of Mr. Alfred F. Satterthwait and Dr. Henry Fox, both of the Bureau of Entomology, who continued the experiments during the writer's absence.

SYNONYMY.

Callipterus trifolii was first described by Mr. J. T. Monell (1882)[2] from specimens collected at Washington, D. C., and forwarded to him by Mr. Theodore Pergande. Buckton (1899) described this species under the name *Chaitophorus maculatus* from specimens collected in India on lucern, or what is known in America as alfalfa (*Medicago sativa*). Dr. Bashambar Das, of the Government college, Lahore, India, has very kindly sent us specimens of *maculatus* Buckton, collected on the type host plant (*Medicago sativa*), and a careful examination has shown no characters distinguishing it from Monell's *trifolii*. Dr. Das writes that to his knowledge the species has not been collected on *Trifolium* in India.

What will probably prove to be identical with the species under discussion was described by Kaltenbach[3] in 1846 as *Aphis ononidis*. We have not as yet had an opportunity to examine the European material relating to this species, however, and thus prefer to leave this question undecided until a comparison can be made. Should it prove identical, it will naturally have priority over both *trifolii* and *maculatus*.

---

[1] Synonym: *Chaitophorus maculatus* Buckton.

[2] Dates in parenthesis refer to Bibliography, p. 40.

[3] Kaltenbach, J. H. Entomologische Zeitung, Stettin, Jahrgang 7, pp. 173-174, June, 1846.

GENERIC POSITION.

Whether or not Kaltenbach's *ononidis* is specifically synonymous with *trifolii*, it can still be definitely placed in the same genus. *Aphis ononidis* was described first by Kaltenbach, and the species has since been placed in the genus *Chaitophorus* by Koch, *Myzocallis* by Passerini, and *Therioaphis* by Walker. As Wilson[1] has pointed out, *Therioaphis* seems hardly sufficiently distinct to be placed as a separate genus. Buckton described the species *maculatus*, which is now considered a synonym of *trifolii*, in the genus *Chaitophorus*, but it is universally considered as not a member of this genus. The species *trifolii* was placed in the genus *Callipterus* by Monell, who described the species, and it has since been placed in the genus *Myzocallis* by some authors. This species can not be placed in Mordwilko's generic table,[2] but can be run down in Wilson's table[3] to the genus *Callipterus*, although in the list of species Wilson places *trifolii* Monell under the genus *Myzocallis*. Likewise in studying Wilson's synopsis of characters of the genera this species can best be placed in the genus *Callipterus*. All of the characters given for the genus *Callipterus* agree reasonably well for *trifolii*, while this is not the case with the characters given for the genus *Myzocallis*.

We must therefore conclude that *trifolii* should be placed in *Callipterus*, although it is recognized as an intermediate species and not a typical member of the genus.

DISTRIBUTION.

IN AMERICA.

In America *Callipterus trifolii* is generally distributed throughout the eastern half of the United States, except possibly in the extreme southern portions. The species was originally described from Washington, D. C., and has since been reported in literature from Iowa (Osborn and Sirrine); Delaware (Sanderson); Illinois, Minnesota, Kansas, North Dakota, Virginia, Missouri, and New York (Davis); Michigan and New York (Gillette); New Jersey (Smith); Indiana (Morrison); and Nebraska (Williams). In addition to these States Mr. R. A. Vickery has taken it in North Carolina, Mr. George G. Ainslie in South Carolina, Tennessee, and Kentucky, and Messrs. E. O. G. Kelly and Paul Hayhurst in Maryland. Prof. F. M. Webster found it in Indiana as early as 1887, our first record of its capture after the original collections were made in 1880. The accompanying

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[1] Wilson, H. F. Can. Ent., vol. 42, no. 8, pp. 253–259, Aug., 1910.
[2] Mordwilko, A. Ann. Rept. Zool. Mus. Imperial Acad. Sci., vol. 13, pp. 353–384, Sept. 17, 1908.
[3] Loc. cit.

map (fig. 10) shows the present known distribution of the species in the United States, compiled largely from records in this office made by various members of the staff.

IN ASIA.

In Asia the species under consideration was first reported from Jodhpur, India, by Buckton (1899), and the writer has received specimens from Dr. Das, presumably collected at Lahore, India.

FOOD PLANTS.

In America the universal food plant of this species is red clover (*Trifolium pratense*), on which it is usually to be found on the underside of the leaves, living more or less solitary. We have reared it also on white clover (*Trifolium repens*).

In 1909 Mr. T. H. Parks, at that time connected with the Bureau of Entomology, conducted a series of experiments in testing the ability of *Callipterus trifolii* to live on various plants. The plants used in these experiments were white clover, sweet clover (*Melilotus* spp.), timothy, spring vetch, Japan clover (*Lespedeza* spp.), sanfoin (*Unobrychis sativa*), alfalfa, bur clover (*Medicago maculata*), alsike clover, English clover, and mammoth clover (*Trifolium medium perenne*). The aphis would not breed on the first seven plants in these tests. On bur clover it lived for a number of days and then disappeared, the results in this case being inconclusive. On alsike, English, and mammoth clovers (all species of *Trifolium*) they bred without difficulty.

FIG. 10.—Map showing distribution of the yellow clover aphis (*Callipterus trifolii*) in the United States. (Original.)

In India the species lives on lucern (*Medicago sativa*)—indeed Buckton received reports that it was destructive to this plant—and, as already stated, Dr. Das reports that it has never been found in that country on *Trifolium*. We are as yet unable to explain why this species lives on *Trifolium* and not alfalfa in America, while in India it is found on alfalfa but apparently not on *Trifolium*.

DESCRIPTIONS.

WINGLESS STEM-MOTHER.

General color gamboge. Head and body bearing numerous tuberculate capitate hairs or spinelike hairs in a more or less regular order, as follows: Head with three in a row on each side of the dorsal median line; two pairs, one not always conspicuous, projecting from the front, and a single one on each side near the posterior border; prothorax with two near anterior border and six along the posterior border; remainder of body bearing two rows of capitate hairs on each side of the dorsal median line, the tubercles bearing these two rows being confluent, so as to present the appearance of a single row on each side, with two hairs to each tubercle; laterad of these are two distinct rows of tuberculate hairs on each side. The tubercles on the head and prothorax are dusky at their apices and the capitate hairs are black; other tubercles are rimmed at base with a blackish line, the apices and hairs being black.

Eyes red. Antennæ reaching about to the cornicles; segment III longest, it being more than one-third longer than VI (base + filament), the base and filament of VI subequal; segment III with 7 to 10, usually 8, oval sensoria in a row, V and base VI with the usual distal ones; segments I and II concolorous with body; III and IV pale, but slightly darker than body color and with a faint brownish tint; V becoming blackish towards tip, and VI black. Beak not quite reaching coxæ of second pair of legs. Legs paler than body color, the tip of tarsus black. Cornicles as long as width at the base, being about as long as antennal segment I, concolorous with body, the basal rim and tip with a narrow blackish line, on border. Cauda globular, concolorous with body, bearing a number of moderately long unknobbed hairs. Anal plate conspicuously bilobed.

Measurements made from two individuals, May 5, 1913, at La Fayette, Ind., immediately upon placing in balsam and before any change of form occurred, are as follows: Length of body, 1.55 mm.; width, 0.77 and 0.81 mm., respectively; length of spines, 0.078 mm.; of tubercles, 0.05 mm.; length of cornicles, 0.061 mm.; width at tip, 0.035 mm.; antennal measurements as follows:

I.	II.	III.	IV.	V.	VI base.	VI filament.	Total.
Mm.	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*
0.061	0.052	0.435	0.261	0.234	0.148	0.139	1.330
		.417	.243	.252	.148	.148	
.061	.052	.495	.287	.261	.156	.139	1.451
.069	.052	.487	.278	.243	.148	.139	1.416

WINGED VIVIPAROUS FEMALE.

(Fig. 11.)

General color of body pale yellowish green, with dusky tuberculate areas more or less uniformly placed on the dorsum. Capitate hairs and tubercles not so prominent as in the apterous forms. Head bearing three capitate hairs, more or less in a row on each side of the median dorsum, an additional one on each side, near the posterior margin, and a pair projecting from the front, one on each side of the median ocellus. Prothorax with two similar hairs near the posterior margin and an additional one on each side. The thoracic plate

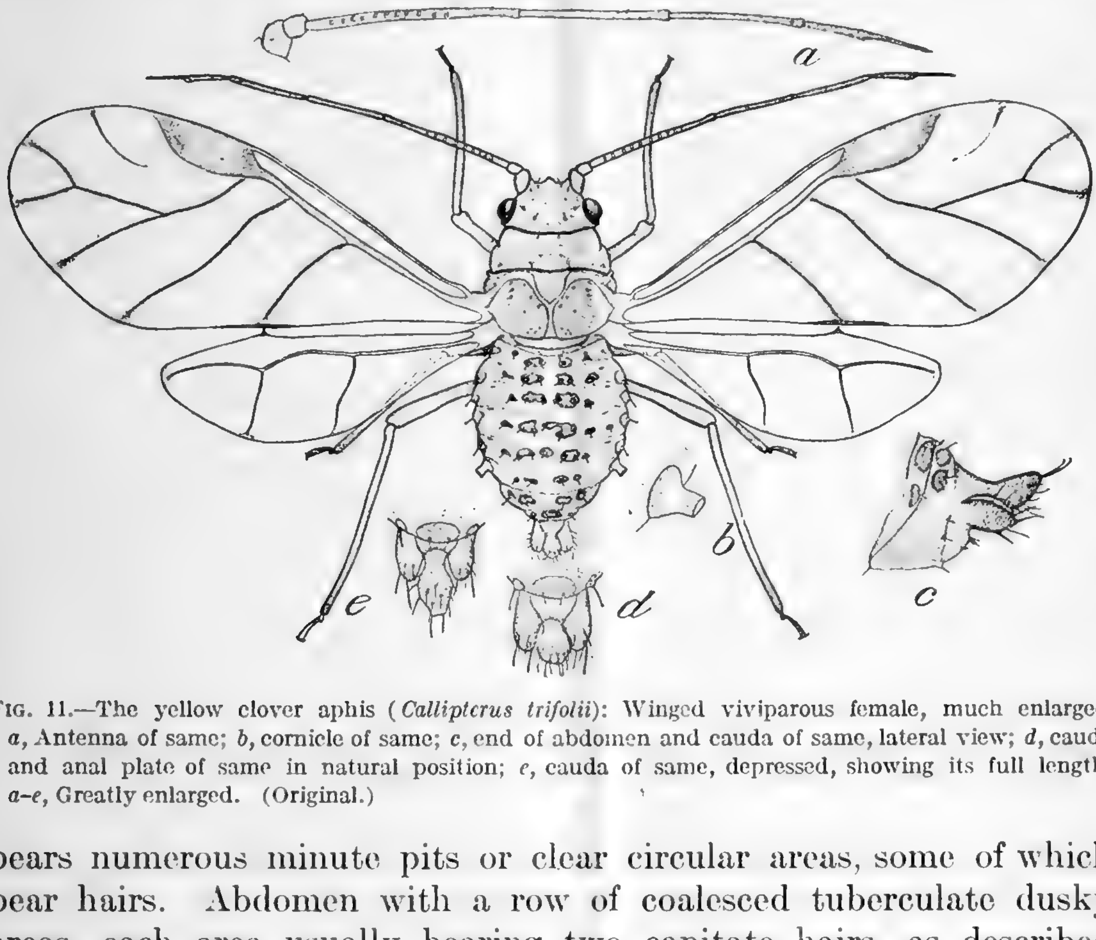


Fig. 11.—The yellow clover aphis (*Callipterus trifolii*): Winged viviparous female, much enlarged *a*, Antenna of same; *b*, cornicle of same; *c*, end of abdomen and cauda of same, lateral view; *d*, cauda and anal plate of same in natural position; *e*, cauda of same, depressed, showing its full length. *a–e*, Greatly enlarged. (Original.)

bears numerous minute pits or clear circular areas, some of which bear hairs. Abdomen with a row of coalesced tuberculate dusky areas, each area usually bearing two capitate hairs, as described for the stem-mother, and a longitudinal row of dusky tuberculate areas, each area smaller than those just mentioned and each bearing but a single hair. On the margins, and often projecting from its body, thus giving the border the appearance of being coarsely dentate, are rows of setæ bearing tuberculate areas, one row on each side. Although there is some slight variation in the position of the hairs and maculations, and the maculations on the abdomen also vary more or less in shape and size, the foregoing is the usual arrangement.

Eyes dark red to brown. Antennæ about as long as the body; relative lengths of segments as for stem-mother; segment III bearing 9 to 12 oval sensoria in a row, and the usual ones at apex of V and of base VI; concolorous with body at base, gradually darkening towards apex (fig. 11, *a*). Beak not reaching coxæ of second pair of legs. Wings hyaline, veins dark brown to blackish, with a very narrow brownish border, and small brownish areas at their apices; basal half of radial sector (stigmal veins) obsolescent toward basal half; terminal forks of the median (discoidal vein) branching at a point slightly less than one-half the distance from the tip of wing to where the media first branches; width almost one-half its length. Legs concolorous with body, excepting tarsi, which are nearly black. Cornicles dusky and about as long as the width at base (fig. 11, *b*). Cauda globular and constricted at middle; a lateral view (fig. 11, *c*) shows it to be decidedly upturned so that a dorsal view usually shows it to be globular (fig. 11, *d*), although when pressed down, as is usually the case in mounted specimens, it appears more or less oval and pointed from tip from above (fig. 11, *e*). Anal plate dusky and bilobed and described for the stem-mother.

Measurements: Length of body, 1.345–1.564, average, 1.454 mm.; width, 0.582–0.691, average, 0.642 mm.; expanse of wings, 4.654 mm.; length of wing, 2.0 mm., width, 0.80 mm.; cornicles, 0.066 mm.; cauda, 0.139 mm.; hind tarsus, 0.129 mm.; antennal measurements as follows:[1]

I.	II.	III.	IV.	V.	VI base.	VI filament.
Mm.	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*
0.0815	0.057	0.522	0.391	....	....	....
.0733	.057	.505	.383	0.359	0.179	0.179
.0733	.049	.513	.375	.326	.163	.163
.0733	.057	.538	.359	.350	.179	.179
.0733	.057	.513	.379	.310	.179	.179
.0815	.057	.538	.375	.326	.147	.147
....	.049	.522	.375	.310	.163	.163
....	.057	.522	.342	.318	.179	.163
.0815	.057	.513	.375	.310	....	....
....	.057	.522	.359	.310	.163	.155
.0815	.057	.497	.359	.310	.163	.146
.0815	.057	.489	.359	.301	.155	.155
[2] .07	.043	.514	.271	.243	.143	.143
([2])	.057	.471	.313	.285	.143	.157
([3])	....	.428	.285	.285	.157	.143
([3])	....	.414	.328	.271	.157	.143
([3])	.042	.428	.285	.285	.143	.143
([3])	.042	.414	.271	....	....	....
([3])	....	.499	.342	.299	.185	.128
([3])	....	.485	.357	....	....	....
[3] .043	.043	.428	.314	.271	.157	.128
[3] .071	.057	.485	.314	.314	.128	.128

[1] From specimens collected at Urbana, Ill., except as noted.
[2] Measurements by J. T. Monell from specimens collected by Paul Hayhurst, at Washington, D. C.
[3] Measurements by J. T. Monell from type specimens, which were collected at Washington, D. C.

WINGLESS VIVIPAROUS FEMALE.

(Fig. 12.)

General color pale yellowish green, with dusky tuberculate areas bearing capitate setæ on the dorsum, arranged as described for the stem-mother and as shown in figure 12. Both the tubercles and capitate hairs (fig. 12, *a*) are more prominent in this form than in the winged female.

Eyes dark red. Antennæ almost as long as the body; relative lengths of segments as in other forms; segment III with 7 to 12, usually 9 or 10, oval sensoria in a row and the usual distal ones on V and base of VI; basal segments pale, the remaining ones gradually darkening toward the tip. Beak scarcely reaching coxæ of second pair of legs. Legs pale, excepting the joints, which are dusky, and the tarsi, which are black. Cornicles (fig. 12, *b*) and cauda as in winged female.

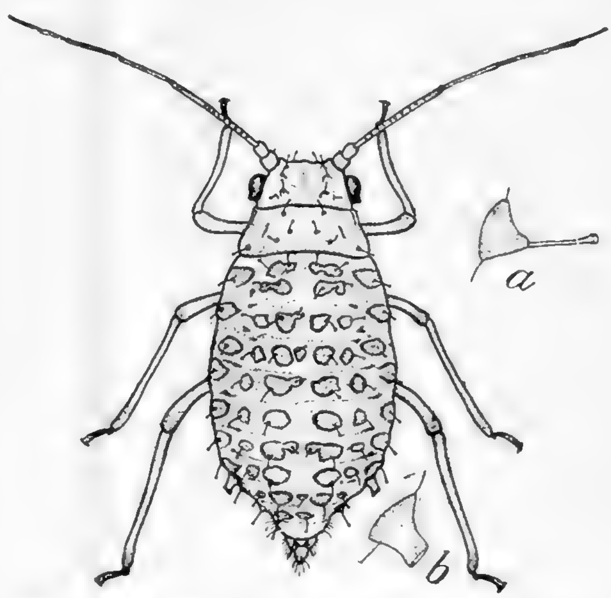


FIG. 12.—The yellow clover aphis: Wingless viviparous female, much enlarged. *a*, Lateral capitate hair of same; *b*, cornicle of same. *a*, *b*, Greatly enlarged. (Original.)

Measurements (from specimens mounted in balsam): Length of body, average, 1.60 mm.; width, average, 0.76 mm.; antenna, averages, segment I, 0.076 mm.; II, 0.053 mm.; III, 0.517 mm.; IV, 0.347 mm.; V, 0.316 mm.; VI base, 0.156 mm.; VI filament, 0.162 mm.; total, average, 1.627 mm.; cornicles, 0.062 mm.; cauda, 0.171 mm.; hind tarsus, 0.130 mm.

WINGED MALE.

(Fig. 13.)

Wingless males unknown. Head and thorax light olive-green; abdomen pale yellowish green, with rather conspicuous black markings. Similar to the winged female but smaller, with more slender body (the illustration, fig. 13, shows the abdomen too robust), and the dusky tubercular areas on the dorsum of abdomen smaller. Head and thorax bearing a number of hairs in a more or less regular order as shown in the illustration. As stated, the abdominal markings are reduced in comparison to those on other forms. The areas of the two median rows are larger than those of the lateral rows, but they vary more or less in the number of hairs borne on each, some having two and others but one. The cephalic and thoracic hairs are unknobbed or but inconspicuously capitate, and those on the abdomen may also be capitate or not, usually inconspicuously knobbed.

Eyes dark red to blackish. Antennæ dusky to black, reaching a little beyond tip of abdomen; relative lengths of segments as in the other forms; segment III with 13 to 16 oval sensoria more or less in a row; IV with 3 to 5; V with 3 to 5, not including the usual distal one; and VI base with 1 sensorium surrounded by several smaller ones at the tip (fig. 13, *a*). Beak not reaching coxæ of second pair of legs. Venation as described for the female. Cornicles and cauda dusky, the latter edged with black; in form they agree with those of the viviparous generations.

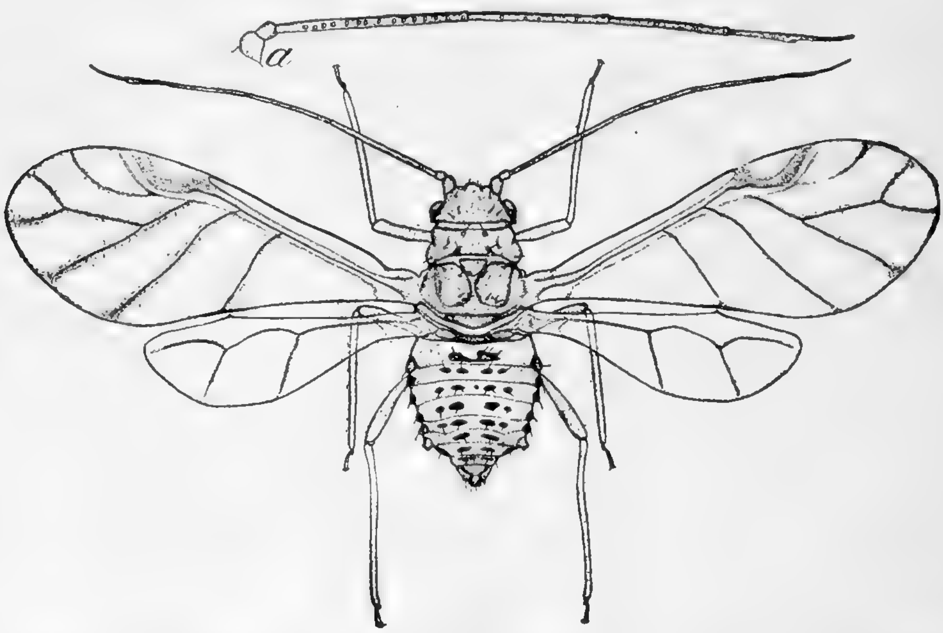
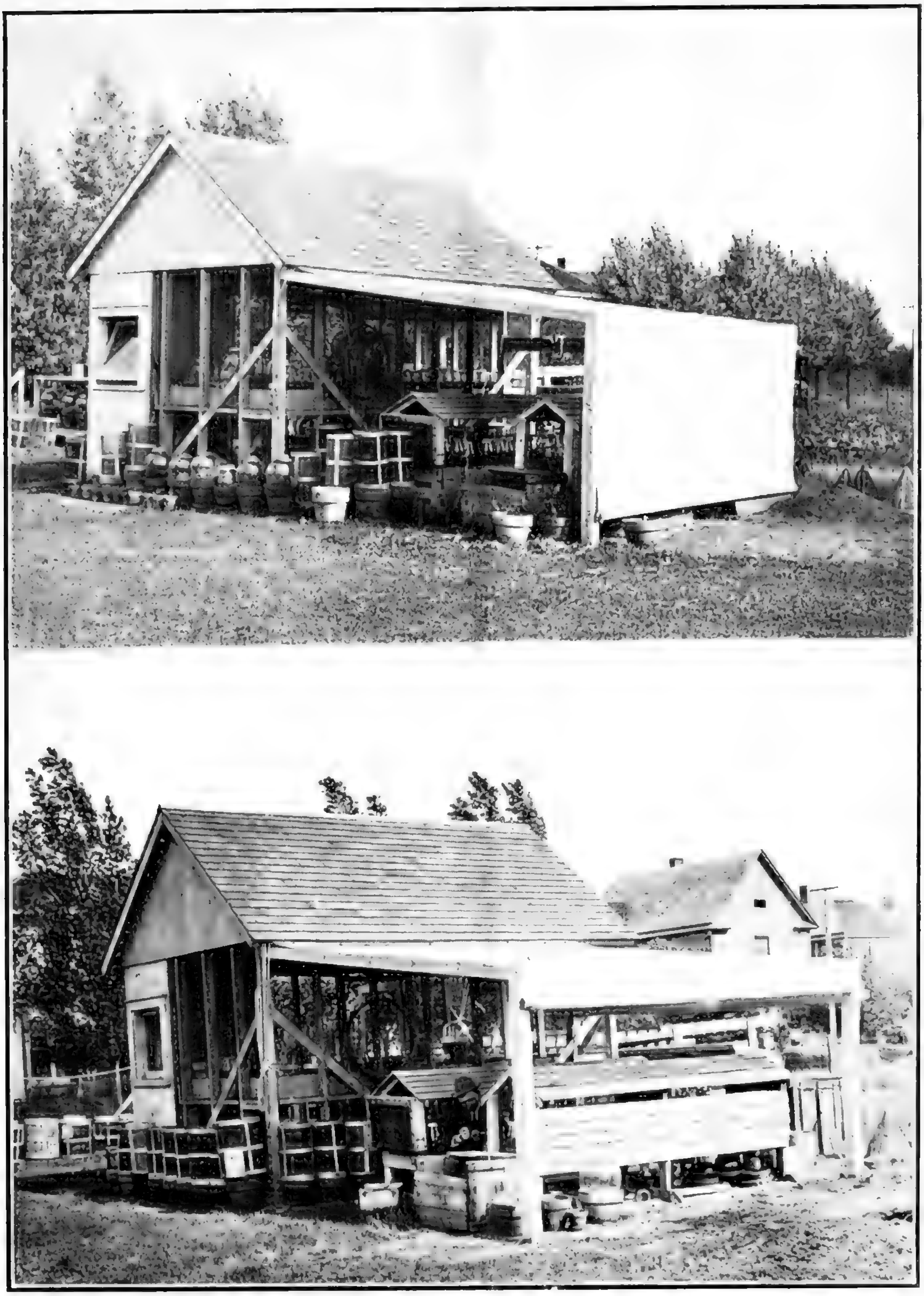


FIG. 13.—The yellow clover aphis: Winged male, much enlarged. *a*, Antenna of same, greatly enlarged. (Original.)

Measurements (averages): Length of body, 1.3 mm.; width, 0.53 mm.; expanse of wings, 4.1 mm.; length of wing, 1.8 mm.; cornicles, 0.049 mm.; hind tarsus, 0.130 mm. Antennal measurements as follows:

I.	II.	III.	IV.	V.	VI base.	VI filament.	Total.
Mm.	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*
0.065	0.053	0.473	0.277	0.261	0.147	0.163	1.439
.065	.057	.473	.277	.277	.147	.163	1.459
.065	.057	.522	.277	.293			
.081	.065	.546	.293	.309	.171	.155	1.620
[1] .065	.049	.505	.326	.309	.163	.163	1.580
[1] .073	.049	.522	.326	.318	.155	.155	1.598
[1] .065	.049	.530	.342	.293	.147	.147	1.573
[1] .065	.049	.554	.359	.277	.139	.139	1.582

[1] Measurements made immediately upon mounting in balsam; other antennal measurements are from balsam mounts after standing and clearing.



OUTDOOR REARING SHELTERS USED IN LIFE-HISTORY STUDIES ON THE YELLOW CLOVER APHIS.

WINGLESS OVIPAROUS FEMALE.

(Fig. 14.)

General color yellowish orange to orange when fully mature. The body is usually yellowish when the female first reaches maturity, but as the eggs, which are of an orange color, begin to develop within the body they show through the semitransparent skin, giving the conspicuous orange color to the body. Head and prothorax pale yellow, mesothorax and metathorax varying from yellow to orange according to age since maturity. Dusky tuberculate areas conspicuous. These and the black capitate hairs arranged as on the stem-mother.

Eyes blackish or brownish black. Antennæ not reaching to base of cornicles; relative lengths of segments as in other forms; segment III bearing 7 to 10 oval sensoria in a row, and segments V and base of VI with the usual distal areas; basal segments concolorous with head, others gradually darkening toward apex. Legs pale yellowish except tarsi; proximal halves of hind tibiæ swollen and bearing 25 to 40 inconspicuous, irregularly placed, circular sensoria (fig. 14, *a*). Cornicles and cauda concolorous with abdomen, often dusky at margins. Cauda knobbed as in other forms, but the anal plate is rounded at the tip and does not have the slightest emargination (fig. 14, *b*).

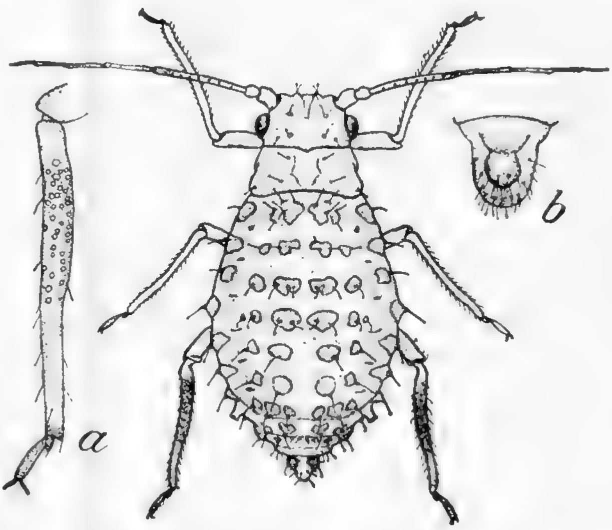


FIG. 14.—The yellow clover aphis: Wingless oviparous female, much enlarged. *a*, Hind tibia of same; *b*, cauda and anal plate of same. *a*, *b*, Greatly enlarged. (Original.)

Measurements: Length of body (average), 1.8 mm.; width, 0.86 mm.; cornicles, 0.061 mm.; hind tarsus, 0.134 mm.; antennal measurements as follows:

I.	II.	III.	IV.	V.	VI base.	VI filament.	Total.
Mm.	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*
0.082	0.057	0.473	0.236	0.228	0.139	0.139	1.354
.065	.057	.434	.204	.204	.122	.139	1.225
.065	.057	.407	.204	.204	.147	.139	1.223
.065	.057	.391	.196	.212	.130	.147	1.198
.065	.065	.399	.196	.212	.130	.147	1.214
.082	.065	.434	.196	.212	.139	.147	1.275
.073	.057	.407	.196	.212	.130	.147	1.222
.065	.065	.399	.196	.212	.130	.147	1.214
.065	.057	.383	.196	.212	.139	.139	1.191
.073	.065	.391	.179	.179	.130	.139	1.156
.073	.057	.359	.179	.196	.122	.139	1.125

EGG.

The egg is elliptical, bright orange when first laid, gradually changing to shining jet black, and measures 0.575 mm. in length by 0.248 mm. in width.

LIFE HISTORY AND HABITS.

With *Callipterus trifolii*, as with most other plant-lice, a number of generations of winged and wingless viviparous females are produced during the summer, and the true sexes, consisting of winged males and wingless oviparous females, appear in the fall; these females in turn laying eggs on the stems and leaves of clover to carry the species over the winter months. This species does not have an alternate host, nor does it ever pass the winter, in the latitude of La Fayette, Ind., as viviparous females. However, in the Southern States it probably does winter as viviparous females, for Mr. Geo. G. Ainslie found the viviparous forms not uncommon at Clemson College, S. C., in December (Dec. 3, 1908), whereas a careful search for sexual individuals proved fruitless. Similar observations were made by Mr. R. A. Vickery at Salisbury, N. C., November 11, 1909.

As is characteristic of this tribe of plant-lice (Callipterini) the species under discussion is sporadic in habit and is very easily roused, the least disturbance causing it to jump from its host. This habit is much to its advantage, for it seems to render the species almost immune from predaceous and parasitic enemies.

METHODS OF STUDY.

The life-history studies here recorded were made in outdoor shelters, and the vivaria used were chimney cages such as had previously been used and described by the writer for other species of aphides.[1] The outdoor shelter consisted of frame benches, placed under a canvas canopy (Pl. II) to protect the cages and shelters from the intense midsummer sun. This was necessary, for while the aphides might live out of doors without special protection from the sun, there they have the advantage of a constant circulation of air which is not possible within the glass chimney cages.

The generation series were begun with the stem-mother hatching from the winter egg, and the first and last born generation series continued to the true sexual forms in the fall. In this way the maximum and minimum number of generations annually was obtained under what might be considered optimum conditions, at least from the standpoint of natural enemies and harmful climatic conditions.

[1] U. S. Dept. Agr., Bur. Ent., Tech. Ser. No. 12, Pt. VIII, p. 159. (See also Bul. 25, Pt. I, of the same series.)

GENERATION EXPERIMENTS.

Eggs which were laid on the stems and leaves of red clover plants in the fall of 1912 were kept out of doors under natural conditions throughout the winter, and these began to hatch during the latter half of April, 1913. The young which were used to begin the continuous-generation experiments hatched April 22, and it is worthy of note that this was almost a month after the eggs of *Macrosiphum pisi*, kept under identical conditions, hatched this same year. This is all the more unusual since *trifolii* invariably produces the sexual forms and deposits its eggs noticeably earlier in the fall than does *pisi*.

The young stem-mother—the aphis hatching from the egg being so called—which hatched April 22 and was placed on a red clover plant gave birth to her first young on May 4 and her last young on May 30. In the first-born generation series, that is, taking the *first young of the first young* in each new generation, 17 generations were obtained, counting the oviparous generation as the last. On the other hand, in the last-born generation series, beginning with the last to be borne by the individual which hatched from the egg April 22 and following the series of the last born of each "last-born" generation, there were in all only 8 generations. In other words, there was a maximum of 17 generations and a minimum of 8, from which we may reckon that the approximate average number of yearly generations is 12½ (Tables I and II).

TABLE I.—*Line of generations of Callipterus trifolii from egg to oviparous generation in fall, La Fayette, Ind., 1913.*

Generation from egg.		Date of birth.	Date of first young.	Age at birth of first young.	Date of last young.	Productive period.	Life after last young.	Number of young.	Average young per day of productive period.	Largest number of young in one day.	Date of death or disappearance.	Total length of life.
				Days.		*Days.*	*Days.*					*Days.*
First-born generation series	1	Apr. 22	May 4	12	May 30	27	1	65	2.4+	7	May 31	39
	2	May 4	May 20	16	June 20	32	13	99	3.1−	7	July 3	60
	3	May 20	June 2	13	June 23	22	11	75	3.4+	6	July 4	45
	4	June 2	June 15	13	June 29	15	1	64	4.3−	8	June 30	28
	5	June 15	June 21	6	June 26	6	1	34	5.6+	8	June 27	12
	6	June 21	June 30	9	July 4	5	0	24	4.8	7	July 4	13
	7	June 30	July 8	8	July 28	21	0	45	2.1+	4	July 28	28
	8	July 8 or 9	July 18	9 to 10	July 29	12	0	26	2.2−	4	July 29	20 to 21
	9	July 19 or 20	July 27	7 to 8	July 31	5	0	24	4.8	8	July 31	12 to 13
	10	July 27	Aug. 3	7	Aug. 14	12	0	42	3.5	7	Aug. 14	18
	11	Aug. 3	Aug. 10	7	Aug. 25	16	2	61	3.8+	8	Aug. 27	24
	12	Aug. 10 (?)	Aug. 17	(?) 7	...do...	9	1	40	4.4+	6	Aug. 26	16
	13	Aug. 17	Aug. 24	7	Aug. 27	4	1	10	2.5	3	Aug. 28	11
	14	Aug. 24	Sept. 2	9	Sept. 10	9	0	34	3.7+	6	Sept. 10	17
	15	Sept. 2 or 3	Sept. 9	6 to 7	Oct. 6	28	0	[1] 66	2.4−	8	Oct. 6	34 to 35
	16	Sept. 9	Sept. 25	16	Oct. 15	21	0	[2] 49	2.3+	7	Oct. 15	36
	17	Sept. 25 [3]	......	......	......	......	......	......	......	......	......	......
Last-born generation series	2	May 30	June 8	9	June 29	22	0	85	3.9−	8	June 29	30
	3	June 29	July 5	6	July 13	9	0	25	2.8−	6	July 13	14
	4	July 11	July 17	6	Aug. 5	20	0	84	4.2	8	Aug. 5	25
	5	Aug. 5	Aug. 11	6	Aug. 20	10	1	47	4.7	9	Aug. 21	16
	6	Aug. 18	Aug. 24	6	Sept. 9	17	0	58	3.4+	7	Sept. 9	22
	7	Sept. 9	Sept. 23	14	Oct. 9	17	0	[4] 41	2.4+	6	Oct. 9	30
	8	Oct. 9 [3]	......	......	......	......	......	......	......	......	......	......

[1] The 3 young born Oct. 5 and 6 were reared to maturity and proved to be 1 viviparous and 2 oviparous females; and of the 7 born Oct. 4, five were reared to maturity and all were oviparous females.

[2] 7 young (2 born Oct. 9, 2 born Oct. 10, and 3 born Oct. 11) kept in a separate cage, and of the 6 maturing 1 was viviparous and the remaining 5 oviparous females.

[3] Oviparous females.

[4] Of the first 7 young, born Sept. 23–24, 5 were reared to maturity, 4 being viviparous and 1 an oviparous female.

TABLE II.—*Table of consecutive generations of Callipterus trifolii, La Fayette, Ind., 1913.*

Date.	Temperature.[1]		First-born generation series.																	Last-born generation series.							
	Maximum.	Minimum.	First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.	Ninth generation.	Tenth generation.	Eleventh generation.	Twelfth generation.	Thirteenth generation.	Fourteenth generation.	Fifteenth generation.	Sixteenth generation.	Seventeenth generation.	First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.
1913.	° *F.*	° *F.*																									
Apr. 22	82	47	[2] b																								
23	81	58	0																								
24	77	59	0																								
25	61	44	0																								
26	64	42	0																								
27	53	37	0																								
28	61	41	0																								
29	77	38	0																								
30	83	43	0																								
May 1	91	48	0																								
2	89	52	0																								
3	87	58	0																								
4	83	62	1	b																							
5	81	81	5	0																							
6	84	53	4	0																							
7	66	42	1	0																							
8	71	45	0	0																							
9	74	53	4	0																							
10	56	36	0	0																							
11	58	30	1	0																							
12	64	42	3	0																							
13	83	53	1	0																							
14	83	60	3	0																							
15	81	62	1	0																							
16	85	49	3	0																							
17	71	50	8	0																							

[1] Temperatures are those recorded from the hour of examination one day to the hour of examination the next.

[2] The position of the letter "b" at the head of each column shows that the aphis was born on the date indicated. The total number of young for each female is given at the foot of each column, respectively.

TABLE II.—*Table of consecutive generations of Callipterus trifolii, La Fayette, Ind., 1913*—Continued.

Date.	Temperature.		First-born generation series.																	Last-born generation series.							
	Maximum.	Minimum.	First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.	Ninth generation.	Tenth generation.	Eleventh generation.	Twelfth generation.	Thirteenth generation.	Fourteenth generation.	Fifteenth generation.	Sixteenth generation.	Seventeenth generation.	First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.
1913.	°F.	°F.																									
May 18	79	48	o	0																							
19	72	50	3	o																							
20	76	56	1	2	b																						
21	82	62	7	3	0																						
22	65	52	1	2	0																						
23	57	48	1	3	0																						
24	70	40	1	2	o																						
25	72	52	1	2	0																						
26	70	54	4	3	o																						
27	60	52	2	2	o																						
28	81	49	2	3	o																						
29	86	57	5	5	o																						
30	87	64	2	4	o																b						
31	78	62		7	o																o						
June 1	82	64		3	o																o						
2	79	59		3	4	b															o						
3	79	61		3	6	o															o						
4	82	54		5	2	o															o						
5	76	56		4	6	o															o						
6	90	62		6	6	o															o						
7	91	55		5	2	o															o						
8	59	44		1	3	o															4						
9	63	47		1	2	o															6						
10	75	45		1	o	o																					
11	75	45		2	o	o															2						
12	82	45		1	5	o															2						
13	85	52		2	3	0															4						
14	91	54		2	5	o															6						
15	95	65		5	4	6	b														5						
16	97	65		7	5	6	o														8						

17	100	66		5	6	8	0														8						
18	97	64		3	4	5	0														4						
19	97	66		1	4	6	0														6						
20	101	66		1	2	5	0														3						
21	95	70		0	2	5	7	b													6						
22	84	62		0	2	4	1	0													2						
23	75	63		0	2	2	5	0													3						
24	81	75		0	0	2	8	0													3						
25	86	72		0	0	6	6	0													3						
26	88	69		0	0	4	7	0													4						
27	92	71		0	0	2		0													5						
28	94	74		0	0	1		0													2						
29	95	74		0	0	2		0													1	b					
30	94	76		0	0			7	b													0					
July 1	94	75		0	0			6	0													0					
2	90	71		0	0			2	0													0					
3	90	73			0			6	0													0					
4	92	74						3	0													0					
5	93	74							0													1					
6	95	66							0													6					
7	84	60							0													2					
8	91	64							2													2					
9	94	66							4	b												3					
10	90	60								0												2					
11	85	57							3	0												5					
12	89	70							2	0												2	b				
13	88	62							2	0												2	0				
14	95	67							3	0													0				
15	94	69							4	0													0				
16	94	76							4	0													0				
17	95	75							2	0													4				
18	88	66							3	1													3				
19	84	64							0	2													6				
20	85	60							0	4	b												6				
21	79	56							2	2	0												2				
22	80	55							0	2	0												4				
23	88	60							0	3	0												7				
24	81	67							4	3	0												2				
25	80	52							2	0	0												3				
26	89	61							3	2	0												8				
27	93	72							2	4	3	b											5				
28	95	73							3	0	8	0											7				
29	94	71								3	2	0											6				
30	98	74									4	0											5				
31	98	74									7	0											6				
Aug. 1	95	66										0											5				
2	87	60										0											0				
3	90	61										4	b										1				
4	87	59										5	0										2				
5	84	59										5	0										2	b			
6	89	62										4	0											0			
7	88	70										7	0											0			

TABLE II.—*Table of consecutive generations of Callipterus trifolii, La Fayette, Ind., 1913*—Continued.

Date.	Temperature.		First-born generation series.																	Last-born generation series.							
	Maximum.	Minimum.	First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.	Ninth generation.	Tenth generation.	Eleventh generation.	Twelfth generation.	Thirteenth generation.	Fourteenth generation.	Fifteenth generation.	Sixteenth generation.	Seventeenth generation.	First generation.	Second generation.	Third generation.	Fourth generation.	Fifth generation.	Sixth generation.	Seventh generation.	Eighth generation.
1913.	° F.	° F.																									
Aug. 8	93	73										3	o											o			
9	97	75										5	o											o			
10	92	73										1	4	b										o			
11	86	68										1	7											9			
12	74	64										2	3	o										6			
13	84	70										4	6	o										4			
14	83	72										1	5	o										3			
15	83	70											8	o										9			
16	91	74											6	o										4			
17	95	73											4	6	b									6			
18	91	73											3	6	o									3	b		
19	86	72											2	5	o									1	o		
20	88	67											4	8	o									2	o		
21	90	72											2	5	o										o		
22	90	68											1	o	o										o		
23	75	58											o	3	o										o		
24	78	55											o	2	3	b									2		
25	86	55											6		3	o									1		
26	82	60											o		2	o									1		
27	92	69													2	o									3		
28	94	66														o									6		
29	94	53														o									1		
30	80	53														o									1		
31	82	61														o									6		
Sept. 1	82	64														o									2		
2	98	64														4	b								6		
3	98	68														2	o								7		
4	98	69														4	o								5		
5	94	64														3	o								2		
6	92	68														6	o								3		

7	91	68														4	o								7		
8	92	64														5	o								3		
9	96	53														4	o								2	b	
10	79	50														2	1	b								o	
11	85	57															5	o								o	
12	90	61															6	o								o	
13	71	52															4	o								o	
14	70	48															1	o								o	
15	73	59															1	o								o	
16	69	56															1	o								o	
17	76	67															7	o								o	
18	73	58															6	o								o	
19	73	52															3	o								o	
20	71	55															1	o								o	
21	55	45															o	o								o	
22	50	42															o	o								o	
23	50	37															1	o								1	
24	76	53															3	o								6	
25																	8	2	b							2	
26																	1	1	o							2	
27																	o	1	o							1	
28																	1	2	o							o	
29																	6	5	o							2	
30																	o	o	o							5	
Oct. 1																	1	5	o							3	
2																	2	2	o							3	
3																	3	1	o							1	
4																	1	4	o							1	
5																	2	3	o							1	
6																	1	2	o							5	
7																		2	o							2	
8																		7	o							5	
9																		6	o							1	b
10																		2	o								o
11																		3	o								o
12																		o	o								o
13																		1	o								o
14																		o	o								o
15																		3	(1)								(1)
			65	99	75	64	34	24	45	26	24	42	61	40	10	34	66	49			85	25	84	47	58	41	

All oviparous.

As will be noticed by referring to figure 15 the first generation extended over a period of 39 days, from April 22 to May 31; the second, 60 days; the third, 54 days, etc.; and the eighth generation, which includes the last generation of the last-born series, being the longest, a period of 128 days. It is interesting to note that on May 4 individuals of the first 2 generations coexisted in the insectary; on June 4, 3 generations; on July 4, 5 generations; on August 4, 8 generations, or from the fourth to the eleventh; on September 4, 10 generations, or from the sixth to the fifteenth; and on October 4, 11 generations, or from the seventh to the seventeenth. Also, it will be observed that sexual generations occurred in the last 10 generations, from the eighth to the seventeenth inclusive, thus, with the additional data previously reported by Webster and Phillips, and by the writer, thoroughly disproving the theory held by some that the sexual forms appear necessarily in a certain definite generation.

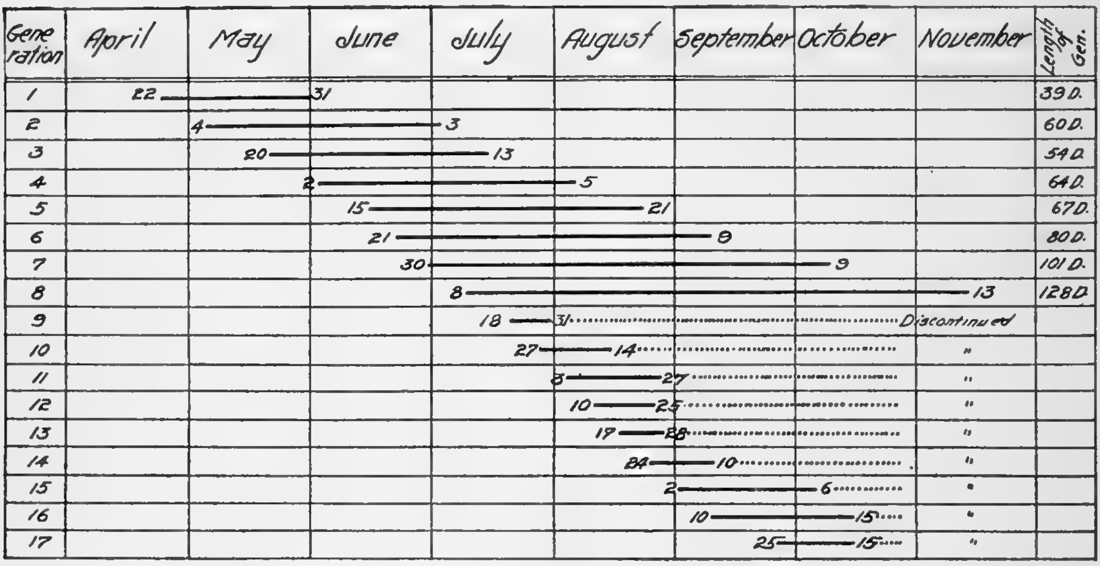


FIG. 15.—Diagram showing periods and succession of generations in the yellow clover aphis, La Fayette, Ind., 1913. (Original.)

Our records show that the first oviparous females were observed in the experimental cages early in October, they having been born September 25, and our field records prove that the sexual forms may be produced even earlier than this. As has been inferred, the sexual forms seem to appear after the earliest weather conditions indicative of winter, although occasionally viviparous females have been observed until killed by cold weather. It was a usual occurrence for the same female to produce young part of which were viviparous and part oviparous.

Again referring to Tables I and II it will be seen that the immature stage varied from 6 to 16 days, depending on the temperature; the average for the year, in the 1913 series, being 9.1 days. The productive period, from birth of first young to birth of last young, likewise varied considerably, covering from 4 to 32 days, with an average of 15.4+days. The largest number of young produced by an individual female was 99 and the average of the 22 regular generations in the series was 50, averaging 3.2+ young per day per female throughout the entire season, the largest number of young produced in a single day by one female being 9.

With only an occasional exception the aphides in these experiments were wingless. Crowded conditions, predicative of a shortage of food, always resulted in a large percentage of winged forms.

Messrs. W. J. Phillips and T. H. Parks followed this species through two series of generations in 1909 at La Fayette, Ind., beginning with young found in the field May 13, and a synopsis of their experiments is here given in Tables III and IV. In general the results they obtained agree with our own studies in 1913.

TABLE III.—*Line of generations of Callipterus trifolii from May 13, 1909, to oviparous generation, La Fayette, Ind.* (*Phillips and Parks*).

Generation from May 13.		Date of birth.	Date of first young.	Age at birth of first young.	Date of last young.	Productive period.	Life after last young.	Number of young.	Average young per day of productive period.	Largest number of young in one day.	Date of death or disappearance.	Total length of life.
				Days.		*Days.*	*Days.*					*Days.*
First-born generation series	1	May 13[1]	May 20	7	June 11	23	1	78	3.3+	7	June 12	30
	2	May 20	May 31	11	June 24	25	1	82	3.2+	7	June 25	36
	3	May 31	June 9	9	June 18	10	1	22	2.2	5	June 19	19
	4	June 9	June 20	11	July 13	24	1	68	2.8+	5	July 14	35
	5	June 20	June 28	8	July 17	20	1	38	1.9	5	July 18	28
	6	June 28	July 10	12	July 22	13	2	44	3.3+	6	July 24	26
	7	July 10	July 17	7	Aug. 10	25	4	68	2.7+	7	Aug. 14	35
	8	July 17	July 26	9	Aug. 6	12	0	38	3.1+	6	Aug. 6	20
	9	July 26	Aug. 2	7	Aug. 16	15	0	43	2.8+	5	Aug. 16	21
	10	Aug. 2	Aug. 13	11	Aug. 17	5	0	19	3.8	7	Aug. 17	15
	11	Aug. 13	Aug. 23	10	Sept. 14	23	2	46	2.0	4	Sept. 16	34
	12	Aug. 23	Sept. 22	10	Sept. 15	14	6?	16	1.1+	3	Sept. 21 ?	29?
	13	Sept. 2	Sept. 11	9	Oct. 18	38	3	[2] 86	2.2+	7	Oct. 21	19
	14	Sept. 11	Sept. 20	9	Sept. 24	5	1	14	2.8	8	Sept. 25	14
	15	Sept. 20	Oct. 7	17	Oct. 21	15	11	[3] 13	.08	4	Nov. 1	42
	16	Oct. 7[4]										
Last-born generation series	2	June 12	June 18	6	July 11	24	1	67	2.7	7	July 12	30
	3	July 11	July 17	6	July 21	5	1	23	4.6	7	July 22	11
	4	July 21	July 29	8	Aug. 16	19	0	43	2.2+	6	Aug. 16	26
	5	Aug. 16	Aug. 26	10	Sept. 5–7	11–13		29		8	Sept. 5–7	20–22
	6	Sept. 5–7	Sept. 15	8–10	Oct. 5	21	1	[5] 32	1.5+	6	Sept. 6	29–31
	7	Oct. 1–5										

[1] Notes do not say definitely that the aphides were born May 13.
[2] The last 8 young (born Oct. 9–18) were reared to maturity and all proved to be oviparous females.
[3] First young was oviparous. Of the 7 others reared to maturity 6 w ere oviparous females and 1 a viviparous female.
[4] Oviparous females.
[5] Of the last 10 young 3 lived to maturity, 1 being an oviparous female and 2 viviparous females.

TABLE IV.—*Line of generations of Callipterus trifolii from May 13, 1909, to oviparous generation, La Fayette, Ind.* (*Phillips and Parks*).

Generation from May 13.		Date of birth.	Date of first young.	Age at birth of first young.	Date of last young.	Productive period.	Life after last young.	Number of young.	Average young per day of productive period.	Largest number of young in one day.	Date of death or disappearance.	Total length of life.
				Days.		*Days.*	*Days.*					*Days.*
First-born generation series	1	May 13[1]	May 20	7	May 25	6	2	27	4.5	6	May 27	14
	2	May 20	May 31	11	June 24	25	1	83	3.3+	7	June 25	36
	3	May 31	June 8	8	June 28	21	0	60	2.8+	7	June 29	29
	4	June 8	June 18	10	July 14	27	3	90	3.3+	7	July 17	36
	5	June 18	June 28	10	Aug. 3	37	1	60	1.06	5	Aug. 4	47
	6	June 28	July 9	11	July 19	11	0	42	3.8+	7	July 19	21
	7	July 9	July 16	7	Aug. 6	22	1	85	3.8+	7	Aug. 7	29
	8	July 16	July 23	7	Aug. 3	12	0	31	2.5+	5	Aug. 3	18
	9	July 23	July 31	8	Aug. 23	24	0	76	3.3+	5	Aug. 23	31
	10	July 31	Aug. 9	9	Aug. 14	6	0	16	2.6+	10	Aug. 14	14
	11	Aug. 9	Aug. 14	5	Aug. 23	10	1	40	4.0	5	Aug. 24	15
	12	Aug. 14	Aug. 23	9	Sept. 17	26	3	71	2.7+	6	Sept. 20	37
	13	Aug. 23	Aug. 30	7	Oct. 2	34	2	78	2.2+	6	Oct. 4	42
	14	Aug. 30	Sept. 11	12	Sept. 23	13	1	41	3.1+	6	Sept. 24	25
	15	Sept. 11	Sept. 20	9	Oct. 21	42	11	[2] 52	1.2+	8	Nov. 1	51
	16	Sept. 20	Oct. 6	16	Oct. 28	23	11	[3] 24	1.0	8	Nov. 8	49
	17	Oct. 6.[4]										
Last-born generation series	3	June 24	July 1	7	July 19	20	3	48	2.4	6	July 21	27
	4	July 19	July 27	5	Aug. 16	21	1	74	3.5+	8	Aug. 17	29
	5	Aug. 16	Aug. 26	10	Oct. 4	40	7	[5] 75	1.8+	5	Oct. 11	56

[1] Exact date of birth not given.
[2] Some of the last-born young were reared to maturity and they proved to be males and oviparous females.
[3] Of the 24 young, 23 were reared to maturity and all proved to be oviparous females.
[4] Oviparous female.
[5] Last young died before maturing.

Mr. R. L. Webster has followed the successive generations of this species in the insectary of the Illinois State Entomologist from the eggs which hatched March 27 through nineteen generations to October 18. The nineteenth generation disappeared before maturing and the oviparous generation was not obtained. In his experiments, reported by Dr. J. W. Folsom (1909), he found that the length of time from birth to maturity varied from 5 to 24 days, with an average for the season of 10 days, and the length of life of an individual varied from 9 to 43 days, with an average of 22. The largest number of young produced in one day by a single female was 13, with a yearly average of 3.7 young per day; the maximum number of young born of a female was 75, the average for the series being 34.8 young per female.

MOLTING.

So far as our observations extend, the yellow clover aphis invariably molts but four times. Table V records the molting records of six individuals from data obtained by Mr. Parks in 1909 at La Fayette, Ind.

TABLE V.—*Periods of molts of Callipterus trifolii, viviparous generation.*

Date of birth.	Age at first molt, second instar.	Age at second molt, third instar.	Age at third molt, fourth instar.	Age at fourth molt, fifth instar.	Age at birth of first young.
1909.	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*
May 15	2	3	6	9	10
May 20	2	6	8	11	11
Do.	2	5	8	10	11
May 31	2	4	6	8	9
Do.	2	5	7	8	8
June 8	2	4	6	9	10

FECUNDITY IN RELATION TO OTHER SPECIES.

In comparison with its associate on clover, *Macrosiphum pisi* Kalt., *Callipterus trifolii* is quite noticeably less prolific. While *pisi*, according to our 1913 experiments, produces an average of about 65 young and a maximum number per female of 124 young, *trifolii*, on the other hand, averages 50 young and produced a maximum of 99 young per female. Likewise a single *pisi* has produced as high as 13 young in one day while the maximum number of young per day borne by a female *trifolii* was 9, and this was an unusual number.

From dissections made in Illinois several years ago the writer found that the oviparous females contained an average of 10 eggs per individual. The past fall (1913) 8 oviparous females were examined and found to contain the following numbers of apparently fully developed eggs each, respectively: 13, 13, 14, 10, 12, 13, 14, 16—an average of 13.1+ eggs per female. In the latter counts only females which had not previously laid eggs were used, while in the earlier counts no choice was made, which probably accounts for the differences in the average. Similar egg counts for *Macrosiphum pisi* show it to be much more prolific in egg production; in fact the counts for *pisi* were nearly twice those for *trifolii*.

Although we find both species attacking red clover, the one (*pisi*) is often quite abundant and destructive to clover, while the other (*trifolii*) is seldom if ever injurious. One of the principal causes of this difference will be readily understood from what has just been noted, namely, the great difference in fecundity of both viviparous and oviparous females. Other habits which doubtless have an influence in making *trifolii* less abundant are its sporadic mode of living, the comparatively late date of hatching from the egg, and the additional fact that it always winters in the egg stage while in *pisi* the eggs hatch earlier in spring and many individuals winter as viviparous females, thus giving it the advantage of an early start. Further, *pisi* has a variety of hosts, which is not true of *trifolii* in America; and, finally, the latter species requires a much smaller quantity of sap for becoming mature than does *pisi*, and as a result it is individually less harmful to the plant.

NATURAL ENEMIES.

Doubtless the most important checks on the yellow clover aphis are the weather conditions, more especially heavy rains. The aphis fungus, *Empusa aphidis*, is likewise quite an important factor in holding this plant-louse in check.

On account of its habits of living singly and jumping from the leaf at the least disturbance, this species is seldom attacked by internal parasites. Mr. Paul Hayhurst noticed a few parasitized specimens of this species at Chevy Chase Lake, Md., July 9, 1907, but apparently no parasites issued. The writer has likewise found occasional specimens parasitized, but has never reared the parasites.

Of the coccinellids, three species, *Megilla maculata* DeG., *Hippodamia convergens* Guer., and *Coccinella 9-notata* Herbst, were reared to the adult stage in the insectary at Washington, from larvæ which were feeding on *Callipterus trifolii* on material received from Cadet, Mo., June 19, 1889.

The writer observed the 9-spotted ladybird (*Coccinella 9-notata* Herbst) attacking the yellow clover aphis at Urbana, Ill., September 18, 1913, and larvæ of what were considered the same species were not uncommon on the badly infested clover plants, devouring the aphides.

At La Fayette, Ind., we have reared a species of *Aphidoletes* from larvæ feeding on this aphis in chimney cages, although it has never been found attacking it in the field.

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INDEX.

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TECHNICAL SERIES, No. 26.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY.
L. O. HOWARD, Entomologist and Chief of Bureau.

AMERICAN BLACK FLIES OR BUFFALO GNATS.

BY

J. R. MALLOCH,
Entomological Assistant.

ISSUED APRIL 6, 1914.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., October 20, 1913.

SIR: I have the honor to transmit herewith a manuscript entitled "American Black Flies or Buffalo Gnats," by J. R. Malloch, an entomological assistant in this bureau. This paper deals with a group of flies of considerable economic importance. As pests to man and domestic animals certain species of the group have long attracted attention in this country and elsewhere. Recently additional interest in these insects has been created by the theory that certain species transmit pellagra. This theory has not been proven and it is not accepted by the great majority of investigators. Nevertheless the importance of the buffalo gnats as pests to man and domestic animals is so great that accurate information regarding the species which exist in this country is highly desirable. This paper includes descriptions of several species new to science and in other respects adds very materially to our knowledge. I recommend the publication of this manuscript as Technical Series No. 26 of the Bureau of Entomology.

Respectfully,
L. O. HOWARD,
Entomologist and Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

AMERICAN BLACK FLIES OR BUFFALO GNATS.

INTRODUCTION.

Both in Europe and in America some of the species of the family Simuliidæ have for years been regarded as being among the worst of insect pests, and in some cases as a menace to the lives of cattle and even of human beings. The common species, *Simulium columbaczense* Schonbauer, of southern Europe, has the reputation of being very destructive and, if credence be given to records, it certainly equals the evil reputation of any other bloodsucking species in so far as the effects of its attacks on cattle are concerned. Lately there has been a suggestion made that some species of this group may be the transmitter of pellagra, and it is to ascertain how many American species occur (in so far as our material permits) and their range that this work has been undertaken. That there are more species than are listed or described in this paper there can be no doubt, but in view of the fact that the early stages of the species are passed in streams, from which it is not easy to remove them and successfully rear them under artificial conditions, a number of closely allied species have not been so far linked up in the adult, pupal, and larval stages. It is essential to the existence of the larvæ that they shall remain in water in which there is a current, and removal to water in a jar or vessel generally kills them after a few hours. The material available for study for the purposes of this paper consists of the collection in the U. S. National Museum and a few specimens kindly loaned by Prof. O. A. Johannsen and Mr. C. W. Johnson. Much of the material in the National Museum was collected by Messrs. A. H. Jennings and W. V. King in connection with the pellagra investigations in North Carolina and South Carolina in 1912.

It is not considered necessary to rewrite the history of the Simuliidæ in this paper, but a bibliography is given on page 69 of the principal papers on the American species in the group, which may be consulted with reference to the biology of the species.

CHARACTERS OF THE GROUP.

EGGS.

The eggs are deposited in many cases on blades of grass, twigs, or leaves of trees which are dipping in running water. According to observations by Jennings and King the females select a twig, leaf, or blade of grass which is suitable, and approaching the margin of same nearest the water commence ovipositing thereon. The number of eggs deposited is very large, and generally several females oviposit on the same leaf, the combined weight of the eggs serving to submerge the leaf or blade of grass and provide the necessary conditions for the emergence of the larvæ. It has been placed on record that the species which oviposit on rocks have the faculty of entering the water to oviposit on the submerged rock surface. The egg masses on rocks are of very considerable extent and must amount to thousands in number. When first deposited they are covered with a peculiar slimy coating and being pale yellowish in color are very conspicuous, but later on they become darkened and whether on leaves or rocks are not so noticeable. It has been stated by Horvath [1] that the female lays from 5,000 to 10,000 eggs. This is undoubtedly an exaggeration, and the estimate was probably arrived at by considering the accumulated mass deposited by a number of females as being the deposit of only one. The eggs are elongate-oval and are very closely packed together on whatever surface they may be deposited. The egg stage occupies about a week, but is affected by weather conditions and also by the date of deposition.

LARVA.

The larvæ are cylindrical in shape, attenuated in the middle, and thickened at each end, most distinctly on the posterior third. In length they vary from about 8 to 15 mm. and possess, besides the head, 12 segments. They vary considerably in color, being almost entirely black in *pictipes* and pale yellowish-white, with slightly darker cross-bands on the segments, in *venustum*. The chief characters of use in distinguishing the species are found in the mouthparts.

The head (Pl. VI, fig. 1) is chitinized and slightly flattened. On each side there are, in all the species which I have examined, two irregularly shaped, black, approximated eye-like spots. On the dorsal surface, well forward and near to the bases of the fans, are situated the three-jointed antennæ (see Pl. VI, fig. 3). The fans (Pl. III, fig. 5) are composed of a large number of rays (Pl. VI, fig. 7) which vary in number, and generally in structure, in the different species. The function of these fans seems to be that of guiding food into the mouth cavity, moving on an articulated stalk and meeting, when brought forward closed, over the mouth opening. The mandibles, which in most cases furnish characters in their dentation for differentiating the species (Pl. III, figs. 1, 2), are situated lower on the head than the fans, and move so as to close pincers-

[1] "Le moucheron de Columbatch." Rovart. Lapok., 1 Band, pp. 195–204.

like over the oral orifice. The maxillæ (Pl. III, fig. 6), which are situated below the mandibles and nearer the center of the mouth, are useful also in separating the larvæ of the different species, though the characters are difficult to see. The labium is heavily chitinized, and presents, in the toothing of its anterior margin, characters which appear to be constant and of a more accessible and a more easily appreciable nature than either the teeth of the mandibles, the shape and bristling of the palpi, or the structure of the antennæ. This organ (Pl. III, fig. 3) presents in the two species of *Prosimulium* (*hirtipes* and *pecuarum*), which have been described in the larval stage, a variation in the structure of the teeth which is clearly distinguishable from that of any of the larvæ of the genus *Simulium* with which I am acquainted. In these two species the central tooth is trifid, and the other teeth are irregularly bifid, or at least not simple as in the species of *Simulium*. Johannsen, on plate 35 in his work on this group, figures the labium of a species from Leland Stanford, Jr., University campus, which very probably is that of a *Prosimulium*. It is generally unsafe to accept distinguishing generic characters of this nature without an extended examination of a large amount of material, and I have not used this in my differentiation of these genera, but it is obvious that it is permissible to indicate its existence and possible significance.

In addition to the mouthparts, already indicated as of importance in the separation of the species, it will, I believe, be found by careful examination that the other parts with which I have not dealt in this paper supply characters of very considerable importance. On the ventral surface of the first segment is an elongated, rounded, and slightly conical proleg, the apex of which is furnished with a number of rows of hooks. This proleg is used by the larva in its movements from place to place in much the same manner as the larvæ of the Geometridæ use the legs on their anterior segments, and their method of progression is somewhat similar to the well-known "loopers" of this family of moths. When disturbed, the larva releases its hold on the rock or other surface and floats down stream attached by its proleg to a silk thread which it emits from the mouth, regaining its former position by means of this thread. At the anal end is a sucker-like disk, around the margin of which are arranged concentric circles of minute hooks similar to those at the apex of the proleg. It is by means of this anal process that the larva attaches itself to the silk threads which it spins on the surface of rocks or plants in the bed of the stream. On the dorsal surface of the last abdominal segment there is a slit-like opening from which the blood gills are projected. (Pl. VI, fig. 6.) These are retractile and vary in form in the different species.

A more extended description of the larva, with a consideration of the uses of the various organs, is given by Johannsen (Bul. 68, N. Y. State Museum, 1903, pp. 345–350), but in the present paper it is only considered necessary to indicate the position of the various organs used in the descriptions.

The larval stage occupies about four to five weeks in summer, but cold weather retards growth, and some species are known to pass the winter in this stage. When full grown the larva spins a cocoon, inside of which it transforms to the pupa. These cocoons are differently shaped in some of the species. In the case of *pictipes* the cocoon somewhat resembles a slipper in shape (Pl. VI, fig. 8), in *venustum* it is more like a conical pocket, while in *hirtipes* it can hardly be called a cocoon, being simply an aggregation of threads, the work of many individuals congregated together on the rock surface, amongst which the larvæ transform to pupæ, and by which they are more or less covered.

PUPA.

The principal character by means of which the pupæ of the different species may be distinguished is the number of respiratory filaments (Pl. IV, figs. 1–6; Pl. VI, figs. 4, 5). These organs are situated on the anterior portion of the thoracic dorsum and consist of from 4 to 60 branches. The number is generally constant in each species, but when there is a very large number of filaments it happens occasionally that there may be a slight variation in numbers in individual specimens. In addition to these respiratory organs as a means of identification, there are situated on the abdomen a number of small hooks on some of the dorsal and also on some of the ventral segments, which serve as a means for the retention of the pupa in its cocoon and which vary in number in the different species.

IMAGO.

In the male the eyes are very large, coming closely together above and leaving no distinct frontal stripe; the upper half has the facets very much larger than the lower, from which they are distinctly divided by a horizontal line. The female has the eyes distinctly separated above, from antennæ to vertex, by a more or less posteriorly divergent-sided frontal stripe, and the eye facets are of almost uniform size, showing more or less tendency to become larger toward the underside in some species. The ocelli are absent in both sexes. The antennæ (Pl. VI, fig. 2) are 11-jointed (various authors have given them as 10-jointed), the basal joint generally short, the second elongated and separated by a more distinct constriction from the third than exists between any of the other joints, the third joint generally subequal in length with the second. The palpi (Pl. V, fig. 9) are four-jointed. The mouthparts of the female are chitinized and projecting, being adapted for piercing; the male has the mouthparts much more rudimentary.

The thorax is peculiarly formed, and the most remarkable feature about it is the very great development of the scutum and the consequent reduction of the prescutum. The diagram given on Plate I, figure 1, will serve to show this clearly. The presence of such a large membranous field on the pleuræ is also remarkable. The mesonotum has always a surface covering of pilosity, which varies in color and also very much in distribution and in form in the different species. These characters are of considerable importance and are extensively used in this paper. There is a group of hairs situated on the upper portion of the mesopleura between the wing base and the base of the haltere, which is throughout this paper referred to as the *pleural tuft.* Immediately behind the posterior spiracle there is an area which sometimes bears hairs; this I have called the *post-spiracular area.*

The abdomen has been considered as consisting of from seven to nine segments by various authors, and though I have always found eight present there is, besides this number, a loose, scale-like appendage at the base, which most authors consider as the basal abdominal segment. I am not certain of the homology of this part, and while I consider it really abdominal (as against thoracic), I have in this paper consistently referred to it as the *basal scale*, and considered the abdomen as possessing, in addition to this, eight distinct segments. No work has been done with the genitalia in this group and, owing to the nature of these organs, it would require very careful work and plenty of fresh material to make a successful study of them. They are not normally so situated as to be of use in identifications.

The legs are strong, and the tarsi generally well developed, the fore and hind pairs being generally broad and the metatarsi very much elongated. The last three tarsal joints are as shown on Plate V, figure 10. In most species there is an extension at the apex of the hind metatarsus, and in the species with this process there is generally a corresponding modification of the second joint, which is explained in my remarks on the genera. The claws of the male are trifid, of the female simple, bifid, or with subbasal tooth. The wings are very broad and the venation is peculiar, resembling *Scatopse* in some respects. (For venation see Pl. I, figs. 1–4.)

GENERIC SYNONYMY.

The generic name *Simulium* was created by Latreille[1] with one species included. This species, *Rhagio colombaschensis* Fabricius, must be accepted as the type even though Latreille in volume 14 of the same publication (1805, p. 294) indicates that this species, in his

[1] Hist. Nat. Crust. et Ins., vol. 3, 1802, p. 426.

opinion, is synonymous with *reptans* Linnæus. In Catalogus Dipterorum, volume 1, 1902, page 288, *colombaschense* Fabricius[1] is given as a synonym of *maculatum* Meigen.[2] I can not understand the reason for this, unless it be that the name *columbaczense* Schonbauer[3] has obtained such currency that there is a disinclination to replace it by a new name, should the slight difference in spelling be accounted insufficient to distinguish the species. Thus it is evident that *Simulium* is a well-authenticated genus.

The resurrection of Meigen's paper of 1800[4] did, however, temporarily alter conditions, and the suggestion has been made, and acted upon in some cases, that *Melusina* Meigen should supplant *Simulium* Latreille. That I have not accepted this view is due, not to the fact that there were no species included in the genus, but that the first species cited as belonging to it, *Tipula regelationis* Linnæus,[5] is that which was given as the type of *Atractocera* Meigen. The placing of this species in *Atractocera* by Meigen was probably based upon a misidentification; still the species, which is now considered as a *Trichocera* Meigen,[6] must be accepted as the type of *Atractocera* Meigen, and as this genus is given for the first time by Hendel[7] as synonymous with *Melusina* Meigen, it follows that *Melusina* must be accepted as the generic name of the group to which *regelationis* Linnæus belongs. In other words, both *Atractocera* Meigen and *Trichocera* Meigen must, if we strictly adhere to the rules governing zoological nomenclature, be considered as synonyms of *Melusina* Meigen. Thus I am able, by adhering to the strict letter of the law, to retain the name best known and most generally used for the family. The question of the retention of *Trichocera* Meigen as the generic name for the group containing *regelationis* Linnæus I shall leave to others to decide upon; it is not within the scope of this paper to discuss more than the validity of the names used within the Simuliidæ.

UNRECOGNIZABLE SPECIES AND SYNONYMS.

In practically every family of Diptera there are species which it is impossible to identify from the original descriptions, and in no family is this more apparent, with the possible exception of the Chironomidæ in Great Britain,[8] than in the Simuliidæ. The species are so similar in general appearance and the tangible characters are so difficult to

[1] Mantissa Ins., vol. 2, 1787, p. 335, No. 15.
[2] Klass., vol. 1, 1804, p. 95, No. 3, *Atractocera*.
[3] Gesch. d. schädl. Kolumb. Mücken, Culex, 1795.
[4] Nouv. Class. Mouch.
[5] Illig. Mag., vol. 2, 1803, p. 263.
[6] Illig. Mag., vol. 2, 1803, p. 262.
[7] Verhandl. zool.-bot. Ges. in Wien, vol. 58, 1908, p. 50.
[8] Verrall, in his list of British Diptera, 1901, places 99 of Walker's species of *Chironomus* among the "unrecognizable species."

see, even with a magnification of over 60, that in many cases the describer, failing to note them, has written a description which might serve equally well for several species.

In a case of this kind, where one can not definitely decide which species of several was originally described, there are two courses available, failing the production of the types: Either arbitrarily fix on one of the species, or place the name among the unrecognizable species. Of these courses, the latter has been most generally adopted with Walker's species, and though Coquillett linked up *pecuarum* Riley with *invenustum* Walker, and *vittatum* Zetterstedt with *decorum* Walker, this does not affect the matter of the acceptance of these names, as the first is quite evidently a misidentification of Walker's species and Zetterstedt's name *vittatum* has priority over Walker's *decorum*. *Pecuarum* Riley was described from Louisiana, and the farthest northern record I know for this species is Westville, Conn., while *invenustum* Walker was described from St. Martins Falls, Albany River, Hudson Bay, Canada. The specimens which I have seen from Labrador and which may be either Walker's species or that recorded as *reptans* Linnæus by Lundbeck,[1] are undoubtedly not *pecuarum*. The only species of Walker's which can be accepted with any degree of certainty is *ochraceum*. In this case the coloration and locality prove good guides, and I believe I am correct in identifying the specimens from Córdoba as belonging to the species Walker had before him when he wrote his description.

I am of the opinion that Coquillett was right in making *argus* Williston a synonym of *vittatum* Zetterstedt, and have followed him in this. *Cinereum* Bellardi I have not seen and I am of the opinion that it will be very difficult, if not impossible, to recognize it. In the case of the species *minutum* Lugger, I believe it is absolutely impossible to recognize what species was intended and have followed Johannsen's synonymy, and the same applies to that author's species *irritatum*. *Pulchrum* Phillipi[2] I do not consider as identical with *tarsale* Williston, and I reinstate the latter name. *Reptans* Linnæus I do not believe occurs in America, and I have not included it in my paper. This species is not well defined even in Europe, and I have been unable to identify any American specimens with either of the two species I obtained as *reptans* from Britain, either or neither of which may be the true *reptans*.

Surcouf and Gonzales-Rincones[3] have proposed the specific name *minutum* for the species described by Dr. Lutz as *exiguum*,[4] which name is preoccupied by *exiguum* Roubaud.[5] The specific name *minu-*

[1] Diptera grœnlandica, 1898.
[2] Aufzählung der chilenischen Dipteren, 1865, p. 633.
[3] Diptéres vulnérantes, vol. 1, 1911, p. 290.
[4] Memoirs d. Instituto Cruz, vol. 1, part 2, 1909, p. 141.
[5] Bull. Mus. Paris, 1906, p. 109.

tum is also preoccupied by a species recorded by Lugger,[1] and I propose for this species the name **lutzi**.[2]

TABLE OF GENERA.

1. Basal joint of hind tarsus generally distinctly prolonged, lappet-like, on posterior surface at apex; second joint with basal scale-like process and dorsal excision; radial vein unforked; basal cell absent___*Simulium*. p. 25.
   Basal joint of hind tarsus generally but little produced at apex posteriorly; second joint linear, without basal scale or dorsal excision; radial vein generally with elongate fork___ 2
2. Face broad; basal cell of wings distinct___*Prosimulium*, p. 15.
   dorsal excision; radial vein unforked; basal cell absent___*Simulium*, p. 25.

TABLE OF LARVÆ.

The following table of larvæ has been arranged to include all the species dealt with in this paper which have been associated with the adults.

1. Labium with the central tooth trifid___ 2
   Labium with the central tooth simple___ 3
2. Only the central labial tooth trifid___*P. pecuarum*, p. 23.
   All teeth except the outer one on each side more or less irregularly trifid___*P. hirtipes*, p. 19.
3. Anal blood gills simple, three in number___*S. vittatum*, p. 55.
   Anal blood gills subdivided___ 4
4. Large species (10–12 mm. in length), almost black in color. *S. pictipes*, p. 57.
   Smaller larvæ, generally yellowish in color, with more or less distinct cross-bands to segments___ 5
5. Last joint of maxillary palpus without setæ___*S. meridionale*, p. 51.
   Last joint of maxillary palpus with setæ___ 6
6. Labium with seven pairs of setæ on ventral surface___*S. piscicidium*, p. 46.
   Labium with less than seven pairs of setæ___ 7
7. Labium with four pairs of setæ___*S. jenningsi*, p. 42.
   Labium with five pairs of setæ___*S. venustum*, p. 44.

The foregoing table is partly constructed from that given by Johannsen in his paper on the group. It is probable that there are groups, instead of single species, with the characters given in this table and in the table for the pupæ (p. 15), but until some one with the necessary knowledge of the anatomy of the larvæ and pupæ devotes considerable time to their study our knowledge must remain fragmentary and unsatisfactory. It is also probable that there are some species which are not possessed of tangible distinctions in the imago stage which may be easily separated in either the larval or pupal stage.

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[1] Bul. 48 Minn. Agr. Exp. Sta., 1896, p. 202.

[2] The manuscript of this paper was completed in December, 1912, but has been delayed in its appearance in print from various causes. In the number of "Insecutor Inscitiæ Menstruus" for December, 1913, there appears a note on American Simuliidæ, which deals with certain matters referred to in this and preceding pages. The writer of the note referred to was cognizant of the existence of this manuscript, and conversant with its contents, which I consider do not accordingly require any alteration due to the appearance of said note.

TABLE OF PUPÆ.

The table of pupæ which follows is arranged to include only the North American species associated in this stage with adults.

1. Respiratory filaments 4 in number .... *S. bracteatum*, p. 39. *S. johannseni*, p. 66.
   Respiratory filaments more than 4 in number 2
2. Respiratory filaments 6 in number 3
   Respiratory filaments more than 6 in number.
3. Each of the three main filaments divided close to base .... *S. meridionale*, p. 66.
   Each of the three main filaments divided at some distance from base, *S. venustum*, p. 44.
4. Respiratory filaments 8 in number 5
   Respiratory filaments more than 8 in number 6
5. Filaments in pairs .... *S. piscicidium*, p. 46.
   Filaments not in pairs (Pl. VI, fig. 4) .... *S. metallicum*, p. 49.
6. Respiratory filaments 9 in number .... *S. pictipes*, p. 57.
   Respiratory filaments 10 or more in number 7
7. Respiratory filaments 10 in number .... *S. jenningsi*, p. 42.
   Respiratory filaments more than 10 in number 8
8. Respiratory filaments 16 in number .... *S. vittatum*, p. 55.
   Respiratory filaments at least 22 in number 9
9. Respiratory filaments 22 to 25 in number .... *S. forbesi*, p. 65.
   Respiratory filaments generally more than 40 in number 10
10. Respiratory filaments at most 48 in number .... *P. pecuarum*, p. 23.
    Respiratory filaments generally 60 or more in number .... *P. hirtipes*, p. 20.

In addition to the species included in the above table there are two species described in this stage which have not been linked up with the imago. One of these, from Arizona,[1] has 8 filaments, and the other, from Santa Cruz Mountains,[2] has 12. It may be that these species are described in the imago stage and have not yet been associated with the pupæ.

Since the completion of the manuscript of this paper I have had the opportunity of working over the material in the collection of the Illinois State laboratory of natural history which has resulted in the addition of *forbesi* to the list of species.

PROSIMULIUM Roubaud.

Prosimulium was originally proposed as a subgenus by Roubaud.[3] The characters which he used for the separation of the group from *Simulium* Latreille were those of the hind tarsus and also the formation of the cocoons, which he considered as possessing a generic value from the fact that they are incomplete, a mere shapeless mass of threads, whereas in *Simulium* the cocoons in the known species are slipper-shaped and separately formed. It may be that his

[1] Trans. Amer. Ent. Soc., 1893, p. 45.
[2] Bul. 68, N. Y. State Mus., 1903, p. 387.
[3] Compt. Rendus Acad. Sci., Paris, 1906, p. 519.

deductions are correct with regard to the formation of the cocoons of this genus, but on the other hand some of the species which are unknown in the early stages may have habits similar to *Simulium* Latreille, and I therefore do not make use of them, preferring to use the characters furnished by the venation of the wings,[1] which was not mentioned by Roubaud in dealing with the group, as well as those of the hind tarsus.

As I have already pointed out, in dealing with the larval characters, it is not improbable that the labium of the larvæ may provide a further character for the separation of this genus from *Simulium*, though that, like the character of the cocoon formation, requires further study before being accepted as a generic rather than a specific character.

Roubaud states that the claws in *Prosimulium* are all of one type, "very simple," and also that the species are confined to "high altitudes or cold regions." These statements are not in accordance with the actual facts of the case, as he included *pecuarum* Riley, which has bifid claws, and was originally described from Louisiana, as one of the species in his original definition of *Prosimulium*. It is always risky to generalize upon insufficient data or material, and though I possess probably a much larger amount of material than Roubaud had, I consider that I have gone as far as my material justifies me in separating the genera by the characters given in my table and in indicating the probable significance of others without giving them as generic distinctions.

GENERIC CHARACTERS.

Eyes in male large, meeting above, the upper facets much larger than the lower and separated by a horizontal line; in female the eyes are separated by a wide and more or less divergent-sided stripe. Antennæ 11-jointed; palpi 4-jointed. Wings with the radial vein furcate, or indistinctly so, or simple (*mutatum*), and a small, closed cell near wing base (Pl. I, fig. 3). Hind tarsi with apex of first joint very slightly produced posteriorly, except in *mutatum*, and second joint linear (Pl. II, figs. 1, 2); tarsal claws tridentate in male, in female simple (Pl. II, fig. 13), or with the base produced thumblike (Pl. II, figs. 14, 16).

Type of genus.—Simulium hirtipes Fries.

TABLE OF SPECIES.

1.	Eyes widely separated above (females)	2
	Eyes closely coherent above (males)	6
2.	Tarsal claws with base produced into an elongated projection, bifid	3
	Tarsal claws with base only slightly tuberculate or rounded, simple	4

[1] I have included in this genus *mutatum*, which has the radius simple, and *pecuarum*, which has it very indistinctly furcate, preferring to retain the former here instead of erecting another genus for it.

3. Furcation of radial vein very short and ill-defined; mesopleuræ bare .... *pecuarum*, p. 21.
   Furcation of radial vein distinct and elongate; mesopleuræ with distinct hairs .... *pleurale*, p. 17.
4. Yellow species .... *fulvum*, p. 18.
   Black species with gray or yellow legs 5
5. Fork of radius long and distinct .... *hirtipes*, p. 18.
   Radius unforked .... *mutatum*, p. 20.
6. Entirely yellow species .... *fulvum*, p. 18.
   Black species 7
7. Fork of radial vein very short, indistinct .... *pecuarum*, p. 21.
   Fork of radial vein long and distinct .... *hirtipes*, p. 18.

Prosimulium pleurale, new species.

Female.—Black-gray, opaque. Frons and face whitish-dusted, antennæ brown-black, palpi concolorous. Mesonotum without stripes or distinct pollinose spots; pleuræ, scutellum, and postscutum concolorous with disk of scutum. Abdomen opaque, black-gray. Legs brownish-yellow; all tarsi, and especially fore pair, and apices of tibiæ darkened. Wings grayish, veins brown, thin veins rather more distinct than usual. Halteres brownish-yellow.

Frons divergent-sided, at vertex twice as wide as at above antennæ, surface thickly covered with long, soft, white hairs; face as long as frons and distinctly longer than broad, colored as frons and similarly haired; antennal pile white, hairs on palpi brown, postocular cilia pale, some longer brown hairs present near eye margins. Mesonotum with long, loose, hairlike, white pilosity, which is longer on the anterior lateral angles and posteriorly; a few longer, dark, upright hairs on posterior fourth; pleural tuft white, extending almost to the lower angle of the epimerum; another group of similarly colored hairs occupying the lower portion of episternum (*eps_2*); postspiracular area pale-haired; scutellum with long, white, upright hairs and decumbent white pilosity. Abdominal basal scale brownish-yellow, the fringe whitish, sides of all segments with long, silky, white hairs, disk with much shorter brown hairs. Legs long, with white hairs and shorter white pilosity; hind tarsi with basal two joints of the usual form in this genus; claws bifid (Pl. II, fig. 16). Wings with costal divisions beyond subcostal vein $2:\frac{3}{4}:1\frac{3}{4}$; veins fine and short-haired; basal wing hairs short, brown.

Length, 4 mm.

Type.—Cat. No. 15403, U. S. National Museum. One female, Kaslo, British Columbia (R. P. Currie).

The early stages are unknown. The situation of the anterior pleural hairs, bifid claws, and furcate radius should readily distinguish this species from any other.

16125°—14——2

Prosimulium fulvum Coquillett.

Female.—Entirely yellow or ocherous; the antennæ except basal three joints, the pleuræ, abdomen, and tarsi more or less brownish. Wings yellowish, the veins distinct. Halteres yellow.

Frons rather strongly divergent, at lower angle of eyes about two-fifths as broad as at upper angle; surface hairs long and numerous, golden yellow in color; face slightly broader than frons at lower angle and rather longer than broad, haired as frons; palpi brown-haired; postocular cilia long, yellow, with a strong admixture of black hairs. Mesonotum with longish, yellow, hairlike pilosity, rather shaggy on anterior, lateral, and especially on posterior margins; pleural tuft yellow, continued downward more than midway to coxæ; scutellum with long yellow pilosity, and shaggy, upright, yellow hairs. Abdomen with yellow basal fringe, and numerous short yellow surface hairs. Legs with long yellow hairs, among which are a few dark ones, the tarsal hairs brownish; tarsal claws simple (Pl. II, fig. 13). Wings with surface hairs yellow, the small cell at base of upper fork of cubitus distinct.

Length, 4–5 mm.

There are females in the collection from Sitka, Virgins Bay, and Kukak Bay, Alaska; from Bear Lake, Kokanee Mountains, Kaslo, South Fork, Lowes Inlet, and Laggan, British Columbia, and Custer County, Colo.

Male.—Similar in size and color to the female, but with much longer hairs, especially those forming the fringe to the basal scale, those on surface of abdomen, and those on the legs. The fore tarsus is slender, and the basal joint of hind tarsus is much dilated, being as broad as the apical portion of hind tibia (Pl. II, fig. 1); the claws are trifid.

The type specimen (Cat. No. 6182, U. S. National Museum) is from Bear Paw Mountain, Mont., September 3, 1895 (Hubbard).

Nothing is known of the life history, or details of the early stages of this species, and there are no records of whether or not it bites either man or animals.

Prosimulium hirtipes Fries.

Female.—Black, opaque. Antennæ with two basal joints pale yellowish-brown. Scutum unstriped, and without any distinct anterior pollinose spots; prescutum and pleuræ sometimes brownish. Abdomen with basal scale brownish; sometimes the segments appear faintly whitish-dusted on posterior margins. Legs brown; coxæ, knees, tips of tibiæ and tarsi, especially fore tarsus, darker. Wings grayish. Halteres brown.

Frons divergent-sided, occupying less than one-third the width of head at upper angle of eyes, and two-thirds as wide above antennæ as at upper angle, surface covered with close-placed, yellow, hairlike pilosity; face slightly narrower than frons at upper angle and distinctly longer than broad, haired as frons; palpi pale-haired, postocular cilia pale. Scutum covered with very closely placed yellow pilosity, which is much longer and upright on posterior fourth, no black hairs present; pleural tuft pale yellow, carried almost to lower margin; scutellum with decumbent yellow pilosity, and long, upright, yellow hairs. Abdominal basal fringe yellow, all segments covered with moderately closely placed, yellow, hairlike pilosity. Legs with yellow pilosity, and similarly colored upright dorsal hairs; fore tarsi slender, joints without apical paired hairs; claws simple. Fork of radius distinct, group of hairs at base of first thick vein yellow; beyond this the hairs on surfaces of veins are brown.

Length, 3.5–4.5 mm.

Localities of specimens examined: Ithaca, N. Y. (O. A. Johannsen); Wellesley, Mount Tom, and Cohasset, Mass.; Cape Charles, Newfoundland; Morristown and Germantown, Pa.; Kingston, R. I.; Rigolet, Labrador; and Moscow, Idaho (collection C. W. Johnson); Cabin John, Md. (J. R. Malloch); White Mountains, N. H. (Morrison); Mount Katahdin, Me.; Williams, Ariz. (H. S. Barber); Kaslo and Laggan, British Columbia (Dyar and Caudell); Plummers Island, Md. (W. L. McAtee). The dates of capture are for the Eastern States confined to the latter part of April and larger part of May; the specimen from Arizona was taken on June 3. The specimens from British Columbia bear the dates July and August, one from Maine (3,000 feet level) August, and the Newfoundland and Labrador specimens were taken in July. In the collection of the Illinois State Laboratory of Natural History there are two females of this species from Algonquin, Ill., one of which bears the date April 29, 1895 (Nason).

Male.—Similar in color and size to the female, but as a rule there is less tendency to have the base of the antennæ and portions of the legs pale. The hairs and pilosity are much darker, being uniformly brown, or yellowish brown, and much longer, especially the basal fringe on abdomen. The hind legs are much more dilated, especially the basal tarsal joint, and the claws are trifid.

There is no indication of pollinosity on thorax or abdomen in any specimen I have examined.

Larva.—Yellowish brown in color; antennæ as in Plate VI, figure 3, mandibles with the apical teeth black, the smaller ones yellowish; labium with the teeth mostly trifid (Pl. III, fig. 3). The maxilla of the larva is shown in Plate III, figure 6. This is the largest species yet found in this stage in America. It occurs in the early months of the year—is stated by some observers to hibernate in this stage—and pupates at the end of April, the imago emerging in about 10 days after pupation takes place.

Pupa.—This species may be known in the pupal stage by the very large number of respiratory filaments (Pl. IV, fig. 5). These number as high as 60 in some cases, but as is generally the case where there is a multiplicity of branches there is a greater tendency to variation in number than with the species which have only a few filaments. No distinct cocoon is formed by this species.

This fly is reported to be a very persistent biter and does not confine its attentions to cattle, but attacks human beings as well.

I have only one poorly preserved European specimen of *hirtipes* before me and can not find any characters to separate it from the American species. They may be identical, but only a knowledge of the early stages of both can definitely decide this.

The species figured in Bulletin 159,[1] Kentucky Agricultural Experiment Station, is quite evidently *hirtipes* and not *pecuarum* Riley.

There are several specimens in collections from the White Mountains and also some from British Columbia which have the legs yellow. These may belong to a different species, but I can not find any distinguishing characters in the specimens other than this, which I consider is too prone to variation to prove reliable.

Prosimulium mutatum, new species.

Female.—Black-gray, subopaque. Only the prescutum, posterior portions of pleuræ, and legs more or less yellowish. Mesonotum without distinct pollinosity, and unstriped. Wings grayish, veins brown. Halteres brown.

Frons gray-dusted, narrow, slightly divergent-sided, occupying about one-fifth the width of head at upper angle of eyes, a distinct, central, longitudinal depression over antennæ, surface hairs pale, sparse; face colored as is frons, a little longer than wide, and as wide as frons at upper angle, surface hairs pale; antennæ with the basal joints not distinctly paler than remainder; hairs on palpi dark; proboscis short; postocular cilia pale, with a few longer black hairs intermixed. Mesonotum with sparse, rather widely separated, yellow, hair-like pilosity; posterior fourth of scutum with a few upright black hairs; pleural tuft pale, long, confined to upper fourth; scutellum with pale upright pilosity and upright brown hairs. Abdomen with pale basal fringe, and scattered pale surface hairs, which are more numerous on lateral margins and apical segments. Legs with pale pilosity and dark, longer, upright dorsal hairs; fore tarsi

[1] Bul. 159, Ky. Agr. Exp. Sta., fig. 4, p. 18; fig. 5, p. 20; fig. 6, p. 21, 1912.

slender, without paired apical hairs; fore tibiæ with weak apical spur; hind tarsi with basal joint distinctly produced at apex (Pl. II, fig. 18), second joint without scale but slightly constricted dorsally at base; tarsal claws simple. Wings without fork to radius, the small closed basal cell present; hairs on wing veins brownish black.

Length, 3–4 mm.

Type.—Cat. No. 15404, U. S. National Museum.

Type locality, Glassboro, N. J., March 28, 1910 (C. T. Greene). Paratypes from Clementon, N. J., May 7, 1910 (C. T. Greene); St. Louis, Mo., April 6, 1904 (W. V. Warner); Kaslo, British Columbia (H. G. Dyar); Mount Rainier, Wash. (M. W. Lyon, jr.); Sitka, Virgins Bay, and Yakutat, Alaska, Harriman Alaska Expedition (T. Kincaid); Metlakatla, Alaska. There is a specimen of this species in the Illinois State Laboratory of Natural History collection from Homer, Ill., April 25, 1909.

This species presents some characters which differ considerably from those of the type of the genus (*hirtipes*), but I do not consider it necessary to create a new genus for its reception, more particularly because at least one character, and the most pronounced, the radial furcation, is only indicated to a slight extent in *pecuarum*, which is clearly congeneric with *hirtipes*. Roubaud in subdividing *Simulium* used the tarsal characters and did not cite the types of his genera. His *Eusimulium* is clearly a synonym of *Simulium*, as the characters indicated for its separation from *Prosimulium* are those possessed by the type of that genus, and the only species mentioned by Roubaud as an example of *Eusimulium* is *aureum* Fries, which possesses the tarsal characters given by him. He evidently considered it inadvisable to use *Simulium* as the name of one of his divisions, because he intended only to make use of these as subgenera, and not genera. Surcouf and Gonzalez-Rincones[1] have, however, used the three names and placed in the genus *Eusimulium*, which they characterize as having the "second hind tarsal joint constricted," a number of species which they evidently knew only from the printed descriptions. In *Simulium sens. strict.* they include several species which they evidently have never had an opportunity of examining, and which certainly possess the same tarsal characters as those they relegate to *Eusimulium*. I have considered Roubaud's genus as a synonym of *Simulium* and also consider that the publication above referred to does not materially affect this position.[2]

Prosimulium pecuarum Riley.

This species is similar in color and size to *mutatum*, but differs as follows: The pilosity on scutum and hairs on abdomen are whitish-yellow, the scutum is more or less distinctly three-striped, the hind

[1] Diptères vulerants des du Venezuela, I, 1912, p. 276.
[2] See footnote 3 to p. 14.

tarsus has the basal joint but little produced at apex (Pl. II, fig. 2), the claws are bifid (Pl. II, fig. 14), and the radius is very indistinctly furcate at apex.

The species was originally described from reared specimens, the larvæ and pupæ of which were stated to have been obtained at Friersons Mill, La., but the type specimen in collection is from a lot obtained by Prof. F. M. Webster at Somerset Landing, La., April 10, 1886. A very large number of these specimens are in the collection. There is also a series of specimens from Lake View, Miss., April 18, 1886; one specimen, College Station, Tex., (F. M. Webster); four specimens, Arkansas, May 6, 1886 (Lugger), and I have seen specimens from Westville, Conn., April 25, 1907 (W. E. Britton), and Iona, N. J., April 21, 1907 (collection C. W. Johnson), which agree with the types, except in being rather darker in color. There are several females of this species in the Illinois State Laboratory of Natural History collection from Aledo, Ill., April 30, 1891, 1 female from Quiver Lake near Havana on the Illinois River, April 30, 1895, and 1 female from Havana, Illinois River, April 14, 1896. The record of *Simulium vittatum* from Mount Carmel, Ill., April 9, in the Twenty-seventh Report of the State Entomologist of Illinois, 1912, page 37, refers to *pecuarum.*

The male specimens from which Riley's description was drawn are not among the material in the collection, and those mentioned as being in Cornell University Museum, by Johannsen, I have found upon examination are females. Thus, I have had to copy the original description.

♂.—Length 1.5 ^{mm}. to 2.2 ^{mm}. Differs considerably from female. *Head* not visible from above, being occupied by the very large confluent eyes; the remaining parts below the eyes are black, with black hairs and bristles; eyes composed of two different kinds of facets, those above being very large, as large again as those of the female, and those in front and surrounding the dwarfed trophi very minute, the dividing line between the sizes being abrupt; antennæ similar to those of the female, more pronounced in color, both the black and reddish being more vivid; maxillary palpi black, and shorter than the antennæ. *Thorax* black above, with sparse yellow hairs; legs somewhat lighter in color, tip of tarsi not black; hairs upon legs longer than in those of female. *Wings* hyaline, veins and base yellowish-brown. *Abdomen* black, with grayish-white posterior margins to segments, dorsally and laterally, and covered with longer yellowish hairs.

Described from two bred specimens.

This species is known popularly as the "buffalo-gnat," and has in the past proven a great pest to cattle in the South, particularly near to the Mississippi and Ohio Rivers. Very few recent specimens are in the collection and the general opinion among entomologists seems to be that it is much less common than in former years, when it is recorded as having been so numerous and so persistent in its attacks on stock as to kill mules and cattle.

Riley's description of larva, pupa, and cocoon follows:

Larva.—Average length when full grown, 7 mm. to 8 mm., subcylindric, the club-shaped posterior third of body being twice as stout as the thoracic joints, and joint 4 the most constricted. Translucent when living, dirty white in alcohol. Immaculate in a very few specimens; distinctly marked in the great majority with brownish dorsal cross-bands in middle of joints, leaving free a white mediodorsal longitudinal line; thoracic joints with three irregular rings of the same color; underside more or less irregularly spotted with brown. *Head* subquadrate, horny, yellowish-brown, with a number of brown spots and lines in regular order as in figure, and two roundish, approximate ocellate black dots on each side under the skin, and seemingly rudimentary organs of sight, from which the future compound eyes originate: *antennæ* uniformly pale, three-jointed, about one-third as long as greatest width of head; joint 1 very stout, fully four times as thick as 2, which is a little longer than 1, straight, slightly tapering towards tip; joint 3 extremely small, a mere triangular tip: *mentum* [labium] subtriangular, with apex cut away and replaced by three groups of very small teeth, of which the central group consists of three teeth, the middle one largest, and the groups on side, of four teeth, of which the second from center is largest; sides of mentum [labium], near apex, with two small teeth each; all the teeth are chitinous and black; a long erect bristle, pointing upward and inward, near each side of mentum: *labrum* horny, densely covered with hair: *mandibles* resembling in shape the profile of the inverted last joint of the human thumb, with a series of teeth in place of the nail; teeth difficult to see, owing to the presence of five distinct brushes of hair; on extreme lower tip of mandibles three large teeth, below them a series of eleven slender and very pointed teeth, of which the first two are the smallest, teeth 3 to 9 increasing and teeth 10 and 11 gradually decreasing in length; a second series of teeth below them consists of two triangular teeth, of which the first is largest: *maxilla* stout, fleshy, with an internal thumb-shaped lobe; *maxillary palpus* two-jointed, first joint cylindric, second very short, crowned with a regular circular row of short spines or warts: labium [hypopharynx] horny, with two brushes of hair above, between which is a very small *ligula*, covered with a small brush of hairs; *fans* composed of a stout stem, bearing about forty-six scythe-shaped rays, lined on the inside by very minute, equidistant, erect hairs of equal length. *Thoracic proleg* faintly four-jointed, subconical, retractile (introversible), very thin and transparent, crowned with about twenty rows of short, sharp hooks, apparently arranged in a circular manner; the hooks, of which ten are in each row, seem to be movable to a certain extent, and are fastened or hinged to small chitinous rods in the epidermis. *Tip of abdomen* formed by a subcylindrical body crowned with rows of hooks. *Breathing organs* below these hooks and on the upper side of abdomen; they consist of three short, cylindrical, soft and retractile tentacles, which connect with the large internal tracheæ. In full-grown larvæ a spot more or less dark is seen on each side of thoracic joint; it is produced by the formation of the coiled breathing tubes of the future pupa.

Pupa.—Average length 5 mm. General color, when fresh, honey yellow; prothoracic filaments brown, and the abdomen dorsally also tinged with brown, except on mediodorsal space; all the members have also a fine brown marginal line. Prothoracic filaments consisting of six main rays, issuing from the basal prominence and subdivided two or three times, so that in most cases as many as forty-eight terminal filaments can be counted. [Pl. IV, fig. 1.] Abdominal joints 3, 4, and 5 each with eight well separated dark-brown and anteriorly-recurved hooks, the four on each side separated by a mediodorsal space; those on joint 3 less conspicuous than those on joints 4 and 5; joint 6 with armature; joints 7, 8, 9, and also subjoint [anal] less distinctly armed near anterior margin with a continuous dorsal row of very minute posteriorly recurved points; ventrally joints 6, 7, and 8 have each four very minute anteriorly recurved hooks.

Cocoon.—Average length 3.5 mm. Not completely made and not entirely covering the pupa, but tightly surrounding its larger portion. Shape very irregular, with no distinct rim at the upper edge, which is more or less ragged. The threads composing it are very coarse, and the meshes rather open and ordinarily filled with mud. Not always fastened separately to objects, but frequently crowded together, without forming, however, such coral-like aggregations as in some of the Northern species.

The species figured by Garman as the "buffalo-gnat" (*S. pecuarum* Riley) in Bulletin No. 159 of the Kentucky Agricultural Experiment Station, 1912, page 18, is not this species but *hirtipes* Fries.

NOTE.—Unfortunately the bulk of the material in the collection is practically all from two localities and there are no males in either lot. Prof. F. M. Webster's material, which included males, collected subsequent to the date on the type lot, from the following localities: Madison and Vinland, Ark.; Cypress Mill, Marble Falls, and Devils River, Tex.; and Wooster, Ohio, can not be found.

PARASIMULIUM, new genus.

This genus differs in the female from *Prosimulium* Roubaud in having the eyes much more widely separated at vertex, in having the frons much higher than highest level of eyes when viewed from the side, in having the face linear, in having the eye facets gradually enlarged as they descend, and in the absence of the closed cell in the wing (see Pl. I, fig. 4).

The male is unknown.

Type of genus.—*Parasimulium furcatum*, new species.

Parasimulium furcatum, new species.

Female.—Black-brown, shining. Frons shining black, undusted; face black; antennæ with second joint black, remaining joints yellow; palpi black. Mesonotum shining black-brown, paler posteriorly; prescutum pale yellowish-brown; pleuræ brown. Abdomen brown, anal organs yellow. Legs pale yellow. Wings grayish, all veins brownish, base of wing very pale yellowish-white. Halteres with brown knob and yellow stalk.

Frons very broad, widely divergent posteriorly, clothed with long, close-lying, yellow-white hairs; face very narrow, linear, raised ridge-like centrally, surface brown-haired; antennæ inserted at above half the height of eyes, the basal joint very short and indistinct, the second joint large, third joint slightly longer than second, and as long as fourth and fifth together, fourth longer than fifth, fifth to tenth subequal, eleventh longer than tenth, pilosity pale, very short. Scutum covered with close-lying yellow hairs except on posterior third where it narrows and has only scattered, longer, upright hairs on the surface; prescutum with upright, rather strong, brownish hairs; pleural tuft indistinct; scutellum with pale brown, upright hairs on posterior margin; postscutum produced. Basal abdominal scale yellowish-brown, fringe white, abdominal segments with scattered pale hairs. Legs with weak pale hairs; no distinct apical tibial spurs; hind tarsi as in *Prosimulium*, tarsal bristles very weak; claws short and stout, simple. Wings with long hairs on thick veins, venation as in Plate I, figure 4.

Length, 1.25 mm.

Type.—Cat. No. 15405, U. S. National Museum.

One female, Bairs Ranch, Redwood Creek, Humboldt County, Cal. (H. S. Barber).

Nothing is known of the early stages of this species.

SIMULIUM Latreille.

TABLES OF MALES.

As most of the species are known in the female sex only, it is not possible to include all the species described from North America in this table.

1. Species with noticeable yellow marks on abdomen or thorax __________ 2
   Species mostly black, only the legs and antennæ with yellow markings_ 3
2. Small species, 1 mm., mostly yellow colored; scutum indistinctly striped __________ *notatum*, p. 33.
   Larger species, 1.5 to 2 mm., mostly black colored; scutum distinctly striped __________ *distinctum*, p. 30.
3. Legs with basal joint of hind tarsus not bicolored __________ 4
   Legs with basal joint of hind tarsus bicolored __________ 5
4. Pilosity of scutum whitish __________ *a*
   Pilosity of scutum golden yellow, or brassy __________ *b*
   a. Scutum unstriped; dorsal excision and scale on second joint of hind tarsus indistinct __________ *meridionale*, p. 49.
   Scutum with black stripes as in female, the outer one on each side curved; second joint of hind tarsus with distinct scale __________ *johannseni*, p. 65.
   b. Pilosity of scutum and abdomen brassy, scale-like__ *bracteatum*, p. 38.
   Pilosity of scutum yellow, hairlike, especially hairlike on abdomen __________ *forbesi*, p. 64.
5. Small species (not more than 2 mm. in length); mid tarsus mostly yellow __________ 6
   Larger species (at least 2 mm. in length); mid tarsus with at most bases of first and second joints pale.
6. Scutum almost entirely covered with pearlaceous pollinosity; one distinct, opaque black, central stripe present __________ *griseum*, p. 53.
   Scutum with two anterior pearlaceous, posteriorly incurved, elongate spots, disk velvety black __________ *jenningsi*, p. 42.
7. Scutum with distinct stripes __________ 8
   Scutum with at most two posteriorly incurved spots on anterior margin_ 10

8. Stripes on scutum curved, the outward extremities of dorso-lateral pair dilated; legs with a narrow black or brown ring or spot near base of tibiæ in addition to the usual dark marks present on the legs in most species ---- *virgatum*, p. 58.
   Stripes on scutum straight, legs with the bases of tibiæ pale, and without a subbasal dark band ---- 9
9. Stripes on scutum not sharply defined, the central black stripe broad at anterior extremity, linear on disk, the outer black stripes short and narrow ---- *glaucum*, p. 60.
   Stripes on scutum generally sharply defined, the black always broader than the white stripes ---- *vittatum*, p. 54.
10. Only two posteriorly incurved, elongate spots on anterior margin; fore tarsus distinctly dilated ---- *venustum*, p. 44.
   In addition to the two spots just mentioned, there are sometimes present two smaller spots on the anterior margin nearer to center and occasionally also faint indications of a central bifid stripe; fore tarsus very slightly dilated ---- *pictipes*, p. 56.

I have not seen the males of *Simulium metallicum* Bellardi, *S. cinereum* Bellardi, nor *S. mexicanum* Bellardi, but translations of the original descriptions are given under the descriptions of these species.

SPECIES GROUPS IN SIMULIUM LATREILLE (FEMALES).

1. Mesopleura with a group of hairs in addition, and anterior to the normal pleural tuft ---- Group A, p. 26.
   Mesopleura bare except for the pleural tuft ---- 2
2. Yellow species; scutum with brown, or white longitudinal stripes, or two discal elongated spots; abdomen and legs with black or brown marks ---- Group B, p. 29.
   Black or gray species, scutum and abdomen never yellow (cf. *griseum*) ---- 3
3. Scutum with three, or five stripes, or only one central stripe, either black or brown on a gray ground, or metallescent pollinose on a black ground, the dorso-lateral pair, when present, distinctly curved, and dilated at anterior extremities ---- Group D, p. 47.
   Scutum with two, or four broad, white, straight, or very slightly curved stripes, which are nearly parallel-sided and not noticeably dilated at anterior extremities, or scutum unstriped ---- 4
4. Scutum unstriped or with only very slight indications of a central, darker, divided stripe ---- Group C, p. 34.
   Scutum distinctly striped, the stripes white or metallescent pollinose ---- Group E, p. 61.

It is not the intention of the writer to indicate from the above arrangement that these groups are entitled to treatment as subgenera; the purpose in separating them thus is merely to facilitate the work of identification of the species.

GROUP A.

Species with hairs on pleuræ in addition to and anterior to the pleural tuft.

TABLE OF SPECIES.

1. Claws with minute subbasal tooth; thoracic pilosity golden yellow, irregularly arranged in small groups; mesopleural hairs situated low down.......... *aureopunctatum*, p. 27.
   Claws simple; thoracic pilosity not arranged in groups, regularly disposed; mesopleural hairs high up near to margin of scutum. *hippovorum*, p. 28.

I have seen very few species of Simuliidæ with the additional pleural hairs, but one of those I have obtained as *reptans* Linnæus, from Britain, another in the collection labeled *S. lineatum* Meigen, variety, and also *subnigrum* Lutz, are in this category, though no one who has previously described any species in the family has ever indicated that he has noticed the presence of these hairs or scales.

Simulium aureopunctatum, new species.

Female.—Black, subopaque. Frons and face with whitish dusting; antennæ brown, two basal joints yellow, palpi black. Scutum unstriped, slightly whitish-dusted anteriorly, but without distinct white spots; prescutum and margin of scutum close to it yellowish; pleuræ black-brown, scutellum and postscutum concolorous with scutum. Abdomen black-brown, basal four segments subopaque, apical four shining. Legs yellow, blackened as follows: Entire ventral surface and apical half of dorsal surface of tibiæ, and entire tarsi of fore pair; coxæ, femora except bases, apical halves of tibiæ, apex of first, apical half of second joint, and apical three joints of tarsi of mid and hind pairs. Dorsal surfaces of all tibiæ with distinct silvering. Wings clear, slightly grayish at tip and on hind margin, thick veins brown. Halteres brownish yellow, stalk darker.

Frons divergent-sided, not one-third as wide at upper angle of eyes as width of head, distinctly narrower above antennæ than at upper angle, surface hairs black, strong but not numerous; face slightly convex, distinctly longer than broad, and slightly broader than frons at upper angle, surface hairs black, on upper portion short and sparse, longer on lowest fourth; palpi black-haired, postocular cilia brown. Scutum with yellow scale-like pilosity which adheres closely to the surface and is arranged in irregular groups of from three to seven scales of uniform length except on posterior fourth where they become longer and are more upright; besides this pilosity the surface bears numerous short, upright, black hairs which are most conspicuous on anterior, lateral, and posterior margins; pleural tuft brown, the anterior pleural hairs golden yellow, scale-like, situated about midway from lower to upper margin on mesopleuræ; postspiracular area haired posteriorly; scutellum with yellow scale-like pilosity and several long, upright, blackish hairs on posterior margin. Basal fringe of abdomen long, yellow, surface hairs on segments short, black-brown. Legs strong; fore tarsi compressed laterally, basal joint as broad as tibia, joints 1–3 with paired apical hairs; all legs with pale pilosity and longer, upright, black dorsal hairs; apical spur absent from fore tibiæ, hind and mid pairs with paired apical spurs; basal joint of hind tarsi as broad as tibiæ, produced apically on posterior surface, claws as in *virgatum* (Pl. II, fig. 11). Wings with outer two thick veins joining costa very close together so that the last costal division is very indistinct.

Length, 3–3.5 mm.

Type and paratypes.—Cat. No. 15406, U. S. National Museum.

Localities: Livingston, Guatemala, and Cacao, Trece Aguas, Alta Vera Paz, Guatemala, April–May (Barber and Schwarz).

Nothing is known of the early stages of this species.

Simulium hippovorum, new species.

Female.—Black, subopaque. Frons and face brownish, thickly covered with white pollinosity; antennæ brown, basal two joints and base of third joint yellow; palpi brown. Scutum with three stripes, the central one narrow, the lateral pair broader, close to the central one, dilated anteriorly and slightly curved; viewed from above in front the whole disk of scutum, except the stripes, is whitish pollinose and also the prescutum; viewed from above and behind, the anterior dilated portion of the lateral stripes is conspicuously white pollinose; pleuræ distinctly whitish pollinose except on membranous portion; scutellum opaque brown; postscutum with silky white pollinosity. Abdomen brown-black, opaque on basal four segments, subshining on apical four. Legs yellow, black as follows: Mid and hind coxæ; apices of tibiæ and entire tarsi of fore legs, narrowly at apices of femora; a spot at bases and broadly at apices of tibiæ; apices of first and from middle of second to fifth joint of tarsi of mid and hind legs. Wings clear, thick veins brown. Halteres yellow.

Frons divergent-sided, at upper angle occupying one-fourth the head width, above antennæ two-thirds as wide as at upper angle, surface hairs brownish yellow, sparse and weak; face broader than frons at upper angle, almost subquadrate, surface hairs more numerous than on frons, whitish; hairs on palpi pale brown; postocular cilia pale, with an admixture of longer, blackish hairs on upper part behind vertex. Pilosity of scutum rather loose and upright, whitish yellow, hairlike, the posterior fourth with a number of longer, upright, blackish hairs; anterior pleural hairs pale and hairlike, close to lateral margin of scutum; pleural tuft pale, confined to upper fourth, postspiracular area pale haired. Abdominal basal fringe pale yellow; surface hairs on segments sparse, pale. Legs with yellow, close-lying pilosity and longer, upright, black dorsal hairs; fore tarsi not noticeably thickened, the paired apical hairs present on joints 1 and 3; hind tarsus of the normal shape for this genus; tarsal claws simple (Pl. II, fig. 12). Wings with dark brown hairs on veins.

Length, 4 mm.

Type.—Cat. No. 15407, U. S. National Museum.

Locality: Sierra Madre, Mexico, head of River Piedras Verdes, altitude about 7,300 feet. In ear of horse (C. H. T. Townsend), one female.

I do not think that this can possibly be the species described as *cinereum* by Bellardi from Mexico, which is stated to attack horses. A translation of Bellardi's description is as follows:

Male and female: Gray, antennæ black, first joint pale. Thorax fuscous and gray pollinose, the humeri pale; pleura light gray, scutellum pale at the tip; halteres white. Abdomen blackish. The front coxæ pale, the middle and hind pairs grayish brown; the femora pale at base, their tips black; tibiæ black, their middle section pale; front tarsi wholly black, the middle and hind pairs with the bases of first and second joints pale. Wings hyaline. Length of body 3 mm.; extent of wings 9 mm.

It is possible that this may prove to be identical with *hippovorum*, but Bellardi's description might apply to more than one species in the genus equally well. I consider it better to have this species clearly described and give it a name by which it may be distinguished than to accept it as Bellardi's species, which may very probably prove to be something entirely different.

The early stages are unknown.

The name *cinereum* was preoccupied when Bellardi used it, and the change of name introduced by Speiser is given in the catalogue at the end of this paper.

GROUP B.

In the species of Group B the thorax, abdomen, and legs are mostly yellow. The ground color of all the species is yellow, with the thorax brown, or white, vittate, and the abdomen and legs more or less darkened.

TABLE OF SPECIES.

1. Scutum with three dark vittæ.. 2
 Scutum with white vittæ or with only two anterior marginal spots..... 3
2. Scutum with three chocolate-colored stripes; abdomen much obscured with brown..*trivittatum*, p. 30.
 Scutum with three deep black stripes; abdomen with three rows of black...*distinctum*, p. 30.
3. Scutum with only anterior spots..............................*notatum*, p. 32.
 Scutum vittate.. 4
4. Larger species (from Mexico), claws with subbasal tooth..*ochraceum*, p. 30.
 Smaller species (from New Mexico and Colorado); claws simple. *bivittatum*, p. 31.

Neither the males, except of *notatum* and *distinctum*, nor the early stages of any of these species are known.

Simulium trivittatum, new species.

Female.—Yellow, opaque. Frons and face thickly white-dusted; antennæ browned from third joint to apex; palpi brown. Scutum with three broad, parallel-sided, chocolate colored stripes, the central one not reaching to scutellum and the lateral pair not reaching to anterior margin; posterior margin of scutellum darkened in center; space between the stripes white-dusted; pleuræ brown on center and slightly white-dusted; scutellum yellow; postscutum brown, subshining. Abdomen with basal scale yellow; segments yellow, with opaque black-brown marks which leave very little of the yellow ground color visible, apical four segments not so much darkened as basal four. Legs yellow, black as follows: Apices of tibiæ and all except base of tarsi of fore pair; apices of first and second and apical three joints of mid and hind tarsi; apices of femora and apices of tibiæ of hind pair. Wings clear, thick veins yellow. Halteres yellow.

Frons divergent-sided, two-thirds as wide at above antennæ as at upper angle of eyes, surface hairs weak, yellow; face longer than frons and one-third longer than broad, surface hairs as on frons; postocular cilia pale. Scutum with very short hairlike yellow pilosity; pleural tuft yellow; scutellum with yellow pilosity and longer upright brownish hairs. Basal fringe on abdomen yellow; all segments with short, scattered, yellow hairs. Legs with pale pilosity and scattered longer dorsal hairs on tarsal joints; fore tarsi slightly thickened; tarsal claws simple. Wing venation normal.

Length, 2 mm.

Type.—Cat. No. 15408, U. S. National Museum.

Locality.—Tampico, Mexico (E. A. Schwarz).

Readily distinguishable from any described species, except *distinctum*, by the brown vittate scutum.

Simulium distinctum Malloch.

This species was described subsequent to the completion of the present paper, but the description appeared some time ago in the Proceedings of the Entomological Society of Washington, 1913, page 133. It is unnecessary to reproduce the description here. *S. trivittatum* closely resembles *distinctum*, though I believe they are distinct.

Locality.—Devils River, Texas.

A specimen from Tamaulipas, Mexico, is with some doubt referred here also.

Simulium ochraceum Walker.

Female.—Yellow, opaque. Face and frons brownish yellow, thickly white-dusted; antennæ yellow, from fourth joint to apex browned; palpi black-brown. Scutum with two white pollinose vittæ, and laterally beyond these stripes a pear-shaped brown mark with the narrow extremity toward the wing base, which stops short of the prescutum and does not touch the white stripes; pleuræ brownish; scutellum yellow. Abdomen with the apical segments more or less blackened and subshining. Legs yellow, blackened as follows: Mid and hind coxæ; fore tarsi except base; apex of first, apical half of second, and entire apical three joints of mid tarsi; apices of femora, apical half of tibiæ, apical half of first and second, and entire apical three joints of tarsi on hind legs. Wings clear, thick veins yellow. Halteres yellow.

Frons divergent-sided, at above antennæ about one-third as broad as at vertex, bare in center, laterally and more broadly posteriorly covered with golden pilosity and among the pile some longer, upright, black hairs; face one-third longer than broad, uniformly but not thickly covered with short, yellow pilosity; antennal pilosity whitish; palpi brown-haired; postocular cilia mostly yellow, with a number of longer, black hairs. Stripes on scutum as broad at anterior margin as the space between them, gradually diverging and somewhat curved posteriorly, becoming narrower and ceasing at a little beyond middle of disk; extreme lateral margins of scutum whitish pollinose, pilosity golden yellow, scale-like and regularly distributed; no black hairs on scutum; pleural tuft brown; postspiracular area brown-haired posteriorly; scutellum with pale yellow pilosity and long, upright brown hairs. Abdominal basal fringe pale yellow, long; segments with scattered, short yellow pile and a few longer back hairs intermixed with them. Legs with close-lying yellow pilosity and scattered, longer, upright, dorsal brown hairs; fore tarsi with the normal paired apical hairs on joints 1 and 3; claws as in Plate II, figure 15. Diagrams of the thoracic elevations of this and the following two species are shown in Plate V, figures 6–8.

Length, 2 mm.

Two females, Cordoba, Mexico (E. Knab).

The records of the occurrence of this species in the United States which I have had the opportunity of examining are erroneous and refer to *notatum* Adams. (See note under *notatum*, p. 33.)

Simulium bivittatum, new species.

Female.—Ocherous, opaque. Frons and face thickly white-dusted, antennæ from apex of third joint to apex of eleventh browned, palpi brown. Scutum with two broad, almost parallel-sided, white-pollinose vittæ; extreme lateral margins of scutum white-pollinose; prescutum and scutum near to it pale yellow; pleuræ yellow, browned on middle; scutellum ocherous; postscutum black. Abdomen yellow, segments 2–6 with a distinct black dorsal spot and brown lateral marks, apical segments subshining. Legs yellow, browned as follows: Mid and hind coxæ; fore tarsi except base; apices of first and second and entire apical three joints of mid and hind tarsi; and apices of hind femora and tibiæ. Wings clear, thick veins yellow, costal vein darker. Halteres yellow.

Frons divergent-sided, at least one-half as broad above antennæ as at upper angle of eyes, surface hairs yellow; face subquadrate, nearly as wide as frons at vertex; surface hairs pale, longer toward mouth edge; antennal pilosity pale; postocular cilia yellow. Pilosity on scutum short, regular, golden yellow, longer just in front of scutellum, no black hairs on disk; pleural tuft pale; postspiracular area pale-haired posteriorly; scutellum with pilosity and upright hairs all yellow. Basal fringe of abdomen pale, apical four segments with rather distinct pale hairs. Legs haired as in *ochraceum*. Claws simple.

Length, 1–1.5 mm.

Type.—Cat. No. 15415, U. S. National Museum.

Locality of type, East Las Vegas, N. Mex., June 1, 1901 (T. D. A. Cockerell). There are also in the national collection two females from Las Vegas Hot Springs, N. Mex., August 19, 1901 (H. S. Barber), and five females from Virginia Dale, Colo., September 31, 1912, taken on cow (Bishopp).

Simulium notatum Adams.

Female.—Ocherous yellow, opaque. Frons and face thickly white-dusted; antennæ slightly darkened from fourth joint to apex; palpi ochreous. Scutum unstriped, only two small triangular spots on anterior margin and very faint indications posteriorly of the stripes of the other species, laterally a darker elongated mark on disk; prescutum and margins of scutum adjacent to it yellow; pleuræ darkened centrally, more distinctly near to coxæ; scutellum yellow; postscutum black-brown. Abdomen yellow; segments, except apical three, with opaque, black dorsal spot, apical three segments slightly shining, their bases browned. Legs yellow, browned, or blackened, as follows: Fore tarsi, except base of first joint; last two joints of mid tarsi; extreme apices of hind tibiæ; and apices of basal three and whole of apical two joints of hind tarsi. Wings as in *bivittatum*, but the costal vein paler. Halteres yellow.

Frons divergent-sided, two-thirds as wide at above antennæ as at upper angle of eyes, surface hairs weak, sparse, whitish; face subquadrate, surface hairs as on frons; antennal pilosity pale; hairs on palpi pale; postocular cilia pale. Scutum with very pale yellow, hair-like pilosity, which is distinctly longer just in front of scutellum; pleural tuft pale; scutellum with yellow pilosity and upright hairs.

Basal fringe of abdomen pale yellow, surface hairs on segments sparse, pale, longer on apical segments, and more numerous. Legs with pale pilosity, hairs brown, shorter, and not so numerous as in *bivittatum*, the paired apical hairs on first and third joints of fore tarsi shorter than in that species; claws simple.

Length, 1–1.5 mm.

Three females, Las Cruces, N. Mex., June 25, 1895 (T. D. A. Cockerell). These are the specimens on which the record of *ochraceum* Walker is based in Entomological News for 1897, page 100. I have not seen the specimens upon which the record at page 172 of the same volume of that publication was based, but they probably belong either to this species or to *bivittatum*.

Male.—Brown. Face white-dusted, antennæ brown, paler on basal two joints, palpi brown. Scutum opaque, evenly covered with whitish gray pollinosity; prescutum and adjoining margin of scutum yellow; pleuræ brownish yellow, whitish pollinose; scutellum yellow, margins of scutum adjoining scutellum and laterally brown; postscutum brown, with whitish pollinosity. Abdomen yellow, with dorsum of segments 1–2 narrowly, and remaining segments broadly blackened, apical three segments broadly silvered on sides. Legs yellow, browned on fore tarsi, mid and hind coxæ, apical two joints of mid tarsi, apices of femora and apices of tibiæ of hind legs (hind tarsi broken off in specimen); claws trifid. Wings clear, thick veins yellow, venation normal. Halteres bright yellow, base of stalk darkened.

Eyes with upper facets very large, with lower facets very minute, hairs on face and palpi pale, postocular cilia weak, pale. Scutum with close-lying, whitish-yellow, hair-like, regular pilosity, which is longer in front of scutellum; pleural tuft whitish; scutellum with white pilosity and longer, upright, white hairs. Abdominal basal fringe pale yellow, hairs on segments sparse, of moderate length, white. Legs with sparse, pale pilosity and scattered, longer, pale hairs; fore tarsi not distinctly thickened, the apical paired hairs weak; hind femora and tibiæ broad; hind tarsi broken off, but undoubtedly possessing the normal characters of *Simulium*.

Length, 1 mm.

Locality: Williams, Ariz. (H. S. Barber), one male.

It may be that this is really a distinct species from the female described herewith, but there are so many points of agreement that I have decided to consider it as the male of *notatum* rather than describe it as new, as I was at first tempted to. The only point which causes me to doubt the safety of this course is the absence of any indication of the white pollinose spots on the scutum, which, if the general rule holds with this group, ought to be even more distinct in this sex than in the female.

GROUP C.

Scutum unstriped, at most the anterior margin with weak indication of a central, divided stripe, and anterior lateral white spots.

TABLE OF SPECIES.

1. Tarsal claws with a distinct subbasal tooth in addition, and anterior, to the normal tuberculate or rounded base 2
   Tarsal claws without subbasal tooth, only the base tuberculate, rounded, or produced thumblike (as in Pl. II, figs. 5 and 7) 5
2. Thoracic pilosity arranged in irregular groups, disk with upright black hairs, in addition to pilosity, which are most distinct on anterior angles .... *mexicanum*, p. 35.
   Pilosity not arranged in groups, regularly disposed 4
4. Thoracic pilosity black or black-brown, fine and hairlike .... *parnassum*, p. 36.
   Thoracic pilosity lanceolate, scalelike, whitish or yellowish in color. *arcticum*, p. 37.
5. Tarsal claws produced thumblike at base 6
   Tarsal claws not produced thumblike at base 7
6. Scutum with brassy, scalelike pilosity; base of tibiæ not blackened. *bracteatum*, p. 38.
   Scutum with yellowish hairlike pilosity; base of tibiæ distinctly blackened .... [1] *johannseni*, p. 65.
7. Pilosity on scutum arranged in punctiform groups, the scales short and broad, small species .... *exiguum*, p. 39.
   Pilosity on scutum not arranged in punctiform groups, either regularly or irregularly disposed 8
8. Scutum with irregularly disposed golden yellow pilosity and upright brown hairs on disk .... *clavipes*, p. 40.
   Scutum with regularly disposed pilosity, discal hairs absent 9
9. Small species (1–1.5 mm. in length); mid tarsi almost all pale; third joint of hind tarsi pale; scutum with pearlaceous pollinosity. *jenningsi*, p. 41.
   Larger species (2–4 mm. in length); mid and hind tarsi black, except bases of first and second joints; scutum with whitish pollinosity 10
10. Scutum more or less shining, the anterior margin at center with indications of a divided stripe; pilosity yellow .... *venustum*, p. 43.
    Scutum not shining, no indications of a central stripe; pilosity whitish. *piscicidium*, p. 45.

Simulium tarsale Williston belongs to this group, but from the description I am unable to place it in the table. In all probability it is distinct from any of those included in my table, but nothing is said of the tarsal claws and certain other essential characters in Williston's description, so that it is impossible to decide its status. The species belonging to this group are the most widely distributed and most closely allied of the Simuliidæ. It is to this segregate that *reptans* Linnæus and several other European species belong.

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[1] I have included *johannseni* here as well as in the group with vittate scutum, as it is closely allied to *bracteatum* in the formation of the claws, but the coloration as given above, though of alcoholic specimens, is quite distinct from that of *bracteatum*, as is also the vestiture of the thorax. For description see pp. 65–66.

Simulium mexicanum Bellardi.

Female.—Black, subopaque, only the apical four abdominal segments distinctly shining. Frons and face white-dusted; antennæ brown, with basal two joints and base of third joint yellowish; palpi brown. Prescutum yellowish, pleuræ with sutures and posterior portions yellowish; scutellum brownish yellow; postscutum brown, whitish pollinose; scutum unstriped and weakly white-dusted. Abdomen with basal scale opaque black; first segment below scale yellow or brown at base, opaque black at apex; segments 2–4 grayish pollinose, with opaque black fasciæ, which are broadest at middle and taper on each side; apical four segments glossy black; venter brownish yellow. Legs black, yellow as follows: Coxæ, femora, and bases of tibiæ of fore pair; apices of coxæ, trochanters, bases and apices of femora, basal halves of tibiæ, and basal halves of first and second joints of tarsi of mid and hind pairs; base of third joint of mid tarsi. Wings grayish, thick veins brown. Halteres yellow, darkened at base of stalk.

Frons almost parallel-sided, not one-third as wide at vertex as the breadth of head, surface hairs black; face longer than frons and wider than frons at upper margin, one-third longer than wide, surface hairs black; hairs on palpi brown; postocular cilia black. Scutum with brassy yellow, scalelike pilosity, which is arranged in irregular groups on the disk; besides the pilosity there is on the disk short, closely placed, black, upright hairs, which are most distinct on the margins; pleural tuft black or brown; postspiracular area pale-haired; scutellum with yellow pilosity and longer, upright black hairs. Basal fringe of abdomen yellow, apical four segments with short black hairs, which are longer at extreme apex. Legs with close-lying yellow pilosity and long, upright, black dorsal hairs, which are very noticeable on the apices of the tarsal joints; fore tarsi with the normal paired apical hairs on joints 1 and 3; the legs are strong and the fore tarsi very distinctly thickened or compressed laterally; tarsal claws with subbasal tooth (Pl. II, fig. 6).

Length, 4 mm.

Two females, Cordoba, Mexico, January 30, 1908 (F. Knab).

These specimens agree so closely with the description given by Bellardi[1] that I have no hesitation in associating them with his species. The early stages are unknown.

A translation of Bellardi's description of the male of *Simulium mexicanum* is as follows:

Black. Head black, frons prominent, triangular, with whitish reflection; antennæ black, first joint and base of second [second and base of third ?] yellow; face prominent, black, the epistome yellowish, with grayish reflection; palpi

[1] Saggio di Ditterologia Messicana, App. 6, 1862.

black, paler at the base; thorax wide, subquadrate, slightly convex, black, with a grayish reflection, and golden scales; humeri pale; pleuræ black, anteriorly and posteriorly, with fuscous spots; scutellum fuscous; halteres white; abdomen black, base of second segment pale yellowish on the sides; fore and middle coxæ wholly yellow, hind ones fuscous, with yellow tips; fore femora wholly yellow, mid and hind pairs fuscous-black, with yellow bases; fore tarsi wholly black; middle tarsi black, with bases of all the joints yellow; hind tarsi black, with base of first joint broadly and of second joint narrowly yellow; wings hyaline, iridescent. Length 4 mm., alar expanse 9 mm.

Simulium parnassum, new species.

Female.—Black, slightly shining; prescutum paler; pleuræ pale along the sutures; abdomen opaque black on basal four segments, shining on apical four; legs black, yellowish as follows: Coxæ, trochanters, bases of tibiæ, and base of first joint of tarsi of fore legs; apices of coxæ, bases of trochanters, bases of femora, of tibiæ narrowly, and of first tarsal joint of mid legs; trochanters, bases of femora and of tibiæ, basal two-thirds of first and basal half of second joint of hind legs. Halteres yellow, stalk dusky at base.

Frons glossy black, sides divergent, about one-third wider at vertex than above antennæ, surface hairs strong, upright, black, present only on lateral margins, especially toward vertex, absent from center; face distinctly longer than broad ($1\frac{1}{3}:1$), grayish pollinose, almost bare on center, with long hairs on lateral and lower margins; antennæ brown, the basal two joints and base of third generally paler; second and third joints elongated, subequal, as long as 4+5; pilosity short, thick, pale; palpi black-brown, black haired; post-ocular cilia black. Mesonotum with very slight pale pollinosity; pilosity black or black-brown, close-lying, regular, in the depression on posterior fourth the hairs much longer and upright; pronotum with numerous black hairs, episternum immediately below it with pale hairs; all the lower parts of pleuræ with silky pollinosity; pleural tuft brown-black, confined to upper fourth; scutellum opaque black, the upright hairs black, no pale hairs present. Abdominal basal scale varying in color from pale yellowish to opaque black, the long hairs pale brownish yellow; membrane beneath scale generally yellow; some specimens have the abdomen inclining to brown; segments almost bare except laterally and apically where there are numerous brown hairs. Legs with close-lying pale pilosity and distinct, longer, upright, black hairs on the dorsal surfaces of femora, tibiæ, and tarsi; the usual paired apical hairs on first and third fore tarsal joints present (Pl. V, fig. 11); hind tibiæ at apices and basal three-fourths of first tarsal joint of hind legs with short, stiff, upright, golden pile; claws with tooth (see Pl. II, fig. 8); wings clear, thick veins brownish, cross-vein at two-fifths from apex of subcosta.

Length, 2–2.5 mm.

Type.—Cat. No. 15409, U. S. National Museum.

Type locality, Red Hill, Moultonburgh, N. H., August 5 (H. G. Dyar). There are specimens from Skyland, Page County, Va., July 15, 1912 (H. G. Dyar), and White Mountains, N. H. (Morrison).

The male and the early stages are unknown.

Simulium arcticum, new species.

Female.—Black; frons shining, very slightly dusted with white, face thickly white dusted, antennæ with two basal joints yellowish. Scutum with two large and generally distinct white pollinose spots on anterior angles of scutum, the latter slightly shining; prescutum brownish; scutellum concolorous with scutum; pleuræ subopaque, distinctly white-dusted, especially on lower portions. Abdomen black, opaque on basal four segments, shining on apical four. In some specimens distinctly gray-dusted laterally and posteriorly on basal five segments. Legs yellow, black as follows: Femora except bases, tibiæ at apices and tarsi of fore legs; coxæ, femora except bases, apical third of tibiæ, and apices of first tarsal joint of mid and hind legs; last four joints of mid tarsi, except extreme base of second; last four joints of hind tarsi except basal half of second. Wings clear, thick veins brownish. Halteres yellow, brownish at base of stalk.

Frons with sides very slightly divergent, unusually broad at antennæ above, occupying about one-fourth the width of head, at vertex about one-third as wide as head, surface hairs only on lateral margins; besides the scale-like hairs there are also present some black, upright hairs; face as broad as frons at vertex, and about one-third longer than broad, surface hairs whitish, absent from upper third, antennal pilosity pale; palpi black, hairs black-brown; postocular cilia pale, with a few intermixed black hairs on lower portions. Scutum covered with close-lying whitish or yellowish pilosity which is regularly arranged and rather long; prescutellar depression of scutum with numerous long, upright, black hairs; pleural tuft pale; scutellum with pale scale-like pilosity and numerous long, upright, black hairs. Abdominal basal scale paler than rest of abdomen, the fringe long and pale, surface hairs on apical segments pale and on lateral margins a number of long black hairs. Legs with rather long, close-lying, pale pilosity and numerous long, upright, black dorsal hairs, those on apices of first and third fore tarsal joints not conspicuous; claws with subbasal tooth (see Pl. II, fig. 4). Wing venation as in *parnassum*.

Length, 3–4 mm.

Type.—Cat. No. 15410, U. S. National Museum.

Type locality, Kaslo, British Columbia (H. G. Dyar). Also from London Hill Mine, Bear Lake, British Columbia (R. P. Currie).

The male and the early stages are unknown.

Simulium bracteatum Coquillett.

Female.—Opaque black or brown-black; basal two joints of antennæ yellow, palpi black-brown. Prescutum and margin of scutum bordering on it yellowish, pleuræ brown, yellowish posteriorly, darker on lower central portions, scutellum and postscutum black-brown. Abdomen opaque black-brown. Legs yellow, darkened on apices of all femora and tibiæ, entire fore and mid tarsi except extreme base of latter, and apices of first and second and all remaining joints of hind tarsi. Wings clear, thick veins yellowish brown. Halteres pale yellow, darkened at base of stalk.

Frons rather narrow, sides divergent, less than one-third the width of head at upper angle of eyes, and more than one-half as wide at lower angle as at upper, surface covered with close-lying, thickly placed, brassy yellow, scalelike pilosity; face paler in color than frons and equal to it in length, distinctly longer than broad, pilosity rather paler and looser than that of frons, antennal pilosity pale; hairs on palpi brownish. Scutum unstriped, pilosity very close, rather scale-like, brassy yellow in color; pleural tuft pale yellow; scutellum with close-lying yellow pilosity and long, upright yellow hairs; postscutum with yellow pilosity. Abdomen with close pilosity, on all segments, of a similar nature to that on mesonotum, apical segment with longish hairs. Legs with close-lying yellow pilosity on the yellow parts, which is longer on the dorsal surfaces, and brown hairs and pilosity on the dark portions; claws as in Plate II, figure 14 (*Prosimulium pecuarum*); hind tarsi with basal joint produced at apex and second with scale and basal constriction.

Length, 2.5–3 mm.

Redescribed from type specimens, Cambridge, Mass., May 31, 1869. There is also one female in the collection from Plummers Island, Md., April 19, 1903 (H. S. Barber), one female from Franconia, N. H. (Mrs. A. T. Slosson), and one female from Los Angeles, Cal. (collection Coquillett).

There are several males and one female in the collection of the Illinois State Laboratory of Natural History from Algonquin, Ill. (Nason).

Male.—Opaque black. Head in type broken off. Scutum with indistinct anterior whitish dusting, prescutum yellowish, pilosity brassy yellow, rather more hairlike than in female and distinctly longer, lateral margins of scutum brownish, pleural tuft pale yellow, scutellar pilosity and hairs long, yellow, postscutum bare. Abdominal basal fringe long, yellow, all segments with long yellow pilosity, that on basal four segments laterally very thickly placed and adhering closely to surface, apical four segments with pilosity much shorter and sparse. Legs brown, apically the joints slightly darkened, pilosity yellow, on fore tibiæ dorsal surfaces silvery, dorsal surfaces of all joints with longer, upright, pale hairs, fore tarsi not distinctly thickened, hind tarsi with basal joint slightly thinner than tibiæ and produced at apex posteriorly, second joint with basal scale and excision; claws trifid. Wings as in female. Halteres brown.

Length, 3 mm.

Locality: Los Angeles, Cal. (collection Coquillett).

In the original description of the male of this species there are so many details left out that I have considered it better to redescribe it.

I have not seen the larva or pupa of this species, but Mr. E. H. Strickland has reared it in Massachusetts. His description of it agrees in both stages very well with that given by Hart for *S. johannseni*.

The larva differs from that of other species of *Simulium*, except *johannseni*, in having the outer tooth on each side rounded and with an apical pointed process. The lateral setæ number two on each side. The pupa has only four respiratory filaments, and should be readily recognizable from any other North American species except *johannseni* by that character alone.

I have not seen the specimens reared by Strickland and have to accept his published authority for the identification.

Simulium exiguum Roubaud.

Female.—Black, subshining. Frons very slightly dusted, face distinctly whitish pollinose, antennæ yellow, basal joint and apical joints slightly browned, palpi yellow, brown at apex. Scutum undusted, pleuræ with distinct pearlaceous pollinosity, postscutum whitish pollinose. Abdomen black, segment below basal scale entirely covered with pearlaceous pollinosity, next segment opaque, the remainder glossy on disk, with slight indications of whitish pollinosity on lateral margins. Legs yellow, blackened on mid and hind coxæ, fore tarsi from apex of first joint to tip, last joint of mid tarsi, middle of femora, apices of tibiæ, ventral surfaces of first joint at apex and last joint of tarsi of hind legs. Wings clear, thick veins yellow. Halteres yellow.

Frons with sides very slightly divergent posteriorly, occupying at upper angle of eyes less than one-third the head width; face much more elongate than usual, nearly twice as long as broad, as broad as frons at lower angle; both face and frons with extremely weak surface hairs; occiput with pearlaceous pollinosity; postocular cilia weak, dark. Scutum with iridescent, golden yellow, rather broad, scalelike pilosity which is arranged in irregular groups; pleural tuft weak, brown; scutellum with similar pilosity to scutum and some long, upright, brown hairs. Abdominal basal fringe short, sparse, brown, apical segments with sparse, dark surface hairs. Legs with pale yellow hairlike pilosity and a few longer, upright, brown dorsal hairs, the normal paired apical hairs present on first and third joints of fore tarsi; fore tarsi slender, hind tarsi with apical four joints three-fourths as long as basal joint; tarsal claws simple. Hairs at base of first vein black, surface hairs on veins black, anal wing fringe whitish.

Length, 1.5–2 mm.

Four females, Sarare, Venezuela (T. Gray), examined by Roubaud; four females taken on board ship 4 miles off Livingston, Guatemala, March 20, 1906, one female, Cacao, Trece Aguas, Guatemala, and one female, same locality, April 12, 1906, labeled "Biting man" (Schwarz and Barber).

This very prettily marked species can not be confounded with any other which I have examined.

The male and the early stages are unknown.

Simulium clavipes, new species.

Female.—Black, subopaque. Frons and face distinctly white-dusted; antennæ brown, the basal two and base of third joints yellow; palpi brown, pale at base. Scutum in some specimens with faint indications of a central stripe and anteriorly with slight whitish pollinosity; scutum shining posteriorly, prescutum yellow; pleuræ brown, darker anteriorly and with whitish pollinosity; scutellum and post-scutum brown, the latter with white pollinosity. Abdomen black, opaque on basal four segments, glossy on apical four. Legs yellow, black on mid and hind coxæ, apices of all tibiæ, and entire tarsi, except base of first joint of mid tarsi, and greater part of first and basal half of second joint of hind tarsi. Wings clear, thick veins brown. Halteres yellow.

Frons slightly divergent-sided, three-fourths as wide at lower angle as at upper, surface hairs brown, sparse, upright; face subquadrate, as broad as frons at lower angles and similarly haired; hairs on palpi brown; postocular cilia brownish black, strong. Scutum with golden yellow pilosity which is rather loose and irregularly arranged, though not grouped; besides the pile there are regularly arranged brown hairs over the entire disk, which are much more distinct on margins and especially posteriorly; pleural tuft brown, sparse; scutellum with yellow decumbent pilosity and long, upright brown hairs. Basal fringe of abdomen yellow, surface hairs on apical segments pale brown, sparse. Legs strong, clothed with yellow pilosity, and with numerous longer, upright, dorsal brown hairs which are more noticeable on tibiæ and tarsi; fore tarsi broad, first and third joints with paired apical hairs; hind tarsi with basal joint narrower than tibiæ, apical four joints about two-thirds as long as basal joint; tarsal claws as shown in Plate II, figure 5.

Length, 3–4 mm.

Type.—Cat. No. 15411, U. S. National Museum.

Locality.—Guadeloupe, West Indies, 4,000-foot level, July (August Busck).

It is improbable that this is the species described as *S. tarsale* by Williston, the description of which is given on pages 46–47. The size, color, and locality are quite enough to justify me in separating it, even if the vestiture were overlooked by Williston in describing his species in so far as the presence of the upright brown hairs on scutum are concerned.

The early stages of this species are unknown, and there are no males among the material in the collection.

Simulium jenningsi, new species.

Female.—Black, shining. Frons and face shining, the former slightly, the latter distinctly white-dusted; antennæ brown, basal three joints paler, yellowish; palpi brown. Scutum shining black, with distinct pearlaceous pollinosity, which does not form spots, but is most distinct near margins of prescutum and tapers off toward center of disk; pleuræ glossy black, distinctly whitish pollinose on lower central portions; scutellum velvety opaque black; postscutum whitish pollinose. Abdomen with basal four segments opaque black, apical four glossy black. Legs black, yellow as follows: Coxæ, bases of femora narrowly, and at bases of tibiæ broadly of fore legs; trochanters, bases of femora, bases of tibiæ broadly, and basal three tarsal joints except apices, on mid and hind legs. All tibiæ silvered on basal half of dorsal surface. Wings clear, basal portions of veins brown, thick veins yellow. Halteres with lemon-yellow knob and brown stalk.

Frons broad, distinctly more than one-third as wide at upper angle of eyes as head width, slightly divergent-sided, hairs sparse, pale, confined to lateral posterior margins; face slightly narrower than frons at widest part, about one-third longer than wide and as long as frons, surface hairs pale, sparse, though more numerous than on frons; hairs on palpi pale; postocular cilia brown. Scutum with yellow, sparse, rather widely placed, regular hairlike pilosity, no long posterior hairs on scutum; pleural tuft sparse, short, brownish; postspiracular area bare; scutellum with upright brown hairs. Basal abdominal fringe brownish yellow, surface hairs on apical four segments sparse, yellowish. Pilosity on legs yellow, except on the basal half of dorsal surfaces of tibiæ where it is white, giving the silvery appearance which is so noticeable in this and allied species; the usual longer dorsal hairs weak; fore tarsi dilated, as broad as tibiæ, first and third joints with paired apical hairs; hind tarsi of similar form to *venustum* Say; claws simple. Wing venation normal, surface hairs and short bristles brownish yellow. Sometimes the pilosity on scutum is brownish or almost black, but this is exceptional.

Length, 1–1.5 mm.

Type.—Cat. No. 15412, U. S. National Museum.

Male.—Similar in size and color to the female except that the mesonotum is velvety opaque black; the scutum has two silvery or pearlaceous stripes running from the margin of the prescutum backward and inward to almost middle of disk; the lateral and posterior margins of scutum are distinctly silvery pollinose; the pilosity is darker and longer, being more hairlike than in female. The abdomen is not distinctly shining on apical segments, and the hairs are longer and darker. The legs are similar in color to those of the female, but the tibiæ are only pale at extreme base; they are longer haired and the claws are trifid (see Pl. V, fig. 12). The eyes are of similar formation to those of the males of *venustum*.

Allotype.—Cat No. 15412, U. S. National Museum.

There are reared specimens in the collection bearing the number 4425. These emerged from pupæ sent to the Bureau of Entomology in May, 1889, from Friersons Mill, La.

An examination of the pupa discloses the fact that this is in all probability the species described in the larval and pupal stages by Johannsen in the paper already mentioned. I give a copy of the characters mentioned by Johannsen for his variety *a* of *venustum*, which he was unable to separate from the type except by size in the imago.

A number of specimens bred from larvæ and pupæ taken from Fall Creek, Ithaca, New York, differs in the adult stage from *venustum* as described above in being uniformly smaller (length 1.5 mm.); having the base of wing brownish and not yellow, and in having the last four abdominal segments of the female a shining black instead of brown. The larva differs as follows: in size averaging less than two-thirds that of *venustum*, labrum [labium] with its toothed edge wider in proportion to its size than in *venustum*, its teeth more nearly of a size, the ventral setæ three in each row, plus a very small one. The pupa differs in having 10 respiratory filaments in each tuft, the hooks on segment 2 more distinct, and the tubercules on the anal segments apparently wanting.

This species stood in the collection as *S. venustum* Say, and both sexes are represented among the specimens reared from the pupæ from Friersons Mill. There are specimens in the collection from Spring Hill, Fairfax County, Va.; Chevy Chase, Md., July 4, 1907; Cabin John, Md., May 16, 1909; Beltsville, Md., September 21, 1911; and Washington, D. C., July 3, 1910 (F. Knab); Minnesota (Lugger); Inman, Spartanburg, and Gramlin, S. C.; and Flat Rock, N. C. (Jennings and King); and Biscayne Bay, Fla. (Mrs. A. T.

Slosson). There are several specimens of both sexes in the collection of the Illinois State Laboratory of Natural History from Algonquin, Ill. (Nason).

This species attacks horses and is a persistent biter in South Carolina, according to the observations of Messrs. Jennings and King. Their data for the adults of the species on which observations were made are as follows:

Lot 382. Gramlin, S. C., August 19, 1912. Two dozen *Simulium* adults collected in ears of a horse. Owner lives some distance out in the country. He gave a history of being bitten by these flies. His team had come from the farm a couple of hours before. No larvæ or pupæ.

Lot 383. Gramlin S. C., August 19, 1912. *Simulium* adults from ears of a horse, collected as horse was passing along the road. No larvæ or pupæ. Driver gave no history of being bitten by the flies.

Lot 214. Flat Rock, N. C., June 5, 1912. *Simulium* adults taken while attacking a horse. Were entering ears and biting on face, neck, and shoulders also. (No larval or pupal material.)

Lot 220. Flat Rock, N. C., June 4, 1912. *Simulium* adults taken while attacking a horse. After removal of horse they continued to dance in small swarms about the same spot. Situation shaded by tall trees. (No larval or pupal material.)

The dates of occurrence of this species range from May 6 on the Louisiana specimens to September 21 on those from Beltsville, Md., and from the continuity it is evident that there must be many broods or an unintermittent reproduction during the entire summer.

The figures given on page 16 of Bulletin 159 of the Kentucky Agricultural Experiment Station by Garman are evidently details of the larva of this species, though the pupa figured on page 15 belongs either to *meridionale* or *venustum.*

Simulium venustum Say.

Female.—Black; frons glossy black, with very little dusting, face black, distinctly white dusted, antennæ with basal three joints yellowish, palpi black. Scutum shining black, with slight whitish pollinosity, especially anteriorly and on sides, prescutum yellowish or brownish, pleuræ black, white dusted, scutellum opaque black. Abdominal basal scale opaque black or brown, basal four segments velvety black, apical four glossy black. Legs yellowish, black as follows: Mid and hind coxæ; femora more or less at apices; tibiæ or apical halves; entire fore tarsi; apices of basal, most of second, and all last three joints of mid and hind tarsi. All tibiæ silvered on dorsal surfaces. Wings clear, basal portion and thick veins brown. Halteres whitish yellow.

Frons very sparsely haired on sides only, about one-half as wide above antennæ as at vertex; face nearly as broad as frons at vertex and very slightly longer than broad measured from highest point in center to mouth margin, the surface hairs black; antennal pilosity white; hairs on palpi brown; postocular cilia pale, with a considerable admixture of black hairs. Scutum with a slight indication of a central black stripe in front; pilosity very close and short, yellow, the normal long upright hairs on posterior depression inconspicuous; plural tuft brown; post-spiracular area pale haired; scutellum with yellow pile and long upright black hairs. Abdominal basal fringe pale brownish yellow; segment beneath scale silvered, yellowish except at apex; apical segments with numerous short brown hairs which are longer on lateral margins. Fore tarsi flattened, the normal paired apical hairs present, surface pilosity pale and short, the upright hairs not very conspicuous; claws simple. Wings with brown hairs at base of first vein.

Length, 2–2.5 mm.

Male.—Opaque black. Antennæ black, the basal two joints and base of third joint yellowish. Scutum velvety black, posterior and lateral margins with silvery pollinose dusting, disk with an oblique backward and inwardly directed white stripe which stops short of middle, pilosity yellowish brown. Abdomen with basal fringe brownish; segments opaque black; first segment, below scale, pearlaceous pollinose; apical ventral segments similarly pollinose. Legs black; anterior tibiæ with basal half yellow, and whitish pollinose on the dorsal surface, hind and mid tibiæ only yellow at bases (Plate V, fig. 1); fore coxæ, base of basal mid tarsal joints, and bases of basal and second hind tarsal joints yellow; claws trifid. Otherwise as in the female, except in the confluent eyes.

Larva.—Yellow, with dark cross-bands on the segments. Fans with about 60 rays. Labium with middle tooth longest, the outer one slightly shorter, and the three intervening teeth considerably smaller.

Pupa.—Respiratory filaments six in number (Pl. IV, fig. 3). Cocoon shaped like a small conical pocket and attached to leaves or stems of plants growing in the water. The cocoons are very closely placed and almost identical with those of *vittatum* and *jenningsi.*

This is one of the commonest species in the genus. There has been much confusion regarding the identity of this and closely allied species, and possibly there is more than one species among those I have before me. An exhaustive study of the early stages may settle this question, but the material before me at present does not permit of my forming a definite opinion as to the specific distinctions of some of the specimens. I have described the male and female above from the same lot of reared specimens, the larvæ and pupæ of which agree with those described by Johannsen. The species was originally described by Say from Shippingsport, Falls of the Ohio.

The material in the U. S. National Museum collection is from the following localities: White River, Ontario, and Oxbow, Saskatchewan, Canada, June, 1907 (F. Knab); St. Louis, Mo., May 6, 1904 (W. V. Warner); Congaree, S. C., March-April, 1912; Abbeville, S. C., April, 1912; Greenwood, S. C., April, 1912; Columbia, S. C., April, 1912; Tacapaw Mills, S. C., August 28, 1912; Spartanburg, S. C., July 15, 1912 (reared); and Greenville, S. C., May, 1912 ("taken ovipositing in stream") (Jennings and King). Specimens in the Illinois State Laboratory of Natural History collection are from Algonquin and Havana, Ill.

The figures given by Garman[1] are evidently those of the larva of *jenningsi* and not *venustum.* The larva and pupa described by Johannsen in his paper as *venustum* var. *a* are those of *jenningsi.*

Simulium piscicidium Riley.

Female.—Black, subopaque. Frons and face with distinct white pollinosity; antennæ brown, basal two joints yellowish; palpi brown. Scutum with white pollinosity on anterior lateral angles posterior to prescutum; prescutum sometimes brownish or yellowish; pleuræ whitish pollinose; scutellum brown or yellowish; postscutum whitish pollinose. Abdomen with basal four segments opaque, the apical four shining, but not glossy; lateral posterior margins of first four segments white pollinose. Legs yellow, blackened as follows: Mid and hind coxæ; apices of femora slightly; apices of tibiæ of all legs distinctly; fore tarsi entirely; entire mid tarsi except base of first joint; hind tarsi except basal two-thirds of first and base of second joint. Wings clear, thick veins yellow, venation normal. Halteres yellow, base of pedicel darkened.

Frons divergent-sided, one-third as wide at upper angle of eyes as head width, two-thirds as wide at lower angle as at upper, surface hairs sparse, white; face as long as frons, about one-third longer than broad, haired as frons; hairs on palpi pale; postocular cilia mostly pale, with a few longer, black hairs intermixed. Scutum with short, hairlike, white, regular pilosity, the hairs on posterior fourth not conspicuous; pleural tuft whitish; postspiracular area sparsely pale haired; scutellum with long, upright, brownish hairs and close-lying pale pilosity. Abdominal basal fringe yellow; surface hairs on segment short, pale, those at apex longer and dark. Legs with pale pilosity and longer, upright, dorsal, brownish hairs; fore tarsi dilated, the apical paired hairs present on joints 1 and 3; claws as in *venustum.* Hairs and short bristles on vein surfaces of wings brownish.

Length, 3–4 mm.

Male.—Deep black. Face silvery pollinose; antennæ entirely black; palpi black. Scutum, viewed from in front, with two black, subtriangular marks on the anterior margin, the space between them with a dull brown stripe which shows conspicuously against the white

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[1] Bul. 159, Ky. Agr. Exp. Sta., 1912, p. 16.

pollinose disk; on each side of this central stripe there is a black stripe which is slightly dilated anteriorly, does not extend either to anterior or posterior margin, and becomes diffuse brownish on margins; viewed from behind the two small, subtriangular spots are bright silvery; the whole disk, except on the aforementioned black stripes, white pollinose. Scutellum slightly white dusted; postscutum silvery. Abdomen with the segment below basal scale and sides of 5 and 6 more or less broadly silvered. Legs black; tibiæ white on dorsal surface; bases of all tibiæ yellow, the hind pair very noticeably yellow on basal half; base of first joint of mid tarsus, all except apex of first joint of hind tarsus, and base of second of the latter yellow.

The pilosity of the scutum is hairlike, pale yellowish, longer posteriorly; there are no black hairs present either on the disk or on the scutellum. Basal abdominal fringe brown. Legs rather slender; fore tarsus slender, the apical hairs not noticeable.

I have not seen the larva of this species, but it is described by Johannsen as having the teeth on the labium more nearly of an equal size than in *venustum*, and the ventral surface of same with seven setæ in each lateral row. The pupa has the respiratory organs with eight branches (Pl. VI, fig. 5). The cocoon is similar to that of *venustum*.

Piscicidium was originally described from Mumford, N. Y., by Riley, and was at one time considered to be, in the larval stage, responsible for the death of young trout. This has been proved to be a mistake. Two specimens of the original series only, marked type, are in the collection. There are also several specimens in the collection from Pine River, Lake Superior, September 7, 1896 (Hubbard); Kukak Bay, Alaska (T. Kincaid); and Lake View, Miss., April 10, 1886.

Coquillett considered this species as synonymous with *venustum* Say, and Johannsen, though possessing larvæ and pupæ, was unable to separate it from Say's species in the perfect state. There is not the slightest doubt that it is a distinct species, possessing characters in all the stages which easily separate it from *venustum*.

I have drawn up the description of the male from a specimen of *venustoides* Hart, which is, I am convinced, synonymous with *piscicidium*. The specimens in the collection of the Illinois State Laboratory of Natural History are from Algonquin, Ill., May, July, August, and October (Nason).

This is in all probability the species recorded as being such a persistent biter in the Lake Superior district.

Simulium tarsale Williston.

The following is a copy of Williston's original description:

♀. Abdomen black, the proximal segments opaque, the distal four segments shining. Length 2 mm.

Front and face black, with a light gray reflection. Antennæ yellow; the distal joints somewhat brownish. Mesonotum deep black; in front, opaque with a silvery shimmer, and with sparse, curly, golden-yellow tomentum; behind, shining. Pleuræ black, whitish pruinose. Abdomen black, the basal segments opaque, the distal four segments somewhat shining, and with a delicate whitish pruinosity. Legs reddish-yellow; tarsi black, except that the proximal half of the middle and hind metatarsi light yellow; first and third joints of the front pair each with two long hairs; second and third joints of the same pair dilated, the fourth and fifth very small; hind metatarsi elongate and stout, the following two joints a little dilated, the fourth and fifth small. Wings hyaline, veins yellow.

This species must belong to the group which is represented by *venustum* Say, and several other closely allied forms, but it is not possible to say just what species the author had before him at the time he wrote his description. I have not seen any species from St. Vincent, which is the type locality of *tarsale*, and can not be certain as to its status. It is, however, highly improbable that it is the *pulchrum* which Philippi described from Chile,[1] as suggested by Hunter.

GROUP D.

Scutum striped, the stripes three or five in number (or one central stripe, *griseum*), the dorso-lateral pair curved, dilated at anterior ends, and generally with the dilated portion white-pollinose, the central stripe generally linear.

TABLE OF SPECIES.

1. Scutum with pearlaceous pollinose stripes .... *metallicum*, p. 48.
   Scutum with black or brown stripes; if these are pollinose they are never metallescent or pearlaceous 2
2. Claws with the base prolonged thumblike 3
   Claws with the base dilated or slightly tuberculate, or with a small subbasal tooth in center in addition to the tuberculate base 5
3. Larger species, 3–4 mm.; abdomen with long hairs laterally, and the black marks showing as a series of black spots on the sides. *johannseni*, p. 65.
   Smaller species, 2–3 mm.; abdomen with the black marks forming fasciæ 4
4. Outer vittæ on scutum much curved, basal scale of second hind tarsal joint indistinct .... *meridionale*, p. 49.
   Outer vittæ slightly curved, basal scale distinct .... *forbesi*, p. 63.
5. Claws simple 6
   Claws with central tooth 6
6. Scutum black, thickly white-dusted, one central black stripe on disk; abdomen yellow, with black dorso-central spots .... *griseum*, p. 52.
   Scutum with at least three stripes, not thickly white-dusted; abdomen never yellow 7

[1] Aufzählung der chilenischen Dipteren, 1865, p. 633.

7. Scutum with five very distinct brown stripes on a light gray ground ---------- *vittatum*, p. 53.
Scutum with three less distinct stripes, ground color dark gray--*pictipes*, p. 55.
8. Legs mostly yellow ---------- *virgatum*, p. 57.
Legs mostly black ---------- *hunteri*, p. 59.

Simulium metallicum Bellardi.

Female.—Black, shining. Frons glossy, only slightly pollinose; face thickly covered with pollinosity which is slightly pearlaceous in color; antennæ with the basal two joints and most of third joint yellow. Scutum with three stripes, the central one narrow, the lateral ones anteriorly dilated and posteriorly divergent, then curved inward and ending at about last third of scutum; viewed from behind these stripes are iridescent or pearlaceous in color; from in front they are opaque black, and the remainder of scutum is pearlaceous; prescutum brownish; pleuræ with pearlaceous dusting, glossy black; scutellum brownish opaque; postscutum with pearlaceous dusting. Abdomen black, opaque on basal four segments, glossy black on apical four, side of first segment under basal scale with pearlaceous dusting, next three with narrow, lateral, whitish, posterior margins. Legs black, yellow as follows: Coxæ at apices, trochanters, and femora of fore pair; trochanters, bases of tibiæ, most of basal, second, and third joints of tarsi of mid pair; trochanters, bases of tibiæ, all but apex of first, and basal half of second tarsal joints of hind pair. All tibiæ silvery white dusted on dorsal surfaces. Halteres bright yellow, stalk brown. Wings clear, basal veins brown, thick veins yellow.

Frons slightly divergent-sided, less than one-third as wide at upper angle of eyes as width of head, surface hairs sparse, brown; face nearly as long as frons and one and one-half times as long as broad, surface hairs pale brown; hairs on palpi brownish; postocular cilia brown. Scutum with sparse, yellow, decumbent, scale-like pilosity which is longer posteriorly; pleural tuft weak, brown; scutellum with long, upright, brown hairs on hind margin. Abdominal basal fringe rather short, yellowish, surface hairs on abdomen sparse, brown. Legs with brownish-yellow pilosity and scattered, upright, dorsal, brown hairs; fore tarsi dilated, basal joint as broad as tibia, and like the third furnished with the apical paired hairs; claws as shown on Plate II, figure 17. Thick veins of wings with black-brown surface hairs and short bristles, thin veins very indistinct.

Length, 2 mm.

There are quite a number of specimens in the collection which I consider are referable to this species. The localities are: Trinidad, West Indies (F. W. Urich); Arroyo di los Nogales, Chihuahua, Mex. (C. H. T. Townsend); San Jose, Costa Rica, Cordoba, and

Orizaba, Mex. (F. Knab); Livingston and Alta Vera Paz, Guatemala (Schwarz and Barber).

A translation of Bellardi's description of the male of *Simulium metallicum* is as follows:

Metallic blue-black. Base of antennæ, halteres, fore femora, middle portions of fore tibiæ, bases of mid and hind tibiæ, and bases of first and second joints of mid and hind tarsi white. Wings hyaline, veins rather indistinct. Length of body, 2 mm.; wing expanse, 5 mm.

Nothing is said as to whether the thorax is striped or not. Roubaud found a female in the Paris Museum, belonging presumably to the original lot from which the male was described, and published a description of it in 1906.[1] He did not redescribe the male.

Larva.—Similar in color to those of *venustum* and *jenningsi* and about the same size as the latter. The labium is of the same type as those of this group also, but the intermediate teeth between the central and outer teeth are very small; in this respect it is more closely allied to *venustum*, though there appear to be only three distinct lateral ventral setæ, as in *jenningsi.*

Pupa.—The species has eight respiratory filaments, but these differ in the branching from *piscicidium*, as shown in Plate VI, figure 4. The cocoon is similar to that of *venustum*, closely woven and found on leaves and stems of plants.

The foregoing details are drawn from material sent in by Mr. F. W. Urich, from Trinidad, along with imagines of this species.

Simulium meridionale Riley.

Female.—Gray, or brown-black with very thick gray dusting, opaque; antennæ and palpi brown-black, the former but little paler at base in some specimens, in others entirely dark. Scutum with three narrow black or brown stripes, the outer two curved, sometimes almost straight on anterior portions; pleuræ gray; scutellum sometimes brownish or yellowish, with gray dusting. Abdomen in type gray with opaque brown-black cross-bands on segments 2–5 which occupy the whole disk on center but taper toward sides, segments 6–8 and portion of 9 visible gray-black with a bluish sheen. This coloration is abnormal, in my opinion, and is very probably due to the fact that the specimen was either drawn from the pupa or was prematurely killed. In the great majority of specimens before me, including a large number of the reared specimens of Riley's original series, the abdomen is more or less distinctly banded with black or brown on segments 2–4 only, and there are dorsal spots in varying

[1] Bul. Mus. Hist. Nat. Paris, vol. 13, p. 519.

degrees of intensity on the other segments. Legs black; in some specimens brownish. Wings clear, thick veins yellowish or brownish. Halteres yellow.

Frons narrow, at vertex not occupying one-fourth the width of head, slightly more than one-half as wide at lower angle as at upper angle of eyes, surface hairs pale, weak, and regularly disposed; face distinctly wider than frons at upper angles, one-fourth longer than wide, hairs as on frons; proboscis very short, in none of the specimens projecting more than length of face; palpi black-haired. Scutum with very short, hairlike, regular, but not closely placed, white pilosity, which is longer on posterior fourth; pleural tuft yellowish white; scutellum with pale hairs. Abdominal basal scale gray, the fringe pale yellowish white, all segments with distinct close-lying pile or hairs, which are white in color and much longer at apex and on sides. Legs with close-lying, white, hairlike pilosity and longer, dorsal, pale hairs; hind tarsi with apex of basal joint produced on posterior surface, second joint with basal scale and constriction; claws bifid, as in Plate II, figure 16 (*Prosimulium pleurale*). Hairs on basal portion of wing veins yellowish.

Length, 2–3 mm.

Redescribed from type specimens, Friersons Mill, La., May, 1888, and December, 1889, and a number of other specimens from Napinka, Manitoba, June 20, 1907 (F. Knab), and Abbeville, Ninety Six, and Greenwood, S. C., April, 1912 (Jennings and King). I have also before me a series of specimens (14) taken in a house at Knoxville, Tenn., by E. C. Cotton, which may be the form described by Townsend as *S. occidentale*.[1] Johannsen considered Townsend's species as a small variety of *meridionale*, the early stages of the former being unknown. The Canadian specimens in this series are much larger (3–4 mm.) than those from Tennessee (1.5–2 mm.) or South Carolina (2.5–3 mm.), but size alone is not a reliable criterion, and structurally the insects appear to me to be identical. It is possible that the early stages may prove different in these forms, but none of the characters given for their separation by Townsend appears to be of specific value in the imagines.

There are some specimens in the collection from Congaree, S. C., April 9, 1912 (Jennings and King), which have the thoracic stripes practically absent, but I do not feel justified in separating them as a distinct species, as in other respects they agree with *meridionale*.[2]

Male.—Velvety, opaque black. Antennæ slightly yellowish on basal two joints and base of third. Scutum with two anterior marginal pollinose spots of a whitish color, lateral and posterior margins similarly pollinose; when worn slightly the stripes, so distinct on scutum of female, may be indistinctly traced; prescutum

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[1] Psyche, 1891, p. 107. [2] See Addenda, p. 63.

brownish or yellowish; pleuræ black, paler, brownish, posteriorly, and with whitish pollinosity; scutellum brownish. Abdomen velvety black, sides of first segment, under basal scale, and apical two to three segments whitish pollinose. Legs brown, tarsi darker.

Head of the usual male form in this genus; face hairs pale; postocular cilia pale, with numerous longer, intermixed black hairs. Scutum with rather long, white, hairlike pilosity, which is most closely placed on margins; pleural tuft pale; scutellar hairs white. Abdominal fringe brownish yellow; all segments with pale, rather short, dorsal hairs, and long lateral hairs of same color. Legs with pale hairlike pubescence which is longer than that of the legs of female; claws trifid. The wing venation is as in female, but the wings are vitreous. Halteres brown.

Redescribed from the original specimens bred from same pupal material as the female type.

The larva and pupa of this species bear a strong resemblance to those of *venustum* Say. The larva may be distinguished from that of *venustum* by the absence of the short bristles from the apical joint of the maxillary palpus, the larger size of the central tooth of the labium as compared with the outer lateral one, and also the presence of only three to four ventral lateral bristles. The pupal respiratory filaments number six, but the pairs divide at very near the base instead of, as in *venustum*, appreciably beyond the base.

This species has the reputation of being a biter, but the only record in the collection is that borne by one specimen from Myrtle, Ga., April 3, 1906 (A. A. Girault)—"on Homo," "found sucking blood from hand."

Simulium tamaulipense Townsend.

The following is a copy of the original description by Townsend:

♀. Length, 1½ mm. Near *S. meridionale*, but smaller and the outer one on each side of the three thoracic lines not curved outward at posterior end. Eyes velvet black, face and front silvery; the front with usually a trace of linear black vitta in one specimen very distinct, in another entirely wanting. Antennæ yellowish, with a silvery covering. Thorax silvery, with three longitudinal lines; the middle one longest, very narrow and linear; the outer ones heavier, straight, slightly divergent posteriorly. Looked at directly from above, the outer lines appear curved, outwardly convex. Scutellum and metascutum below scutellum, both brownish in some lights but in others they seem to be wholly silvery, the various portions appearing different in color to the view at the same time. Abdomen silvery, but the third and fourth segments wholly brownish, sometimes with a round median silvery spot on each. Legs yellowish, shaded with silvery, tarsi blackish or brownish; hind metatarsi yellowish, except at distal end. Wings clear, whitish, veins dilute pale yellowish. Halteres and wing bases pale dilute yellowish.

Four ♀'s, Reynosa, Tamaulipas [Mexico]. A small species taken on car windows of railway train, May 10th.

Described from four dried specimens.

This description fits *meridionale* in practically every respect, except that the form of the tarsal claws is not indicated. Though the outer stripes are given as "not curved outward at posterior end," they appear to represent a form often met with in this species, where the apices of the side stripes are indistinct. I consider it highly probable that this is merely a synonym of *meridionale* Riley, but I have not seen the types, and there are no disadvantages to be apprehended from retaining *tamaulipense* as a possible distinct species until some one examines the original specimens.

Simulium griseum Coquillett.

Female.—Opaque gray-brown; frons and face thickly white-gray dusted; antennæ brown, the basal two joints and base of third yellow; palpi brown-black. Scutum gray-brown, very thickly covered with white dusting except on center, where there is a more or less distinct longitudinal stripe, and on lateral and posterior margins, where the ground color becomes yellowish; pleuræ gray, paler posteriorly; scutellum yellow; postscutum gray-black. Abdomen tawny yellow, first five segments with a rounded, opaque black, dorso-central spot, that on the segment beneath basal scale the least distinct, remaining segments yellow with slightly darkened dorsum; sometimes in addition to the central spot there are indications of lateral spots on the first four segments. Legs yellow, black as follows: Mid and hind coxæ; entire fore tarsi; hind femora; hind tibiæ; basal three joints of both mid and hind tarsi at apices; and last two joints of mid and hind tarsi entirely. Wings clear, thick veins yellowish. Halteres yellow.

Frons divergent-sided, its width at upper angle of eyes equal to its length from lower to upper angle and one-fourth wider than at lower angle, surface hairs yellow; face as long as frons, subquadrate, surface hairs yellow; postocular cilia pale. Scutum with pale yellow pilosity which is regularly distributed and elongate scale-like, short except on posterior margin; viewed from behind there is an indication of two white spots on the anterior margin of scutum at the inner angle of prescutum; pleural tuft yellow; hairs on scutellum yellow. Abdominal basal scale yellow and yellow-haired; surface hairs on abdomen yellow. Legs with pale yellow pilosity and a few scattered upright brown hairs which are most noticeable at apices and on dorsal surfaces of tarsal joints; basal joint of hind tarsi with apical extension, second with basal scale and constriction, claws as shown in Plate II, figure 7 (*venustum*). Wing venation normal, hairs on wing base not numerous, yellow.

Length, 1.5–2 mm.

Two females marked Colorado, No. 1605 (C. F. Baker); one female Pecos, N. Mex., June 28, on horse (M. Grabham); and three females Inyo County (?), Cal. (A. Davidson).

The first mentioned specimens are the type lot and are slightly smaller than those from California.

Male.—Eyes of the normal form of the males in this genus; face white-pollinose, antennæ brown, paler on basal two joints; postocular cilia pale. Scutum with white pollinosity, which is distinctly pearlaceous on anterior margin; the whole disk pollinose except a posteriorly abbreviated, central, longitudinal, opaque black stripe, and faint indications of two much shorter lateral stripes; pilosity hairlike, white; prescutum yellow; pleuræ brown, darker on center; scutellum yellow. Abdomen opaque black; segment below basal scale yellow, fifth segment and postero-lateral margins of the apical segments yellow. Legs colored as in female, but the hind femora are only darkened at apices, and the claws are trifid. In other respects similar to female. One specimen, Colorado, No. 1605; no other data. It bears the type label "Cat. No. 10381 U. S. N. M."

The early stages are unknown.

Simulium vittatum Zetterstedt.

Female.—Gray, opaque, or opaque black with very thick gray dusting, except on the portion of body given as black in description. Antennæ brown, basal two joints yellowish; palpi and proboscis brown. Scutum with a straight dorso-central stripe which is sometimes linear, but generally with a brownish suffusion, broadest at anterior third; this stripe reaches the anterior margin and stops at about posterior fourth; on either side of this central stripe there is a bicurved stripe which is triangularly dilated at anterior extremity, then much narrowed, bent inward on anterior half, and bent outward and slightly dilated on its posterior half, joining the central stripe, or almost so, with an inward curve at posterior fourth; laterally beyond these two stripes are other two which stop much short of the prescutum, and also of the end of central stripe; generally these outer stripes are dilated anteriorly; pleuræ unicolorous gray; scutellum slightly darkened on disk. Abdomen with basal scale with a black central spot; first, second, and third segments with a basal crossband of black which is produced centrally; the next three segments with a posteriorly tridentated, black crossband; the fourth and fifth with an additional lateral black spot; apical segments darkened. Legs black, all tibiæ whitish yellow on basal half, the division between the colors generally very abrupt, mid tarsi with basal joint yellow or whitish at base, hind tarsi with two basal joints pale at base, tibiæ whitish dusted, dorsally, at base. Wings clear, thick veins brown. Halteres yellow.

Frons slightly divergent-sided, less than one-third as wide as head at upper angle of eyes, surface hairs pale, sparse; face subquadrate, as broad as frons at upper angle, surface hairs pale, more numerous than on face, postocular cilia pale, with a few intermixed, longer, blackish hairs. Scutum with whitish hairlike pilosity, a few longer, dark hairs in posterior depression; pleural tuft pale; scutellum with upright pale hairs. Abdominal basal fringe white; apical segments of abdomen with sparse, short, white hairs. Legs with white pilosity and longer, brownish, upright, dorsal hairs, fore tarsi slightly dilated, the apical paired hairs absent or very inconspicuous; claws simple (Pl. II, fig. 9). Wing venation normal.

Length, 2–3 mm.

Male.—Opaque, velvety black. Antennæ black, sometimes slightly paler at base. Scutum with anterior, posterior, and lateral margins white pollinose; in some lights there are visible two straight longitudinal dorsal stripes which do not reach beyond middle of disk; in one or two cases there is an indication of the white spots, which show in many specimens of *pictipes* Hagen, on the anterior margin slightly nearer center than stripes; pilosity yellow, hairlike; pleural tuft brownish. Basal fringe of abdomen brown, abdominal segments opaque black, sides of segments 1–3 generally silvery pollinose. Legs colored as in female, but the mid tibiæ generally less distinctly pale at base, and the hairs longer; claws trifid. Otherwise as female. Hind leg of male figured on Plate V, figure 2.

There are specimens in the collection which I consider as belonging to this species from the following localities: Glencoe, Nebr. (E. A. Dodge); Richmond, Ind. (W. S. Ratcliff); Minnesota (Lugger); Grand Rapids, Minn., August 18, 1896; Niagara Falls, November, 1896, Pikes Peak, Colo., 10,000 feet, September 17 (T. D. A. Cockerell); Death Valley, Cal., April, 1891 (Koebele); Los Angeles, Cal., July (collection Coquillett); Onaga, Kans., in hog's ear; Yakutat and Kadiak, Alaska, June–July (T. Kincaid); Spartanburg, S. C., July, 1912 (Jennings and King); Sabina, Tex., March 22, 1911 (C. T. Atkinson); Victoria, Tampico, Mexico, December, 1910, biting burros (F. C. Bishopp). There are examples of this species in the Illinois State Laboratory of Natural History collection from Ottawa and Algonquin, Ill. The species has been found commonly in all stages at Havana on the Illinois River. The larvæ and pupæ have been taken in the Illinois River and also in various creeks in Illinois.

There are only two cases in which this species is given as attacking animals in the foregoing list. Johannsen does not give any indication of its habits, but Lugger,[1] in referring to this species as

[1] Bul. 48, Minn. Agr. Exp. Sta., 1896, p. 207.

S. tribulatum, deals at some length with its habits. Its distribution is quite the widest of any of the American species. It may be that there are more than one species in the material before me, but I can not find any characters to separate the Alaskan specimens from those of Mexico. *Argus* Williston is, I consider, identical with *vittatum*. Sometimes the thorax gets wet and the stripes, being visible only through the presence of the pollinosity in good specimens, become indistinct or practically invisible. There is nothing strange in the fact that they are not mentioned in Williston's original description of his species, if his specimen was not in good condition.

The larva, as described by Johannsen, is as follows:

Somewhat mottled gray, the sides of each segment blackish. The head is of the usual reddish brown color; the pale yellow antennæ long and cylindrical, the second joint about one-third the length of the first, the third is a pointed process at tip of the second. The fans have about 40 rays, the cilia being relatively minute. The mandibles are provided with three large apical teeth besides the row of secondary ones; the apical pair of bristles is present. The maxillary palpus has a few spines, and a tuft of a few spines on the basal joint. * * * The labium has an elongated middle tooth, those at the end nearly as long, the intermediate ones short, and there are six bristles in each of the two longitudinal rows on the ventral surface. The three blood gills at caudal end are unbranched.

The pupal respiratory organs are as shown in Plate IV, figure 4.

The cocoon is similar to that of *venustum* Say, and is attached to leaves or plant stems in the water. Occasionally there are only 15, instead of 16, filaments in the respiratory organs. I have seen the pupæ from Spartanburg, S. C. (Jennings and King).

Simulium pictipes Hagen.

Female.—Dark gray, opaque; frons and face very thickly white-dusted; antennæ brown, yellowish on basal two joints; palpi brown-black. Scutum thickly gray-dusted, with three brown or black stripes, the central one straight, the lateral ones curved, and dilated slightly anteriorly, the dilated portion with white pollinose spot when viewed from behind; pleuræ gray, opaque; scutellum and post-scutum concolorous. Abdomen gray, segments 2–4 broadly opaque brown or black-brown on dorsum, the one below basal scale only slightly darker on center. Legs dark gray, only the bases of tibiæ and bases of first tarsal joints of mid and hind legs paler, except in immature specimens, when the legs may be yellowish, but they never show so distinctly bicolored as in *virgatum* or *hunteri*. Wings grayish, the veins rather more distinct than usual. Halteres yellow, darker at base of stalk.

Frons slightly raised in center, divergent-sided, as long as broad at upper angle of eyes, where it is one-fourth wider than at lower angle of eyes; surface hairs white, with a slight admixture of black ones, most numerous on lateral margins; face as broad as frons at center, slightly longer than broad, the surface hairs yellowish white; palpi black haired; postocular cilia white and black intermixed, the black hairs strongest. Scutum with yellowish white, regular, hairlike pilosity, anterior angles with short intermixed black hairs, posterior fourth with distinct, long, black, upright hairs; pleural tuft whitish; post-spiracular area haired; scutellum with whitish pilosity and upright black hairs. Abdominal basal scale opaque black, fringe pale, whitish; surface hairs on abdomen short, pale yellow or whitish. Legs with whitish pilosity and some upright black hairs, which are most noticeable on dorsal surfaces and tarsal joints, the paired apical fore tarsal hairs not so conspicuous as in *venustum* and its allies; tarsal claws simple (Pl. II, fig. 10).

Length, 3–4 mm.

One female from Ithaca, N. Y., September 2, 1888 (Dr. L. O. Howard), and three reared females from Rosslyn, Va., October 5, 1912 (J. R. Malloch), are in the collection. I have also seen larval, pupal, and adult material from South Carolina (Jennings and King).

Male.—Opaque velvety black. Basal two joints of antennæ slightly yellowish. Scutum with anterior angles and lateral and posterior margins broadly white-pollinose; sometimes there are two small spots on the anterior margin, nearer the center than the large patches on anterior angles of scutum behind prescutum, and in some specimens there are also two central faint whitish longitudinal stripes; pleuræ whitish dusted, postscutum with silky, white pollinosity. Abdomen with first segment under basal scale and sides of fourth to seventh silvered. Legs black, the knees and base of hind metatarsus more or less distinctly yellowish. Wings clear; thick veins brown. Halteres yellow.

Hairs on face and palpi brown, postocular cilia brown; pilosity on thorax yellow and hairlike, short on disk of scutum, longer anteriorly, laterally, and posteriorly, and with a few black, upright hairs intermixed on posterior fourth; pleural tuft pale brown; scutellum with yellow pilosity and long, upright, brown hairs. Basal abdominal fringe brownish yellow, surface hairs on abdomen brown. Legs with yellow pilosity, which is most noticeable on femora and tibiæ, and long, upright, dorsal, black hairs, the paired fore tarsal hairs present on joints 1–3; fore tarsus not thickened, hind tarsus with basal joint narrower than thickest portion of hind tibiæ; claws trifid. Size and venation as in female.

There are a number of specimens before me from Ithaca, N. Y. (Dr. L. O. Howard), most of which have the anterior punctiform marks and dorso-central stripes distinct. The localities for the other specimens in the collection are Rosslyn, Va. (F. Knab), one reared specimen from same locality (J. R. Malloch), and a reared series from South Carolina (Jennings and King).

Larva.—Length 9 to 12 mm. Sometimes almost entirely black in color. The fans (Pl. III, fig. 5) have about 60 rays which have regularly spaced setæ and slightly shorter and much finer ciliæ between them. The mandibles are as figured on Plate III, figure 2, and respiratory organs as in Plate VI, figure 6. The labium has the central tooth longest and in general outline approaches the *venustum* type of dentation (Pl. III, fig. 4). So far as my experience goes—and that of Messrs. Jennings and King substantiates it—the larvæ of this species are always found on rock surfaces where there is a rapid current, such as on waterfalls, and are difficult of detection owing to their dark color which harmonizes well with that of the rocks. If such conditions are essential to the larvæ it will account for the presence of the species in certain suitable localities and its absence from others where such conditions do not prevail.

Pupa.—The respiratory filaments consist of nine branches (Pl. IV, fig. 2). The cocoons are slipper shaped and yellow-brown in color (Pl. VI, fig. 8). They are placed close together on the rock surface with the open ends pointing downstream. Owing to their pale color and their being placed closely together they are easily seen on the dark surface of the rocks. It is not difficult to obtain imagines from the pupæ if they are kept on damp—not wet—cotton.

The adult female will bite horses, but there is no published record of its attacking human beings that I can find. One specimen in the collection of the U. S. National Museum from Plummers Island, Md., November 3, 1901, bears a label with the word "biting," but Mr. H. S. Barber, who took the specimen, does not recollect the particulars of its capture.

Simulium virgatum Coquillett.

Female.—Black-brown, opaque. Frons and face with thick whitish gray dusting; antennæ brown, the two basal joints yellow; palpi black-brown. Scutum distinctly striped, central stripe narrow, linear, lateral pair curved, the anterior dilated portion filled with white pollinosity forming a pear-shaped spot, the anterior angle of which is as broad as the space between the spots; lateral margins darkened; pleuræ distinctly white-dusted, scutellum concolorous with scutum; postscutum with white silky pollinosity. Abdomen black-brown, opaque on basal four segments, subshining on apical four, all segments with distinct, narrow, white-pollinose fasciæ on hind margins. Legs yellow, brown, or black-brown, as follows: Apices of femora, a narrow ring or spot at bases and apical halves of all tibiæ; entire fore tarsi; apices of first and second and remaining joints of mid and hind tarsi (Pl. V, fig. 3). Wings slightly grayish, thick veins brown. Halteres yellow.

Frons divergent-sided, above antennæ more than half as broad as at upper angle of eyes, surface hairs brown, upright, and regularly distributed; face not as long as frons and slightly longer than broad, surface hairs pale and shorter than those on frons; hairs on palpi pale; postocular cilia pale, with an admixture of brown hairs. Scutum with white pilosity, which is short, close-lying, and regular except on margins, where it is rather longer and looser; a few short brown upright hairs are present on lateral anterior angles and many longer ones on posterior fourth; pleural tuft grayish white; scutellum with close-lying white pilosity and long, upright, brown marginal hairs. Abdominal basal scale brown, fringe white; segments of abdomen almost bare, only a few scattered brown hairs present, those on apical segments most distinct. Legs with close-lying, short, pale pilosity and longer, brown, upright hairs on dorsal surfaces; the normal paired apical hairs present on the fore tarsi and longer hairs also on hind tarsal joints 2–3; hind tarsi with basal joint produced and second joint with basal scale and constriction (Pl. V, fig. 5); claws with sub-basal tooth (Pl. II, fig. 11). Venation of wings normal except that the cross-vein is at slightly beyond middle of subcosta; hairs on basal part of wing brown, anal marginal hairs white.

Length, 3–4 mm.

Redescribed from the two type specimens from Las Vegas, N. Mex., August (H. S. Barber). These have the scutum indistinctly reddish and differ in this respect only from a series in the collection from Los Angeles, Cal., which was taken in June and July. I can find no other characters which would justify me in separating them as distinct species.

Male.—Opaque black-brown. Face white-dusted; antennæ brown. basal two joints yellowish; palpi black-brown. Scutum with two distinct silvery-white stripes on dorsum; these stripes are anteriorly slightly convergent and terminate with an outward curve on anterior margin of scutum; they do not extend posteriorly beyond the last fourth of disk; lateral margins and anterior angles of scutum white-pollinose; pleuræ white-pollinose; postscutum with silky, white pollinosity. Abdomen opaque black at base, apical three segments slightly shining, first segment below basal scale and fifth almost entirely silvery white, venter yellowish laterally. Legs yellow, blackened as follows: Mid and hind coxæ; apices of all femora and tibiæ as well as slightly at base of latter; entire fore tarsi; apices of basal joint of mid and hind tarsi; apical four joints of mid and all but base of second joint of hind tarsi. Wings grayish, thick veins brown. Halteres with clear yellow knobs and darkened stalk.

Hairs on face pale brown, on palpi brown, postocular cilia dark brown. Pilosity on scutum regular, rather scalelike, golden yellow, a few dark hairs on anterior angles and longer and more numerous hairs of black-brown color on posterior fourth; pleural tuft yellow; scutellum with yellow pilosity and long upright brown hairs; basal fringe and surface hairs on abdomen pale yellow. Pilosity on legs almost white, except on darkened portions where it is pale brown, numerous long pale brown dorsal hairs on all joints, the fore tarsi with paired apical hairs on joints 1 and 3, those on joint 2 not so distinct; fore tarsi not thicker than mid pair, thinner than fore tibiæ; hind legs as in Plate V, figure 4; claws trifid. Wings and size as in female.

Redescribed from the type specimen, Las Vegas, N. Mex. (H. S. Barber). There is another specimen from the same locality in the collection, also taken by Mr. Barber.

Nothing is known of the early stages of this species.

Simulium hunteri, new species.

Female.—Black; frons shining black, face white-dusted. Scutum three-striped, opaque; pleuræ opaque black, gray-dusted. Abdomen opaque, velvety black on basal four segments, shining black on apical four. Legs black, yellow as follows: Coxæ, trochanters, and dorsal surface of tibiæ of fore legs; trochanters, bases of femora and tibiæ, and basal two-thirds of first tarsal joint of mid and hind legs; basal third of second hind tarsal joint. Wings grayish, thick veins brown; halteres yellow, darkened at base of stalk.

Frons with sides divergent, about two-thirds as wide above antennæ as at vertex, undusted, surface with yellow scale-like pilosity and upright black hairs on lateral and posterior margins; face thickly white-dusted, about one-fourth longer than broad, as broad as frons at upper angle of eyes, surface hairs yellow, with some darker, brown ones mixed; palpi black, pale-haired; antennæ black, yellowish on basal two and base of third joints. Scutum gray-dusted, with irregularly arranged, golden yellow, scale-like pilosity, and with two large white pollinose spots on anterior margin which are each more than twice as broad anteriorly as the black space between them; these spots are only visible when viewed from behind and occupy the dilated anterior portions of the posteriorly narrower black stripe; viewed from in front and above the dorsum of scutum has a central, black, narrow stripe and two curved stripes beyond them, as well as an indication of a narrow lateral stripe on each side; pleural tuft and hairs on postspiracular area brownish yellow; scutellum with close-lying yellow pilosity and upright black hairs. Abdominal basal scale brown or black, fringe yellow; lateral posterior margins of abdominal segments gray-dusted, apical segments with numerous black hairs and a few intermixed pale scales, the hairs at apex long. Legs with long, yellow, scale-like pilosity on femora and upright, dorsal, black hairs on these as well as tarsi, the normal paired fore tarsal hairs present on apices of first and third joints; hairs on tarsi concolorous with joints; claws with subbasal tooth (see Pl. II, fig. 3). Wings with venation normal. Halteres pale yellow, darkened at base of stalk.

Length, 3.5–4 mm.

Type.—Cat. No. 15413, U. S. National Museum.

Type locality, Virginia Dale, Colo., September 31, 1912 (collector Bishopp). Submitted for identification by Mr. W. D. Hunter (No. 3065). One specimen from Glenora, British Columbia, and another from Ainsworth, British Columbia, evidently belong to this or a closely allied species, but their condition is too poor to say for certain.

This species is very close to *virgatum* Coquillett, but the legs are much darker in color; this character is very consistent throughout the series of 13 specimens), and the frons is also in most of the specimens entirely glossy black. There is a slight dusting present on one or two of the specimens in the series, but nothing like the thick white pollinosity which is found on that of *virgatum*.

None of the specimens of *virgatum* bear any label as to habits, but the type series of *hunteri* was taken on cows. The early stages are unknown in this species.

Simulium glaucum Coquillett.

Male.—Black, opaque. Antennæ and palpi black; face white-dusted. Scutum with distinct white pollinosity, which is bright silvery on two triangular patches on the anterior margin dorsad of the lateral extensions of the prescutum; central opaque black stripe broad and well defined anteriorly, linear and diffused posteriorly; on either side of this stripe is an abbreviated linear mark which is evidently the rudiment of the dorso-lateral line of *virgatum*, and nearer the lateral margin is a broader black stripe which is diffused on margins and anteriorly abbreviated; pleuræ white-pollinose; scutellum slightly pollinose. Abdomen opaque black, sides of segment below basal scale and apical four segments laterally silvered. Legs black; femora paler at apices; tibiæ and basal joints of mid and hind tarsi broadly yellow at bases; second joint of hind tarsi pale at base. Wings clear, thick veins yellowish. Halteres yellow, base of stalk blackened.

Face hairs and postocular cilia pale. Scutum with white, hair-like pilosity, which is longer posteriorly and on the margins; pleural tuft whitish yellow; hairs on scutellum pale, upright. Basal abdominal fringe yellow, in some lights brown; lateral hairs on abdominal segments white. Legs with pale pilosity and longer, upright, dorsal pale hairs, which are conspicuous on posterior surface of fore femora; fore tarsi not dilated, the paired apical hairs absent; hind tarsus of the normal *Simulium* form; claws trifid. Surface hairs and short bristles on wing veins brownish yellow.

Redescribed from type specimen. Locality, Kansas City, Mo. (C. F. Adams).

This species belongs to the same group as *virgatum* Coquillett and *hunteri*, new species. The male of the latter is unknown, and it is possible that this may be identical with it, but it is not unlikely that it may belong to a quite distinct species. There is very little resemblance between the males and females of any species in this genus and it is difficult to associate them correctly.

The early stages and the female are unknown.

GROUP E.

Species with two or four stripes on scutum; the stripes straight or very slightly curved. white or pearlaceous pollinose.

TABLE OF SPECIES.

1. Stripes on scutum not curved; scutellum with close-lying yellow pilosity; abdomen with rounded, dorso-central, opaque black spot on basal four segments____*hæmatopotum*, p. 62.
   Stripes on scutum slightly curved; scutellum with very indistinct, sparse, yellow pilosity; abdomen with bases of all segments opaque velvety black and apices with whitish pollinosity____*quadrivittatum*, p. 61.

Simulium quadrivittatum Loew.

Female.—Black. Frons and face thickly covered with bluish-white pollinosity; antennæ yellow, distinctly browned from fourth joint to apex; palpi brown-black. Scutum velvety, opaque black; two bluish-white, slightly iridescent, pollinose stripes on the dorsum, which are slightly dilated anteriorly and a little curved; posterior margin of scutum, and lateral margins, as well as prescutum, similarly pollinose; pleuræ with bluish-white pollen; scutellum opaque black; postscutum with iridescent pollen. Abdomen black; basal four segments opaque, with bluish-white pollinosity on first segment below basal scale and on the posterior lateral margins of next three; apical four segments glossy black. Legs black-brown, yellowish as follows: Bases of all tibiæ; mid tarsi except apices of joints and last joint; hind tarsi except apices of joints 1–3. Bases of all tibiæ and of first hind tarsal joint silvery. Wings clear, basal veins brown, thick veins yellow, thin veins colorless. Halteres yellow, stalk black-brown.

Frons slightly divergent-sided, not one-third the head width at upper angle of eyes, almost bare of hairs; face one-third longer than wide, surface hairs very weak and sparse; hairs on palpi brown; postocular cilia brown. Scutum with yellow, hairlike pilosity; pleural tuft brown, very weak; scutellum with upright brown hairs. Basal fringe of abdomen brownish-yellow, surface hairs on segments brown, weak, except at apex where they become distinctly longer. Legs with brownish-yellow pilosity and scattered, longer upright, brown dorsal hairs; fore tarsi not dilated, first and third joints with paired apical hairs; claws simple. Cross-vein on wing but little beyond middle of subcosta; basal hairs on wing and short bristles on thick veins brown.

Length, 2 mm.

This species was originally described from Cuba and is represented in the collection by specimens from Cayamas, Cuba (E. A. Schwarz); La Palma, Costa Rica (Biolley); and Utuado, Porto Rico, marked "biting flies" (C. W. Richmond). There is also a large series of specimens from Trinidad River and Cabima, Panama, May, 1911 (Busck), which agree with the Cuban specimens, except that the thoracic stripes are less distinct and the specimens average rather less in size and are darker in color.

Nothing is known of the early stages of this species, and the male is also unknown.

Simulium hæmatopotum, new species.

Female.—Black. Frons and face with shining pearlaceous pollinosity. Antennæ yellow, browned from fourth joint to tip; palpi brown, paler at base. Scutum velvety black, with two broad pearlaceous stripes, which are broader at anterior ends than the black space between them, taper slightly posteriorly, but are uncurved; posterior and lateral margins similarly pollinose; pleuræ shining black, with more or less distinct pearlaceous pollinosity; scutellum brown; postscutum with pearlaceous pollinosity. Abdomen brownish; opaque on basal four segments, each of which has a rounded, opaque, black dorsal, and a less distinct lateral spot, posterior margins of these segments whitish dusted; apical four segments with dorsal portions shining; the fifth segment with a rounded dorsal spot, the others almost entirely black. Legs yellow, black as follows: Mid and hind coxæ; fore tarsi; apices of first four and all apical joints of mid tarsi; femora except bases, apical half of tibiæ, apical halves of joints 1–3, and all last two joints of tarsi of hind legs. Wings clear, basal and thick veins yellow. Halteres yellow, stalk blackened.

Frons slightly divergent-sided, less than one-third the head width at upper angle of eyes, surface hairs weak, brownish yellow; face as long as frons and one-half longer than broad, haired as frons; hairs on palpi brown; postocular cilia brown. Scutum with close-lying, golden-yellow, hairlike pilosity; pleural tuft brownish yellow;

scutellum with closely placed yellow pilosity, and brownish, upright, longer hairs. Abdominal basal fringe short, yellow; segments of abdomen with short, sparse, yellow hairs, and longer, dark hairs at apex. Legs with pale yellowish pilosity, which is whitish at bases of tibiæ and on basal joint of hind tarsi; dorsal surfaces with longer, blackish, upright hairs; fore tarsi slightly dilated, the paired apical hairs present on joints 1 and 3; claws simple. Wings with brown hairs at base and brown surface hairs on thick veins; cross-vein at two-fifths from end of subcosta.

Length, 1.5–2 mm.

Type.—Cat. No. 15414 U. S. National Museum.

Locality.—Santa Lucrecia, Vera Cruz, Mexico (F. W. Urich). There is also a specimen from Cayamas, Cuba (E. A. Schwarz) which evidently belongs to this species.

The series taken by F. W. Urich is labeled "Bloodsucking, man, October, 1911."

The early stages and the male are unknown.

ADDENDA.

When the manuscript of this paper was under preparation I had considerable doubt as to whether there were not several closely allied forms confused under certain specific names, this being particularly the case with *meridionale*. That size can not always be accepted as a safe guide to the separation of species is abundantly evident to any student of insects, and although in the series of specimens in the National Museum collection there was much disparity in this respect, the specimens presented no tangible characters which, without the confirmatory evidence provided by a knowledge of the early stages, might be accepted as of specific value. Thus I left under one name at least three forms which may in the larval and pupal stages prove to be very dissimilar. The distinctions in the adults are very minute in the genus *Simulium* and are hardly appreciable to anyone unacquainted with the family. I am therefore pleased to have had access to the material belonging to the Illinois State Laboratory of Natural History because of the additional light the material representing the early stages therein contained has cast upon the question of the number of species in the *meridionale* group. Prof. S. A. Forbes has kindly given me permission to include the matter in this addenda as part of my paper.

Simulium forbesi, new species.

Female.—Black, covered with a pale-gray pollinosity, which gives to the insect a pale-gray appearance. Antennæ and palpi black, the former rarely slightly paler at bases. Scutum with three black vittæ, the central one narrow, the outer pair broader, more or less distinctly curved outward at anterior extremity, and convex on the posterior half; pleuræ gray pollinose, scutellum and postscutellum gray pollinose. Basal abdominal scale gray and next three segments broadly black-brown, opaque, on dorsum, lateral margins gray pollinose, next segment more narrowly blackened on dorsum, the lateral margins and remaining segments gray pollinose. Legs black; generally only the bases of tibiæ yellow, but occasionally, in immature specimens, the black color is confined to the apices of femora, bases and apices of tibiæ, and apices of tarsal joints. Wings clear. Halteres yellow.

Frons at upper angle barely more than one-fifth the head width, slightly converging toward antennæ, the surface with short, white, decumbent pilosity; face distinctly wider than widest part of frons, and longer than wide, the surface with pilosity similar to that on frons; antennal pile short and inconspicuous, whitish; palpi with short whitish pile. Scutum with closely placed pilosity which is hair-like, yellowish white in color, and adheres closely to surface, becoming slightly longer, but not upright, posteriorly; scutellum with much longer pilosity, which is concolorous with that on scutum and upright on margin; pleural tuft whitish, postspiracular area bare. Basal abdominal scale with pale fringe; the hairs on segments of abdomen short and pale. Legs normal in shape; fore tarsi very slightly thickened, the apical, paired hairs not distinguishable; hind tarsi with distinct scale and dorsal excision on second joint; claws bifid; surface of all legs with pale hairs, which are most conspicuous on the tibiæ, giving them a whitish appearance.

Male.—Deep black, opaque. Face silvery pollinose; antennæ and palpi black. Scutum with rarely a slight silvery pollinosity posteriorly and on the lateral margins, and otherwise velvety black; pleuræ slightly covered with white pollinosity; scutellum velvety black; postscutum slightly pollinose, glossy. Abdomen velvety black, only the venter yellowish, no silvering noticeable on any of the specimens before me; hairs on surface short, yellowish. Legs colored as in the female, surface hairs yellow, with an admixture of longer brown upright hairs on the dorsal surfaces. Wings clear, veins pale yellowish, the thin veins very indistinct. Halteres brown.

The head is formed as in other species of this genus, the upper eye facets being conspicuously enlarged while the lower half of the eye has small facets. The scutum is thickly covered with pile, which is golden yellow in color and rather more scalelike than that of the male; there are no upright hairs on disk, and posteriorly the pilosity is decumbent as in the female; scutellum with yellowish pile and upright brownish hairs on margin. Basal fringe of abdomen brownish, the surface hairs also brown. Fore tarsus slender; hind tarsus only slightly dilated; apical paired hairs absent from fore tarsus, or indistinguishable, hind tarsus formed as in female; claws trifid. Wings normal.

Length, 2–2.5 mm.

Type.—Locality, Illinois River, at Havana. A very large number of both sexes were taken, many of them reared from pupæ which were found in the river. A description of the pupa follows.

Pupa.—Yellow, becoming brown before emergence of the imago, the colors of which may be distinctly traced through the body wall of the pupa some time before it is ready to emerge. The respiratory organs branch near the base, generally into three main stems, the branch or stem which is directed anteriorly again breaking into two stems which are bifid from near their bases; the central stem is again subdivided into three smaller branches, the central one ending in 2 filaments and the other two in 4 each; the posteriorly directed branch generally divides at near to the base, a further subdivision taking place a little farther up, each of the latter branches generally having 2 filaments, making as a rule from 22 to 24 or 25 filaments in all. The abdomen has on the fourth and fifth segments (counting the segment showing just behind the scutellum as the first) a transverse row of four short hooks, the points of which are turned cephalad; on each side of the dorsal line, a somewhat similar series on the eighth segment which are more numerous, smaller, and almost connected in center; on the ninth segment the row is almost continuous on the posterior margin of the segment. The fifth, sixth, seventh, and eighth ventral segments have each two hooks on each side which are much closer, in each pair, to each other than the transverse space between the pairs.

Length, 3–3.5 mm.

The cocoon, which is generally attached to stems of plants or to posts in the stream, is very similar to that of *johanniseni.*

The type and paratypes of this species are in the Illinois State Laboratory of Natural History.

I have much pleasure in dedicating this species to Dr. Stephen A. Forbes, who has done so much to elucidate questions in connection with this group on the Illinois River.

Simulium johannseni Hart.

This species is very clearly described by Hart in the Twenty-seventh Report of the State Entomologist of Illinois, 1912, page 32. It is only necessary for me to point out that the male has the three vittæ on the scutum generally distinct and the pilosity whitish. The color of the legs in both species is as given in the description herewith for *forbesi,* although in alcoholic specimens the color is as figured by Hart in his original description. Fresh females of *johannseni* have the dorso-lateral stripes generally discontinued before the anterior margin and not outwardly curved, as well as the central line extremely narrow; the pilosity over the whole insect is longer than in *forbesi* and conspicuously so on the abdomen; the marking on the abdomen is usually confined to a series of spots, one on each side of the first four segments exclusive of the basal scale. The species is also noticeably larger than either *forbesi* or *meridionale*, being 3–4 mm. in length.

For description of larva and pupa see Hart's paper above mentioned.

It is possible that the larger specimens mentioned as in the U. S. National Museum collection under *meridionale* are really this species, but I have no means of determining that question at present.

So far as my material permits me to judge, *johannseni* occurs at Havana, Ill., till the end of May, when its place is taken by *forbesi*, which is equally abundant.

Simulium meridionale Riley and its allies.

The three species which I at present recognize as belonging to this group are *meridionale* Riley, *johannseni* Hart, and *forbesi* new species.

The pupal stages of these three species, which are very closely allied in the adult stage, are very distinct and may be readily separated from one another by the number of pupal respiratory filaments. In *johannseni* these are 4 in number, in *meridionale* 6, and in *forbesi* generally 24 or 25, although, as is the case when a large number of filaments are present, there may be a slight variation in the total number in individual specimens. *Johannseni* is the only species which I have seen with four pupal filaments, although *bracteatum* has been recorded by Strickland as possessing this number also. I have not seen Strickland's material, so can not confirm the identification.

The adult females of this group of species may be readily distinguished from other North American forms by their possession of the following combination of characters: Scutum with three vittæ, the submedian pair curved; the pilosity hairlike on scutum; abdomen more or less distinctly spotted on middle of each dorsal segment; legs generally almost unicolorous, rarely distinctly bicolored (in alcoholic specimens this bicoloring is conspicuous in the case of *johannseni*); claws bifid. The males are not so readily separated, but I have inserted them in my synoptic key, by means of which I believe they may be readily located.

From the data gathered in the field work on this group in the Illinois River region, near Havana, it is evident that *johannseni*, although a pest owing to the great numbers in which it occurs, does not appear to be guilty of biting man. It has, on the other hand, been clearly proven that *forbesi* is given to attacking man and also stock. As it occurs in great numbers there is a possibility of its doing considerable damage, although as a general rule it is not very troublesome away from the river. Mr. C. A. Hart has found specimens of *Simulium forbesi* in Mason County, over 5 miles southeast of Havana. As the nearest possible breeding place of the species is the Illinois River, it is evident that the species can fly for a considerable distance. As there was no appreciable diminution in the numbers of the species at this distance it was quite clear that these were not merely accidental stragglers, whose presence was due to their being carried by stock or otherwise, and that the ditches, which are very small in that vicinity and never present favorable breeding quarters at any time, could not possibly have stocked the country so thoroughly with the insects. No extended investigations were carried out to discover the extent of the area covered by the species, but according to reports obtained, and which there is no reason to discredit, the range of the species was considerably wider than ascertained by Mr. Hart. No evidence has been discovered to prove that *johannseni* or *forbesi* live in the larval stage in ditches such as are present in the part of Mason County above referred to.

It may be of interest to mention that the agents of the Illinois State Laboratory of Natural History have found the parasites mentioned by Strickland commonly in *Simulium* larvæ in both the Illinois River and the Sangamon River at near the source of the latter. So far as the records indicate, *vittatum* was the only species affected, but the percentage of parasitized individuals was very large.

In the records of the work done by agents of the Bureau of Entomology many years ago there occurs a note on these parasites, but the fact was not mentioned in any of the published reports on the family.

CATALOGUE OF NORTH AMERICAN AND CENTRAL AMERICAN SIMULIIDÆ.

[[a] Types in United States National Museum; [b] Represented in United States National Museum.]

Prosimulium Roubaud. Comptes-Rendus Acad. Sci., Paris, 1906, pp. 519–521.
- [a] **pleurale** Malloch. This paper, p. 17.
- [b] **hirtipes** Fries. Monogr. Simulium, 1824, no. 17.
  - *pecuarum* Garman (not Riley). Bul. 159, Ky. Agr. Exp. Sta., 1912, p. 18.
- [a] **fulvum** Coquillett. Proc. U. S. Nat. Mus., vol. 25, 1903, p. 96.
  - *ochraceum* Coquillett (not Walker). Proc. Wash. Acad. Sci., vol. 2, 1900, p. 393.
- [a] **pecuarum** Riley. Rept. U. S. Dept. Agr. f. 1886 (1887), p. 512.
- [a] **mutatum** Malloch. This paper, p. 20.

Parasimulium Malloch. This paper, p. 24.
- [a] **furcatum** Malloch. This paper, p. 24.

Simulium Latreille. Hist. Nat. Crust. Ins., vol. 3, 1802, p. 426.
- [a] **aureopunctatum** Malloch. This paper, p. 27.
- [b] **subnigrum** Lutz. Mem. Inst. Oswaldo Cruz, vol. 2, part 2, p. 239.
- [a] **hippovorum** Malloch. This paper, p. 28.
- [b] **ochraceum** Walker. Trans. Ent. Soc. Lond., vol. 5, 1861, p. 332.
- [b] **notatum** Adams. Kans. Univ. Sci. Bul., vol. 2, 1904, p. 434.
- [a] **bivittatum** Malloch. This paper, p. 31.
- [a] **trivittatum** Malloch. This paper, p. 30.
- [a] **distinctum** Malloch, Proc. Ent. Soc. Wash., vol. 15, 1913, p. 133.
- [b] **pictipes** Hagen. Proc. Bost. Soc. Nat. Hist., vol. 20, 1879, p. 305.
  - *innoxium* Comstock. Manual for the Study of Insects, 1895, p. 452.
- [a] **virgatum** Coquillett. Proc. U. S. Nat. Mus., vol. 25, 1903, p. 97.
- [a] **griseum** Coquillett. Bul. 10, new ser., Div. Ent., U. S. Dept. Agr., 1898, p. 69.
- [b] **vittatum** Zetterstedt. Ins. Lappon., 1840, p. 803.
  - *argus* Williston. Bul. 7, Div. Orn. and Mamm., U. S. Dept. Agr., 1893, p. 253.
  - ? *decorum* Walker. List Dipt. Brit. Mus., vol. 1, 1848, p. 112.
  - *minutum* Lugger. Bul. 48, Minn. Agr. Exp. Sta., 1896, p. 202. (Johannsen.)
- **forbesi** Malloch. This paper, p. 63.
- [a] **meridionale** Riley. Rept. U. S. Dept. Agr. f. 1886 (1887), p. 513.
  - *occidentale* Townsend. (?) Psyche, 1891, p. 107.
- **johannseni** Hart. 27th Rept. State Ent. Ill., 1912, p. 42.
- **tamaulipense.** Townsend. Journ. N. Y. Ent. Soc., vol. 5, 1898, p. 171.
- [a] **hunteri** Malloch. This paper, p. 59.
- [b] **venustum** Say. Journ. Acad. Sci. Phila., vol. 3, 1829, p. 28.
  - *venustoides* Hart. (Female.) 27th Rept. State Ent. Ill., 1912, p. 42.
- [a] **jenningsi** Malloch. This paper, p. 41.
  - *venustum* var. *a* Johannsen. Bul. 68, N. Y. State Mus., 1903, p. 381.

Simulium Latreille—Continued.

[a] **parnassum** Malloch. This paper, p. 36.
[a] **arcticum** Malloch. This paper, p. 37.
[a] **clavipes** Malloch. This paper, p. 40.
tarsale Williston. Trans. Ent. Soc. Lond., 1896, p. 268.
pulchrum Johannsen (not Philippi). Bul. 68, N. Y. State Mus., 1903, p. 376.
[b] **exiguum** Roubaud. Bul. Mus. Paris, 1906, p. 109.
[b] **metallicum** Bellardi. Saggio Ditter. Mess., 1859, vol. 1, p. 14.
[b] **mexicanum** Bellardi. Saggio Ditter. Mess. app., 1861–62, p. 6.
[a] **bracteatum** Coquillett. Bul. 10, new ser., Div. Ent., U. S. Dept. Agr., 1898, p. 69.
[a] **piscicidium** Riley. Amer. Ent., vol. 2, 1870, p. 367.
venustoides Hart, 27th Rept. State Ent. Ill., 1912, p. 42.
tephrodes Speiser. Ins. Börse, 1904, p. 148.
cinereum Bellardi. Saggio Ditter. Mess., vol. 1, 1859, p. 13. Preoccupied name.
[b] **quadrivittatum** Loew. Dipt. Amer. Sept. Ind., Cent. 2, species 2.
[a] **hæmatopotum** Malloch. This paper, p. 62.
[a] **glaucum** Coquillett. Proc. U. S. Nat. Mus., 1903, vol. 25, p. 97.

UNRECOGNIZABLE SPECIES.

Similium irritatum Lugger. 2d Rept. Ent. Minn., 1896, p. 177.
Simulium invenustum Walker. List Dipt. Brit. Mus., vol. 1, 1848, p. 112.
Simulium molestum Harris. Ins. Inj. Veg., 3d ed., 1862, p. 601.
Simulium tribulatum Lugger. 2d Rept. Ent. Minn., 1896, p. 205. Johannsen gives it as probably a synonym of *vittatum* Zett.

A LIST OF THE PRINCIPAL PAPERS DEALING WITH THE LIFE HISTORIES OF AMERICAN SIMULIIDÆ.

1870. OSTEN SACKEN, C. R.—On the transformations of *Simulium*.<Amer. Ent. and Bot., vol. 2, pp. 229–331.

1880. HAGEN, H. A.—A new species of *Simulium* with a remarkable nymphal case.<Proc. Bost. Soc. Nat. Hist., vol. 20, pp. 305–307.

1880. BARNARD, W. S.—Notes on the development of a black fly (*Simulium*) common in the rapids around Ithaca, N Y.<Amer. Ent., vol. 3, pp. 191–193.

1883. HAGEN, H. A.—*Simulium* feeding on chrysalides.<Ent. Monthl. Mag., vol. 19, pp. 254–255.

1885. RILEY, C. V.—The southern buffalo gnat (*Simulium* sp.).<Rept. Ent., U. S. Dept. Agr. f. 1884, pp. 340–345.

1886. DORAN, E. W.—The buffalo gnat.<Rept. on Econ. Ent. of Tenn. to the Bureau of Agr. Stat., Mines, and Immigr., pp. 239–242.

1887. WEBSTER, F. M.—Report on buffalo gnats.<Bul. 14, Div. Ent., U. S. Dept. Agr., pp. 29–39.

1887. RILEY, C. V.—Buffalo gnats.<Repts. Ent., U. S. Dept. Agr. f. 1886, pp. 492–517.

1889. WEBSTER, F. M.—*Simulium* or Buffalo gnats.<Rept. Bur. Anim. Ind., U. S. Dept. Agr. f. 1887 (1889), pp. 456–465.

1892. WEBSTER, F. M.—Buffalo gnats (Simuliidæ) in Indiana and Illinois, Proc. Ind. Acad. Sci., December, 1892, pp. 155–159.

1895. TOWNSEND, C. H. T.—On the correlation of habit in nemocerous and brachycerous Diptera between aquatic larvæ and bloodsucking adult females.<Journ. N. Y. Ent. Soc., vol. 3, pp. 134–136.

1895. MIALL, L. C.—The natural history of aquatic insects. *Simulium*, pp. 175–188.

1896. LUGGER, O.—Buffalo gnats, black flies.<2nd Ann. Rept. Ent. State Exp. Sta., Univ. Minn., pp. 172–182.

1896. OSBORN, H.—Insects affecting domestic animals.<Bul. 5, new ser., Div. Ent., U. S. Dept. Agr., pp. 31–58.

1901. KELLOGG, V. L.—Food of larvæ of *Simulium* and *Blepharocera*.<Psyche, vol. 9, pp. 166–167.

1901. NEEDHAM, J. G., and BETTEN, C.—Aquatic insects of the Adirondacks. <Bul. 47, N. Y. State Mus., pp. 393, 407–408, 574.

1902. TAYLOR, T. H.—On the tracheal system of *Simulium*.<Trans. Ent. Soc. Lond., 1902, pp. 701–716.

1903. JOHANNSEN, O. A.—Aquatic nematocerous diptera.<Aquatic Insects in New York State, pt. 6, Bul. 68, N. Y. State Mus., pp. 336–388.

1904. WEBSTER, F. M.—The suppression and control of the plague of gnats in the valley of the lower Mississippi River, and the relation thereto of the present levee system, irrigation in the arid West, and tile drainage in the Middle West.<Proc. 25th Ann. Meet. Soc. Prom. Agr. Sci., pp. 53–72.

1905. HEADLEE, T. J.—Blood gills of *Simulium pictipes*.<Amer. Nat., vol. 41, pp. 875–885.

1909. LUTZ, DR. A.—Brazilian Simuliidæ.<Mem. Inst. Oswaldo Cruz, vol. 1, pt. 2, pp. 124–146.

1910. LUTZ, DR. A.—Brazilian Simuliidæ.<Mem. Inst. Oswaldo Cruz, vol. 2, pt. 2, pp. 213–262.

1910. STRICKLAND, E. H.—Some parasites of *Simulium* larvæ and their effects on the development of the host.<Biol. Bul., vol. 21, no. 5, October, 1911, pp. 302–334.

1912. GARMAN, H.—A preliminary study of Kentucky localities in which pellagra is prevalent.<Bul. 159, Ky. Agr. Exp. Sta.

1912. FORBES, S. A.—Black-flies and buffalo-gnats (*Simulium*) as possible carriers of pellagra in Illinois.<27th Rept. State Ent. Ill., pp. 21–55.

1913. STRICKLAND, E. H.—Further observations on the parasites of *Simulium* larvæ. Journ. Morph., Phil., vol. 24, p. 43.

INDEX TO GENERA AND SPECIES.

[Pages on which genera and species are described are given in black-faced type.]

PLATE I.

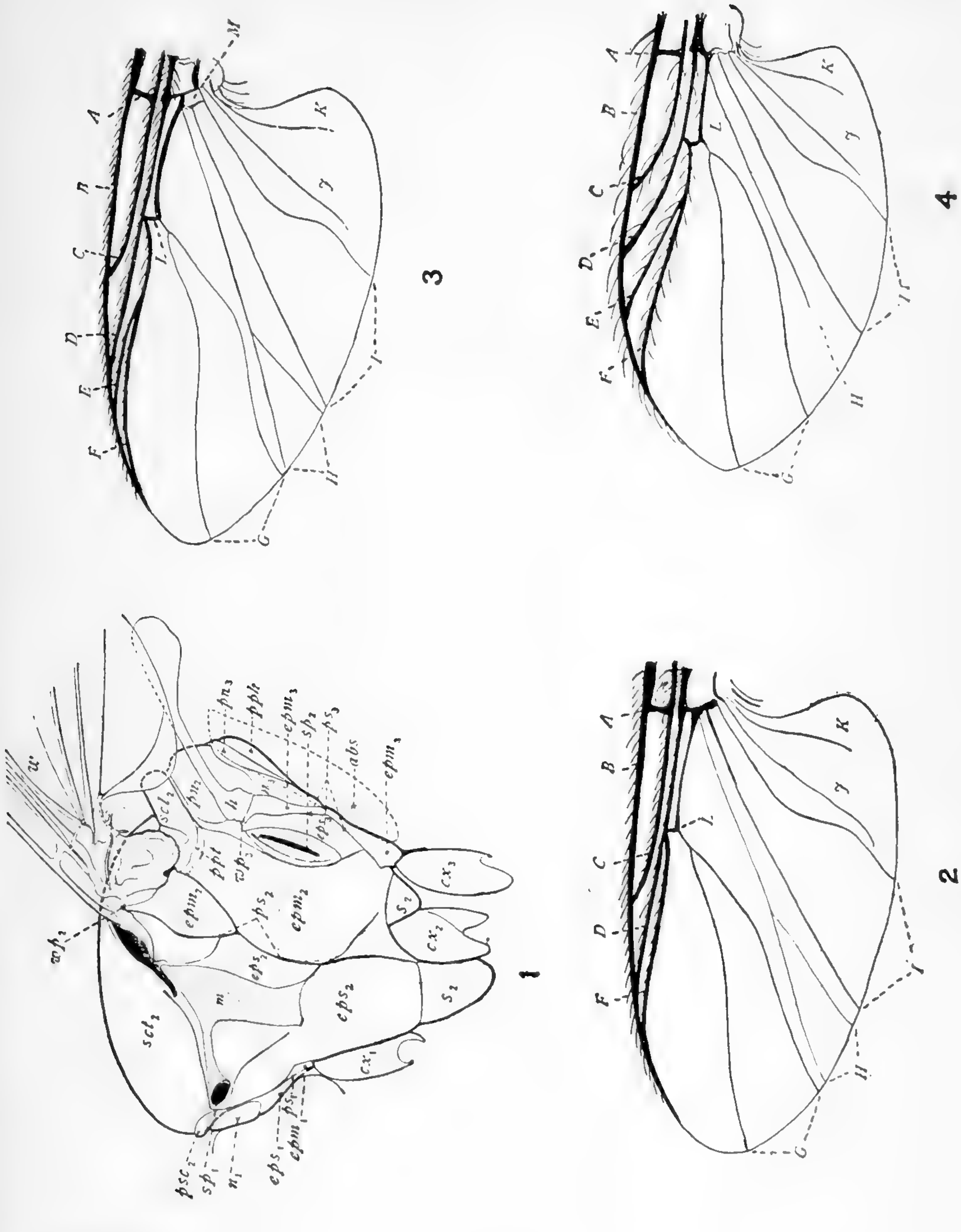
ANATOMICAL DETAILS AND WING VENATION OF SIMULIIDÆ.

Fig. 1.—Lateral view of thorax of *Prosimulium pleurale:* n_1, Pronotum; psc_2, proscutum; sct_2, scutum; scl_2, scutellum; pn_2, mesothoracic postnotum; n_3, metanotum; pn_3, metathoracic postnotum; *pph*, postphragma; *w*, wing; *h*, haltere; $sp_{1\ 2}$, prothoracic and mesothoracic spiracles; $eps_{1\ 2\ 3}$, prothoracic, mesothoracic, and metathoracic episterna; $epm_{1\ 2\ 3}$, prothoracic, mesothoracic, and metathoracic epimera; *m*, membranous area; $ps_{1\ 2\ 3}$, prothoracic, mesothoracic, and metathoracic sutures; $wp_{2\ 3}$, pleural wing sutures; *ppt*, postparapterum; s_2, divided mesosternum; $cx_{1\ 2\ 3}$, coxæ; *abs*, abdominal basal scale. The pleural tuft occupies the area covered by the letters *ppt* and wp_3 in figure.

2.—Wing of *Simulium: A*, humeral vein; *B*, costa; *C*, subcosta; *D*, first longitudinal vein; *E*, upper branch of radius or third longitudinal vein; *F*, lower branch of radius; *G*, fourth longitudinal vein or medius; *H*, fold which has been sometimes considered as the cubitus; *I*, cubitus or fifth longitudinal vein; in cases where the fold has been reckoned as the cubitus this vein has been named the anal vein.

3.—Wing of *Prosimulium.* (Explanation as in fig. 2.)

4.—Wing of *Parasimulium.* (Explanation as in fig. 2.) (Original.)



ANATOMICAL DETAILS AND WING VENATION OF SIMULIIDÆ.

16125°—14——6

Plate II.

LEGS AND TARSAL CLAWS OF SIMULIIDÆ.

Fig. 1.—Hind femur, tibia, and two basal tarsal joints of *Prosimulium fulvum*, male.

2.—Same of *Prosimulium pecuarum*, female.

3.—Claw of *Simulium hunteri*, female.

4.—Claw of *Simulium arcticum*, female.

5.—Claw of *Simulium clavipes*, female.

6.—Claw of *Simulium mexicanum*, female.

7.—Claw of *Simulium venustum*, female.

8.—Claw of *Simulium parnassum*, female.

9.—Claw of *Simulium vittatum*, female.

10.—Claw of *Simulium pictipes*, female.

11.—Claw of *Simulium virgatum*, female.

12.—Claw of *Simulium hippovorum*, female.

13.—Claw of *Prosimulium fulvum*, female.

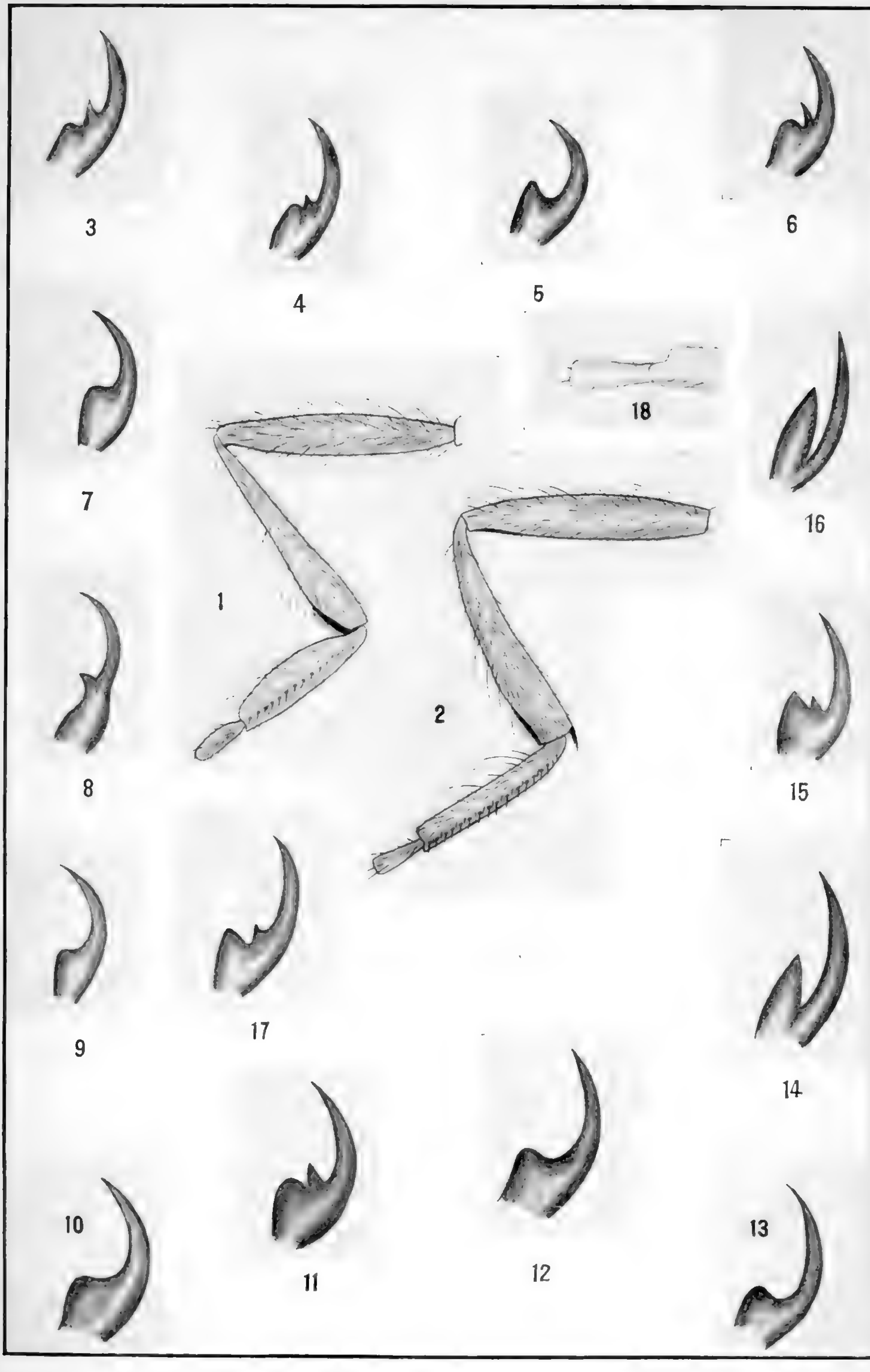
14.—Claw of *Prosimulium pecuarum*, female.

15.—Claw of *Simulium ochraceum*, female.

16.—Claw of *Prosimulium pleurale*, female.

17.—Claw of *Simulium metallicum*, female.

18.—Apex of basal and second joint of hind tarsus of *Prosimulium mutatum*, female. (Original.)

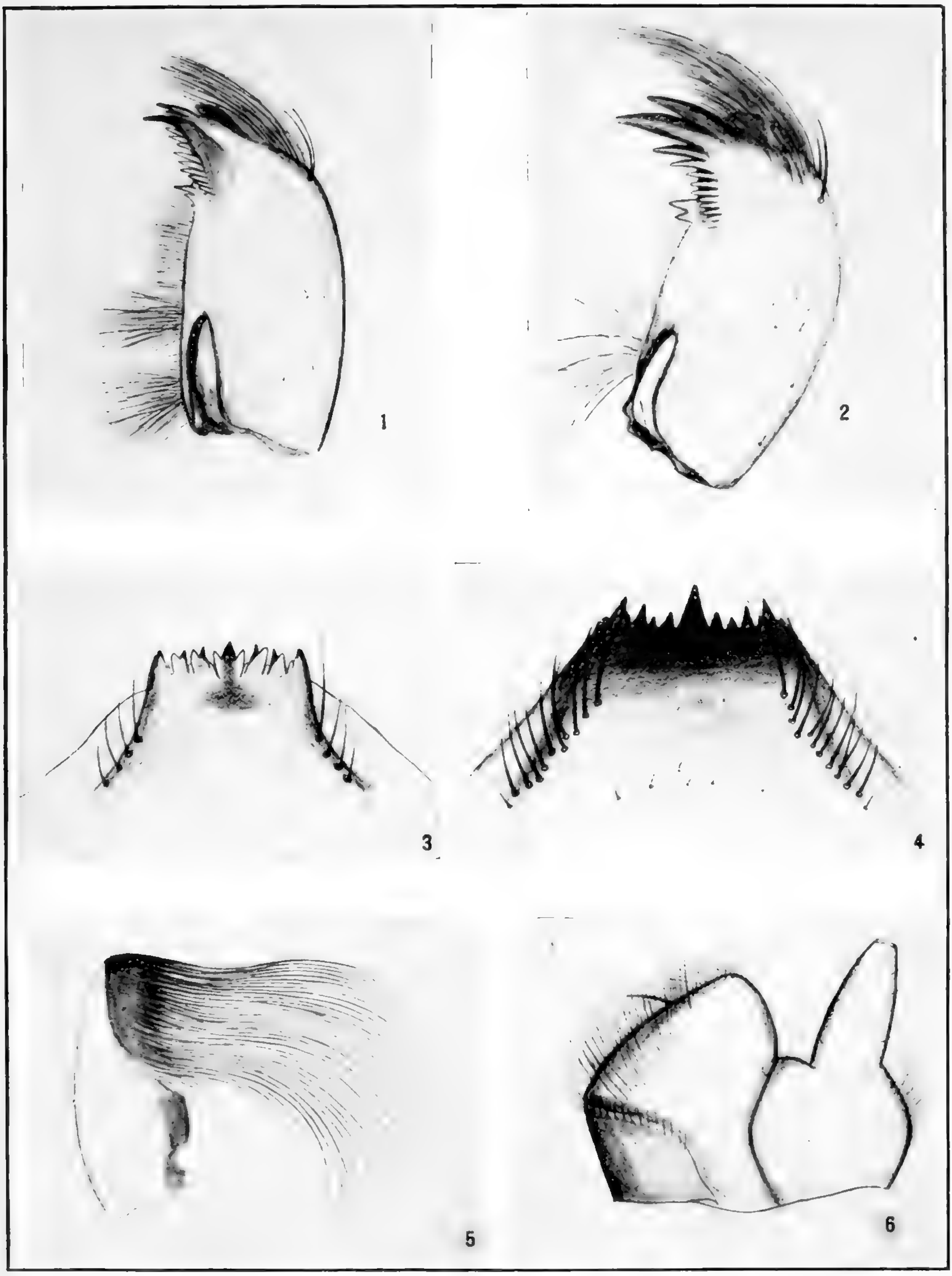


LEGS AND TARSAL CLAWS OF SIMULIIDÆ.

Plate III.

LARVAL CHARACTERS OF SIMULIIDÆ.

Fig. 1.—Mandible of larva of *Simulium jenningsi.*
2.—Mandible of larva of *Simulium pictipes.*
3.—Labium of larva of *Prosimulium hirtipes.*
4.—Labium of larva of *Simulium pictipes.*
5.—Fan of larva of *Simulium pictipes.*
6.—Maxilla of larva of *Prosimulium hirtipes.* (Original.)

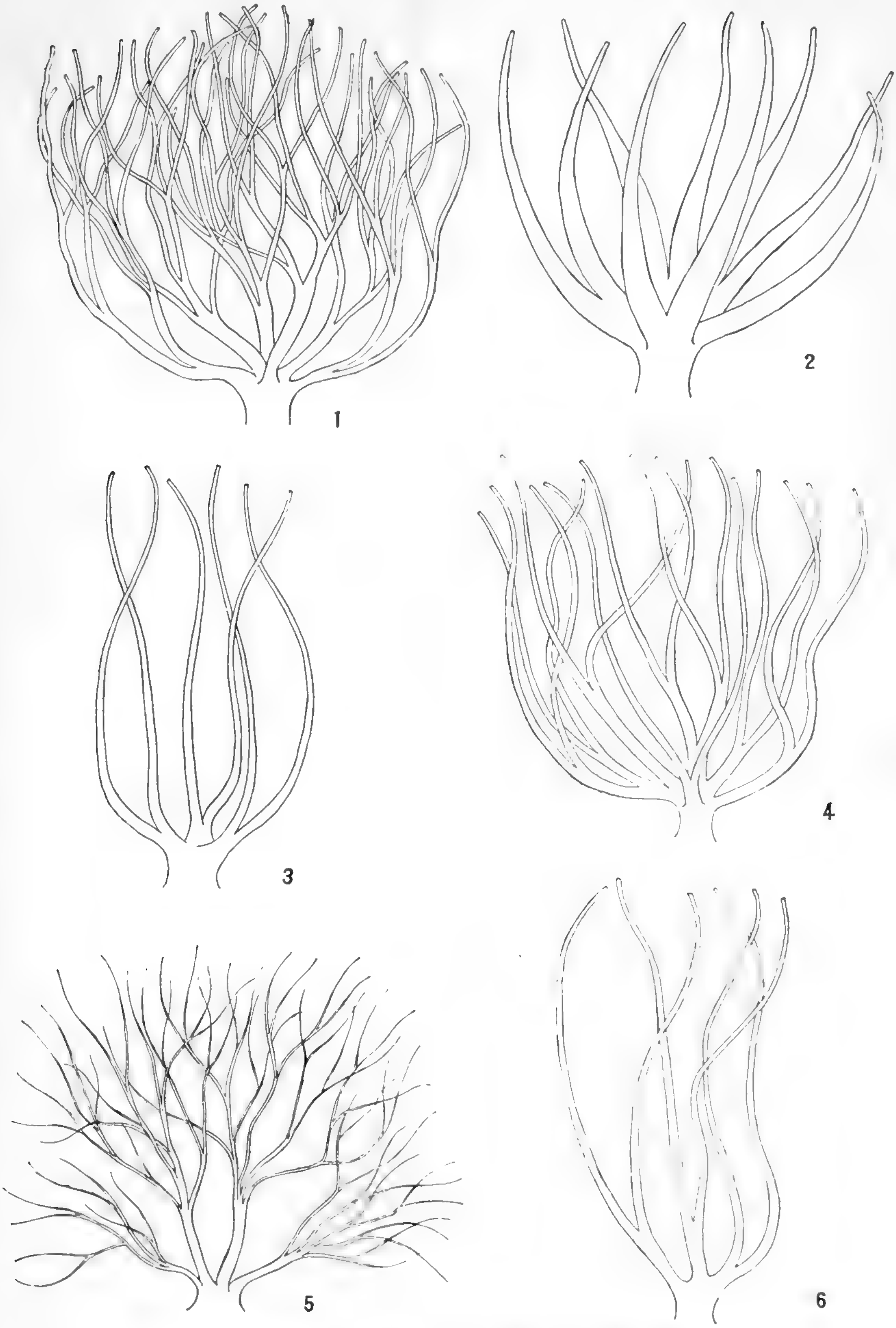


LARVAL CHARACTERS OF SIMULIIDÆ.

PLATE IV.

RESPIRATORY FILAMENTS OF PUPÆ OF SIMULIIDÆ.

Fig. 1.—*Prosimulium pecuarum.*
2.—*Simulium pictipes.*
3.—*Simulium venustum.*
4.—*Simulium vittatum.*
5.—*Prosimulium hirtipes.*
6.—*Simulium meridionale.* (Original.)



RESPIRATORY FILAMENTS OF PUPÆ OF SIMULIIDÆ.

Plate V.

ANATOMICAL DETAILS OF SIMULIIDÆ.

Fig. 1.—Femora, tibiæ, and basal two joints of tarsus of hind leg of *Simulium venustum*, male.

2.—Same of *Simulium vittatum*, male.

3.—Same of *Simulium virgatum*, female.

4.—Same of *Simulium virgatum*, male.

5.—Apex of first and whole of second joint of hind tarsus of *Simulium virgatum* from posterior side.

6.—Side elevation of scutum of *Simulium notatum*, female.

7.—Same of *Simulium bivittatum*, female.

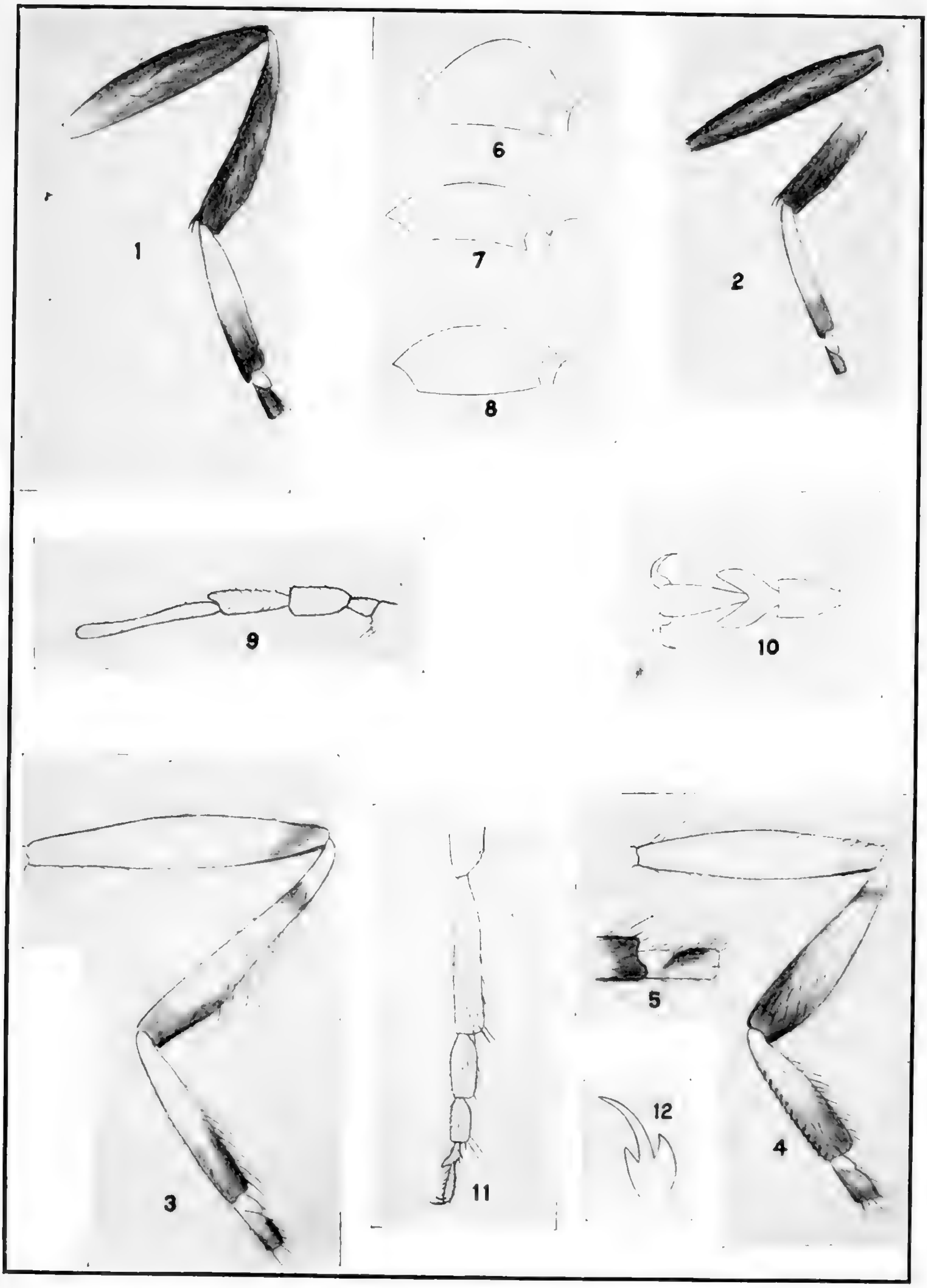
8.—Same of *Simulium ochraceum*, female.

9.—Palpus of *Simulium piscicidium*, female.

10.—Last three tarsal joints in *Simulium*.

11.—Fore tarsus of *Simulium parnassum*, female.

12.—Tarsal claw of *Simulium jenningsi*, male. (Original.)

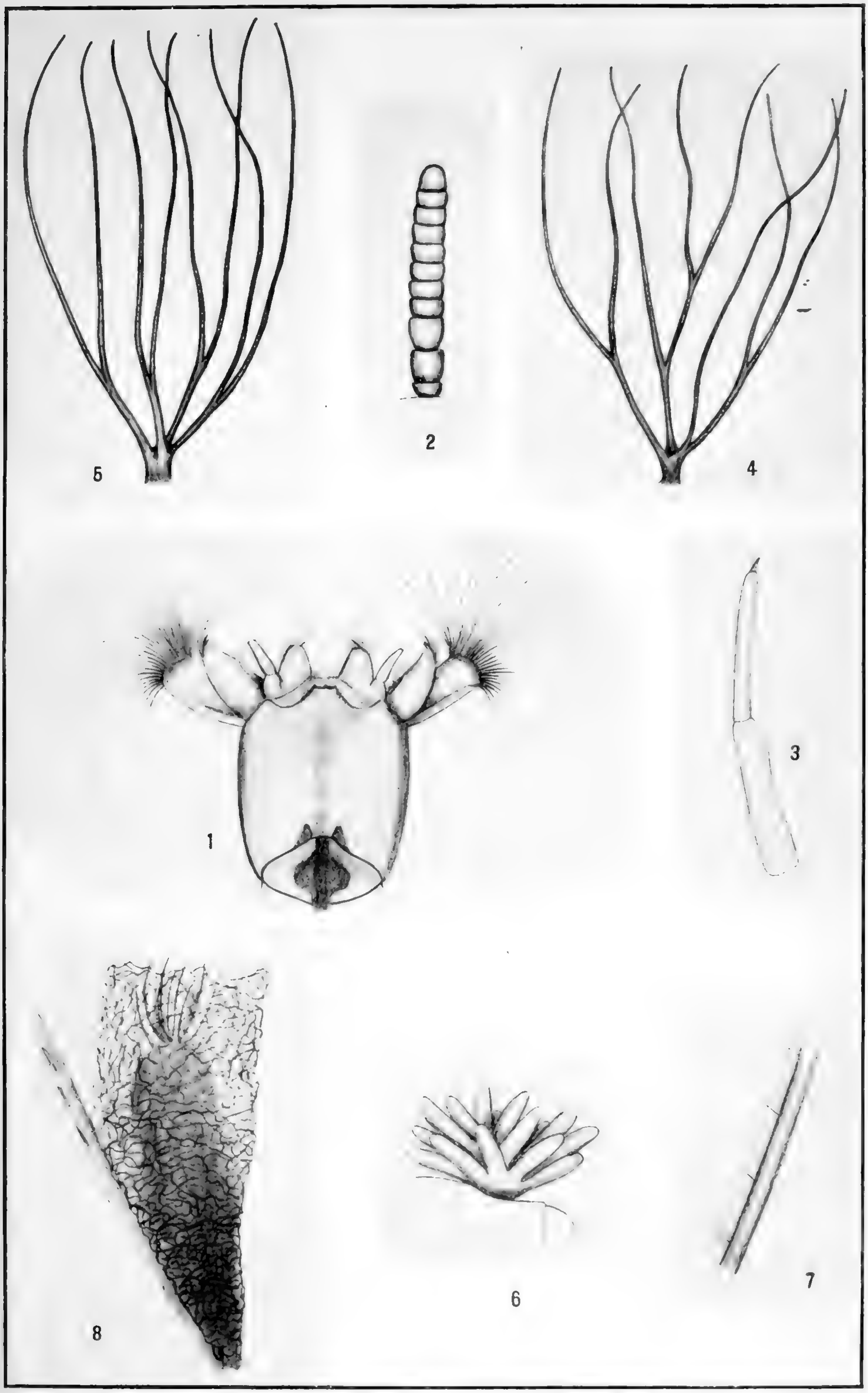


ANATOMICAL DETAILS OF SIMULIIDÆ.

PLATE VI.

ANATOMICAL DETAILS OF SIMULIIDÆ.

Fig. 1.—Head of larva of *Simulium meridionale* from ventral aspect
2.—Antenna of *Simulium*, imago.
3.—Antenna of *Prosimulium hirtipes*, larva.
4.—Pupal respiratory filaments of *Simulium metallicum.*
5.—Pupal respiratory filaments of *Simulium piscicidium.*
6.—Larval respiratory filaments of *Simulium pictipes.*
7.—Portion of ray of mouth fan of *Prosimulium hirtipes*, larva.
8.—Cocoon of *Simulium pictipes.* (Original.)



ANATOMICAL DETAILS OF SIMULIIDÆ.

TECHNICAL SERIES, No. 27.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

CLASSIFICATION OF THE ALEYRODIDÆ.

CONTENTS AND INDEX.

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BY

A. L. QUAINTANCE,

In Charge of Deciduous Fruit Insect Investigations,

AND

A. C. BAKER,

Entomological Assistant.

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A. F. BURGESS, *in charge of gipsy moth and brown-tail moth investigations.*
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MABEL COLCORD, *in charge of library.*

CONTENTS.

PART I.

PART II.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

CORRIGENDA.

Prof. T. D. A. Cockerell has called to the attention of the authors an oversight in Part II, which we desire speedily to correct. *Asterochiton* Maskell was used for a series of species represented by *vaporariorum*, since the first species described under this genus by Maskell proved to be this insect under the name of *papillifer*. We had overlooked the fact that Prof. Cockerell had designated *aureus* as the type of *Asterochiton* (Proceedings of the Academy of Sciences of Philadelphia, 1902, page 282> and had proposed a subgeneric name, *Trialeurodes*, with *pergandei* as type, a specie of the *vaporariorum* series. *Asterochiton* of our paper must, therefore, replace *Dialeurodoides*, and *Trialeurodes* Cockerell, *Asterochiton*.

Aleyrodes olivinus Silvestri should be added to the list of species of *Aleurolobus*.

Tetraleurodes mori var. *arizonensis*, while described in Science Gossip as cited, was named in Bulletin 67 of the Florida Agricultural Experiment Station, page 666 (1903).

ERRATA.

Plate I, facing page 8, line 5 from bottom, for *cockerelli* read *cockerellii*.
Page 20, line 3 from bottom, for *nane* read *nahe*.
Page 32, line 4, for *cauded* read *caudad*.
Page 33, line 19, for *Dialourodicus* read *Dialeurodicus*.
Page 80, legend to fig. 11, line 2, after *antenna of adult* insert period.
Page 98, line 15 from bottom, after (*1903*). insert (*India*.).
Page 100, line 9, for *29* read *28*.
Page 101, line 10, for *euphorbiara* read *euphorbiarum*.
Page 101, line 22, after (*1900*). insert (*U. S. A.*).
Page 102, line 5 from bottom, after (*1911*). insert (*Japan.*).
Page 102, line 4 from bottom, for *signatus* read *T-signatus*.
Page 103, line 17, after (*1911*). insert (*Japan.*).
Page 105, line 19 from bottom, after (*1900*). insert (*Georgia and D. C.*).
Page 105, line 16 from bottom, for *9* read *96*.
Page 106, line 3, after *16* insert semicolon and after *Pl* insert period.
Page 108, line 16 from bottom, after (*1900*). insert (*Florida*.).
Page 109, line 3 from bottom, for *48* read *46*.

TECHNICAL SERIES, NO. 27, PART I.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Entomology,
Washington, D. C., August 14, 1912.

Sir: I have the honor to transmit herewith for publication as Technical Series No. 27, Part I, of this bureau a manuscript dealing with the insects of the family Aleyrodidæ, or white flies. This family includes several species of insects of the greatest economic importance, and other species are attracting attention by reason of their increasing abundance and injuries. The bureau is therefore frequently called upon to determine these insects, not only from this country but from many parts of the world. This family has been much neglected by entomologists and there has thus not been established a system of classification for the various forms. It is the aim of the present paper to furnish this needed system of classification, which, it is believed, will be found most useful to those interested in the family. Part II will contain an account of the species of the large and important genus *Aleyrodes* and will complete the monograph of the family.

Respectfully,

L. O. Howard,
Entomologist and Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

*

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

CLASSIFICATION OF THE ALEYRODIDÆ—PART I.

INTRODUCTION.

Few groups of insects have been more neglected by entomologists and collectors than the Aleyrodidæ. It is believed that comparatively few of all the species which undoubtedly exist have as yet found their way into collections. The family is widely distributed in the temperate and tropical regions of the world, and it will perhaps, when thoroughly worked, prove to be about as rich in species as the Coccidæ or Aphididæ.

Beginning with Maskell's paper, which appeared in 1895, there have followed a number of publications dealing with the Aleyrodidæ, most of them systematic in character, but some dealing with the biology and habits of certain species of considerable economic importance. These papers have come from widely separated parts of the world, as New Zealand, the United States, India, Europe, Japan, etc., and indicate an increasing and widespread interest in these insects.

Until 1907 only two genera for the family were recognized, *Aleyrodes* and *Aleurodicus*. Since this date, however, three additional genera have been established, namely, *Aleurochiton*, *Paraleyrodes*, and *Udamoselis*, the discovery of which has thrown much light on the probable position of the Aleyrodidæ in relation to other families of insects, and on the lines of descent of the several subgroups within the family itself.

The insect collections of the United States National Museum and of the Bureau of Entomology contain a large amount of material of this family received from correspondents from many parts of the country, and have been recently considerably augmented by the large series of specimens attained by Mr. R. S. Woglum, of the Bureau of Entomology, in connection with his search for natural enemies of the citrus white fly (*Aleyrodes citri* R. & H.) in the Orient. The bureau also has, as stated in an earlier publication, through the kindness of the New Zealand Institute, the temporary custody of the Maskell collection of Aleyrodidæ, including nearly all of his types. It has therefore seemed appropriate to undertake, at this time, a revision of the group as a whole, and to determine as accurately as possible a system of classification based upon the natural relationship of the various forms.

The present paper deals with certain features of the anatomy and external structure of the Aleyrodidæ, and attempts to show the position of the family among homopterous insects. All species of the family at present known are treated, save those belonging to *Aleyrodes*, and this genus will be made the subject of a later publication.

It is hoped by the writers that this paper will facilitate the classification of these insects and further stimulate the interest already evidenced in them.

MORPHOLOGY OF THE ALEYRODIDÆ.

THE EGG.

The eggs of insects belonging to this family are elongate-oval in shape and are smooth on the surface or variously sculptured. This egg marking is often one of the simplest means of distinguishing between two closely allied species. The eggs are provided at or near their larger end with a stalk which, in such species as *Aleurodicus holmesii*, is extremely long. (Pl. XIX, fig. 6.) It serves as an attachment for the egg, but it also seems to direct the spermatozoa at the time of fertilization. At this time the stalk is filled with protoplasm and the mycropylar structure is plainly visible within the egg just at its entrance. After fertilization this protoplasm dries up and the stalk becomes a hollow tube. Cary, in his work on embryology,[1] [a] arrives at a similar conclusion, for he says:

> The spermatozoan moves up through the protoplasm contained in the stalk of the egg, while the female pronucleus moves down and comes to lie at the entrance of the stalk. Immediately after the act of fertilization the protoplasmic contents of the stalk shrivel and dry up.

If, however, the primary function of this stalk is for the direction of the spermatozoa, it is strange that there should be such great variation in its length. It is certainly, however, not comparable to the protective stalk in eggs of such forms as *Chrysopa*, for it is not a waxy secretion but an extension of the chorion. The eggs of some psyllids, which are closely related to the aleyrodids, possess stalks, but their exact function is unknown to us.

The arrangement of the eggs upon the leaf varies greatly with different species. The females of some insert the setæ into the tissues and, using the rostrum as center and the body as radius, place the eggs in regular circles. This habit was first noticed by Réaumur in 1736, whose interesting observation we here quote.[2]

> Pour y parvenir, & pour avoir l'histoire de notre petit papillon, le 25. Juin je choisis une feuille sur laquelle il y en avoit un seul très-tranquille, & que je

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[a] The small figures refer to the "Literature," page 97.

jugeai y vouloir faire ses oeufs; je marquai l'endroit de la feuille où il étoit. Je trouvai, le lendemain 26. le papillon dans la même place; le 27. il n'en avoit pas changé, mais tout auprès de lui il y avoit un petit espace à peu près circulaire, aisé à distinguer du reste de la feuille; il étoit poudré d'une poudre blanche, de celle qui blanchit toutes les parties de ce papillon; là elle éteignoit la vivacité du verd. Cet espace avoit environ une ligne de diamétre. Sur sa circonférence j'observai trois petits corps que je crus être des oeufs, & qui en étoient réellement. Enfin le 28. le papillon s'étoit éloigné d'un demi pouce au plus de la place où je l'avois toûjours trouvé pendant les jours précédens. Il me fut plus aisé alors d'observer sans crainte de l'inquiéter, les petits corps qui étoient arrangés autour de la circonférence du petit espace qu'il avoit blanchi. Avec le secours d'une forte loupe, je reconnus que leur figure étoit assés semblable à celle des oeufs ordinaires, elle tenoit pourtant plus de la cylindrique. Ces oeufs sont oblongs, ce sont de petits cylindres dont les deux bouts sont amenés en pointes arrondies; leur plus grand diamétre étoit à peu près dirigé vers le centre de l'espace circulaire.

In American literature Dr. Britton appears to have given the first account in 1902, though Davis mentions it in Insect Life, Volume VII, 1894. In describing the habits of a species on lettuce, Dr. Britton says:[3]

The female first thrust her beak into the leaf and depositing an egg swung about with her beak still inserted and serving as a pivot, continuing to deposit eggs in a circle of about one millimeter in diameter. One of these circles contained six, while another had nine eggs.

The same habit was described and figured by Dr. Back[4] for *Aleyrodes howardi* Quaintance, and it has been described in connection with the description of species by the senior author and other writers. Some species, however, use no definite arrangement but scatter the eggs irregularly over the leaf almost exclusively upon the underside. The number of eggs deposited seems to be fairly large if the proper food conditions are found. Dr. Zehntner[5] gives 150 to 200 eggs for *Aleyrodes bergi* Signoret, and Morrill and Back[6] have secured 211 from a female of *Aleyrodes citri* Riley & Howard.

Dr. Morrill was the first to note parthenogenesis in this family[7] and we give therefore his original observations on the subject[7b].

Adult females have been isolated on plants previously free from *Aleyrodes* in any stage, for the purpose of determining the duration of adult life, the number of eggs laid by each female, whether or not parthenogenesis occurs, and, if so, its character. The females isolated for the purpose of these observations were seen to emerge from their pupa cases, and consequently there was no possibility of their having been fertilized. The plants upon which these females were kept were growing in small pots covered with lantern chimneys, which were closed at the top with cheesecloth. Four trials were made:

1. April 3, 1902, an unfertilized female began egg laying, and on April 17, three eggs were observed to have hatched.
2. April 17, 1902, an unfertilized female began egg laying, and on April 29 several eggs had hatched.
3. Dec. 8, 1902, a female emerged, was isolated on a tomato plant, and began egg laying Dec. 12 (females usually begin egg laying on the second or third

day after emergence), and continued, averaging four per day for eleven days. Personal observations were here discontinued, but E. A. Back, an undergraduate student at the Entomological Laboratory, noted that the adult died Jan. 1, 1903. On Jan. 7 I found the plant dead, apparently from cold, and on examination of the leaves I found that about three-fourths of the eggs had hatched, and that some of the larvæ were in the second instar at the time the plant died. Quite a number of eggs were found that had certainly been laid during my absence, but they were not counted.

4. March 17, 1903, a female emerged from its pupa case, and was isolated on tomato and chickweed growing in the same pot. Egg laying began March 18. Eggs were deposited on the stems and upper and lower surface of the leaves of both plants, making it impossible to count from day to day all the eggs that had been laid. On April 2, forty-nine eggs were counted, and on April 22 eighty more were known to have been added to this number. There were about eight days altogether when the female was in such a position on the plant that no attempt was made to count the eggs for fear of disturbing her. At a very low estimate, twenty-five eggs were laid during these days. The offspring of this female began to emerge as adults on April 22, and the original female was transferred to a chickweed plant growing in another pot. By an accident I lost on the same day the positive identity of this insect, but I am quite sure that she produced the forty-nine eggs which I counted on April 29, after which observations on this insect were discontinued. So far as observed, all the eggs laid by this female hatched and the young reached maturity, the adults being males without exception.

To summarize these observations, unfertilized eggs hatch and the larvæ develop into adults of the male sex. Two females were known to lay forty-four and one hundred and twenty-nine eggs respectively, and in both cases many more were undoubtedly laid. These same insects lived in the adult condition for twenty-three and more than thirty-six days respectively.

I have tried several times to isolate a female which had certainly been impregnated, but was unsuccessful. It is not impossible to do this, however, and I suspect that when this is done the young produced from fertilized eggs will all develop into females, giving us a condition similar to that which is generally believed to occur in the honey bees, and known as arrhenotoky.

In regard to the length of adult life, I might further add that in greenhouses where there are millions of live adults on the plants, it is difficult to find a single dead specimen on the benches, providing they have not been killed by artificial means. This is a further indication that natural deaths among adults are rare, and that the adult life of each individual may extend over many weeks.

Should it prove true that unfertilized eggs of this insect produce only males and fertilized eggs only females, then the number of adult males and females will be in direct proportion to the number of unfertilized and fertilized eggs. In Psyche (April, 1903) I gave an estimate of the proportion of the two sexes of *Aleyrodes* in nature, based on actual count of eighty-five specimens of adult *Aleyrodes* taken at random, representing four different species. The figures given were twenty males to sixty-five females. For the purpose of obtaining a more exact idea of the proportion of the sexes in the present series I counted one hundred adults taken at random, and found twenty-three males to seventy-seven females.

Morrill and Back[6] have further established the phenomenon in *Aleyrodes citri* and it is not improbable that it will be found to occur in many species.

The duration of the egg stage is about 12 days for the commoner forms. Temperature, however, seems to have a considerable influence upon the length of the stage, for in uniformly warm weather a much shorter time is necessary and under unfavorable circumstances the time may be greatly extended. The larva emerges from the egg by means of a longitudinal fissure in the anterior part of the egg and the time required for escaping from the shell varies considerably. In connection with her studies of Aleyrodidæ in California, Miss Bemis observed the hatching of numerous eggs and says:[3]

> In the eggs under observation, there elapsed from forty-two minutes to three hours and eight minutes from the time that the shell began to open until the larva was free. The egg that took the greater time was upon dry material and was dark brown in color, the shell when empty keeping its upright position and shape, so that the slow hatching was probably due to the toughness of the chorion.

In our experience the drying of the material upon which the eggs are placed greatly retards or even prevents hatching.

THE HEAD OF THE ADULT.

The head is somewhat triangular in shape and is carried in such a way that its anterior surface is slanting ventro-caudad. The compound eyes are of the agglomerate type. They are usually constricted in the middle (reniform), or in some species are entirely divided by a tongue-shaped portion of the integument. It sometimes happens also that the facets of these two sections are different in size. The ocelli are two in number and situated close to the anterior margin of the compound eyes. The position of these ocelli relative to the compound eyes varies in the different species.

The antennæ are placed below the eyes in shallow antennal sockets. They bear a striking resemblance to those of the Aphididæ. As a rule, they are composed of seven segments, of which the third is the longest. The first and second are always short and thick, while the others are elongate, subcylindrical, and covered with numerous imbrications. Circular fringed sensoria occur usually on segments III, V, and VII (see *Aleurodicus giganteus*, Pl. XXIV, fig. 10), and spike sensoria are sometimes also found. Fine hairs are scattered here and there or are found encircling the segments, and segment VII always terminates in a bristle-like armature. There is great variation in the length of the segments among different species in the genus *Aleyrodes* as at present understood. As a rule, segment VII is short, often the shortest of all. In species like *graminicola*, however, it is as long as all the other segments together and in *longicornis* very much longer. This variation may prove to be of importance in dividing the genus when the forms have been carefully studied. In *Paraleyrodes* segments III to VII have become united so as to form two.

The vertex is rounded in most forms and often possesses a median longitudinal ridge or marking. In some forms, however, as in the genera *Udamoselis* and *Dialeurodicus*, it is produced into a large cone-shaped structure. This prominence between the insertions of the antennæ in both of these genera seems to point to their close relation.

The frons is rounded when viewed from the side and when viewed from the front it is somewhat U-shaped, the bottom of the U forming the suture between it and the clypeus. Its upper edges extend backward. Below the clypeus is the labium, which is trapezium-shaped. The edges of this, as well as those of the clypeus, are slightly turned back so that as the structure lies on the labium there will be a better situation for the setæ. Below the labrum is a triangular sclerite, the epipharynx. All of these sclerites are somewhat united into an elongate triangular structure which, together with the setæ, remains attached to the head and is easily separable from the labium.

The labium is inserted in the base of the head on what is apparently a projection of the thorax. It is of considerable length and is composed of three segments. The relative length of these segments seems to vary in the different forms. Near its proximal end the labium is bent strongly caudad and appears to be grooved for its entire length. At the base this groove is wide, but more centrally it becomes narrower. The first (proximal) segment is much the longest and is narrow. It is in many forms, armed with a few scattered hairs. The second segment is thicker and shorter and the sutures separating it from the first are not well defined. This has no doubt given rise to Marlatt's statement that the labium is two-segmented.[9] The third segment is short in *Aleyrodes*, while in *Aleurodicus* it is considerably longer. It is more heavily chitinized than the others and tapers distad. It is covered with numerous hairs and its tip is bilobed. Each of these lateral lobes is armed with three pegged-spiked taste sensoria situated close together (Pl. II, fig. 4). It is noteworthy that very similar lobes and the same number of similar pegged sensoria occur on the labium of the Psyllidæ. The labium in that family is also bent on its proximal part.

The maxillary and mandibular sclerites are present below the frons, the lower extremity of the former becoming projections. The setæ, four in number, constitute two pairs. Those of the inner or maxillary pair are closely pressed against each other and sometimes for this reason appear as only one. The outer or mandibular setæ to a certain extent inclose the maxillary ones.

In his excellent paper on the hackberry Psylla, Stough has pointed out the very great similarity between the mouthparts in this family and those of the Psyllidæ. He says:[10]

The mouthparts, exclusive of the labium, are almost identical with, though larger than, those of the Aleurodidæ which I have examined. The same sclerites are present, arranged similarly, though somewhat differently shaped. The labrum is much shorter and smaller proportionately than in this family, and the setæ seem to be relatively shorter. The end of the labium has the same lateral processes, but these are relatively smaller. The Aleurodid labium has a bend similar to that of Pachypsylla.

THE DIGESTIVE SYSTEM.

(Pl. II, fig. 2.)

Our observations on the digestive system of the adult are as follows: Leaving the mouthparts the pharynx is met with as a narrow tube which passes gradually into the œsophagus. In the metathorax there is a distinct enlargement, the midintestine, and from this are given off two large saclike structures. From Cary's work [1] we consider these gastric cæcæ, for he says, "After the dorsal wall of the enteron has closed a pair of diverticula are given off from near its anterior end." The midintestine is looped, as shown in the illustration, and joins the hind intestine in the anterior part of the body. This latter is narrow but is more dilated caudad of the vasiform orifice, where the anal opening occurs.

The nature of this orifice in the immature stages and the function of the lingula seem to have been imperfectly understood by some recent writers. The older writers, however, apparently had, in general, the correct idea of it. Westwood, for example, in his description of *Aleyrodes vaporariorum*,[11] speaking of this structure, says, "With the anal apparatus placed at some distance from the hinder end of the body."

Peal, in 1903, discussed this structure at some length. We quote the following from his paper:[12]

> Some time back, while I was examining an aleurodid which in its earlier stages is remarkably flat and transparent, I was fortunate enough to observe the lingula in motion. This organ was shot out beyond the vasiform orifice with extreme rapidity, it being protruded some four or five times a second.
>
> When the lingula was shot out, the vasiform orifice moved in unison, the upper edge being bent inwards while the whole organ moved caudad. The internal opening of the lingula lies directly in the path of the rudimentary circulatory system, and when the organ is in motion it throws the circulatory fluid into a pulsating motion for some distance within the body cavity. I have been unable, so far, to detect the actual formation of the globules of honeydew, but as soon as the lingula comes to rest after a series of protusions a small globule may be seen just within the lower end of the lingula. This globule advances slowly, being apparently forced forward by the movement of the lingula, and after awhile reaches the tip of that organ. I have never observed these globules within the lingula of an adult insect, but once on examining an adult male of *Aleurodes simula*, I perceived a globule of honeydew emerging from the lingula.
>
> There is no doubt that the function of the organ is the secretion of honeydew and the operculum may be regarded as a protective covering to this organ.

It would appear from this that Peal considered the vasiform orifice as a special secreting structure and honeydew to be connected in some way with the circulation. Miss Bemis seems to have a somewhat similar idea about the lingula, for she says,[8] "In some species there are seen minute, blunt tubes on the apex of the lingula through which the fluid may be secreted."

In the introduction to a paper on Aleyrodidæ[13] Tullgren discusses the vasiform orifice. His idea of its nature seems to be the correct one, but he does not go into detail, and we believe him wrong in calling the vasiform orifice the anal opening, for the anus proper seems to open within it.

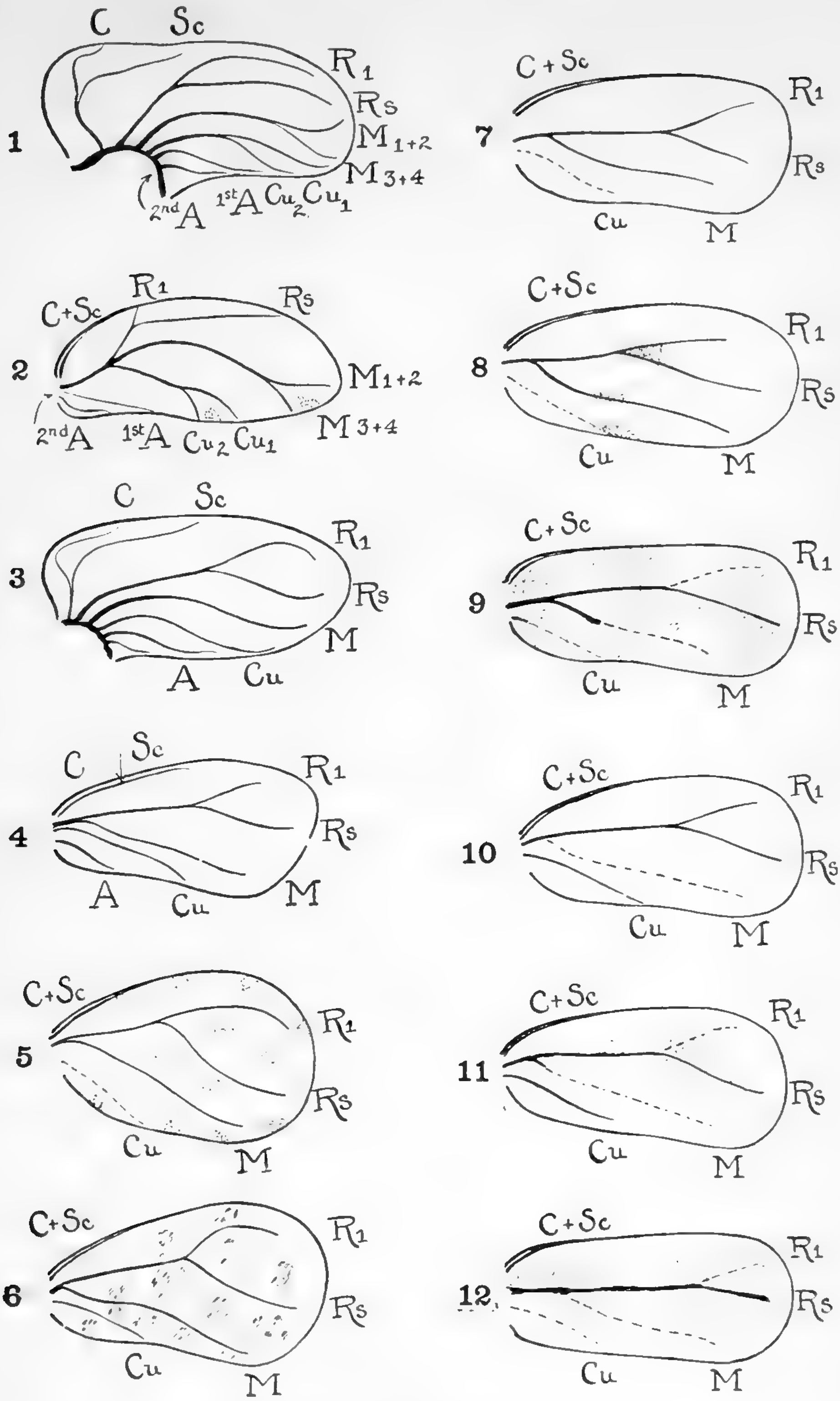
In the forms examined by us the anus appears to open below the lingula (Pl. II, fig. 5) which functions as the supraanal plate. We are unable to find a definite opening at the tip of the lingula. In any case, whether the anus is always at the base or sometimes at the apex, as in the Psyllidæ, this in no way alters the standing of the lingula, which would in either case be the supraanal plate. The operculum is a little more difficult to place. It would not appear strange if it were believed to correspond to the rudimentary last abdominal segment in the Aphididæ, as suggested by Tullgren, for its position in regard to the anal plate is very similar. It does not, however, often appear as a distinct segment, but looks like the rolled-back edge of the lingula.

The substance known as honeydew is, as implied above, merely the excrement of the insects. It is deposited in large quantities by the larvæ, pupæ, and adults and forms a medium for the growth of several fungi. The early pupæ excrete much more than the late pupæ, while the larvæ, in the earlier instars, excrete the most of all, the substance being ejected once or twice for every minute, although not always at regular intervals. The salivary glands are two rounded bodies situated one on either side of the head and united by small ducts.

The exact nature of the wound of the puncturing setæ of Aleyrodidæ we have not ascertained, but in all probability it is similar to that made by the Aphididæ and the Coccidæ, where the setæ pass around the outer cells and finally puncture the soft bast cells from which the proteid content is taken. These proteid substances form the bulk of the insects' food, while much of the sugars taken in at the same time are passed out as honeydew.

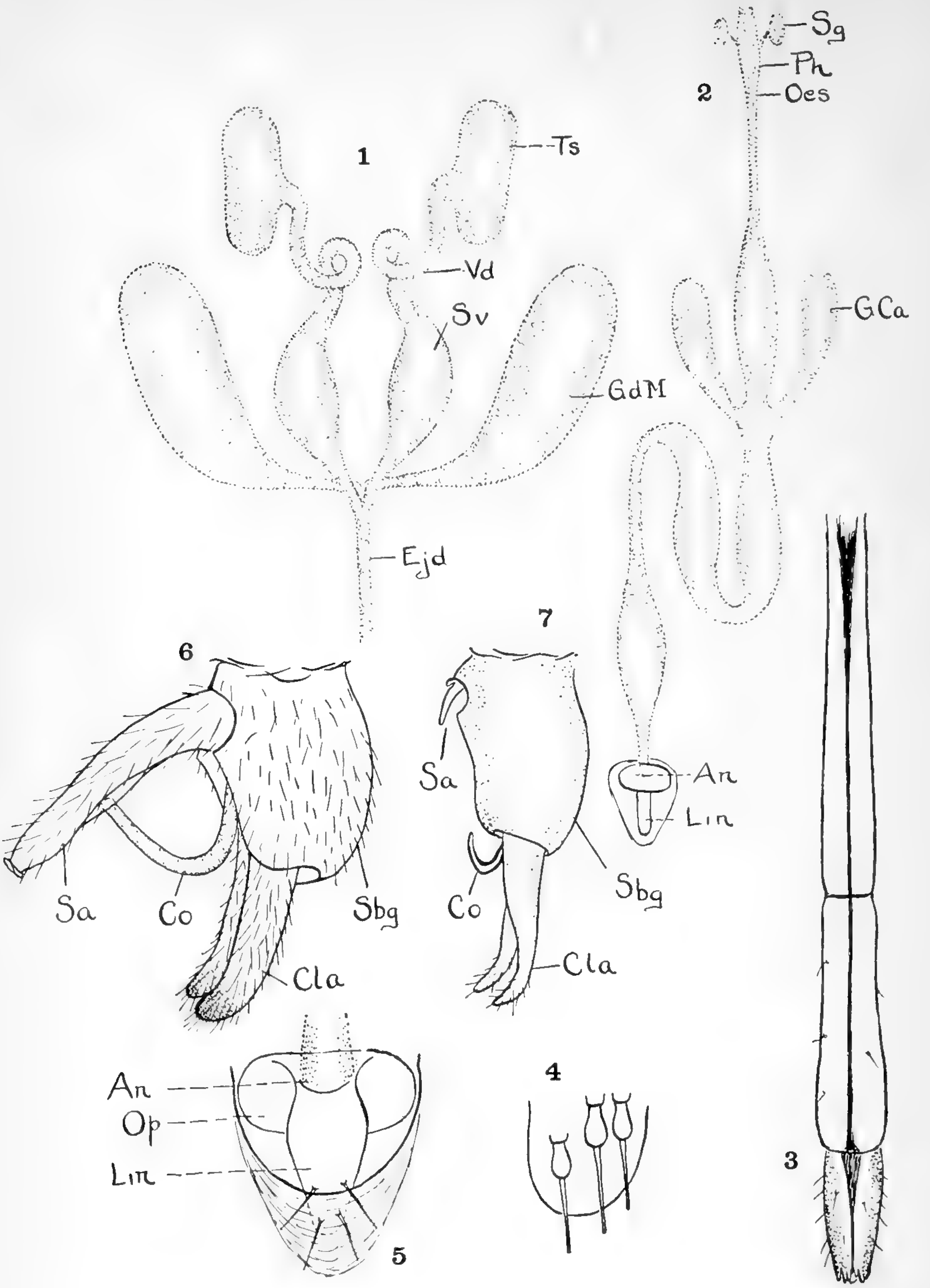
THE WINGS.

The wings are first noticed in the late embryo as imaginal disks produced as ingrowths of the hypodermis. These, losing their connection with the outer layer, soon take on the appearance of closed



WING VENATION IN THE ALEYRODIDÆ.

Fig. 1.—Theoretical origin of the veins of the psyllid genus *Trioza*, showing tracheæ. Fig. 2.—Forewing of *Trioza* sp. Fig. 3.—Theoretical origin of the veins of Aleyrodidæ, showing tracheæ. Fig. 4.—Forewing of *Udamoselis pigmentaria*. Fig. 5.—Forewing of *Dialeurodicus cockerelli*. Fig. 6.—Forewing of *Aleurodicus conspurcatus*. Fig. 7.—Forewing of *Aleurodicus destructor*. Fig. 8.—Forewing of *Aleurodicus* (*Metaleurodicus*) *minimus*. Fig. 9.—Forewing of *Paraleyrodes perseæ*. Fig. 10.—Forewing of *Aleurochiton aceris*. Fig. 11.—Forewing of *Aleyrodes* sp. Fig. 12.—Forewing of *Neomaskellia comata*. (Original.)



ANATOMICAL DETAILS IN THE ALEYRODIDÆ.

Fig. 1.—Male reproductive organs: *Ts*, testis; *Vd*, vas deferens; *Sv*, seminal vesicle; *GdM*, glandula mucosa; *Ejd*, ejaculatory duct. Fig. 2.—Digestive tract: *Sg*, salivary glands; *Ph*, pharynx; *Oes*, oesophagus; *GCa*, gastric cæca; *An*, anus; *Lin*, lingula. Fig. 3.—Labium of *Aleyrodes* sp. Fig. 4.—Taste sensoria on lobe of apex of labium. Fig. 5.—Vasiform orifice, ventral view: *An*, anus; *Op*, operculum; *Lin*, lingula. Fig. 6.—Diagram of genital segment of male Psylla: *Sa*, supraanal plate; *Co*, copulatory organ; *Cla*, claspers; *Sbg*, subgenital plate. Fig. 7.—Diagram of genital segment of male *Aleurodicus*: *Sa*, supraanal plate; *Co*, copulatory organ; *Cla*, claspers; *Sbg*, subgenital plate. (Original.)

sacs. During the pupal stage the wing disks come to lie outside the body, the pads are developed, and in the late pupæ the wings themselves are folded up within the case. They are four in number, membranous, and are composed of two thin, superimposed lamellæ. In the preparation of mounts with potassium hydroxid, these plates often become separated and the wings become opaque and sac-like in form. The border of the wings all around in most species is covered with a series of knob-like or bead-like projections on which occur a number of fine hairs. These hairs vary in number. In some species there is a large central hair on each knob with two or three small ones on each side. In others the hairs are subequal in length and very minute. In *Aleurodicus* the proximal half of the costal margin of the forewing is armed with a number of large spine-like hairs situated on small receptacles. These hairs are placed a short distance in from the costal margin and are arranged along what apparently represents the subcosta. The hairs are directed distad. The hind wing of all species is armed on the proximal portion of its costal margin with a row of strong curved hairs which aid in keeping the wings together during flight. The number of these hairs varies, but from seven to nine hairs are most usually met with. In the Psyllidæ a similar row of hairs is situated in the same region, but there is usually a larger number. In the Aphididæ, on the other hand, this structure is usually replaced by three hook-like hairs situated, not at the base, but on the distal half of the wing.

To illustrate the venation in this family we will use as a basis of comparison the wing of a species of the psyllid genus *Trioza* (Pl. I, fig. 2), following the nomenclature as worked out for that genus by Miss Patch.[14] Comparing with this the wings of *Udamoselis pigmentaria* Enderlein (Pl. I, fig. 4), we see that the veins of the costal region are separate, although very close. These undoubtedly represent the costa and subcosta. We find that radius $_1$ and the radial sector are represented in exactly the same manner as in *Trioza*. The media and cubitus have a position very similar to these veins in the psyllid, but are not branched, while the first anal, the only one present, is in identically the same position in both forms. For species possessing these veins the subfamily Udamoselinæ has been erected and at present includes only the one known form.

In the genus *Aleurodicus* (Pl. I, fig. 7) the costal vein is made up of costa and subcosta. These are as a rule united, but in some species they are separated at the base and can be distinctly traced. The veins radius $_1$, radial sector, and media, are represented as they are in *Udamoselis*. The cubitus and anal, however, have disappeared. This disappearance of the cubitus and the retention of the media form one of the main lines of descent in the family and for the forms showing it the subfamily Aleurodicinæ may be erected. It is worthy of mention that in *minimus* Quaintance (Pl. I, fig. 8) the cubitus is represented by a faint line or fold and in *conspurcatus* (Pl. I, fig. 6) it is retained, this latter species possibly being a connecting form.

In the genus *Aleurochiton* (Pl. I, fig. 10) this state of affairs does not hold, but an opposite line of descent is indicated and the forms showing this may be grouped in the subfamily Aleyrodinæ. Here the costa and subcosta are united to form one vein. Radius $_1$ and the radial sector are present as in *Aleurodicus.* The media, however, is absent or only faintly indicated in freshly emerged specimens. The cubitus, on the contrary, is well retained and forms a distinct vein. It may be noticed here that the pupa of *Aleurochiton* has not the large compound pores of *Aleurodicus.*

In examining a wing of the genus *Aleyrodes* (Pl. I, fig. 11) we see that the costa and subcosta are again united, the radial sector is retained, but the radius $_1$ has disappeared. In some material a faint rudiment of this vein is noticeable. The media, as in *Aleurochiton*, has entirely disappeared and is made out plainly only in the fresh wing. In some species, however, the rudiment of this vein is noticeable and has been observed as early as the time of Signoret, for he says, speaking of *fragariæ*[16] "Dans cette espece, entre la nervure mediane et la nervure oblique de la base, j'en ai observe le commencement d'une seconde." The cubitus is here retained and forms the second vein of the wing. It is evident, then, that *Aleyrodes* is an offshoot from *Aleurochiton* by the reduction of radius $_1$. This is borne out also by the pupa, which has no large compound pores. The careful work of Miss Patch[14] on tracheation in this genus corresponds exactly with our observations. She figures and describes the venation in *Aleyrodes* sp. and shows clearly that the second vein of the wing is the cubitus. Her words are, "The second vein of the wing of *Aleurodes* is cubitus, as will be seen by comparing figures 44 and 45, where the second vein is shown to follow the courses of the cubital trachea." In this family Miss Patch, however, treated only the genus *Aleyrodes.*

The venation in the genus *Paraleyrodes* (Pl. I, fig. 9) appears at first glance like that of *Aleyrodes*, but more careful study shows it to be very different. The costa and subcosta are here united and the radial sector is retained. The second vein of the wing, however, is not the cubitus, but the remnant of the media, and can be found as a branch of the main vein. Moreover, in some specimens of *perseæ* the cubitus can be seen faintly indicated in its usual position. This venation shows, then, that *Paraleyrodes* is not closely related to *Aleyrodes*, but is a branch from *Aleurodicus* by the reduction of the media and radius $_1$. This view is also borne out by the structure of the pupa, which has the compound pores of *Aleurodicus*, and of the foot, which has the paronychium represented by a spine as in that genus.

In *Neomaskellia comata* Maskell (Pl. I, fig. 12, and Pl. XXXIV) we find the greatest reduction in the family. Here the costa and subcosta are united, and in the body of the wing only one vein, the radial sector, remains. (It should be noted here that Maskell's figure of this species is wrong. Our drawings were made from his type and the small vein he figures does not exist.) It is evident, then, from the venation that *comata* forms the type of a new genus. This is also indicated by the hairy psyllid-like claspers.

The species *Dialeurodicus cockerellii* (Quaintance) (Pl. I, fig. 5; Pl. IV, fig. 3) shows the same wing venation as *Aleurodicus*, but the type of vertex and the absence of compound pores immediately place it elsewhere.

In this connection should be mentioned an article by Sophie Rostrup [16] which, since it is apparently followed by Dr. Max Wolff, deserves some notice. As the communication is short we quote it entire:

Aleurodider er en lille med Skjoldlus og Bladlopper naerbeslaegtet Familie af smaa, møllignende Dyr. Ved et Besøg af mig i Ringsted i August 1908 indsamlede Landbrugskandidat, Gaardejer *Pallesen*, Kaerehave, Blade af Gulerødder, angrebne af Krusesyge, paa hvis Underside der fandtes en Del smaa Dyr, om hvilke Hr. *Pallesen* meddelte mig, at han ofte havde set dem paa saadanne Blade. Ved naermere Undersøgelse viste de sig at høre til ovennaevnte Familie. Imidlertid fandtes der ingen udviklede Insekter, kun Larver og Nymfer; saa vidt det kan afgøres efter dette Udviklingsstadium, synes de at høre til Slaegten *Aleurodicus*, der hidtil ikke har vaeret kendt fra Evropa. Larver og Nymfer er forsynede med et fint Voksovertraek og sidder ubevaegeligt med deres lange, tynde Snabel indboret i Plantevaevet og suger af dette. Spørgsmaalet, om disse Dyrs Sugning staar i Forbindelse med Krusesygen og i saa Tilfaelde, hvilken Del de har i denne, kan paa naervaerende Tidspunkt ikke afgøres. Professor *Kølpin Ravn* mener oftere at have bemaerket disse Dyr paa Gulerod.

It is evident by examining the figures that the specimens referred to do not represent a species of *Aleurodicus*, but belong to the Psyllidæ and are very likely near *Trioza*. The pulvillus of the foot, the general form, the marginal wax fringe, the wing venation, the lack of vasiform orifice, in fact, all the characters noticeable in these figures are those of the Psyllidæ and not of the Aleyrodidæ. Any ideas, therefore, based on the venation in these figures must be discarded.

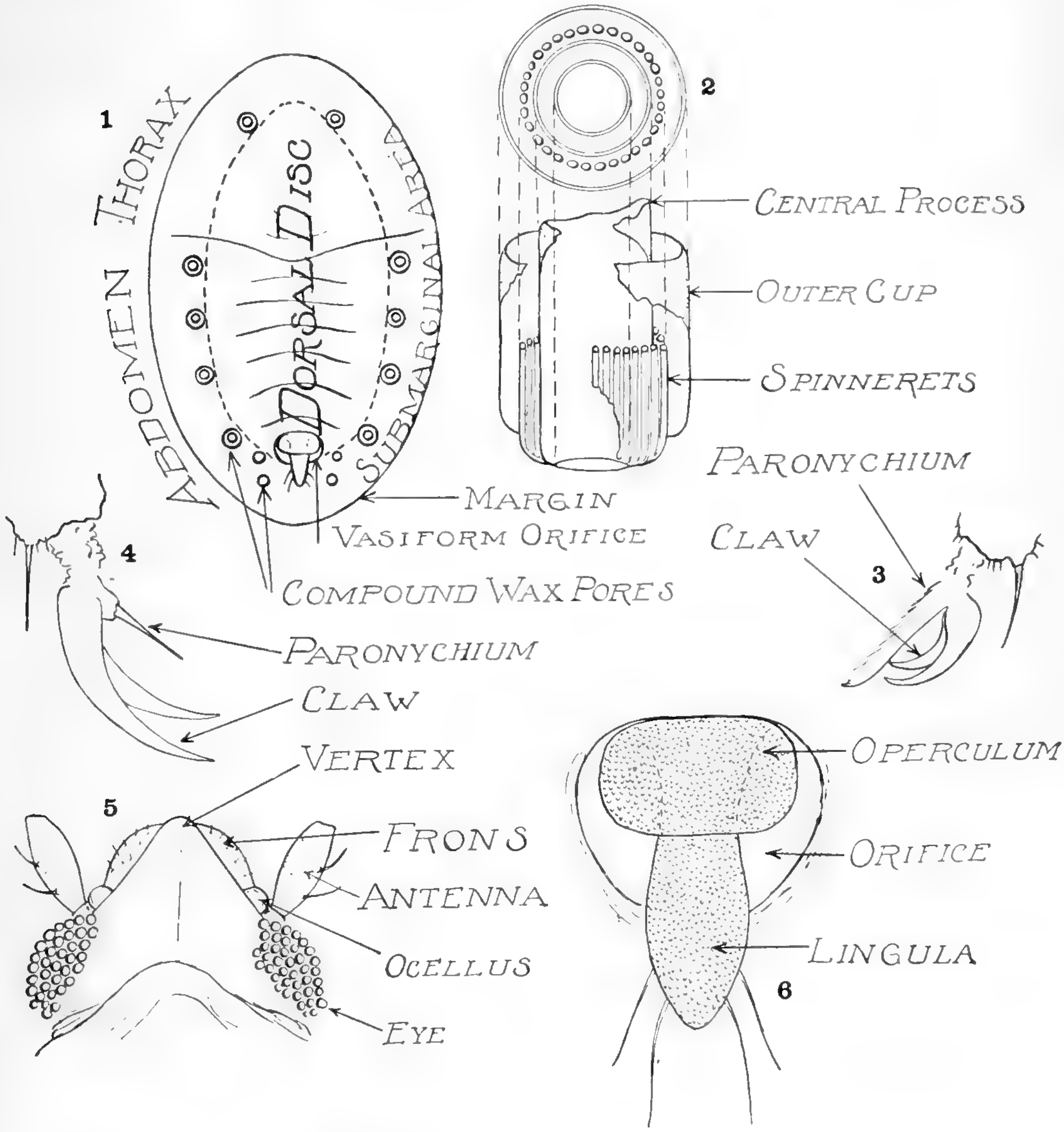
MALE GENITAL ORGANS.

In male Aleyrodidæ the abdomen ends in a heavily chitinized collar on the dorsal surface of which is found the vasiform orifice and from the extremity of which protrude the claspers and the copulatory organ. It does not seem impossible that this last segment represents the subgenital plate and has been produced by the fusion of the upper margins of that plate, while the lingula, as explained elsewhere, represents the supraanal plate. This would seem suggested from the state of affairs found in the Psyllidæ, for in comparing *Psylla* sp. (Pl. II, fig. 6) and *Aleurodicus* sp. (Pl. II, fig. 7) it will be seen that the genital segments are very similar. If in the psyllid the upper margins of the subgenital plate were united above the claspers and the supraanal plate reduced, they would be almost identical. In any case, however, the close relation of the two families seems indicated by this structure. The shape and armature of the claspers vary considerably in different species, but as a rule these organs are curved at the distal end and armed with a number of spines. Those of *comata* are very hairy and psyllidlike. Each clasper generally has on the outer margin of its distal part a rounded shoulder and its distal end is formed into two processes for the attachment of the muscles. The copulating organ is found between the claspers. It is usually single, but in *Paraleyrodes perseæ* it appears bifurcate. It is an elongate, subcylindric rod, tapering on its distal part and swollen at the base. In some forms it appears grooved on its upper surface for the reception of the penis, but in others we are not able to make this out, but the two seem fused into one structure. The penis is carried recurved toward the vasiform orifice in a manner very similar to that found in the Psyllidæ. The ejaculatory duct extends cephalad some distance from the base of the penis, where it has its origin in the union of the two *vasa deferentia.*

The testes (Pl. II, fig. 1) are globose or elongate bodies situated one on each side of the median line of the abdomen. The *vas deferens*, in leaving the testis, is coiled upon itself and then swollen considerably to form the seminal vesicle. Again contracting, it is united with its fellow and forms the ejaculatory duct. At this place of union are found the openings of the ducts leading from the two large sac-shaped structures, in all probability the glandulæ mucosæ. The external genital organs of the male are definitely formed in the pupal stage and fairly early in this stage the claspers can be seen fully shaped. They are developed, according to Cary, from the two pairs of posterior abdominal imaginal disks. The reproductive organs can be seen in all the larval stages as a pair of gland-like masses, one on either side of the abdomen.

FEMALE GENITAL ORGANS.

The supragenital segment in female Aleyrodidæ shows some variation in form. In *Aleyrodes* it is broad and crescent-shaped and is armed with regularly placed hairs. It is often differently pigmented from the surrounding portions of the body and is situated some dis-



DIAGRAMS OF ALEYRODID STRUCTURES.

Fig. 1.—Pupa case. Fig. 2.—Compound wax pore. Fig. 3.—Foot of subfamily Aleyrodinæ. Fig. 4.—Foot of subfamily Aleurodicinæ. Fig. 5.—Head. Fig. 6.—Vasiform orifice. (Original.)

tance cephalad from the tip of the ovipositor. In *Dialeurodicus* it appears to be very similar in shape, but in *Aleurodicus* it is narrower and more elongate, while in *Paraleyrodes* it is rounded. What apparently corresponds to the subgenital plate here is a large structure covering the caudal ventral portion and extending some distance dorsad on each side. The structure of the ovipositor is considerably like that found in the Psyllidæ, while it differs quite markedly from the structure present in the Aphididæ. It is composed of six parts, the outer covering of which usually bears a definite number of hairs. These parts are grouped into pairs. The inner and upper pair of these is usually distinct for some distance, at least, and the parts are easily separable. The outer pairs, however, have grown together almost entirely and appear as one pair. Occasionally, though, they can be seen split at their tips, as is the middle pair, and they are sometimes sculptured or serrate. Extending throughout the ovipositor there are a number of chitinized rods. These appear to be composed of parts jointed together and working one against another. There are present toward the tip flattened structures which apparently correspond to the "sting palpi" of the Psyllidæ. The ovaries are two in number and very large. They are composed of five-chambered ovarian tubes and in some cases almost entirely fill the abdomen. The *receptaculum seminalis* is ventral and the oviduct, coiling upon itself considerably, opens between the valves of the ovipositor.

LEGS OF THE ADULT.

The rudiments of the legs appear very early in the embryonic state, at about the same time as those of the mouthparts. A study of the legs of the adults is interesting, as it tends to throw some light on the position of the family. The three pairs are considerably alike, varying only in the relative lengths of the different segments. The femora and tibiæ are elongate and armed with spines and hairs. The tibiæ especially possess several longitudinal rows composed of prominent spines placed close together. On the distal third these become fewer in number, excepting for a comblike structure, which is found in at least several species. The distal end of the tibiæ is surrounded by a number of short spines which, though much weaker, suggest the jumping spines of the Psyllidæ. The tarsus is composed of two segments almost equal in length, and in this regard it is much closer to the Psyllidæ than to the Aphididæ, in which one segment is very much reduced, or to the Coccidæ and some Aphididæ, in which it is altogether lost. Attaching the claws and paronychium to the tarsus proper are a number of irregular pieces difficult to make out and which may be part of the tarsus. The foot itself seems much nearer to that of the Psyllidæ than to that of the Aphididæ, for the

Psyllidæ have a prominent bilobed pulvillus, while the Aphididæ have practically none. In some forms in the Aleyrodinæ the paronychium is very prominent, and in all forms it is represented either by a pad or a spinelike structure. The paronychium in the Aleyrodidæ, however, is never bilobed as in the Psyllidæ, though in some species there is a slight indication of this.

WAX PORES OF PUPA CASE.

The secretion of wax is very common in many of the Homoptera and is particularly noticeable in the families related to the Aleyrodidæ, namely, Psyllidæ, Aphididæ, and Coccidæ. In the Psyllidæ besides the anal wax glands there are in the larvæ of many species abdominal and marginal wax glands, the marginal ones of which secrete long, fine, hollow, brittle, waxen hairs, which form a fringe about the insect. In the Aphididæ the glands are usually grouped. In *Schizoneura* and some species of *Pemphigus* the secreting cells are arranged in rings, while in *Chermes*, *Mindarius*, etc., they are agglomerate in nature, and in some forms these agglomerate pores are surrounded by a chitinized ring.

In the larvæ of the Aleyrodidæ we have three types of pores, namely, simple, agglomerate, and compound. In the Aleyrodinæ the dorsal pores present are all simple, though many of them may be larger than others and arranged in definite rows, producing a fringe comparable to that in the larvæ of the Psyllidæ. It is in the Aleurodicinæ that the development of special wax secreting structures is found and this development seems to throw some light on the relation of the forms. In *Dialeurodicus* the dorsal pores are simple and usually scattered, though in *silvestrii* the greater number of them are collected into a subdorsal band. In the species *lahillei* these simple pores have taken on a definite and restricted arrangement, forming agglomerate pores as in some Aphididæ. In the center of some of these, however, is found a large, chitinous process which points to these as near the forerunners of the true compound pores in *Aleurodicus*. This fact, together with the shape of the lingula, wing, etc., seems to indicate that *lahillei* is the type of a new genus older than *Aleurodicus*, but not so old as *Dialeurodicus*. In *Aleurodicus* the compound pores have a constant structure in all the species, indicated in Plate III, figure 2. The chitinous ring surrounding the agglomerate pores in some other forms is here a definite elevated cup-like structure. Within this cup the spinnerets are arranged in a ring similar to the ring in *Schizoneura*, but, unlike these cells, are produced into more or less elevated rods or tubes. Within this ring of spinneret rods is a chitinous process, apparently hollow, which may be very long, as in *holmesii*, or as short as the outer cup. In *Paraleyrodes*, while the pore is of the same compound type, it is different in appearance, for here the ring of spinnerets is not extended into rod-shaped structures, but is seen only at the base. The outer cup is very shallow and the central chitinous process is split into a number of sections. It would appear that in *Paraleyrodes* the spinnerets and outer cup have become shortened at the same time with the media and radius$_1$. The compound pores of the forms belonging to the subgenus *Metaleurodicus* are of an intermediate nature. The spinnerets are reduced in *minima* and *cardini* in a manner comparable to those of *Paraleyrodes*, but the central process is entire. In *altissimus* besides the reduction of the spinnerets, the central process is split into three divisions. In these forms, however, the lingula is short and generally included, unlike the typical forms of *Aleurodicus* or *Paraleyrodes*. Unfortunately the adult of *altissimus* has never been secured as, from the pupa, it appears to be a very interesting form; but whether it is nearer *Paraleyrodes* or *Aleurodicus* can be decided only by an examination of all the stages.

RESPIRATORY SYSTEM.

The respiratory system in Aleyrodidæ seems to be more fully developed in the larval stages than in the adults. In some forms, as in those belonging to the *citri* group, there are in the immature stages special breathing folds developed which are often indicated on the dorsal surface by sculpturing and the outer extremity of each is guarded by stellate or other serrations on the margin of the case. The folds are three in number, there being a latero-thoracic pair and a caudal fold, this latter extending from the vasiform orifice caudad to the margin and forming a Y-shaped structure which extends to the posterior thoracic pair of spiracles. In some species, even when the thoracic folds are not noticeable, the caudal fold will be long and deep. The courses of the various tracheæ have been worked out by Woodworth for *Aleyrodes citri*[17] and the observations of more recent writers on the subject, as well as those made by ourselves, only substantiate his findings.

In the adult the system follows the same plan as in the larva. There are the same number (four pairs) of spiracles present, one pair of which is abdominal and situated near the vasiform orifice. The trunks and girdle are, however, much more reduced in the mature insect.

METAMORPHOSIS.

The metamorphosis in this family has always been an interesting and problematical subject of study. During the later larval stages the antennæ, mouthparts, and legs become, to a certain extent, atrophied. In the pupal stage, however, they appear to be, in some cases at least, functional. In *Dialeurodicus cockerellii*, for example, there is not only a prominent labium in this stage, but it is armed with taste sensoria. The function of the nervous system is not suspended during the entire life of aleyrodids, but as a similar state of affairs is found in such forms as the Muscidæ, this indicates little. The digestive system, with a few alterations, seems to pass over from the larva to the adult. The reproductive organs develop in the pupal stage and some, though not extensive, histolysis occurs. The adults without question feed, for they may be seen in the act and the honeydew excreted is a further evidence of this. It would appear that during the first part of the last (pupal) instar, the insect lives a life similar to that led in the earlier stages. During the last part, however, activity seems to cease for a short time, while transformation takes place within the larval skin. This change appears to be gradual in some respects and the metamorphosis in the Aleyrodidæ may be considered as of an intermediate type.

The adult emerges through a T-shaped opening on the dorsum of the pupa case. A short time before this opening is noticed, the insect may be seen fully formed within the case, and as it crowds in from the edges the rupture takes place. The thorax is first to emerge, followed by the head. The antennæ and legs are next worked free and the insect assumes an upright or recurved position similar to that adopted by many other insects in this process. Finally the abdomen is worked free and the insect moves away. The time normally occupied in this process is only a few minutes. Where the pupa cases are hard, however, a much longer time is required and it is not uncommon to see insects struggle for hours and finally die without being able to free themselves. After the adults have left the case it requires some minutes for the wings to expand and the colors and waxy secretion to develop. Morrill and Back[6] have given careful observations on the act of emergence of *Aleyrodes citri*, which in the main agree with ours here recorded. They also give the effects of temperature and humidity on the emergence of that species, stating "that temperature and not humidity is the more important factor governing emergence in Florida." On the other hand, Mr. R. S. Woglum, of the Bureau of Entomology, who has made extensive observations on this species in India and the Orient, is of the opinion that humidity is the governing factor. He states that the emergence of the flies, at least in any numbers, always follows a rise in humidity, while the optimum temperature under these conditions, together with a low humidity, seems to check emergence.

CLASSIFICATION.

Until recently only two genera, *Aleyrodes* and *Aleurodicus*, were recognized for the family Aleyrodidæ. Within the past three or four years, however, there have been established the additional genera

Aleurochiton, *Paraleyrodes*, and *Udamoselis*. These genera include species showing a considerable variation in important characters and, with other material available, furnish a basis for the consideration of their relationships and probable lines of descent. Information on these questions is essential for a correct understanding of the position of the family among the Homoptera and for the assignment within the family of the various species into natural groups.

Until the recent paper by Dr. Enderlein[18] no attempt has been made to divide the family into subfamilies, and to date there has been no attempt to show the natural relations of the genera. Enderlein erected the subfamily Udamoselinæ, in which he included also *Aleurodicus*, and the subfamily Aleyrodinæ, in which were placed all other known forms.

In the following classification we restrict Udamoselinæ to the forms in which both media and cubitus are present. Our reasons for this, our ideas on the relation of the genera and the systematic position of the family, and a discussion of the subfamilies follow. It appears to us, from a careful study of the different forms, that the Aleyrodidæ are not intermediate in position between the Aphididæ and Coccidæ but that they form an offshoot from the psyllid stem. This is indicated by the wing venation and by the structure of the mouthparts, legs, and genitalia.

The venation of the wings of this family has been compared with that of a psyllid wing under a separate heading (p. 9) and it is clear that the ancestor of the Aleyrodidæ had a wing form and venation very similar to the psyllid type. Under another heading (pp. 12–13) the genitalia of this family and those of the Psyllidæ have been compared. The resemblance here is very striking. In the males only a slight modification of the structure found in the Psyllidæ is necessary to produce the type found in *Aleurodicus*, while the Aphididæ have a widely different structure. In the females, too, the same condition is found to be true. The ovipositors in the two families are remarkably alike, while in the Aphididæ this structure shows almost no resemblance. In this second character, then, the two families are thus seen to be closely related.

The mouthparts show the most remarkable resemblance. In fact, with a variation in form of some parts and a difference in size, the two are identical. Even the same number of similarly formed taste sensoria are present on the labium.

In the legs, again, this similarity is to be noticed. In the presence of the pulvillus and the segmentation of the tarsus, the Aleyrodidæ are much closer to the Psyllidæ than to the Aphididæ.

The family itself shows two distinct lines of descent. In the one the media is retained, the cubitus is lost, and large compound wax pores are often developed in the pupæ. In the other the media is lost, the cubitus is retained, and no pupal compound wax pores are present. This divides the family at once into two distinct subfamilies to which the names Aleurodicinæ and Aleyrodinæ may be applied. Outside of these two subfamilies we have the form *Udamoselis pigmentaria*, which is much more generalized than any other. It retains both media and cubitus and we place it, at present, alone in the Udamoselinæ. We have included in the Aleyrodinæ three genera, *Aleurochiton*, *Aleyrodes*, and *Neomaskellia*. The first is the most primitive, and from it *Aleyrodes* has arisen by the reduction of radius $_1$. *Neomaskellia*, however, seems to have separated earlier than *Aleyrodes*, for it retains very hairy psyllid-like claspers and the wing venation is more reduced. The genus *Aleyrodes* at present includes many diversified forms and a careful study of these will no doubt necessitate the breaking up of the genus.

In the subfamily Aleurodicinæ the most primitive form seems to be *Dialeurodicus cockerellii*. This species, while it has developed the wing venation of *Aleurodicus*, still retains head characters which ally it to *Udamoselis*. The pupa, too, has no compound wax pores as in the genus *Aleurodicus*. With this species as type, Cockerell erected *Dialeurodicus* and placed it as a subgenus of *Aleurodicus*. It is evident, however, that this does not represent its true position, but that it is considerably older than *Aleurodicus*. We therefore make it the type of a genus rather than a subgenus. The species described as *Aleurodicus lahillei*, as discussed under wax pores (p. 14), shows characters intermediate between *Dialeurodicus* and *Aleurodicus*. These characters are so marked and evidently intermediate that we make it the type of a new genus, *Leonardius*, allied to *Dialeurodicus* in wing form, vertex, and vasiform orifice, and showing a development toward *Aleurodicus* in wax-secreting structures. The genus *Aleurodicus* is separated at once by the wing venation, the definite wax-pore structures, and the long exserted lingula. There are, however, forms of this type in general structure which have an included lingula and wax pores tending toward those of *Paraleyrodes*. For these forms we erect a subgenus, *Metaleurodicus*. This subgenus does not seem to be directly on the line toward *Paraleyrodes*. It is, as far as wax pores are concerned, but the lingula seems to place the group by itself.

The genus *Paraleyrodes* is plainly derived from near *Aleurodicus* by the reduction of the radius and part of the media, and by the shortening of the spinnerets and the cup of the wax pore. At the same time some of the segments of the antennæ have united. It is the most specialized genus of the Aleurodicinæ as *Neomaskellia* is the most specialized in the Aleyrodinæ. The position of the family and the relations of the genera, as we understand them, are shown in figure 1.

Family ALEYRODIDÆ Westwood.

Small or minute insects; oviparous, eggs stalked; metamorphosis intermediate; larval stages (except first) quiescent upon leaves of plants; most species surrounded or covered with a waxy secretion.

Mature sexes with four wings which are transparent, white, clouded or mottled with spots or bands. Antennæ in most genera of seven segments; compound eyes single or divided (reniform); ocelli two. Tarsi of two segments, terminating in two claws and a median process or paronychium; mouthparts suctorial, labium long, 3-segmented,

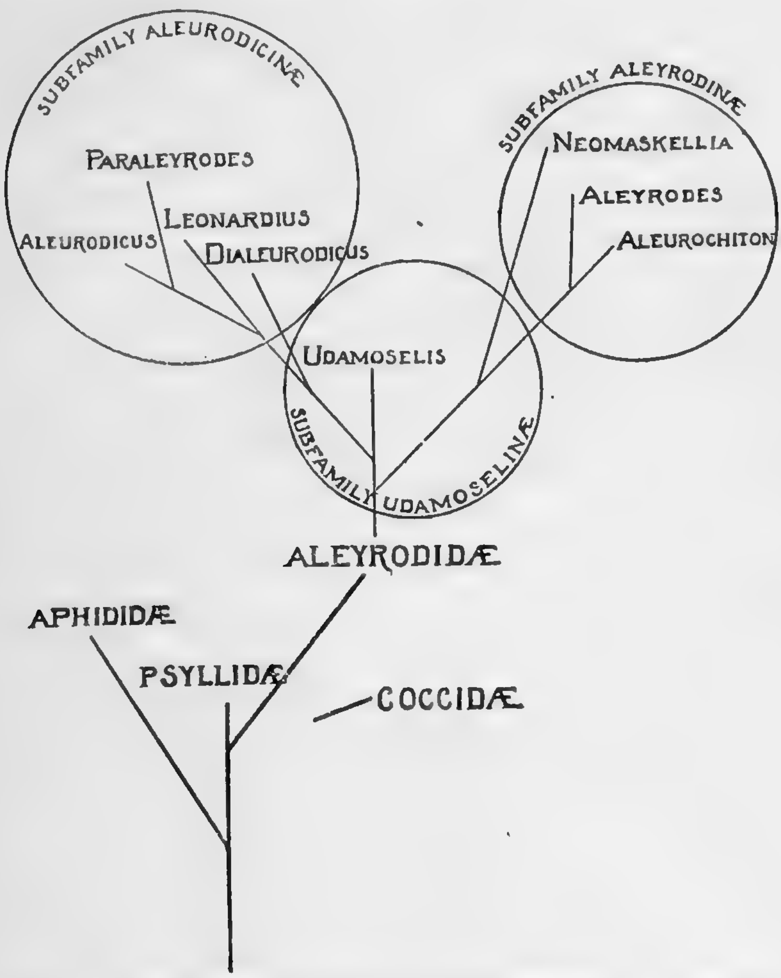


Fig. 1.—Genealogical diagram of the Aleyrodidæ. (Original.)

setæ four; male genitalia a pair of prominent claspers; female genitalia an acute ovipositor. Anus opening dorsally at the so-called "vasiform orifice."

Subfamilies of the Aleyrodidæ.

A. Forewing with radius₁, radial sector, media, cubitus, and anal veins present. Vertex produced .... I. *Udamoselinæ*.

B. Forewing with radial sector and media present; radius₁ absent or present; paronychium spine-like .... II. *Aleurodicinæ* n. subfam.

C. Forewing with radial sector and cubitus present; radius₁ absent or present; paronychium blade-like .... III. *Aleyrodinæ*.

I. Subfamily Udamoselinæ Enderlein.

The members of this subfamily have the forewing with the costa and subcosta distinct. The radius$_1$, radial sector, media, cubitus, and anal vein are present.

One genus only, *Udamoselis*, is known.

Genus UDAMOSELIS Enderlein.

Udamoselis Enderlein, Zool. Anz., Bd. 34, N. 7/8, p. 231 (1909).

This genus was erected by Enderlein, who characterized it as follows:

UDAMOSELIS nov. gen.

(Fig. 2.)

Radialramus und Media bilden im Vorder- und Hinterflügel zusammen eine Gabel, im Vorderflügel ist der Radialramus verkürzt. Cubitus im Vorder- und

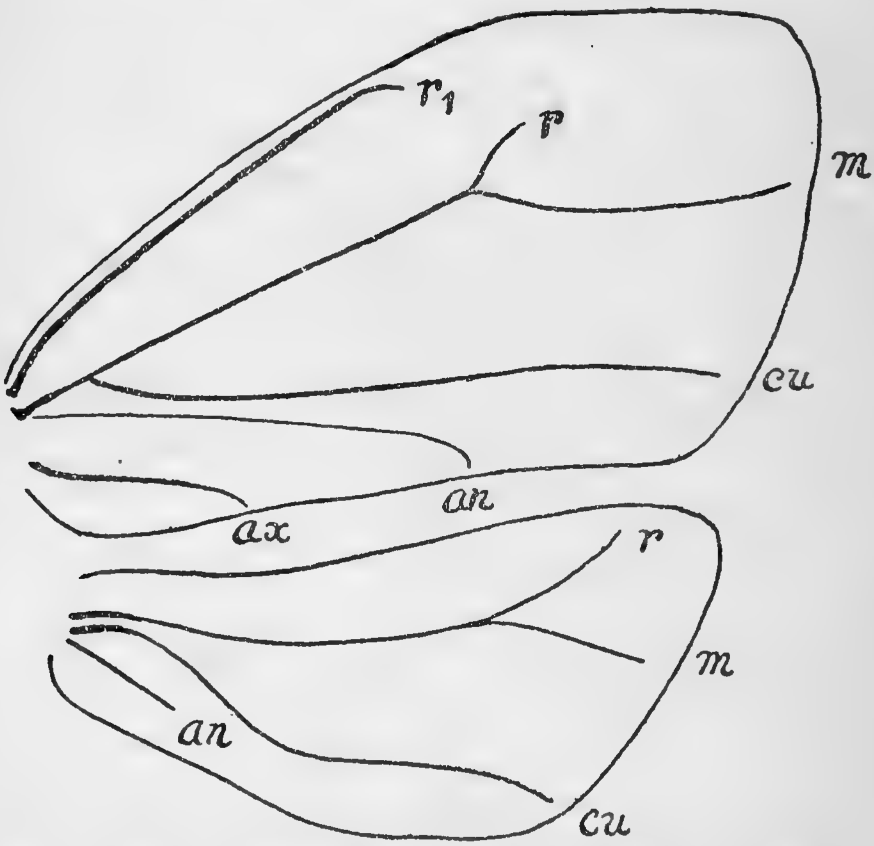


Fig. 2.—Wings of *Udamoselis pigmentaria*. (Redrawn from Enderlein.)

Hinterflügel vorhanden, im Vorderflügel aus der Media nahe der Basis, im Hinterflügel dicht neben der Wurzel der Media entspringend. Analis (*an*) im Vorderflügel als feine, aber sehr scharfe helle Linie (*sutura clavi*), im Hinterflügel weniger deutlich. Axillaris (*ax*) im Vorderflügel als deutliche Ader entwickelt, sie fehlt im Hinterflügel. Abdomen sehr lang und dunn (♂).

In der Mitte der Stirn ein ziemlich grösser kegelförmiger Höcker. Jede der beiden grossen Ocellen liegen dicht dem Innenrand der Augen nane am Hinterrand des Scheitels an.

Type, *pigmentaria* Enderlein.

[Translation.]

UDAMOSELIS nov. gen.

(Fig. 2.)

The radial ramus and the media both in the fore and hind wings form a branched fork; in the forewing the radial ramus is shortened. The cubitus is present both in the fore and the hind wing; in the forewing it has its origin in the media near its base, in the hind wing it starts close to the root of the media. Analis visible in the forewing as a fine but very distinct bright line (*sutura clavi*), in the hind wing it is less distinct. The axillary (*ax*) is developed as a distinct vein in the forewing; in the hind wing it is wanting. The abdomen of the male insect is very long and attenuated.

In the middle of the front of the head there is a rather large cone-shaped protuberance. Each one of the two large ocelli lies close to the internal margin of the compound eyes near the posterior margin of the occiput.

The terminology of wing-veins used by Dr. Enderlein in the preceding diagnosis does not correspond with our ideas on the subject. As discussed under "The wings," we consider the costa as represented by the margin, and the "fork" as formed by radius$_1$ and the radial sector. Below we tabulate, therefore, Dr. Enderlein's terms, giving in each case what we consider the correct term:

Enderlein	r_1=Subcosta.	Enderlein	*cu*=Media.
	r =Radius$_1$.		*an*=Cubitus.
	m =Radial sector.		*ax*=Anal.

Udamoselis pigmentaria Enderlein.

(Fig. 2.)

Udamoselis pigmentaria Enderlein, Zoologischen Anzeiger, Bd. 34, No. 7/8, p. 231 (1909).

ORIGINAL DESCRIPTION.

♂. Kopf sehr klein, breiter als lang, kaum so breit wie die Hälfte der Thoracalbreite. Augen sehr gross, blassgelblich, jedes Auge nimmt 1/3 der Kopfbreite ein und ist von Kopflänge. Scheitel blassgelblich, äusserster Hinterrand in der Mitte schwarz, Scheitelnaht sehr tief, der Hinterrand ziemlich tief stumpfwinkelig ausgeschnitten; die beiden Scheitelhälften klein, etwas länger als breit. Die beiden Basalglieder der Fühler ziemlich dick und braun, Fühlerinsertion zur Hälfte in den Augenrand eingerückt, der Augeninnenrand an dieser Stelle schmal und tief eingebuchtet, Einbuchtung viel tiefer als breit. (*Fühlergeissel abgebrochen*). Den Zwischenraum zwischen den Fühlerinsertionen füllt ein grosser ziemlich hoher kegelförmiger schwarzer Stirnaufsatz. Clypeus relativ gross, in Gestalt eines gleichseitigen Dreiecks, dessen eine Ecke nach vorn gerichtet ist, rostgelb, mit ziemlich langen und ziemlich dichtstehenden, senkrecht abstehenden braunen Haaren besetzt. Rüssel etwas länger als die Kopfhöhe, die beiden Glieder etwa gleichlang, 1. Glied gelblich, am Ende bräunlich; 2. Glied gelblich, Endhälfte schwarz, nach der Spitze zu allmählich zugespitzt. Wangen sehr kurz, nur vor den Augen, Schläfen fehlen.

Thorax rostbraun, Scutellum und Postscutellum bräunlichgelb. Pronotum kurz, Hinterrand in der Mitte etwas flach eingedrückt. Mesonotum sehr kräftig und dick, hoch gewölbt; Antedorsum schmal, nach hinten lang und spitz ausgezogen und gewölbt, und durch tiefe Parapsidenfurchen abgesetzt; die beiden Seitenflügel der Dorsa in der Mitte kurz vereinigt und durch kleine Furche getrennt; Scutellum als Querwulst, die etwa $2\frac{1}{2}$ mal so breit wie lang ist. Ähnlich ist das Postscutellum, nur etwas kleiner. Der Hinterrand des Scutellum und Postscutellums setzt sich jederseits in eine scharfe Querleiste fort. Das Andorsum des Metanotum ist fast so gross wie das des Mesonotum, und ist durch eine sehr scharfe Medianfurche in 2 Hälften zerlegt. Auch die Dorsa des Metanotum sind in der Mitte nicht voneinander abgesetzt. Hinter dem Postscutellum fällt es hinten steil ab.

Abdomen sehr lang und schmal; die sieben ersten Glieder kurz, etwas flach, fast 1 mm. breit und neben den Seiten oben mit Längsfurche; 8. und 9. Segment schmäler, röhrenförmig, 8. so lang wie breit, 9. etwa 4 mal so lang wie breit. 1. Tergit kurz, in der Mitte mit drei ziemlich dichstehenden feinen, aber scharfen Längskielen; 2. Tergit mit einem ebensolchen Mediankiel. 8. Tergit nach hinten zu etwas steil ansteigend. Am Ende des 1. Drittels der Oberseite des 9. Tergites ein kleiner Höcker, der hinten eingedrückt ist. 1. Sternit sehr kurz, mit feinem Mediankiel; 2. Sternit mit zwei dicht gedrängten Mediankielen; 3. Sternit vorn mit einem kleinem, flach dreieckigen, etwas eingesenkten Feld, von dem jederseits ein feiner, aber scharfer Kiel ausgeht, beide divergieren nach hinten zu und stehen senkrecht zueinander; beide Kiele setzen sich geradlinig an dem 4. Sternit bis zu den Hinterecken fort. Zangen (des ♂) sehr schlank oval und sehr lang, etwas mehr als $\frac{2}{3}$ des 9. Segments. Penis kurz. Abdomen oben bräunlichgelb. Mitten der Tergithälften des 2. Tergits mit schwärzlichem Wisch, 8. Tergit schwarz äusserster Hinterrand fein bräunlichgelb gesäumt; unten bräunlichgelb mit graubräunlichem Hauch.

Beine ziemlich klein und zart, sehr spärlich und kurz pubesziert; blass bräunlichgelb. Schenkel mit kleinen braunen Punkten besprenkelt. Schienen und Tarsen dünn, äusserste Spitze der Schienen und des 1. Tarsengliedes blassbraun, Endhälfte des 2. Tarsengliedes schwarz; die beiden Klauen klein und ziemlich zart, rostgelb. Ein Empodialanhang (Paronychium) ist mit der Lupe nicht erkennbar. Hinterschiene etwas länger als die übrigen, die Tarsenglieder bei allen Beinen fast gleich, und zwar das zweite ungefähr $\frac{2}{3}$ des ersten. Die beiden Tarsenglieder sind zusammen ungefähr die Hälfte der Schiene. Klauenlänge ungefähr $\frac{1}{3}$ der Länge des 2. Tarsengliedes.

Flügelspitzen beider Flügel ziemlich eckig, aber abgerundet. Die Gabel fast rechtwinkelig im Vorderflügel, spitzwinkelig im Hinterflügel. Clavus im Vorderflügel gross, bis in die Mitte des Hinterrandes reichend; im Hinterflügel klein, etwa bis zum Ende des ersten Viertels des Hinterrandes reichend. Vorderflügel relativ breit, Hinterflügel ziemlich schmal, besonders im Basalteil. Cubitus im Hinterflügel gebogen.

Flügelfärbung und Zeichnung auf der Ober- und Unterseite gleichmässig. Grundfarbe des Vorderflügels ockergelb, mit feiner verwaschener brauner Sprenkelung, die nur an folgenden Stellen fehlt: ein ziemlich grosser, halbkreisförmiger, mit der Basis dem Aussenrande aufliegender Fleck an der Mündung von *m*, ein ebensolcher am Vorderrand dicht vor des Spitze, ein ebensolcher etwas grösser an der Mündung von *an*, der den Cubitus nahezu tangiert, ein weiterer, etwas kleinerer und verwaschener dicht neben diesem in der Mitte des Hinterrandes und ein nahezu kreisrunder in der Mitte zwischen der Radialgabelungsstelle und dem Cubitus. Zwischen den beiden hellen Flecken am Flügelhinterrand ein ziemlich dunkelbrauner Fleck. Hinterflügel ziemlich dicht und dunkelbraun besprenkelt, Spitze etwas lichter; am Vörderrande am Ende des 1. und am Ende des 2. Drittels je ein grösserer ockergelber Fleck. Flügel völlig matt, ohne jeden Glanz, ohne Pubescenz und ohne Bestäubung.

Vorderflügellänge 5.5 mm.	Thoracalbreite, 1½ mm.
Hinterflügellänge 3¾ mm.	Länge des 9. Segmentes 1¾ mm.
Körperlänge 7 mm.	Zangenlänge 1¼ mm.
Abdominallänge 4¾ mm.	

Vaterland: wahrscheinlich Südamerika. 1 ♂.

[Translation.]

Male.—Head very small, wider than long, hardly as wide as one-half of the thoracic width. Compound eyes very large, pale yellow; each compound eye occupies one-third of the width of the head and equals the head in length. Vertex pale yellow, its extreme posterior margin black in the center. Epicranial suture very deep, the posterior margin deeply cut. The two halves of the vertex small, somewhat longer than wide. The two basal joints of the antennæ rather thick, and brown; the insertion partly in the margin of the compound eyes. The interior margin of the compound eyes deeply sinuate at this place, the sinus being much deeper than wide. (Remainder of the antennæ broken off.) The interval between the insertions of the antennæ is occupied by a large, rather high, cone-shaped, black frontal protuberance. Clypeus relatively large, in the form of an equilateral triangle; one angle being turned to the front, rusty yellow, provided with brown hairs that are rather long and more or less close together, standing off at right angles. Proboscis somewhat longer than the height of the head, the two joints nearly equal in length. First joint yellowish, brownish at the end; second joint yellowish, black at the end, and gradually coming to an acuminate point. Cheeks very short, only in front of the eyes, " temples " not present.

Thorax reddish brown, scutellum and postscutellum brownish yellow. Pronotum short, its posterior margin having slight flat depression in the center. Mesonotum very robust and thick, highly arched. Antedorsum narrow, attenuated toward the rear end and arched and set off by deep parapsidal furrows; the two lateral wings of the dorsa united in the middle for a short distance and separated by a small groove. Scutellum in the form of a cross welt which is about two and one-half times as wide as it is long. Postscutellum very similar in shape, but somewhat smaller in size. The posterior margin of the scutellum and the postscutellum is continued on each side by an acute crosswise welt. The andorsum of the metanotum is almost as large as that of the mesonotum and is divided by a very sharp median furrow into two halves. The dorsa of the metanotum are likewise not set off from each other in the center. Behind the postscutellum there is an abrupt declivity.

Abdomen very long and narrow; the first seven segments are short, somewhat flat, almost 1 mm. in width, and having along their sides a superior longitudinal furrow; eighth and ninth segments narrower, tubuliform; the eighth as long as it is wide; the ninth about 4 times longer than wide. First tergite short, provided in its center with three quite distinct, fine, but plainly visible, longitudinal keels. Second tergite with one similar median keel. Eighth tergite somewhat steeply acclivous toward the rear. At the end of the first third of the upper side of the ninth tergite is a small protuberance which is indented in the rear part. First sternite very short, provided with a fine median keel; second sternite furnished with two median keels that are closely crowded together; third sternite provided at the front with a small, flatly triangular, somewhat indented field, from which issues on each side a very fine but distinct keel. These two keels diverge toward the rear and become perpendicular to each other. Both of these keels are continued in a straight line in the fourth sternite as far as the posterior covers. Forceps (of the male) narrowly oval and very long, at times exceeding two-thirds the length of the ninth segment. Penis short. Upper side of the abdomen brownish yellow. In the center of the second tergite there is a blackish stripe. Eighth tergite black, its extreme posterior margin bordered by a fine brownish-yellow seam. The ventral side of the abdomen brownish yellow, with a brownish-gray cast.

Legs very small and slender, very sparsely and briefly pubescent, pale brownish yellow. Femur sprinkled with small brown dots. Tibiæ and the tarsi thin; distal ends of both the tibia and the first tarsal joint pale brown; distal half of the second tarsal joint black. The two claws small and quite slender, rusty yellow. An empodial appendage (paronychium) is not visible under the magnifying glass. Posterior tibia somewhat longer than the others; the tarsal joints in all the legs almost equal in length, the second being about two-thirds as long as the first. The two tarsal joints are together about one-half the length of the tibia. Length of the claws about one-third the length of the second tarsal joint.

Ends of both wings somewhat angular, but rounded off. The bifurcation almost rectangular in the forewing, but acute-angled in the hind wing. Club in the forewing large, extending as far as the middle of the posterior margin. Forewings relatively broad, the hind wings rather narrow, particularly in the proximal part. Cubitus in the hind wing curved.

Color of the wings and markings on the upper and lower sides uniform. Basal color of the forewing ochraceous yellow, with a rather finely increscent brown sprinkling, which is wanting only in the following locations: A pretty large semicircular spot, its base resting on the exterior margin at the mouth of *an;* another spot at the anterior margin close before the point; a still larger spot near the embouchure of *an*, which almost touches the cubitus, and furthermore a smaller spot close beside the cubitus in the middle of the posterior margin; finally, an almost circular spot in the middle between the cubitus and the point of bifurcation of the radial vein. Between the two light-colored spots on the posterior margin of the wings there is a spot of rather dark-brown color. Hind wings sprinkled densely with dark-brown spots. Their apices somewhat lighter in color. There is a large ochraceous spot along the anterior margin at the end of the first third and another at the end of the second third of its length. Wings quite colorless, without any luster, without pubescence, and without any powdering.

Length of forewings 5.5 mm.; length of hind wings 3.75 mm.; length of body 7 mm.; length of abdomen 4.75 mm.; width of thorax 1.5 mm.; length of the ninth segment 1.75 mm.; length of forceps 1.25 mm.

Habitat.—In all probability South America. One male.

II. Subfamily Aleurodicinæ n. subfam.

The members of this subfamily are characterized by the presence in the forewing of the radial sector and media. Radius $_1$ may or may not be present, and the cubitus is rarely faintly indicated.

The type genus is *Aleurodicus.*

Four genera are at present included in the subfamily, which may be separated as follows:

Genera of the Aleurodicinæ.

A. Pupa case without large compound pores. Forewing with radius $_1$ and media well developed; vertex produced; lingula included; antennæ of seven segments .... *Dialeurodicus.*

B. Pupa case with no compound pores, but with agglomerate pores; radius $_1$ and media well developed; antennæ of seven segments .... *Leonardius.*

C. Pupa case with large compound pores; radius $_1$ and media well developed; antennæ of seven segments .... *Aleurodicus.*

D. Pupa case with compound pores; radius $_1$ absent; media considerably reduced; antennæ of four segments .... *Paraleyrodes.*

Genus DIALEURODICUS (Cockerell) n. gen.

Forewing with radius$_1$, radial sector, and media retained. Vertex produced into a prominent cone-shaped process. Antennæ of seven segments, of which the third is the longest. Paronychium of the foot represented by a stout spine. Pupa case flat; no compound pores present but simple pores, either scattered over the surface or somewhat collected into areas; vasiform orifice small, lingula setose, short conical, included and armed with four spines.

Type, *cockerellii* Quaintance.

Species of Dialeurodicus.

I. Dorsum of pupa case with scattered simple pores; large, oval, flat, size about 1.63 by 1.23 mm., yellowish brown; surface without reticulations; wax tubes forming the marginal rim, separated by rather shallow incisions. Adults with large spotted wings ---- *cockerellii.*

II. Dorsum of pupa case without scattered simple pores; large, oval, flat, size about 1.7 by 1.40 mm. Dark brown to blackish (shiny jet-black on leaf); surface with some reticulations; wax tubes forming margin of rim, separated by deep incisions ------------- *tessellatus.*

III. Dorsum of pupa case with scattered simple pores and a broad subdorsal band all around of closely set simple pores divided by body sutures into six more or less distinct patches. Subovate in shape, size 1.5 by 1.12 mm., marginal wax tubes separated by shallow incisions -- *silvestrii.*

IV. Dorsum of pupa case with four pairs of wax-secreting pores on abdominal segments 4 to 7 and a submarginal rim all around of simple pores. Dorsal disk dark brown, with four radiating patches of same color on each side. Shape elongate, elliptical, narrowed cephalad, size 2.36 by 1.28 mm. Margin of case entire ------------ *pulcherrimus.*

Dialeurodicus cockerellii (Quaintance).

(Pl. IV, figs. 1–14; Pl. VII, fig. 1; text fig. 3.)

Aleurodicus cockerellii Quaintance, Tech. Series 8, Div. Ent., U. S. Dept. Agr., p. 45, (1900).

ORIGINAL DESCRIPTION.

Pupa case.—Size about 1.63 by 1.23 mm.; subovate in shape, smaller end cephalad. Color uniformly yellowish. There is but slight waxy exudation from dorsum, which is more or less mealy. No wax rods have been observed. Dried specimens separate easily from leaf, leaving usually a ring of white mealy wax of the size and shape of case; extending from the periphery inward are light lines of this mealy wax, more or less distinctly marking the position of the abdominal sutures of the case. Dorsum of pupa case almost flat, but as seen under a hand lens is much wrinkled transversely in dried material. These folds or ridges occur mainly along the body segments and posteriorly become much curved around the vasiform orifice. Under the microscope the abdominal segments are indistinct and scarcely elevated, except in the medio-dorsal line, where a slight rounded keel may be observed. Margin of case practically entire. Very slight furrows or thickenings extend mesad a short distance from margin of case, rather marking the margin into more or less distinct rectangular figures. Just within the margin all around is a series of very small disc-like pores, usually one to each of these marginal rectangles. Dorsum void of well developed setæ, except a pair just within the caudal margin; but there is a pair of small setæ at vasiform orifice, and very minute setæ occur here and there on the dorsum. The five or more pairs of large compound pores, so usual on dorsum of pupa case of *Aleurodicus*, seem to be absent in this species, but very many minute transparent pores may be detected on dorsum under high power of microscope.

Vasiform orifice subcordate, somewhat longer than wide; cephalic margin straight; at caudal end there is a short, stout, spine-like protrusion. Operculum subrectangular, about half length of orifice; cephalic and caudal margins practically straight, lateral margins rounded; lateral and caudal margins thick; minutely setose. Lingula quite as long as orifice, very broad, and bearing distally two pairs of setæ, the smaller pair proximad; minutely setose.

Rudimentary legs and antennæ on ventral surface quite distinct. Distal joint of legs with a straight and truncate spine. Antennæ usual, minutely ringed.

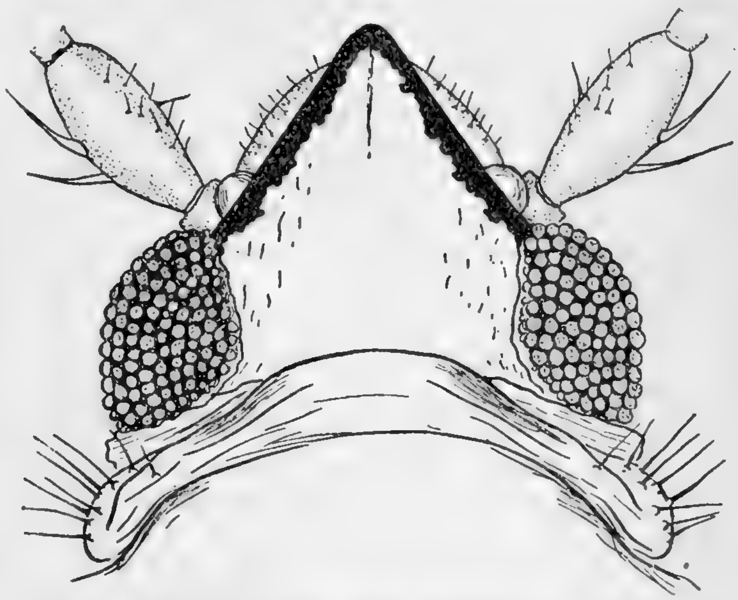


FIG. 3.—Head of *Dialeurodicus cockerellii.* (Original.)

Adult ♀.—Length, about 1.96 mm.; fore-wing, about 2.4 by 1.6 mm.; length of hind tibia, 0.8 mm.; length of hind tarsus, 0.56 mm.; length of front tarsus, 0.32 mm.; color, bright yellow, legs and antennæ paler; wings very broad, and rounded distally. Wings marked with more or less circular spots of brownish black. In forewings, along cephalic margin, are three spots about equidistant, and farther distad, on curve of wing, is a spot somewhat farther from the third spot than are two and three from each other. There is a spot on the margin of outer caudal curve of wing and three spots on the caudal margin, which, however, are not equidistant, as in the spots on cephalic margin. Within the area bounded by the distal fork of the vein are two spots, and within the area bounded caudad by the proximal branch are from three to five spots. In hind wings there is a spot on outer cephalic margin, and on the outer caudal margin are two spots. There are two spots in the area bounded by the distal fork of vein, and likewise two spots in the area bounded caudad by the proximal branch of vein. Head as seen from above acute cephalad, and margined with deep reddish or brownish black, continuous with eyes which are of same color. Joint 1 of antennæ short, subcylindrical, distal and irregularly notched or toothed. Joint 2 thick, club-shaped, about three times longer than basal and bearing two or three setæ on outer lateral surface. Joint 3 quite long—quite twice the length of fourth. Distal joint short, terminating in a single seta.

Received by the Division of Entomology at Washington from Dr. F. Noack, Instituto Agronomico, Campinas, Estado de S. Paulo, Brazil, on leaves of a myrtaceous plant, March 30, 1898, and again from Dr. Noack, on same plant, June 14, 1898. The writer has also received specimens of this insect from Prof. T. D. A. Cockerell, to whom they had been sent by Dr. Noack. The adults are unique, in the genus *Aleurodicus*, from the more or less circular spots on the wings. Div. Ent., Nos. 8010 and 8115. Type pupa-case, 8010, described from nine specimens, and specimens on leaf from Prof. Cockerell. Type, adult, 8115, described from two specimens.

Mr. Adolph Hempel[19] has been able to observe this species in nature, and has added the following interesting descriptive remarks:

Grown larva and pupa yellowish, about 1.87 millim. long and 1.33 millim. wide; very flat; lateral edge thin. Dorsum covered with a dense thick mass of white secretion, arranged in a marginal fringe, and a submarginal oval ring.

Adult male light yellow in color; head, eyes, wings, and antennæ as in the female Body narrow, 2.21 millim. long. Extent of wings 4.93 millim. Genitalia large, .430 millim. long, forcipate, tips strongly curved. Penis fine, tip curved upward, .190 millim. long.

Eggs small, elongate, slightly curved, light yellowish, with a short peduncle; usually laid in an irregular mass and covered with a fine white powder. The eggs hatch in from 11 to 13 days. The larva stage lasts from 44–46 days, and the pupa stage from 15–16 days.

Hab. Campinas, State of S. Paulo, on the underside of leaves of a cultivated guava (*Psidium cattleianum*). The entire under surface of the leaves becomes coated with a fine white powder, while the upper surface is usually covered with a black fungus.

Type.—No. 14761, U. S. National Museum.

Dialeurodicus silvestrii (Leonardi).

(Pl. V. figs. 1–6.)

Aleurodicus silvestrii Leonardi, Bollettino del Lab. di Zool. generale e agraria della R. Scuola superiore d'Agricoltura in Portici, vol. 4, pp. 320–322 (1910).

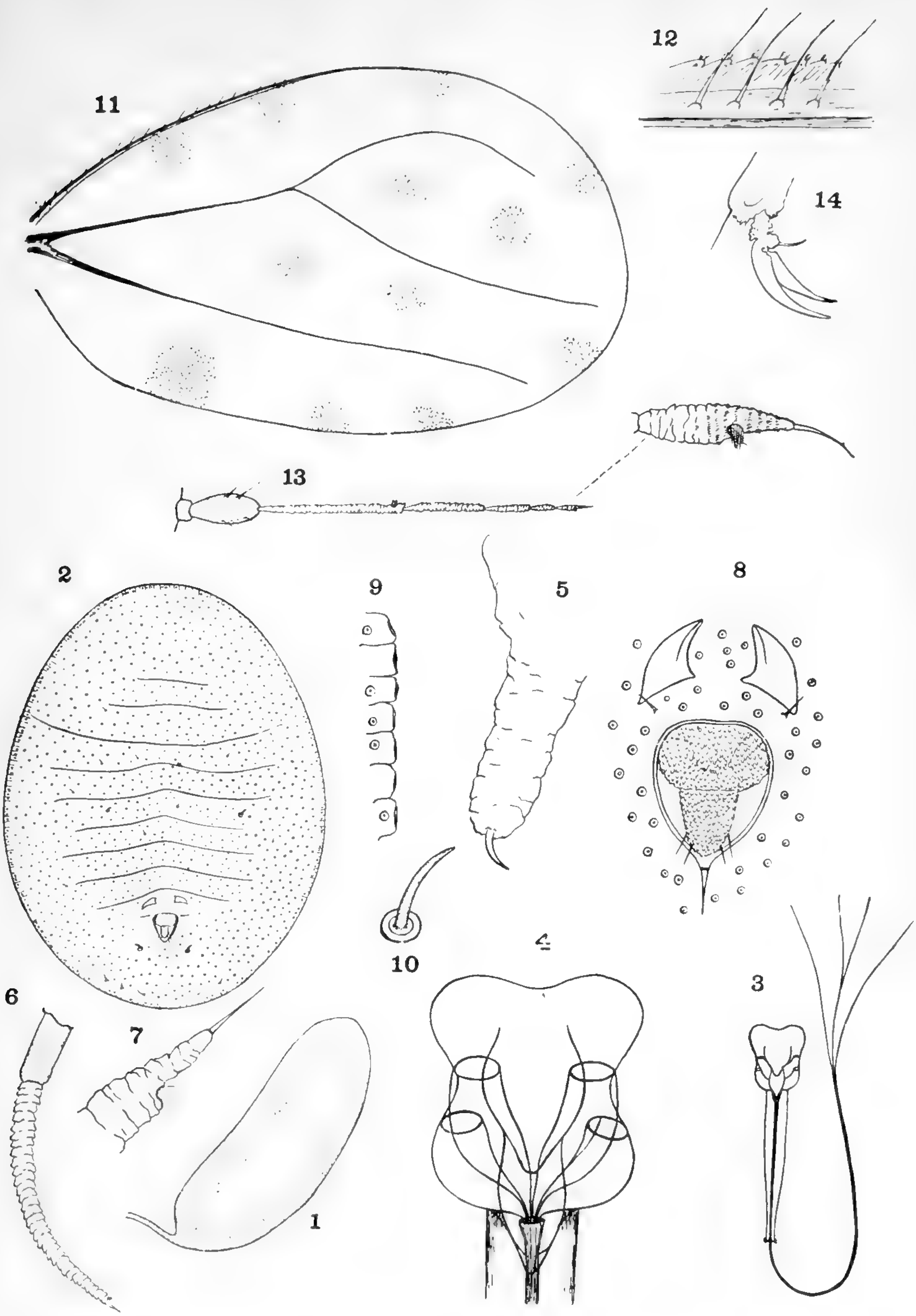
ORIGINAL DESCRIPTION.

Larva (*ultimo stadio*).—Corpo ovale, piatto, un poco più acuminato all'innanzi che di dietro, provvisto, lungo il margine libero, di una stretta frangia ininterrotta di cera biance nivea.

Al dorso si osservano 6 nastri cerosi bianchissimi, molto vistosi, i quali sono contigui colle loro basi delimitando in tal modo un'area centrale di forma esagonale allungata nel senso diametro longitudinale. Quest'area, coperta da pochi glomeruli di cera, viene a costituire, direi quasi, il fondo di un'elegante cestella i di cui lati sarebbero costituiti dai summentovati nastri cerosi i quali, da prima, si dirigono in alto per poi ripiegarsi, contorti più o meno, lateralmente.

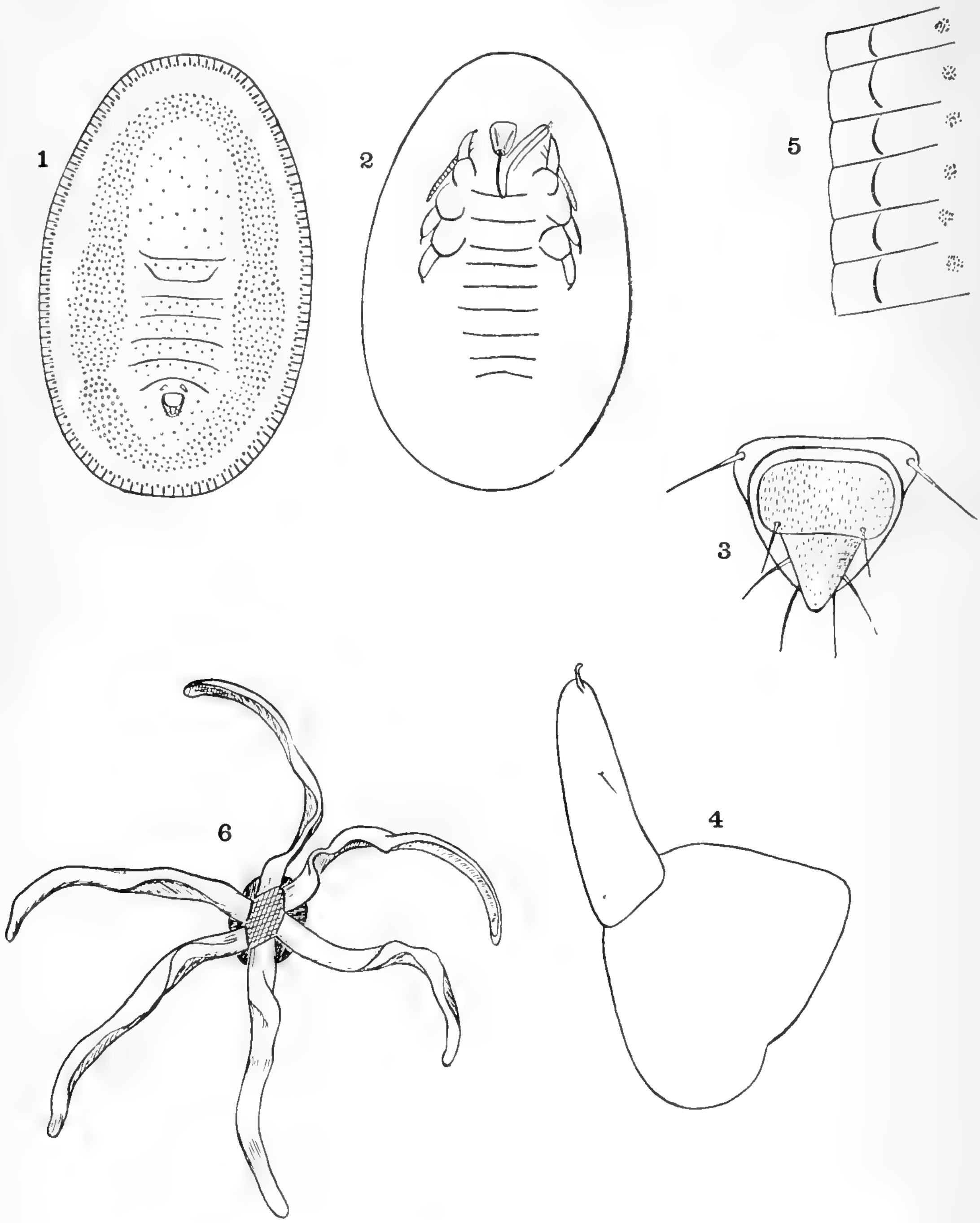
Denudato l'insetto esso appare di un bel colore vitellino uniforme. I segmenti del corpo sono ben ristinti tra loro specie quelli che costituiscono l'addome. Al dorso, lungo il margine, a breve distanza da esso, si osserva una serie di ghiandole ciripare che corre parallela al margine stesso.

Nell'area mediana dorsale, tutt'all'ingiro, vi sono un gran numero di sbocchi di ghiandole ciripare raccolti in 6 distinti aggruppamenti, de i quali tre sono diposti a destra e tre a sinistra del diametro longitudinale del corpo dell'insetto.



DIALEURODICUS COCKERELLII.

Fig. 1.—Egg. Fig. 2.—Pupa case. Fig. 3.—Rostrum. Fig. 4.—Trophic tubercle. Fig. 5.—Leg of pupa. Fig. 6.—Antenna of pupa. Fig. 7.—Tip of same. Fig. 8.—Vasiform orifice of pupa. Fig. 9.—Margin of pupa case. Fig. 10.—Dorsal spine of pupa case. Fig. 11.—Forewing of adult. Fig. 12.—Costal margin of forewing. Fig. 13.—Antenna of adult. Fig. 14.—Foot of adult. (Original.)



DIALEURODICUS SILVESTRII.

Fig. 1.—Pupa case, dorsal view. Fig. 2.—Same, ventral view. Fig. 3.—Vasiform orifice of pupa. Fig. 4.—Leg of pupa. Fig. 5.—Margin of pupa case. Fig. 6.—Pupa case, showing wax secretion. (Figures redrawn from Leonardi.)

L'aggruppamento mediano destro, come il corrispondente di sinistra, sono bene distinti dagli aggruppamenti contigui, di cui i due anteriori, come pure i due posteriori finiscono col confluire tra loro rispettivamente all'apice anteriore ed a quello posteriore del corpo degl'insetto, ove d'altronde i detti aggruppamenti presentano il maggiore ristringimento loro. La cera segregata da sì fatte ghiandole ciripare è quella che va a formare i nastri cerosi prima ricordati. Altre ghiandole di simile fabbrica, con disposizione simmetrica, trovansi diffuse sul tegumento compreso tra gli aggruppamenti di cui si è ora tenuto parola, mentre ne è privo, fatta eccezione per la serie di ghiandole circummarginali già descritte, la porzione posta al di là di essi.

L'apertura anale, in confronto di quella della specie precedente, è molto più ridotta nelle dimensioni e l'opercolo che la ricopre, in paragone, è molto più largo che lungo, la lunghezza, riuscendo, a malo pena più lunga della metà della larghezza. La linguetta per forma, per numero e per disposizione dei peli vistosi di cui è ornata rassomiglia a quella della specie precedente salvo che le dimensioni sono proporzionate a quelle del rispettivo opercolo.

Dal lato del ventre l'insetto non presente nulla di speciale, eccetto le zampe che come nell' *Aleurodicus Lahillei* portano al loro apice anzichè una ventosa un robusto uncino.

Lunghezza del corpo 1500 μ.

Larghezza del corpo 1120 μ.

Lunghezza dei nastri cerosi circa ½ centimetro.

Larghezza dei nastri cerosi circa ½ millimetro.

Adulti.—Sconosciuti.

Habitat.—Raccolto a Jalapa (Mexico) su foglie di una pianta rimasta indeterminata.

Gl'insetti per lo più riuniti in numerose colonie, si fissano d'ordinario ai lati della nervatura mediana della foglia disponendosi alternativamente uno di quà e l'altro al di là di detta nervatura formando nel loro complesso un'elegante disegno che spicca sul verde della foglia grazie alla bianchezza perfetta dei nastri cerosi che si innalzano dal dorso dell'insetto.

[Translation.]

Larva (*last stage*).—Body oval, flat, a little more acuminate at the anterior end than at the posterior end, provided along its free margin with a narrow uninterrupted fringe of snowy white wax. At the dorsum there are seen six very white waxy slender tentacles, very conspicuous, which are contiguous at their base, delimiting in this manner a central area of hexagonal shape elongated in the direction of the longitudinal diameter. This area, covered with little globules of wax, constitutes, so to say, the bottom of an elegant cestus ("cestella") the sides of which are formed by the base of the above-named waxy tentacles, which at first are directed upward, and then bend down, contorted, more or less, laterally.

When denuded, this insect appears of a beautiful uniform vitelline color. The segments of the body are quite distinct, particularly those that constitute the abdomen. At the back, along the margin, and a short distance from the same, there can be seen a row of wax-producing glands which runs parallel to this margin.

In the median dorsal area, all around, there are a large number of mouths of wax-producing glands, collected in six distinct groups, of which three are arranged at the right and three at the left of the longitudinal diameter of the body of the insect. The middle group on the right, as well as that on the left, is quite distinct from the contiguous groups, of which the two anterior ones, as well as the two posterior ones, unite respectively at the anterior apex and at the posterior apex of the body of the insect, at which points these groups are of their smallest width. The wax secreted by these wax-producing glands is that which goes to form the above-recorded six waxy tentacles. Other glands of similar nature, symmetrically disposed, are found spread out upon the tegument comprised between the groups of which we have just spoken, but such glands are wanting, with the exception of the row of circummarginal glands already described, on the part of the tegument outside of the principal groups.

The anal aperture, as compared with that of the preceding species, is much smaller in size, and the operculum which covers it is, in comparison, much wider than long, the length being scarcely more than one-half of the width. The lingula, by its shape and by the number and disposition of the sightly hairs with which it is ornamented, resembles that of the preceding species except that the dimensions are proportionate to those of the respective operculum.

As regards the venter the insect presents no special features except the legs which, like those of *Aleurodicus lahillei*, carry at their apex a robust claw rather than a pulvillus.

Length of body 1.500 mm.; width of body 1.120 mm.; length of the waxy tentacles about 5 mm.; width of the waxy tentacles about 0.5 mm.

Adults.—Not known.

Habitat.—Collected at Jalapa, in Mexico, upon the leaves of a plant the species of which is undetermined.

The insects, for the most part collected in numerous colonies, are ordinarily attached to the sides of the middle vein of the leaf, disposed alternately on the one and the other side of this vein, forming in their totality an elegant design which shines upon the verdure of the leaf, thanks to the perfect whiteness of the waxy tentacles which arise from the back of the insect.

Dialeurodicus tessellatus n. sp.

(Pl. VI, fig. 1; Pl. VII, fig. 2.)

From Ceara, Brazil, on *Eugenia mitchelli.* Received January, 1906, from Mr. F. Richa. This species in the pupal stage closely resembles *D. cockerellii*, but differs in the character of margin of case, in the vasiform orifice, absence of wax pores on dorsum, and darker color of eggs and pupa case.

DESCRIPTION.

Egg.—Length about 0.32 mm; color shiny brown or blackish, without markings; stalk short (Pl. VI, fig. 1).

Pupa case.—Size about 1.7 mm. long by 1.40 mm. wide; case flat, applied closely to leaf, the body segments distinct as transverse ridges; color, under hand lens, shiny dark brown or blackish (Pl. VI, fig. 2).

The specimens in hand show no waxy secretions from dorsum of case nor from the marginal wax tubes. The larvæ have a narrow fringe all around the white wax from the marginal wax tubes. Under microscope, pupa case brown, the more central portion darker; lighter bands, more evident on the sides, extending transversely across dorsum, marking the segments.

Case without the compound wax pores present in *Aleurodicus*, and the simple wax pores, scattered over dorsum in *cockerellii*, are, in the present species, absent. There are, however, numerous minute clear points over entire dorsal surface, some occurring singly and others in pairs, one of which is smaller (Pl. VI, fig. 7). The marginal wax tubes are quite distinct; the incisions deep and acute, notably more so than in *cockerellii*. Just within the margin all around is a series of simple wax pores on the marginal wax tubes. (Pl. VI, fig. 8.)

Case very flat, the lighter specimens showing a coarse network of darker lines on dorsal surface (Pl. VI, fig. 2); margin without spines or setæ. Vasiform orifice cordate, about as broad as long; caudal end terminating in a subcircular orifice or pore; operculum subrectangular, the sides rounded and margins straight—about twice as wide as long. Lingula not exserted, stout, subspatulate, bearing two pairs of spines. (Pl. VI, fig. 6.) On ventral surface, legs, antennæ, and rostrum quite distinct; antennæ rather short, ending in a finger-like process; rostrum unusually well developed, being about 0.18 mm. long; legs short, stout, ending in single hook. (Figs. 3–5.)

Adults.—Unknown.

Type.—No. 14762, U. S. National Museum. Described from several pupæ in balsam mounts and specimens on foliage.

Dialeurodicus pulcherrimus n. sp.

(Pl. VIII, figs. 1–8.)

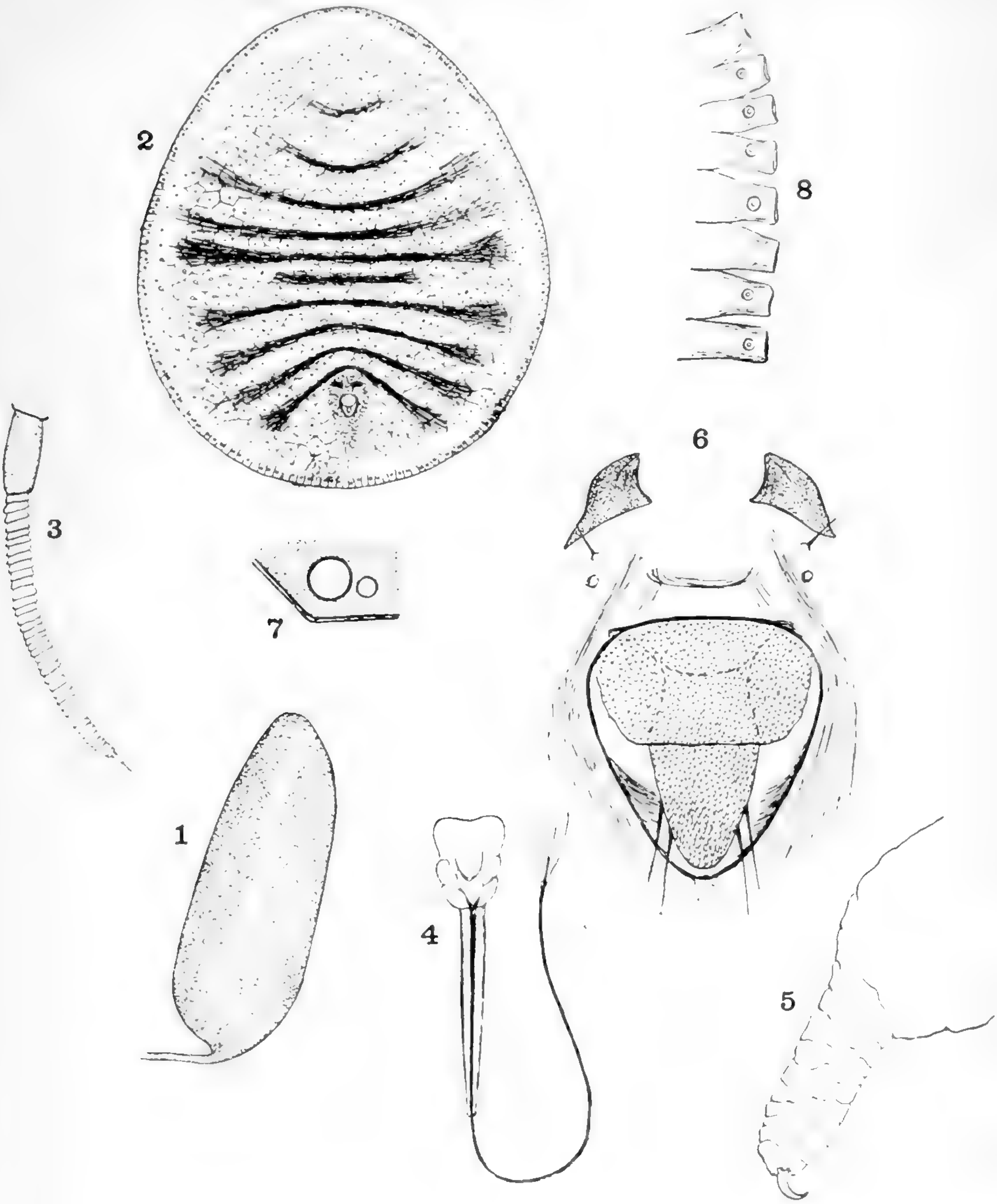
This species differs from the typical form in the genus by having the frons produced acutely and extending beyond the cone of the vertex. The shape of the pupa case is also somewhat different from that of *cockerellii*. The general characters, however, seem to approach most nearly to those of *Dialeurodicus*.

DESCRIPTION.

Pupa case (Pl. VIII, fig. 1).—Shape elongate elliptical, considerably narrower cephalad than cauded; dorsum somewhat rounded, with the abdominal segments distinct, the sutures very plainly marked on the subdorsal area. Vasiform orifice (Pl. VIII, fig. 2) subcordate, as wide as long, with the anterior margin straight; operculum transverse, considerably wider than long, the caudal margin straight but indented at each side, as shown in the figure; on each side of caudal margin, just at base of this indentation, a small seta is situated. Lingula short, conical, and forming together with the operculum almost a perfect cone. Its tip is armed with two pairs of large setæ and both operculum and lingula are minutely setose. Margin (Pl. VIII, fig. 3) entire and just within it all around is a row of simple wax pores. On the subdorsal area are four pairs of wax pores, one pair on each of segments 4 to 7. These pores (Pl. VIII, fig. 4) have a clear rim and a central dusky area with a dentate margin. Placed irregularly near these are also noticed a number of minute, clear, pore-like areas.

The case, under the microscope, is transparent, with the exception of a central dark-brown region and four radiating bands of the same color on each side, the position of which are shown in Plate VIII, figure 1. A narrow, colorless, central longitudinal band is present on segments 3 to 8, inclusive. Each of the dark radiating bands has extending through its center a darker line and the marginal pores are closer together on the dark areas than elsewhere. Size of case 2.368 mm. by 1.28 mm.

Adult female.—Head (Pl. VIII, figs. 6 and 7) with the vertex produced into a cone-like process; frons also produced into a similar process, which extends beyond it; lower portion of the frons and face armed with numerous spines. Compound eyes dark brown, constricted in the middle; ocelli prominent, bordered by a dark red area. The antennæ are absent from the specimens at hand. Fore-wing (fig. 4) shaded with brown and mottled with a darker shade of the same color as shown in figure. The extent and intensity of these maculations varies somewhat with the individual; veins brown, the cubitus represented by a transparent "fold;" proximal portion of costal margin armed with stiff hairs and entire margin with small projections on which setæ are situated. Size 2.38 mm. by 1.504 mm. Hind wing with brown maculations, as shown in Plate VIII, figure 4; the proximal portion of the costal margin with usually eleven prominent bristles. Size 1.92 mm. by 0.704 mm. Paronychium of foot (Pl. VIII, fig. 8) armed with a prominent bristle. Lingula of vasiform orifice broad and rounded. Length from vertex to tip of ovipositor 1.91 mm.; fore-tibia 0.48 mm.; hind tibia 0.8 mm. Color



DIALEURODICUS TESSELLATUS.

Fig. 1.—Egg. Fig. 2.—Pupa case. Fig. 3.—Antennæ of pupa. Fig. 4.—Rostrum of pupa. Fig. 5.—Leg of pupa. Fig. 6.—Vasiform orifice of pupa. Fig. 7. Paired pores of dorsum of pupa case. Fig. 8.—Margin of pupa case. (Original.)

FIG. 1.—PUPÆ AND WAXY SECRETION OF DIALEURODICUS COCKERELLII ON LEAF. (ORIGINAL.)

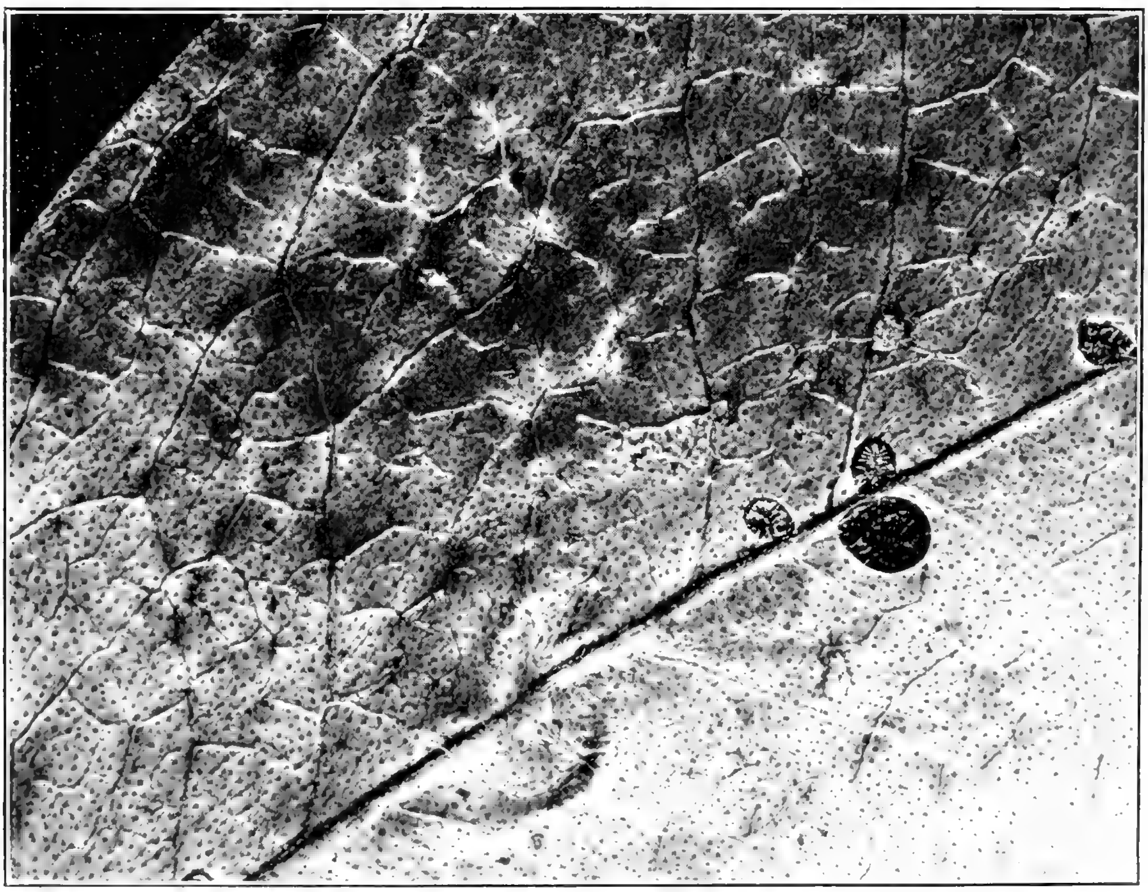
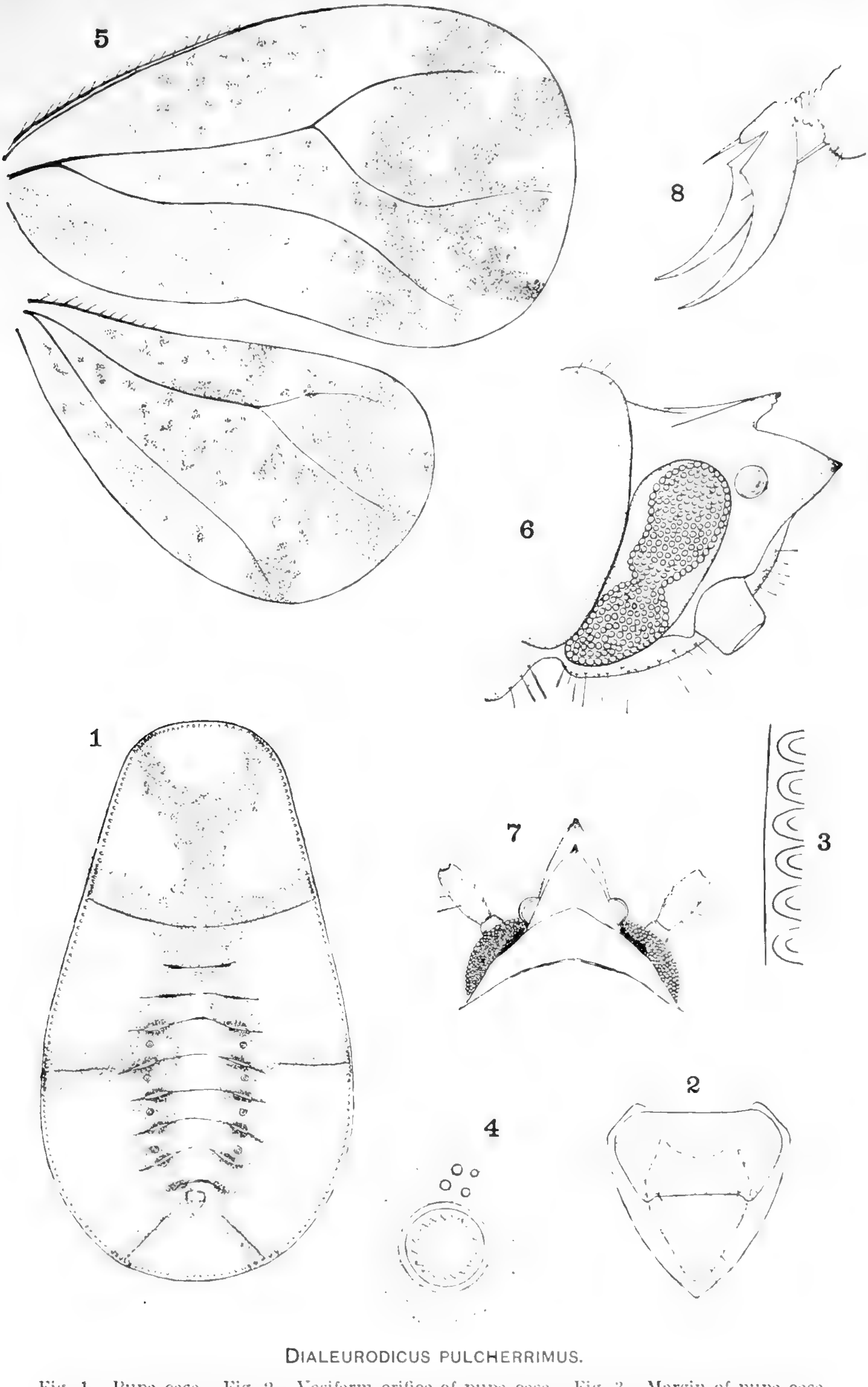


FIG. 2. PUPÆ OF DIALEURODICUS TESSELLATUS ON LEAF. ORIGINAL.)



DIALEURODICUS PULCHERRIMUS.

Fig. 1.—Pupa case. Fig. 2.—Vasiform orifice of pupa case. Fig. 3.—Margin of pupa case. Fig. 4.—Subdorsal pores of pupa case. Fig. 5.—Wings of adult. Fig. 6.—Head of adult, lateral view. Fig. 7.—Head of adult, dorsal view. Fig. 8.—Foot of adult. (Fig. 7 less enlarged than Fig. 6.) (Original.)

yellowish brown; shaded on the thorax, the dorsum of the abdomen, and the articulations of the appendages with dusky to brown.

Male.—Unknown.

Type.—No. 14778, U. S. National Museum. Described from five females in balsam and two pupa cases, one in balsam and one dry upon the leaf. Taken by Dr. F. W. Urich on coconut in Trinidad.

Genus LEONARDIUS n. gen.

Forewing with radius $_1$, radial sector, and media forming the veins; cubitus present in freshly emerged wing and traces of it sometimes present later; form of wings rounded, color generally mottled. Vertex produced, somewhat cone-shaped. Antennæ of seven segments of which the third is the longest. Paronychium a narrow spined process; pupa case with a series of agglomerate pores, some of which (the two anterior abdominal pairs) take on the nature of compound pores. Lingula of pupa case conical, included, setose, and armed with four spines.

Type, *lahillei* Leonardi.

This genus is related to *Dialourodicus* in the acute vertex and the wing form of the adult and in the character of the vasiform orifice of the pupa case. The tendency toward the development of compound pores in the pupa shows its relation to *Aleurodicus.*

Leonardius lahillei (Leonardi.)

(Pl. IX, figs. 1–14; text figs. 4, 5.)

Aleurodicus lahillei Leonardi, Bollettino del Laboratorio di Zoologia generale e agraria della R. Scuola superiore d'Agricoltura in Portici, vol. 4, p. 316 (1910).

ORIGINAL DESCRIPTION.

Larva (*ultimo stadio*).—Corpo di forma decisamente ovale con polo anteriore appena un po' più acuminato del posteriore, leggermente convesso e circoscritto, lungo il margine, da uno strato, abbastanza cospicuo, di secrezione cerosa biancogrigiastra, sulla quale viene a poggiare l'orlo libero del corpo dell'insetto. Il corpo di questi, lungo il margine ibero, e notevolmente ispessito e presenta tutt' all'ingiro una frangia cerosa ininterrotta e molto breve. Al dorso l'insetto è rivestito da altri glomeruli cerosi e di più presenta, ancora, verso la regione mediana di esso, 4 filamenti cerosi molto lunghi e robusti come si può rilevare dalla (fig. 1).

Eliminata la cera, che più o meno bene riveste la superficie del corpo dell' insetto, questo, appare di una tinta ferruginea più oscura lungo la regione marginale che non sia verso la regione mediana.

Di più si nota ancora che la regione cefalica del corpo non è ben distinta dal torace quanto quest'ultimo dall'addome, come i segmenti toracici, in confronto degli addominali, sono meno bene separati tra loro.

La consistenza del tegumento dorsale non è uniforme, ma, al contrario, essa mostra delle zone, variabili in dimensioni, in cui la cuticola è assai esile ed incolora e tali zone corispondono ad aggruppamenti di numerose e minuscole ghiandole ciripare che colla loro presenza conferiscono a quelle l'aspetto di tante membrane cribrose. Dette zone possiamo distinguerle in due categorie a seconda delle loro dimensioni e tanto le une che le altre, rispetto al diametro longitudinale del corpo, hanno disposizione di perfetta simmetria. Il numero delle zone maggiori è di 7 paia cosi disposte: Un paio situato nella regione cefalica, un paio sul secondo segmento addominale, un'altro sul IV segmento addominale e gli altri distribuiti un paio per caiscuno dei successivi anelli. Il secondo e terzo paio rappresentano le zone più vistose e sono caraterizzate per presentare, verso il centro, lo sbocco di una grossa ghiandola ciripara provvista di un robusto processo chitiniso conico, più o meno curvato, sul quale viene a modellarsi il lungo filamento ceroso prima ricordato; le zone successive diminuiscono in dimensioni man mano che si riprocede verso l'estremità posteriore.

Le zone della seconda serie, sono, come si é già osservato, assai meno cospicue e si trovano distribuite particolarmente nella regione cefalica conforme quanto vedesi nella fig. 2, no. 1.

Parallelamente al margine del corpo, a breve distanza da esso, corre tutt' all'ingiro una corona di brevi peli distribuiti simmetricamente; un'altro paio di peli cosi fatti possiedono ancora i segmenti toracici ed uno la regione cefalica. I segmenti dell'addome presentano pochi sbocchi di minute ghiandole ciripare anch'esse disposte in serie ora semplice ora duplice.

L'apertura anale presenta l'opercolo piuttosto ampio, poco più largo che lungo con linguetta conica, ottusa all'apice e provvista verso l'estremità, ai lati, di due paia di setole lunghette e abbastanza robuste; un'altro palo di peli meno vistosi sta piantato sull'opercolo, uno a destra e l'altro a sinistra della base della linguetta.

Dal lato de ventre l'insetto non presenta alcunchè di particolare, salvo le zampe rudimentali che diversamente di quanto si nota nelle forme del genere *Aleurodes* non sono provviste al loro estremo, come quelle, di una grossa ventosa, ma semplicemente di un robusto uncino.

Questo carattere, suppongo, deve essere costante per le specie che rientrano nel gruppo degli *Aleurodicus*, poichè lo riscontrai anche nella specie che descriverò in appresso, la quale non v'ha dubbio sia un'autentico *Aleurodicus*, presentando ben distinti tutti i caratteri specifici che servono a tener distinte le forme che compongono detto gruppo dagli altri. Se esso sarà convalidato, ripeto, da altre osservazioni potrà fornire un'ottimo carattere diagnostico tutte le volte che per la mancanza delle forme adulte lo stadio corrispondente a quello ora descritto presenti gli altri caratteri poco spiccati di maniera da lasciare lo studioso in dubbio circa il posto da assegnare alla specie.

Lunghezza del corpo 1520 μ.

Larghezza " " 1000 μ.

Filamenti cerosi lunghi oltre un centimetro.

" " grossi 80 μ.

Lunghezza del processo conico che sorregge il filamento ceroso 200 μ.

Adulto ♀.—Forma generale del corpo conforme quella delle specie congeneri. Ali bene sviluppate, le anteriori molto più ampie delle posteriori, rivestite da una tenuissima secrezione cerosa biancastra.

Tanto le ali anteriori che quelle posteriori presentano numerose macchie brunastre, di sviluppo vario ed a contorni più o meno frastegliati conforme quanto osservasi nella fig. 2, No. 8.

Zampe piuttosto lunghe, mediocremente robuste, disuguali tra loro essendo più breve il paio anteriore. La variabilità della lunghezza delle zampe e dovuta specie alla maggiore lunghezza che raggiungono tra tutti gli articoli la tibia ed il tarso, giacché anca, trocantere e feorme in tutte e tre le paia di zampe sono di egual lunghezza. Tutti gli articoli della zampe sono forniti di peli i quali nel complesso sono brevi ed esili, i più delicati, ma numerosi, sono quelli inseriti sull'anca, mentre i più robusti, per quanto brevissimi, sono quelli piantati sulla tibia la quale, verso il suo apice distale, presenta ancora due sproni di discrete dimensioni. Il tarso al suo apice è armato di due lunghe e robuste unghie di cui una al suo margine interno è unidentata, mentre l'altra è inerme. Tra le due unghie vi ha poi un empodio in forma di lamina fogliare il quale presenta l'orlo marginale esterno fornito di numerosi peluzzi. L'estremità posteriore dell'addome termina in un ovopositore costituito da 4 pezzi di cui i due esterni hanno l'orlo esterno dentato. L'ultimo sternite mostra un certo numero di peli disposti simmetricamente (fig. 2, No. 11).

L'apertura anale è riparata da un'opercolo a forma trapezoidale munito di linguetta che arriva a mala pena o di poco o sopravanzare il margine posteriore dell'opercolo.

Nulla posso dire delle antenne con precisione perche i due esemplari femmine venuti in mio possesso le avevano spezzate; dia resti rinvenuti mi sembra, però, che esse debbano essere conformi o poco dissimili da quelle delle altre specie.

Colore del corpo bruno.

Lunghezza del corpo più di un millimetro e mezzo.

Ala anteriore lunga 2250 μ.
" " larga 1350 μ.
" posteriore lunga 1920 μ.
" " larga 1120 μ.

Zampe del I paio lunghe 1660 μ	anca	150 μ
	trocantere	100 μ
	femore	450 μ
	tibia	540 μ
	I articolo del tarso	220 μ
	II " " "	130 μ
	unghie	70 μ
Zampe del II paio lunghe 1750 μ	anca	150 μ
	trocantere	100 μ
	femore	450 μ
	tibia	600 μ
	I articolo del tarso	230 μ
	II " " "	130 μ
	unghie	90 μ
Zampa del III paio lunghe 1940 μ	anca	150 μ
	trocantere	100 μ
	femore	450 μ
	tibia	700 μ
	I articolo del tarso	300 μ
	II " " "	150 μ
	unghie	90 μ

Habitat.—Raccolto nell'Argentina su una pianta rimasta indeterminata.

L'insetto si rinviene fissato alla pagina superiore delle foglie, in colonie più o meno numerose e la sua presenza è facilmente avvertibile causa l'ammasso dei lunghi filamenti cerosi dorsali che si intrecciano tra loro in tutte le direzioni formando cosi una specie di rete che probabilmente ha l'ufficio di proteggere gli insetti sottostanti dai nemici che li insidiano.

[Translation.]

Larva (last stage).—The body is of decisively oval shape, with its anterior end slightly more acuminate than the posterior end. It is slightly convex, and along its margin it is surrounded by a sufficiently conspicuous stratum of a grayish-white waxy secretion, upon which rests the free end of the body of this insect. The body of this insect, along its free margin, is considerably inspissated, and it presents all around an uninterrupted and very narrow waxy fringe. On the dorsum this insect is partially covered by other waxy glomerules, and, furthermore, it has near the median line of the dorsum four very long and robust waxy filaments, such as can be seen in figure 1 [fig. 4].

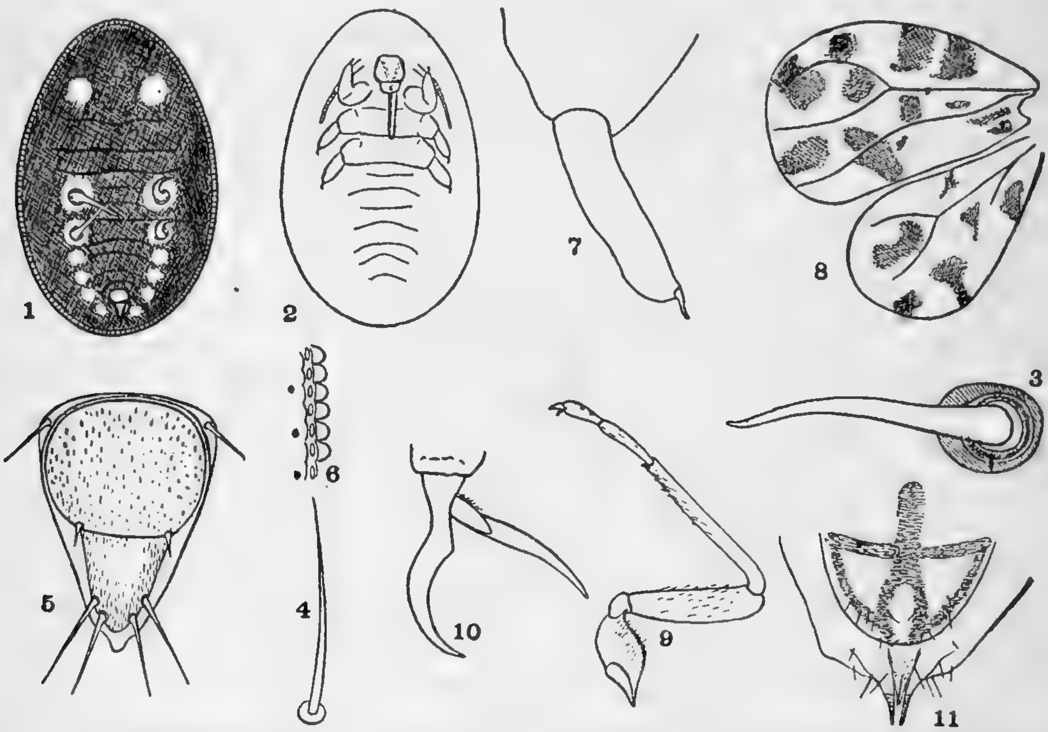


FIG. 4.—*Leonardius lahillei: 1,* Pupa case, dorsal view; *2,* pupa case, ventral view; *3,* anterior abdominal wax pore; *4,* spine of pupa case; *5,* vasiform orifice of pupa case; *6,* margin of pupa case; *7,* leg of pupa; *8,* wings of adult; *9,* leg of adult; *10,* foot of adult, *11,* female genitalia. (Redrawn from Leonardi.)

If the wax, which more or less invests the surface of the body of the insect, is removed its color is a ferruginous tint, darker along the marginal region, but less so toward the central region.

Moreover, it can be noted that the cephalic region of the body is not very distinct from the thorax. The thorax is more distinct from the abdomen, as the divisions between the thoracic segments, as compared with the abdominal segments, are less well marked.

The consistency of the dorsal tegument is not uniform, but, on the contrary, it shows zones, variable in dimension, in which the cuticle is very thin and transparent, and these zones correspond to groups of numerous and minute wax-producing glands whose presence causes these to assume the appearance of so many cribrate membranes.

These zones we can segregate into two categories according to their dimensions and both, as regards the longitudinal diameter of the body, are arranged in perfect symmetry. The number of the major zones is seven pairs, arranged as follows: One pair situated in the cephalic region, one pair upon the second abdominal segment, another pair upon the fourth abdominal segment, and the others distributed per pair upon each of the succeeding rings. The second and the third pairs represent the most conspicuous zones and are characterized by presenting toward the center the mouth of a thick wax-producing gland provided with a robust chitinous conical process, more or less curved, upon which is placed the long waxy filament formerly described. The succeeding zones decrease in size successively as we proceed backward toward the posterior extremity.

The zones of the second series are, as has already been stated, much less conspicuous and are distributed chiefly in the cephalic region, as can be observed by examining figure 2, No. 1 [fig. 4, *1*].

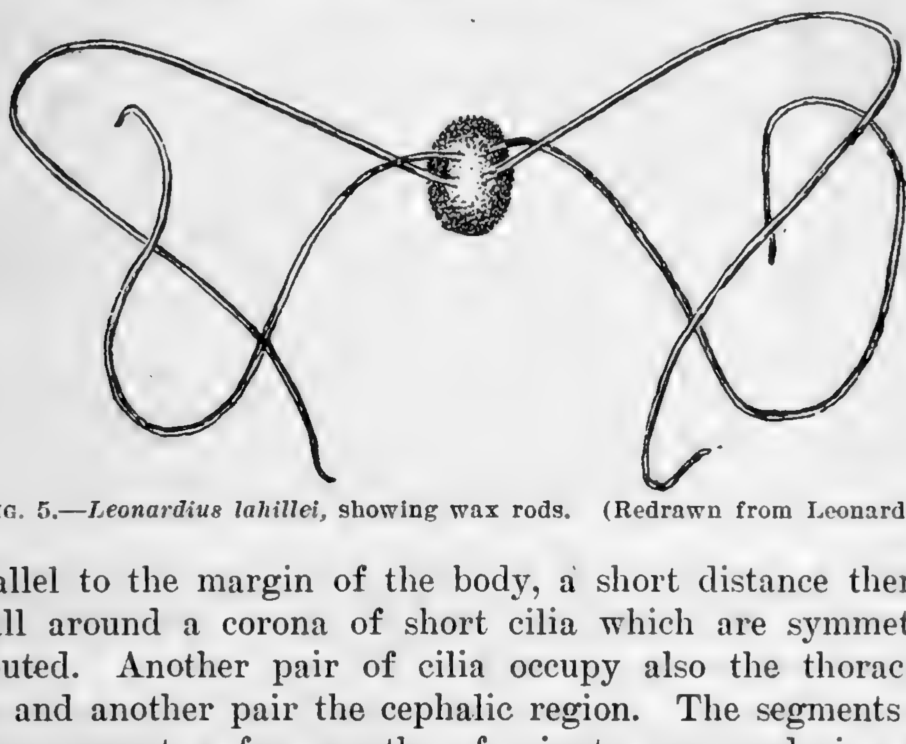


FIG. 5.—*Leonardius lahillei,* showing wax rods. (Redrawn from Leonardi.)

Parallel to the margin of the body, a short distance therefrom, runs all around a corona of short cilia which are symmetrically distributed. Another pair of cilia occupy also the thoracic segments, and another pair the cephalic region. The segments of the abdomen present a few mouths of minute wax-producing glands which are disposed in rows, sometimes single, sometimes double.

The anal aperture shows the operculum of rather large size, its width slightly exceeding its length, furnished with a conical lingula, obtuse at the apex, and furnished near the end laterally with two pairs of rather long bristles that are quite robust. Another pair of hairs that are less conspicuous is attached to the operculum, one at the right and the other at the left of the base of the lingula.

In regard to the venter, the insect presents no particular features except the rudimentary legs, which differ from those generally noted in the forms of the genus *Aleyrodes* at their extremity in not being provided, like the others, with a pulvillus, but only with a robust claw.

These characteristics, I suppose, are constant in the species which form the group *Aleurodicus*, because I find them also in the species which I shall describe after this, of which there is no doubt that it is an authentic *Aleurodicus*, as it presents very distinctly all the specific characteristics which serve to keep distinct from others the forms composing this group. This will be confirmed, I repeat, by other observations which will be able to furnish a perfect diagnostic characterization, notwithstanding the fact that by the absence of the adult forms the corresponding stage of the insect here described presents the other characteristics little conspicuous, so as to leave the author in doubt in regard to the place which ought to be assigned to the species.

Length of body 1.520 mm.; width of body 1.000 mm.; length of waxy filaments exceeds 1 centimeter; thickness of waxy filaments 0.080 mm.; length of the conical process which supports the waxy filament 0.200 mm.

Adult female.—The general shape of the body conforms to that of the congeneric species. The wings are well developed, the anterior being much larger than the hind wings. They are covered with a very thin, whitish, waxy secretion.

The forewings as well as the hind wings present numerous brown spots of varying size and with a contour more or less notched, as can be seen from figure 2, No. 8 [fig. 4, *8*].

The legs are rather long, of medium thickness, subequal, the anterior pair being shorter. The variability of the length of the legs is due chiefly to the difference in length which exists between all the joints of the tibia and the tarsus, while the coxa, the trochanter, and the femur in all three pairs of legs are of equal length. All the joints of the legs are furnished with cilia which, on the whole, are short and slender. Those inserted on the coxa are more delicate but more numerous, while those inserted on the tibia are more robust and shorter in length. The tibia near its distal apex presents also two spurs of considerable size. The tarsus at its apex is provided with two long, robust claws, one of which at its internal margin is furnished with a tooth, the other being unarmed. Between the two claws there is an empodium in the shape of a foliate lamina in which the external marginal edge is furnished with numerous fine hairs. The hind end of the abdomen terminates in an ovipositor consisting of four pieces the outside two of which present a dentate external margin. The last sternite shows a certain number of hairs systematically arranged. (Fig 2, No. 11 [fig. 4, *11*]).

The anal aperture is sheltered by an operculum of a trapezoidal shape provided with a lingula which hardly at all, or only a short distance, projects beyond the posterior margin of the operculum.

I can state nothing with precision about the antennæ because in the two female specimens which came into my possession they had been broken off; from the small remainder still intact it seems to me, however, that they are alike in conformation with, or only little dissimilar from, the antennæ of other species.

Color of body brown. Length of body a little more than 1.5 mm.; length of forewing 2.250 mm.; width of forewing 1.350 mm.; length of hind wing 1.920 mm.; width of hind wing 1.120 mm.

		mm.
Length (total) of the first pair of legs 1.660 mm.	coxa	0.150
	trochanter	.10
	femur	.450
	tibia	.540
	1st tarsal joint	.220
	2d tarsal joint	.130
	claws	.070
Length (total) of the second pair of legs 1.750 mm.	coxa	.150
	trochanter	.100
	femur	.450
	tibia	.600
	1st tarsal joint	.230
	2d tarsal joint	.130
	claws	.090
Length (total) of the third pair of legs 1.940 mm.	coxa	.150
	trochanter	.100
	femur	.450
	tibia	.700
	1st tarsal joint	.300
	2d tarsal joint	.150
	claws	.090

Habitat.—Collected in Argentina upon a plant not classified.

This insect is found attached to the upper surface of the leaves, in colonies more or less numerous, and its presence is readily ascertained because of the accumulation of the long dorsal waxy filaments which are interlaced amongst each other in all directions, thus forming a kind of net whose probable office is the protection of the insects from the enemies which infest it.

On January 18, 1912, Dr. C. W. Hooker sent from Mayaguez, Porto Rico, specimens of an aleyrodid taken on *Phoradendron*, parasitic on almond. These insects belong to the genus *Leonardius* herein described. They agree closely with the description of *lahillei* given by Leonardi. Slight differences are, however, noticeable. In our specimens, for example, the forewings are slightly shorter than the body, while in *lahillei* they are longer. The wings are also somewhat differentily marked, as will be seen from the illustrations, and the legs are relatively shorter in our specimens. We prefer, however, pending a careful comparison of the types, to leave the present form under the name of *lahillei* and give the following descriptive remarks.

DESCRIPTIVE REMARKS.

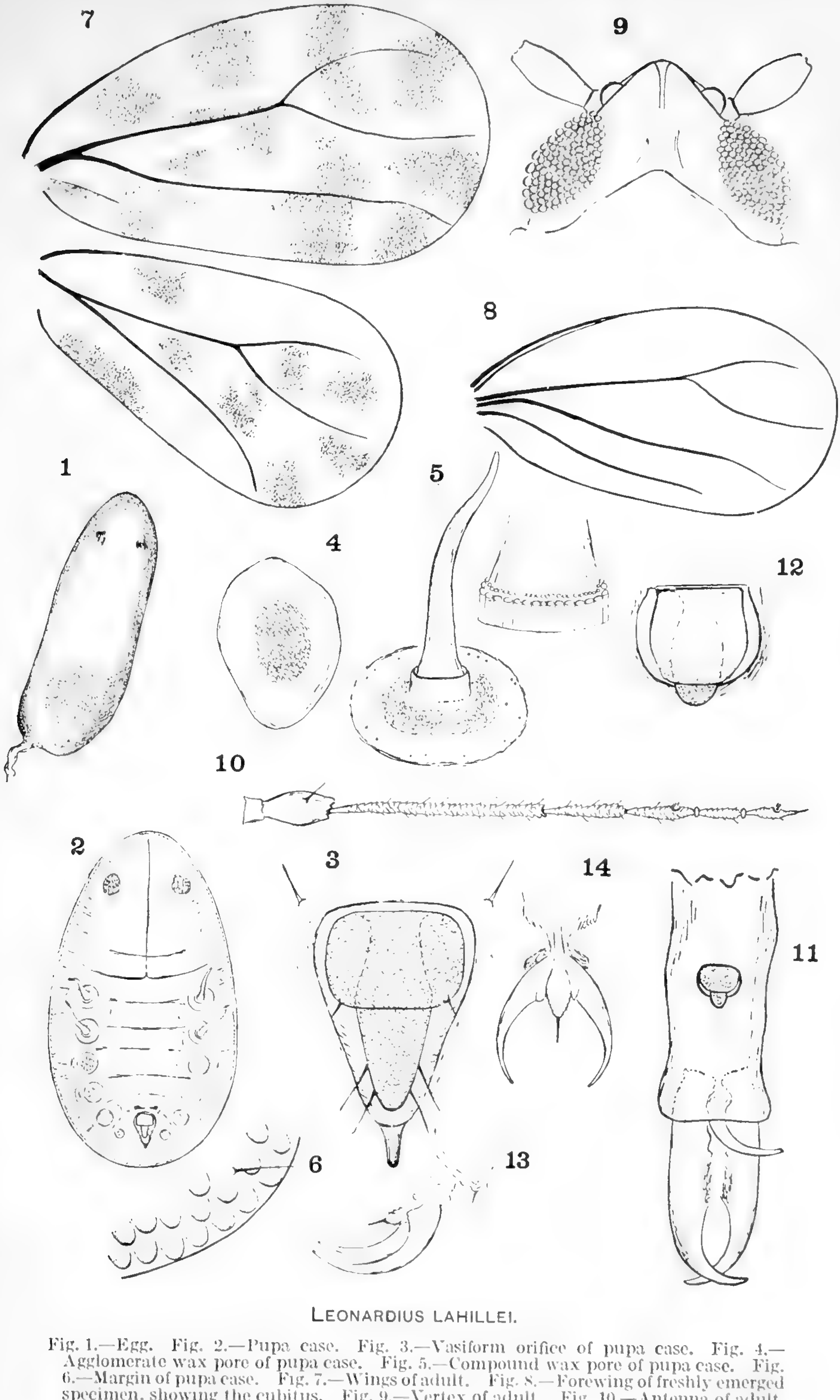
Egg (Pl. IX, fig. 1).—Length, 0.352 mm. Shape elongate elliptical, surface unmarked, but numerous oily globules showing from within; stalk short, inserted slightly laterad of the base; color yellowish, with an orange-red area (part of the embryonic structure) at or near the base; red eyespots of the embryo often visible through the shell.

Pupa case (Pl. IX, fig. 2).—Length, 1.44 mm.; width, 0.88 mm. Shape somewhat oval, broadest across the anterior part of the abdomen, narrower cephalad, dorsum slightly rounded, with the segments of the abdomen and the median longitudinal thoracic suture fairly distinct. There are seven pairs of large wax pores on the dorsum, one pair on the thorax, and six pairs on the abdomen. The thoracic pair and the four caudal abdominal pairs are of the agglomerate type (Pl. IX, fig. 4). They consist of a clear marginal area and a central area composed of numerous small papillæ or rod-like pores, giving this area the appearance of a brush. The two anterior abdominal pairs (Pl. IX, fig. 5) have something of the nature of the true compound pores of *Aleurodicus.* There is a central process which is elongate and somewhat curved. Encircling this at the base is a series of spinnerets which are not elevated. The outer cup is shallow and outside it on the derm is a circular area of papillæ-like pores similar to those present in the agglomerate pore. This is bounded again by a clear area in which are a few scattered simple pores.

The vasiform orifice (Pl. IX, fig. 3) is elongate cordate, with the anterior edge straight and the latero-caudad margin armed with teeth or folds. The caudal end is armed with a prominent projection. The operculum is almost rectangular, with rounded edges, somewhat broader than long and armed on the latero-caudad border with two spines. The lingula is conical, rather elongate, included, and armed with four spines. Both operculum and lingula are setose.

A pair of small setæ is situated just cephalad of the vasiform orifice, and within the margin of the case all around is a series of fine setæ. The margin itself is entire but just within it (Pl. IX, fig. 6) are two or three rows of rounded papillæ-like pores.

The color of the case under the microscope is yellow, shading into reddish brown near the margin. On the leaf it appears brown.



LEONARDIUS LAHILLEI.

Fig. 1.—Egg. Fig. 2.—Pupa case. Fig. 3.—Vasiform orifice of pupa case. Fig. 4.—Agglomerate wax pore of pupa case. Fig. 5.—Compound wax pore of pupa case. Fig. 6.—Margin of pupa case. Fig. 7.—Wings of adult. Fig. 8.—Forewing of freshly emerged specimen, showing the cubitus. Fig. 9.—Vertex of adult. Fig. 10.—Antenna of adult. Fig. 11.—Male genitalia. Fig. 12.—Vasiform orifice of adult male. Fig. 13.—Foot of adult. Fig. 14.—Same, showing claws spread. (Original.)

There is a short, evenly trimmed marginal fringe of white wax all around and from the two anterior abdominal pairs of pores extremely long overhanging white waxen rods are secreted, one from each pore. These give the case the appearance of a phalangid with four white legs. The agglomerate pores secrete a small amount of granular wax.

Adult female.—Length, 2.24 mm. Vertex (Pl. IX, fig. 9) produced, somewhat cone-shaped, with a median longitudinal furrow; ocelli large and distinct. Antennæ (Pl. IX, fig. 10) of seven segments: I, 0.064 mm., cylindrical; II, 0.096 mm., broad, pyriform; III, 0.208 mm., narrow, cylindrical; IV, 0.128 mm., cylindrical; V, 0.08 mm., cylindrical, armed near its distal end with a fringed sensorium; VI, 0.016 mm., cylindrical; VII, 0.064 mm., armed at about its median part with a fringed sensorium and terminating in a bristle. Segments III–VII imbricated and armed with fine hairs. Between segments V and VI and VI and VII small ring-like segments can sometimes be observed.

Forewings 2 mm. long, 1.2 mm. wide, transparent, marked with dark brown, as shown in Plate IX, figure 7; hind wings 1.76 mm. by 0.96 mm., marked with brown, as in Pl. IX, figure 7. In the forewings of freshly emerged adults, before the markings are evident the cubitus can be distinctly seen (Pl. IX, fig. 8).

Fore-tibiæ 0.448 mm.; fore-tarsi, proximal segment 0.192 mm., distal 0.112 mm.; hind tibiæ 0.72 mm.; hind tarsus, proximal segment 0.288 mm., distal 0.144 mm.; claws of foot (Pl. IX, fig. 14) well curved and acute, paronychium a narrow hairy structure armed with a central spine; ovipositor acute, armed with the usual spines. Color of head and thorax a reddish brown, shaded on the segments and appendages with dusky. Eyes brownish black, apparently not divided. Abdomen a brownish yellow, the red portions of the eggs within often showing as a red blotch.

Adult male.—In general appearance similar to the female. Forewings 1.84 mm. by 0.9 mm.; length from vertex to tips of claspers 2.64 mm.; genital segment 0.512 mm. long (Pl. IX, fig. 11); claspers 0.48 mm., curved and acute; penis short and recurved.

Genus **ALEURODICUS** Douglas.

Aleurodicus Morgan, Ent. Mo. Mag. (2) vol. 3, p. 32 (1892).

Forms in this genus have radius$_1$, radial sector, and the media present in the forewing, with sometimes an indication of the cubitus. The paronychium is represented by a large spine and the pupa case has large compound wax pores. A study of the forms indicates three subgenera.

Type, *anonæ* Morgan.

Subgenera of Aleurodicus.

I. Lingula of pupa case long, spatulate or conical, exserted; lingula of adult long, narrow, and included; compound pores as illustrated in Plate III, fig. 2.

A. Sides of pupa case flat, not deflexed under ventral surface; vertex of adult rounded ---------- Subgen. *Aleurodicus.*

B. Sides of pupa case deflexed under ventral surface; vertex of adult slightly bilobed ---------- Subgen. *Lecanoideus.*

II. Lingula of pupa case short, conical, usually included; lingula of adult broad, rounded, and exserted; compound wax pores of pupa case as illustrated in Plate XXVII, figure 3 ---------- Subgen. *Metaleurodicus.*

Subgenus **ALEURODICUS** n. subgen.

Fore wings with the veins as given for the genus. Vertex rounded, antennæ of seven segments, of which the third is the longest; claspers of male long and narrow; penis recurved, usually short; pupa case flat, with a number of large compound wax pores of the type illustrated in Plate III, figure 2, and sometimes a number of small reduced ones. Vasiform orifice with a long, setose, spatulate exserted lingula, which is armed with four long spines. Size usually large.

Type, *anonæ* Morgan.

Species of Subgenus Aleurodicus.[a]

I. Pupa case with seven pairs of compound wax pores, one cephalic pair, and six abdominal pairs.

A. All seven pairs of pores equally developed; size of pupa case 1.33 to 1.5 mm. long by 0.83 to 1 mm. wide; pores broad and shallow; margin of case with irregular rectangular areas and a submarginal row of strong hairs; outline of case subelliptical to ovate; wings white, unmarked ---------- *destructor.*

B. The two caudal pairs of wax pores and the cephalic pair more fully developed than the other four pairs, and with very long central chitinized processes; size of pupa case 1 by 0.53 mm., shape elliptical; edge of case with large crenulations; egg with the stalk much longer than the egg itself. Case raised on a vertical fringe of white wax and the dorsal surface covered with a plate of fused dirty white wax, through which the compound pores may be seen ---------- *holmesii.*

C. The two caudal pairs of pores are much smaller than the other five pairs.

1. Dorsal disk, as well as the submarginal area, covered with numerous simple pores; compound pores very large and well developed; margin of case entire, with a row of stout hairs just within. Lingula long, with four very prominent hairs; operculum with

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[a] It has not seemed wise to attempt to include in this key *anonæ* Curtis and *conspurcatus* Enderlein. In the former species the description is too vague, and in the latter the immature stages are as yet unknown.

two large hairs on caudal margin, one on either side. Size of pupa case 1.3 by 0.92 mm. Shape broadly elliptical. Forewing of adult (female) 2.27 mm. long, marked with dusky spots, six forming a ring around the margin of the wing, two being central. Segment V of antennæ with a fringed sensorium and a stout spine near its distal end. Waxy secretion of pupa a series of fluted bands from simple wax pores, much longer than case is wide, and from the compound wax pores are produced very long, curling, brittle, glassy wax rods________________*neglectus.*

2. Dorsal disc without small simple pores, but the submarginal area all around with very many, forming a band.

a. Exposed portion of lingula of pupa case long and spatulate; operculum without a pair of spines on its caudal margin.

(1). Forewing of adult with one large central reddish brown marking over the radial fork and extending from the costal margin to or beyond the media. Length of forewing (female) 2.60 mm.; genital segment of the male transversely wrinkled or striate. Pupa case with submarginal row of stout hairs; size 1.30 by 0.70 mm. Shape elliptical. A prominent palisade of white wax raises the case from the leaf. Dorsum void of secretion, except the glassy wax rods from compound wax pores__________*guppyii.*

(2). Forewing of adult with four transverse gray bands, of which only the third and fourth are joined by a longitudinal band (Pl. XIV). Length of forewing (female) about 2.4 mm. Pupa case ovoid or subelliptical, variable in size, from 1.15 to 1.3 mm. long by 0.7 to 0.85 mm. wide. Dorsum of case powdered with dirty white wax, and case raised by palisade of white wax. Lingula unusually large, dark brown in color________ *dugesii.*

b. Exposed portion of lingula of pupa case short and conical; caudal margin of operculum with a pair of spines.

(1). Pupa case broadly elliptical, with two large, dark, latero-dorsad areas extending the full length of the case. Margin entire, with a row of small simple pores some distance within it. All around on the submarginal area is a row of stout hairs. These occur a considerable distance mesad on the dorsum, some of them almost between the compound pores; spinnerets of the compound pores spread apart. Size of case 1.33 by 1.15 mm____ *pulvinatus.*

(2). Pupa case without dark latero-dorsad areas, but of uniform yellowish color; margin entire and just within it a row all around of large boat-shaped simple pores. A submarginal row of long hairs present inserted in about the same region. Spinnerets of compound pores compact. Size of case variable, ranging in length from 0.98 to 1.26 mm., and in width from 0.98 to 0.7 mm. Shape broadly oval, slightly narrower on cephalic end. Forewing of adult with two very faint dusky markings, one extending from the costal margin over the radial fork, the other at the apex of the wing. Length of forewing (female) 2.15 mm.; claspers of male very long and narrow. Immature insects occurring along midrib of leaf and surrounded by a copious secretion of cottony-white wax__________________*cocois.*

3. Submarginal area of pupa case without a band of small simple pores, but just within the margin all around, one row of disk-like simple pores. Forewing of adult with four more or less distinct dusky areas, one within the radial fork, one on either side of the union of radius $_1$ and radial sector, and one on the proximal costal margin. Waxy secretion composed of distinct fine rods. *trinidadensis.*

II. Pupa case with six pairs of compound wax pores, there being five pairs of abdominal pores, of which the caudal pair is reduced.

A. Case with marginal row of large simple wax pores, bearing within several fine rods; margin itself entire and just within it a row of prominent hairs. Compound wax pores with the spinnerets much reduced and short; lingula spatulate, very long and large, being about three times as long as the operculum, armed with four stout hairs. Size of case 1 by 0.84 mm., shape broadly elliptical. Length of forewing (female) 2 mm. Wings banded with dusky, as shown in Plate XXII, figure 5........................*ornatus.*

B. Pupa case without a marginal row of large, simple wax pores, but the submarginal area covered with numerous very small pores; margin entire; caudal margin of case with two large spines. Compound wax pores with the central process about the same height as the cup and the spinnerets not reduced and short, but about two-thirds the length of the central process. Lingula very long, spatulate, armed with four hairs. Caudal margin of operculum with two spines or hairs situated near the center. *jamaicensis.*

III. Pupa case with five pairs of compound wax pores, there being four abdominal and one cephalic pair, all of which are equally developed. Margin of case entire; just within it a row of large simple pores; smaller pores similar to these are scattered over the entire dorsum; lingula very long, narrow, tapering, and armed with four hairs. Size of case 1.25 by 0.85 mm.; shape elliptical; waxy secretion fairly abundant, semiflocculent or cottony, and more or less hiding the insects beneath..*coccolobæ.*

Aleurodicus anonæ Morgan.

(Plate X, figs. 1–12.)

Aleurodicus anonæ Morgan, Ent. Mo. Mag. (2) vol. 3, p. 32 (1892).

[a] FIG. 1. Larva of *Aleurodicus anonæ,* n. sp., surrounded with white secretion.
2. Mouth organs of same; *a,* mandibular; *b,* maxillary setæ; *c,* labium; *d,* labrum.
3. Imago, same species, ♀ x 22.
4. Genital organs of male; *a,* penis.
5. Posterior leg of imago.
6. Labium of same.
7. Genital organs of ♀ imago; *a,* colon.
8. Larva, deprived of the white secretion, x 22.
9. Leg of same.
10. Lateral funnel-shaped secreting gland of same.
11. Anus, colon, and ileum of same.
12. Marginal secreting glands of same.

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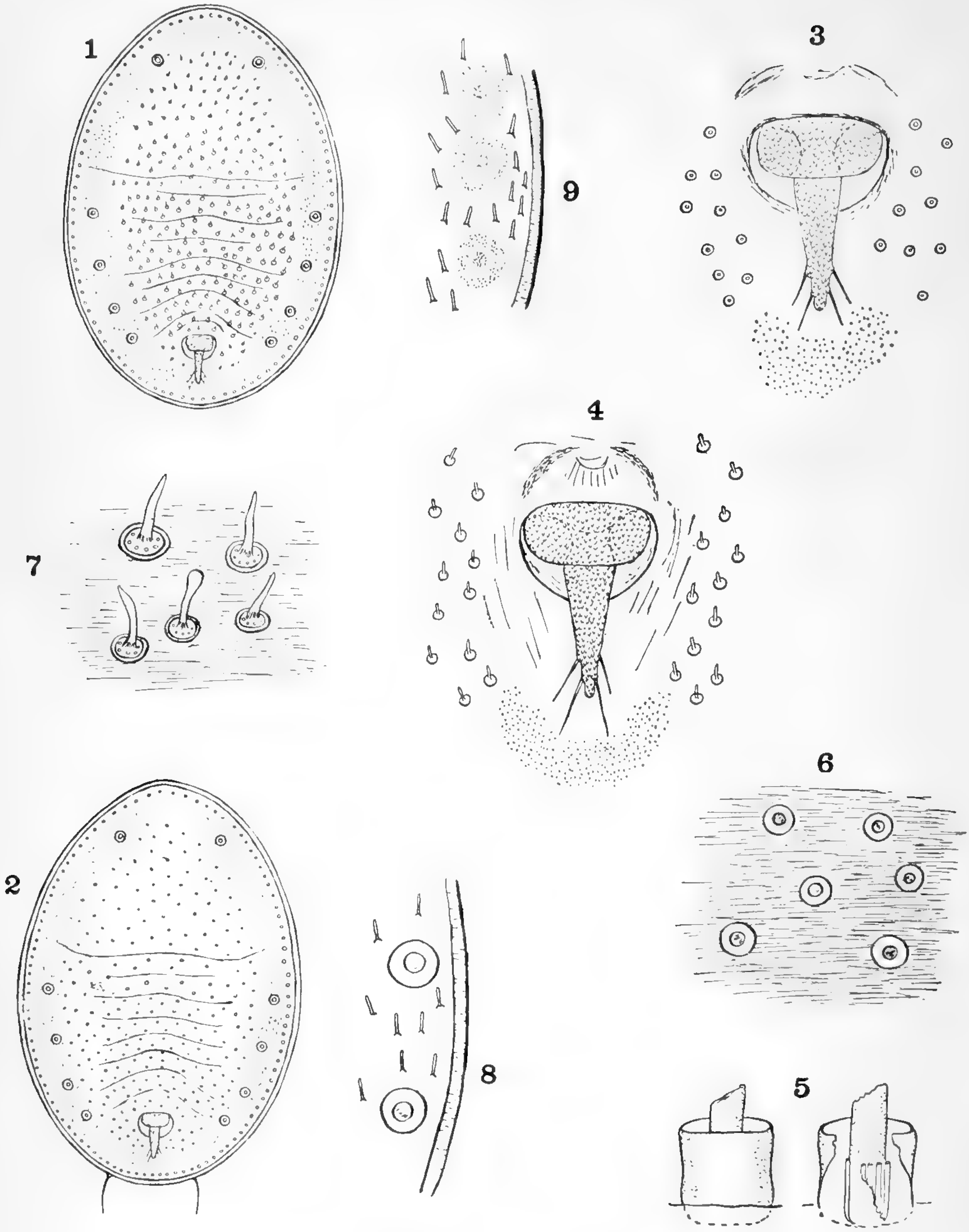
[a] Explanation of Plate I [Plate X], quoted from original description.

ALEURODICUS ANONÆ.

Fig. 1.—Larva surrounded with white secretion. Fig. 2.—Mouthparts of same: *a*, Mandibular; *b*, maxillary setæ; *c*, labium; *d*, labrum. Fig. 3.—Imago, same species, female, x 22. Fig. 4.—Genital organs of male. Fig. 5.—Posterior leg of imago. Fig. 6.—Labium of same. Fig. 7. Genital organs of female imago. Fig. 8.—Larva, deprived of white secretion, x 22. Fig. 9.—Leg of same. Fig. 10.—Lateral funnel-shaped secreting gland of same. Fig. 11.—Anus, colon, and ilium of same. Fig. 12.—Marginal secreting glands of same. (After Morgan.)



ALEURODICUS COCCOLOBÆ.

Fig. 1.—Pupa case parasitized. Fig. 2.—Pupa case nonparasitized. Fig 3.—Vasiform orifice of nonparasitized pupa case. Fig. 4.—Vasiform orifice of parasitized pupa case. Fig. 5.—Compound wax pores of pupa case. Fig. 6. -Dorsal pores of normal form. Fig. 7.—Dorsal pores of parasitized form. Fig. 8.—Margin of normal pupa case. Fig 9.—Margin of parasitized pupa case. (Original.)

We have seen no example of this species. Material in the bureau collection supposed to be *anonæ*, on careful scrutiny, does not fairly conform to the original and rather indefinite description. So far as we are aware *anonæ* has not been rediscovered since it was described. Following is the original description:

Larva. Oval, depressed, ochreous. Longest diameter 1.25 mm. Antennæ apparently only 2-jointed, the second long and lateral, infundibuliform, compound spinnerets on each side, and posterior to these, two more simply constructed and smaller secret-glands on one side, also one on each side anterior to the first pair of legs. Labium one-jointed, prolonged. Labrum quadrilateral. Mandibular organs short, with the maxillary setæ long and fine (Pl. I [X], fig. 2.) Anus large, with long framework of colon easily distinguishable.

♂ and ♀ adult. Length 2.25 mm. Antennæ long, 7-jointed; basal joint short; second longer; third very long; fourth and fifth subequal; sixth and seventh shorter. Legs long; the posterior pair considerably longer than the others. Tarsus 2-jointed; in the posterior pair of legs the first joint of the tarsus is the longest, in the others equal. Two claws. Tibia and tarsus pinnate. One stout spine at junction of coxa with trochanter. Several small stout spines at junction of tibia and tarsus. Head inserted. Mesonotum chitinous, well developed. Scutellum, a pair of pyriform plates. Wings white, ample, broad; anterior incumbent, length 3 mm.; posterior, length 2 mm. (Pl. I [X], fig. 3); strong central nervure bifurcated near the apex; branch nervure proceeding from the base of the central nervure. Genital organs of female bivalvular, and between the halves is situated the ovipositor (Pl. I [X], fig. 7). In the male the valvular organs are modified in the form of forceps, between which lies the penis (Pl. X, fig. 4). On the last segment of both sexes are two external processes.

Habitat: *Anona muricata* and *Richardia pacifica*, Demerara.

(Aleurodicus) Aleyrodes asarumis Shimer.

Aleyrodes asarumis Shimer, Trans. Amer. Ent. Soc., vol. 1, p. 281 (1867).
Aleurodicus asarumis Riley and Howard, Insect Life, vol. 5, p. 219 (1893).
Aleyrodes acteæ Britton, Ent. News, vol. 16, p. 65, pl. 4 (1905).

This species was described as an *Aleyrodes* by Dr. Shimer. It was later transferred to *Aleurodicus* by Riley and Howard in Insect Life, Volume V, page 219, apparently without an examination of the form, and this placing has been followed by all subsequent writers. In Canada it occurs in large numbers on the underside of the leaves of the wild ginger and the cohosh, the plants from which Shimer described it. An examination of specimens, both of pupa and adults, collected by Prof. T. D. Jarvis, show the species to be an *Aleyrodes* and not an *Aleurodicus*. This we would expect, for all known forms of the genus *Aleurodicus* inhabit the warmer regions. Following Riley and Howard, Dr. Britton considered Shimer's species an *Aleurodicus* and redescribed and figured the form from the same plant under the name of *Aleyrodes acteæ*, in Entomological News, March 1905. His excellent description and figures can now be transferred to Shimer's species and finally settle the standing of *asarumis.*

Aleurodicus coccolobæ n. sp.

(Plate XI, figs. 1–8.)

Collected on seagrape (*Coccoloba uvifera*), Progreso, Yucatan, by Samuel Henshaw, June 24, 1904, and forwarded to the Bureau of Entomology by Professor Cockerell. Only a fragment of leaf bearing a few pupæ is at hand, but the species is so distinct that its recognition from the pupal stage alone will be easy.

DESCRIPTION.

Pupa case.—Size 1.25 mm. by 0.85 mm.; elliptical in outline, moderately convex. As seen under hand lens the abdominal segments are quite distinct as transverse ridges. Color dull yellowish; parasitized specimens brownish black or plumbeous. There is a fairly abundant secretion of wax more or less hiding the insects beneath. The secretion consists of the usual long wax rods from the compound wax pores and a fairly copious secretion of semiflocculent or cottony wax from dorsum of case. There is a secretion all around of a narrow, short rim of fused glassy wax, seen best upon the removal of the more abundant flocculent secretion, and which largely persists on the leaf after removal of case (Pl. XI, fig. 2).

Under the microscope the case is pale yellow to almost colorless. Dorsum of case thickly covered with pores which, however, in the nonparasitized individuals, are made out with some difficulty. On the more central dorsal area, or dorsal disc, the pores are fairly large and scattered promiscuously. The smaller pores occur in a submarginal zone all around the case, and just within margin all around is a closely set row of pores somewhat larger than those on the dorsal disc (Pl. XI, fig. 2). The location of these pores is very evident in parasitized pupæ (Pl. XI, fig. 1), which condition apparently produces rather important structural changes in the pores. In the case of the pores on the dorsal disc there is produced from center of pore a short papilla or peg, acute, rounded, or swollen at tip. From each of the smaller pores forming the submarginal zone is produced a short finger-like process. The pores just within margin of case all around show a group of small dark granules surrounded by many minute granulations. In the single parasitized pupa of *jamaicensis*, constituting the type of this species, are to be noted the same minute finger-like processes from the submarginal zone of pores, but the dorsal pores above mentioned appear to be wanting in *jamaicensis*, and in comparing the lingulæ the species are readily seen to be different.

Margin and dorsum of case apparently without spines, except a pair on caudal end of case.

On each side of the abdominal region are four compound wax pores, and there is a pair present on the cephalic end of case (Pl. XI, fig. 5). There are no reduced compound pores on caudal end of case as in many species.

Vasiform orifice broadly cordate. Operculum subrectangular and about twice as broad as long, the ends rounded. Lingula long, exserted, tapering regularly from base to narrow tip. Two pairs of spines arise near distal end of lingula (Pl. XI, fig. 3).

Adult.—Unknown.

Type.—No. 14765, U. S. National Museum. Described from a few pupæ on leaf, and three parasitized specimens in balsam mount.

Aleurodicus cocois (Curtis).

(Pl. XII, figs. 1–15; Pl. XIV, fig. 1; text figs. 6–9.)

Aleurodes cocois Curtis, Gardeners' Chronicle, 1846, p. 284.
Aleurodicus iridescens Cockerell, Psyche, vol. 8, p. 226 (1898).

This species was described by Curtis from specimens on coconut and was transferred to *Aleurodicus* by Morgan (l. c.). Later it was fully described by Riley and Howard in Insect Life, Volume V, page 314, and later Cockerell described what appears to be the same insect as *Aleurodicus iridescens* in Psyche, June, 1898. These three descriptions and the figures accompanying them are herewith reproduced.

ORIGINAL DESCRIPTION.

[Fig. 6 (1, 2, 3, 4, 5).]

Aleyrodes cocois (the Cocoa-nut Aleyrodes). There is a little white mealy fly which sometimes infests the cabbages, and an allied species has been sent from the West Indies, which differs from it in its structure and economy. We are indebted to Sir Robert Schomburgk for specimens of this curious and destructive insect, the publication of whose history will be acceptable to the cultivator of exotics, and it is to be hoped that it may lead to the discovery of some mode of extirpating it. Sir Robert says, "On my arrival in Barbadoes, I was forcibly struck with the withered appearance of the Cocoa-nut trees, and I have since been told that a disease is prevailing amongst them which threatens to destroy all the Cocoa-nut trees in the island. This remarkable disease showed itself in the island after the fatal hurricane in 1831, and there are only a few trees which are not afflicted by it. It is no doubt to be ascribed to an insect allied to *Aleyrodes.* A great many of the plantations of Cocoa-nut trees which formerly yielded an income of 200 £ or 300 £ per annum have not a single tree which bears fruit. The lower leaves die first and fall off, the flowers follow, or if nuts should have been formed they dwindle away and do not arrive at maturity; ultimately the budding leaves are attacked, and the crown drops off, leaving the withered trunk.

"It is considered that this disease has been introduced since the hurricane, from some of the neighbouring islands, when it became necessary to replace a number of Cocoa-nut trees which had been destroyed; but some pretend that it has been occasioned by the introduction of guano. Smoking, &c., has been of no avail, and as the insect most sagaciously places itself under the leaflet, where it is protected against the weather, the heaviest rain does not affect it. It has been advised to root up all Cocoa-nut trees in the island, and after the lapse of a year, when it is thought the insect may be destroyed, to replant the plantations from seeds imported from an island where the insect does not exist.

"On carefully examining the leaves of the Cocoa-nut, it is evident there are two distinct insects upon the under surface, an *Aleyrodes* and a *Coccus*. They adhere to the under side of the leaf, and are surrounded by a whitish cottony or resinous powder; both sexes of the *Aleyrodes* at rest and with their wings closed are exhibited, of their natural size, on a portion of the leaf (fig. 1) [fig. 6, *1*], and also some oval animals producing the white powder in abundance from the margins of their sides, and these I suppose are the larva state of the *Aleyrodes*. There are also numbers of white linear cases, as shown at fig. 5 [fig. 6, *5*], which I conceive to be the pupæ of a male *Coccus;* indeed I found one of the perfect insects sticking to the surface. At fig. 2 [fig. 6, *2*] I have represented the under side of one of the larvæ; it is oval, concave, ochreous, and shining, with six minute legs and ventral wings, like a female *Coccus;* but I could not detect any proboscis or antennæ. I must, however, observe that the objects had all suffered from extreme pressure and great heat, and it is not unusual for the proboscis to be broken off in removing such animals from the surface on which they are feeding."

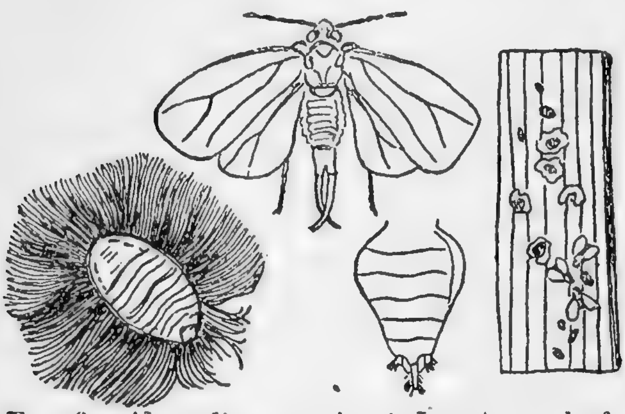


FIG. 6.—*Aleurodicus cocois: 1,* Insects on leaf; *2,* pupa case; *3,* adult; *4,* abdomen. (From Curtis.)

The winged specimens are larger than any of our British *Aleyrodes*, and from the neuration of the wings being different, as well as from the remarkable anal forceps of the male, this insect might with great propriety be separated from the genus *Aleyrodes*. *A. cocois* is bright ochreous, the head is rounded, the eyes are black, oval, and notched on the inside, and I think I could discern two minute ocelli on on the inner margins; the antennæ are as long as the thorax, slender, and apparently seven-jointed, basal joint stoutish; second, the longest. The rostrum is stout and moderately long; the thorax is nearly orbicular, the scutel distinct, the abdomen short and oval in the male, with the last segment long, narrowed, and cylindrical, producing two long incurved claws, forming a pair of forceps (fig. 3) [fig. 6, *3*]; wings apparently horizontal in repose, clothed with white scales or hairs, giving them a powdered appearance; superior ample, subelliptical, with a strong costal nervure, and a furcate one with a longitudinal nervure beneath it, issuing from near the base; inferior wings smaller, with a single forked nervure. Six legs slender, hinder long but simple; the tarsi biarticulate, basal joint the longest, the second terminated by two slender claws. Female similar, but the abdomen is ovate-conic, the apex terminated by a very acute transparent valve with a small oval hairy lobe on each side (fig. 4) [fig. 6, *4*].

As insects will remain in an embryo state for long periods, every vestige of the infested trees should be burnt as soon as they are taken down, and the most diligent search must be made after the *Aleyrodes* upon plants of the same natural order as the Cocoa-nut, to ascertain if there are not colonies established elsewhere. There is the larva of a little beetle, called *Scymnus*, which destroys the European *Aleyrodes*, and it is remarkable that no parasitic insect should have appeared to check the increase of the Cocoa-nut species, but this may arise from the disease having been imported without its usual attendant antidote. Fumigating with sulphur would arrest the plague, if it could be applied; but then it ought to be done simultaneously to be effective, or else at a season when the insects are inactive.—Ruricola.

RILEY'S AND HOWARD'S DESCRIPTION.

(Figs. 7, 8, 9.)

The egg (fig. 41, *a*) [fig. 8, *a*].—We know the egg only from specimens taken from the bodies of gravid females. Length, 0.29 mm.; greatest width, 0.11 mm.; length of pedicel, 0.064 mm. From these measurements it will be seen that the

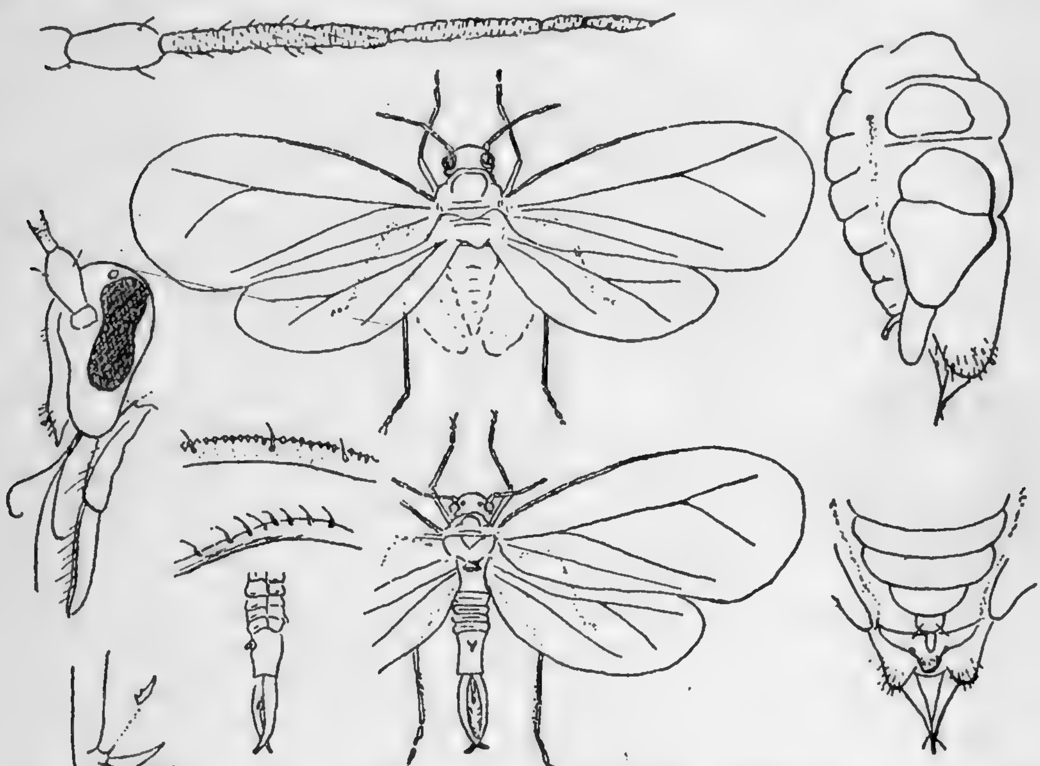


FIG. 7.—*Aleurodicus cocois: a,* Adult female; *b,* side view of abdomen; *c,* dorsal view of abdomen; *d,* antenna; *e,* head from side; *f,* costa of forewing; *g,* costa of hind wing; *h,* tarsus; *i,* pulvillus; *k,* adult male; *l,* claspers. (From Riley and Howard.)

egg is broader in proportion to its length than that of *Aleyrodes citri.* The pedicel, instead of arising from the base of the egg, has its origin on the side, somewhat above the base, as shown at fig. 41, *a.* No sculpturing is observable.

Newly-hatched larva, first stage (fig. 41, *b*) [fig. 8, *b*].—What we assume from its size to be the first stage has been sparingly found in a more or less dried up condition upon the leaves of guava received. It is 0.41 mm. long and 0.19 mm. wide, regularly elliptical, flattened and smooth. Twelve hairs of medium length protrude from each side. Antennæ short, apparently five-jointed, joints subequal. Rostrum one-jointed, arising from a point half way between the middle of the body and the anterior extremity. The dorsal anal pore is distinct, and the long conical organ protrudes.

Larva, intermediate stage (fig. 41, *d, g*) [fig. 8, *d, g*].—A stage intermediate between the newly hatched larva and that which seems full grown has been found and carefully studied. It is flattened, of short, oval form, 1.02 mm. long and 0.84 mm. wide. The legs are plain and are short, stout, and apparently three-jointed. The basal joint is very stout, nearly as broad as long; the second joint is slender, about twice as long as broad; the third joint is very short, and bears a single, stout, curved hook. The rostrum is distinct, one jointed, and three filaments protrude. Each abdominal segment bears laterally a large, complicated pore, from which protrudes a glassy filament, short in this stage, but very long in the following. A smaller pore is situated just laterad of the base of the antenna and those on the anal and pre-anal segments are smaller than those on the others. Antennæ six-jointed. Joint 1 short, stout; joints 2 and 3 long, sub-equal in length, and each five times as long as 1; joint 4 one-half as long as 2 or 3; joint 5 one-half as long as 4, sharply pointed at tip. Dorso-anal pore large, distinct; protrusile organ conical in shape, supported by a tri-lobed chitinous framework. Entire dorsal surface of body finely granulate, the ventral surface granulate laterally to the large pores. Each ventral-abdominal segment bears a transverse row of eight small secretory pores, each of which seems to be tri-cellular.

Adult larva (fig. 40) [fig. 9].—Closely resembles the preceding, except that it is much more convex, and has very long glassy filaments and an abundant

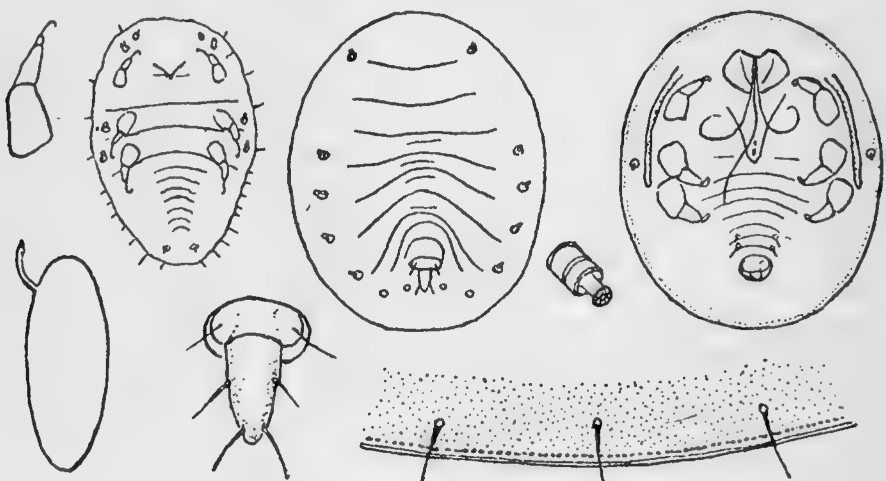


FIG. 8.—*Aleurodicus cocois: a,* Egg; *b,* first larva; *c,* leg of same; *d,* intermediate larva, dorsal view; *e,* protrusile organ of same; *f,* secretory pore of same; *g,* intermediate larva, ventral view; *h,* margin of body of same. (From Riley and Howard.)

secretion of white wax. Abdominal segments very distinct, arched anterodorsally, with a medium longitudinal ridge. The skin of this larva splits transverso-dorsally along the hinder edge of the thorax, and from the middle of this slit medially and longitudinally to the cephalic end of the body. From this double slit the pupa presumably emerges.

Adult female (fig. 39, *a*) [fig. 7, *a*].—Length, 2.1 mm.; expanse, 4.1 mm. Color dull honey-yellow; eyes darker; abdomen, when swollen with eggs, much lighter and bordered with abundant waxy secretions. Antennæ six-jointed. Basal joint short, stout; joint 2 (scape) twice as long, equal to it in width; flagellum rugoso-annulate; joint 3 longest, more than twice as long as 1 and 2 together, and equal in length to 4, 5, and 6 together. In dried specimens it becomes especially constricted at two points; joint 4 rather more than half as long as 3; joint 5 less than half as long as 4; join 6 equal in length to 5. Joint 6 with a bristle at tip, the other joints with sparse, short bristles. Head conical when seen from above, the rostrum plainly 2-jointed, but perhaps with a basal joint; the apical joint acute, nearly as long as the preceding joint. Eyes pyriform, large.

Two ocelli, large and conspicuous. Wings large, subopaque, median vein divided at two-thirds wing length. Costa of fore-wing finely crenulate to tip, furnished with sparse bristles arising below edge of wing. Costa of hind wing with 8 or 9 rather long bristles or hairs near base. Legs slender, moderately long, hind tibia with an internal row of bristles, tarsi 2-jointed, two large tarsal hooks, with a median basal hook-like appendage much smaller than the lateral hooks. Abdomen with six plain tergites, but five visible urites. Sixth tergite bearing a pronounced median curved papilla; ovipositor acute.

Adult male (fig. 39, *k*) [fig. 7, *k*].—Resembles the female except in being more slender and longer by virtue of the two large forficular claspers, nearly as long as the entire abdomen and which gave the average specimen a total length of 2.8 mm., as against 2.1 mm. for the female. Between the two claspers is a short curved style rather more than one-third the length of the claspers. Sixth tergite bears a median papilla and the fourth urite a similar one. Color of abdomen much darker than in female, particularly at hind border of segments; claspers still darker.

Fig. 9.—*Aleurodicus cocois: a,* Skin of full-grown larva from below; *b,* skin of full-grown larva from above. (From Riley and Howard.)

COCKERELL'S DESCRIPTION OF ALEURODICUS IRIDESCENS.

Agrees with *A. asarumis* in having some blackish coloration at the forking of the wing-vein, but differs in having the body and legs a deep chrome yellow, and the eyes not divided. Length of anterior wing 2 mm.; wings noticeably iridescent; a blackish line on the costa. Pupæ along the mid-rib of the leaf, as in *Aleurodicus pulvinata* (Maskell as *Aleurodes*), surrounded by abundant cottony secretion. Pupæ dark grey or plumbeous, varying to brownish, structural characters as usual in the genus. Vasiform orifice semicircular; operculum very broad, broadly truncated at end. Four large round orifices on each side of the abdomen, some distance from the margin, but not nearly so large as Maskell figures for *pulvinata;* four very much smaller orifices in the caudal region, laterad of the vasiform orifice, the two hindmost nearer to each other than are the anterior ones; two of the large orifices at the cephalic end, and also four small ones as in *pulvinata*, but they are very minute.

Hab.—Ocean beach between El Faro and San Pedro, Tabasco, Mex., June 12, 1897, on "Jicaco," a bush with large leaves growing on the sand flats (Townsend) Div. Ent. 7824.

In the original description there is little given by means of which this species could be distinguished from others in the same genus.

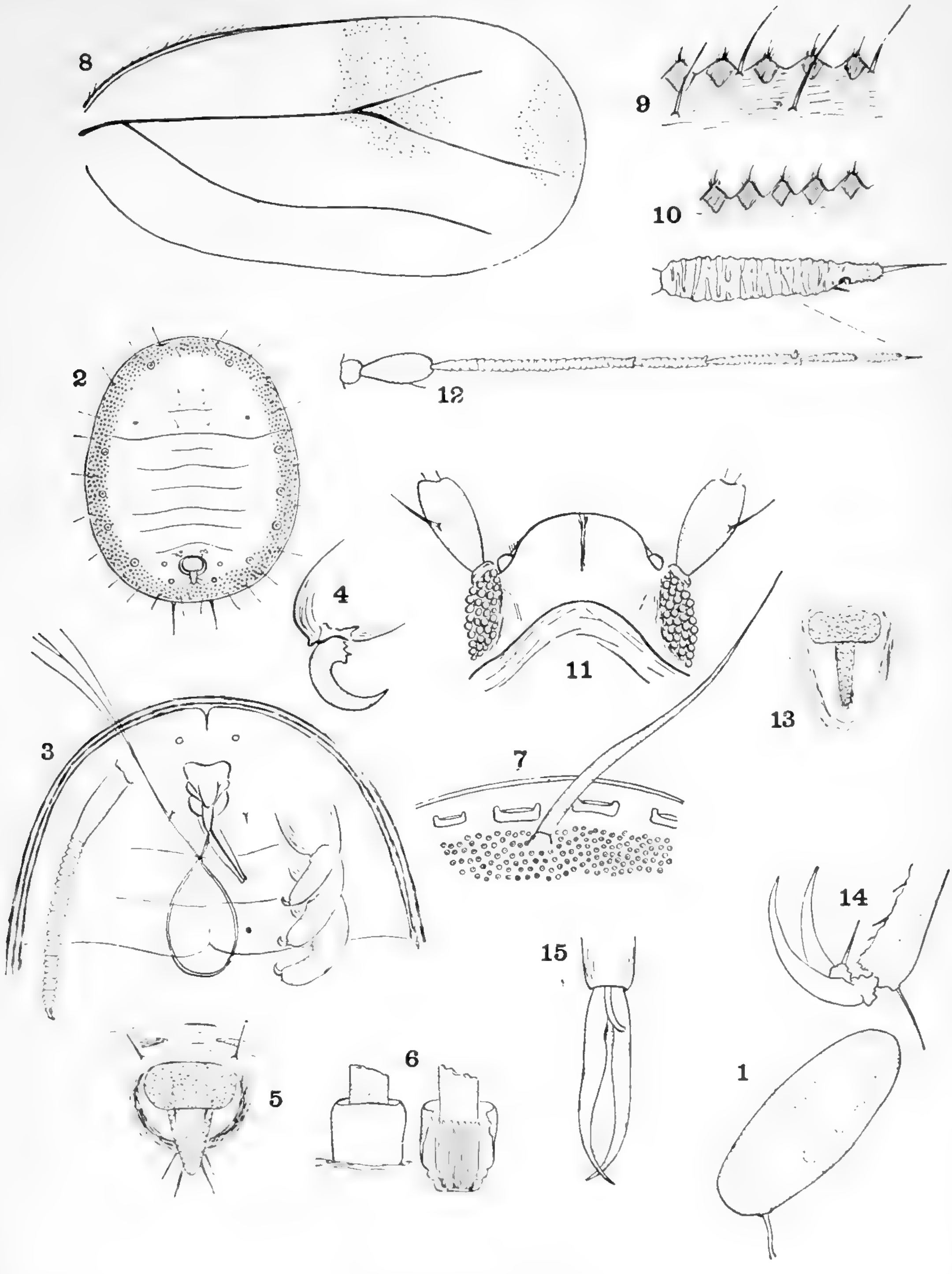
Realizing this, Riley and Howard made a careful description of the form. The material upon which their descriptions were based is preserved in the bureau collection, and the following includes a study of this same material. Unfortunately, a slight marking on the forewings of the species was not considered of importance by Riley and Howard, as it was no doubt overlooked by Curtis. This oversight has led Cockerell into the error of redescribing the form as *iridescens*. Now, however, that Riley and Howard's specimens, Cockerell's types, and many other examples are at hand for study, there is little doubt that all these forms are the same species.

DESCRIPTIVE REMARKS.

Pupa case.—The pupa cases representing the Riley and Howard material and those composing Cockerell's types, as well as numerous others, are identical in structure as follows: The case (Pl. XII, fig. 2) is surrounded by a row of bristle-like hairs inserted on the dorsum just within the margin. There are usually 13 of these to a side. One pair of long, prominent caudal hairs is also present. Margin entire, and within it all around (Pl. XII, fig. 7) is a row of large, simple, boat-shaped pores and the submarginal area is covered with very many minute, simple ones. Along the median thoracic region there are four pairs of small tubercled setæ and on the cephalolateral portion a pair of large compound pores of the type illustrated in Plate XII, figure 6. The abdominal region has along each side four large compound pores similar to the thoracic pair, and on either side of the vasiform orifice are two reduced ones. The vasiform orifice is nearly cordate and just cephalad of it is a pair of setæ, one on each side. The operculum is subelliptical, broader than long, and armed caudad with two prominent bristles. The lingula is conical, exserted, and possesses two pairs of bristles. Both operculum and lingula are minutely setose.

On the underside (Pl. XII, fig. 3) the mouthparts, legs, and antennæ are distinct. The trophic tubercle is large, the labium quite distinct, while the setæ are usually carried in the form of a loop. The antennæ are of two segments, 0.33 mm. long, and the proximal segment is short, subcylindrical, and unarmed. The distal one is much longer and annulated. At its distal end a short unguis is present and at the base of this a fringed sensorium. The legs are short, thick, of two segments, and armed with a solitary curved claw (Pl. XII, fig. 4).

There is considerable variation in the size of the pupa cases, and on this ground it might be possible to separate *iridescens* from *cocois*. Since, however, we have considerable difference in the cases of the latter species, depending upon locality and food plants, it seems hardly justifiable to select the larger specimens and call them a differ-



ALEURODICUS COCOIS.

Fig. 1.—Egg. Fig. 2.—Pupa case. Fig. 3.—Portion of venter of pupa case. Fig. 4.—Claw of pupa. Fig. 5.—Vasiform orifice of pupa case. Fig. 6.—Compound wax pore of pupa case. Fig. 7.—Margin of pupa case, showing boat-shaped pores. Fig. 8.—Forewing of adult. Fig. 9.—Proximal costal margin of forewing. Fig. 10.—Distal costal margin of same. Fig. 11.—Head of adult. Fig. 12.—Antenna of adult. Fig. 13.—Vasiform orifice of adult. Fig. 14.—Foot of adult. Fig. 15.—Male genitalia. (Original.)

ent species. On the other hand, we have specimens from the Canal Zone in which the pupa cases are of quite a different form from the usual type, being broader. There appear three varieties, one with a large and comparatively elongate pupa, one with a small elongate pupa, and one with a broad pupa. In these there appear no structural differences. The larger material, that which we might call the *iridescens* material, has an average of 1.22 mm. by 0.92 mm., the smaller material an average of 1.06 mm. by 0.75 mm., while the Canal Zone material, lot No. 6768, has an average of 1 mm. by 0.89 mm. The largest specimen found in any material was 1.26 mm. by 0.98 mm. and the smallest 0.98 mm. by 0.7 mm.

The arrangement of the pupæ upon the leaf in reference to the median vein and the waxy secretion developed about them is similar in Cockerell's type of *iridescens* and in *cocois* (Pl. XIV, fig. 1). The difference in host would easily account for the slight difference seen.

Adults.—Some variation is shown in the adults, first, as to size and, secondly, as to wing marking. The type of Cockerell's *iridescens* in the U. S. National Museum collection is a small male and will be discussed under that sex. The vertex (Pl. XII, fig. 11) is rounded and the antennæ (Pl. XII, fig. 12) are of seven segments, not six, as stated by Riley and Howard. Segment III is much the longer; II, IV, and V nearly equal in length, while VI and VII are somewhat shorter. All the segments are imbricated, and V and VII are armed with fringed sensoria. The paronychium of the foot is the usual spine, and the basal segment of the tarsus is nearly twice as long as the distal one. The forewings are armed on the costal margin (Pl. XII, fig. 9) with conical hairy projections and two alternate rows of large bristle-like hairs. The remainder of the margin (Pl. XII, fig. 10) lacks these hairs. The wings are marked with two dusky patches, one from the costal margin crossing the radial fork and the other at the distal extremity of the wing. In most forms these patches, especially the distal one, are very indistinct, but many degrees of intensity of shading occur, and in specimens from Progreso, Yucatan, lot No. 3286, the clouding is quite marked. Some dry specimens in which we were not able to distinguish any marking showed it quite plainly when balsam mounts were made.

The female genitalia are of the ordinary *Aleurodicus* type. The forewing is 2.15 mm. by 1.15 mm., the hind tibiæ 0.77 mm., and the tarsi together 0.307 mm.

The males show a great range in size. This is shown in a comparative measurement of parts. The type of *iridescens* has claspers 0.4 mm. long, and the width of the genital segment is 0.22 mm. In material of *cocois*, from different regions and hosts, a range from 0.4 mm. to 0.92 mm. is met with in the claspers, depending upon the size of the individual. The average seems to be nearly 0.8 mm. In the wings a similar variation is met with. In endeavoring to determine whether Cockerell's type was different from the forms of *cocois*, a large series of male wings was measured. Some were found smaller than Cockerell's *iridescens* and some larger, while in every case the relative position and lengths of the veins were practically identical. The average length of the forewing is 2 mm. and its width 0.89 mm., and the hind tibiæ average 0.7 mm.

The species is represented from the following localities and upon the following hosts:

Locality.	Host.	Collector.	Bureau of Entomology No.
Port of Spain, Trinidad	Guava	H. Caracciola	Quaintance No. 3287.
El Faro and San Pedro, Mexico (*iridescens*).	"Jicaco"	C. H. T. Townsend	Quaintance No. 3277 (U. S. Nat. Mus. Type No. 14772).
Progreso, Yucatan	*Coccoloba uvifera*	F. Knab	Quaintance No. 3286.
Barbados, West Indies	Coconut palm	Sir Daniel Morris	Quaintance No. 1706.
Venezuela	Guava	Dr. A. Ernst	Quaintance No. 3272.
Isthmian Canal Zone	Guava (?)	E. A. Schwarz	Quaintance No. 6768.

Aleurodicus conspurcatus Enderlein.

(Fig. 10.)

Aleurodicus conspurcatus Enderlein, Stett. Ent. Zeit., 1909, p. 282.

The following is Enderlein's diagnosis of this species. It is unknown to us in nature, but evidently shows a relation to species more generalized than those of this genus by the retention of the cubitus (Enderlein's *analis*). When all the stages are known, it may be necessary to remove it to one of the earlier genera.

ORIGINAL DESCRIPTION.

Hell bräunlich gelb, Augen grau; Beine blass ockergelblich; Spitzenhälfte des Abdomen grau, Seiten der Basalhälfte ockergelb. Abdomen sehr schmal und schlank (♂), letztes Glied etwa 2½ mal so lang wie breit, vorletztes etwa so lang wie breit, beim ♀ gedrungen und kurz. Endzange des ♂ sehr lang und schlank, und erst am Ende nach innen umgebogen, etwa ¾ des letzten Segmentes; Penis in Form eines stäbchenförmigen Anhangs am Grunde der Zangen und zwischen ihnen, sehr kurz (nur etwa ¼ der Zangenlänge), dünn und senkrecht aufgerichtet. Stirnrand von oben gesehen eine etwas abgerundete rechtwinklige Ecke bildend.

Flügel hyalin, weiss bestäubt; Vorder- und Hinterflügel mit kleinen, unregelmässig geformten, braunen, spärlich verteilten Flecken. Die Costa im Vorderflügel fein, aber deutlich; der Radialramus (*r*) in beiden Flügeln in der Mitte stark nach dem Aussenrande zu umgebogen. Der Cubitus endet in beiden Flügeln an der Hinterecke des Aussenrandes; im Vorderflügel ist er nahe der Basis stark, nahe dem Ende schwach wellig gebuchtet. Analis im Vorderflügel fein aber deutlich bis zur Mündung in der Mitte des Hinterrandes zu verfolgen; im Hinterflügel fehlt sie. In beiden Flügeln erreichen Media und *cu* nicht ganz den Flügelrand, der Radialramus endet ziemlich weit vom Flügelrand entfernt.

Körperlänge ♂ 2.5 mm., ♀ 2 mm.; Abdominallänge ♂ 1.75 mm., ♀ 1 mm.; Vorderflügellange ♂ 2.5 mm., ♀ 3 mm., Hinterflügellange ♂ 2.1 mm., ♀ 2.75 mm. Grösste Vorderflügelbreite ♂ 1.5 mm., ♀ 2 mm. Grösste Hinterflügelbreite ♂ 1.15 mm., ♀ 1.5 mm.

Süd-Brasilien. Santa Catharina. 13 Exemplare (3 ♂ und 10 ♀). Gesammelt von Lüderwaldt.

Typen im Stettiner Zoologischen Museum.

[Translation.]

Clear brownish yellow. Compound eyes gray. Legs pale ochre-yellow, lower half of abdomen gray, the lateral part of the basal

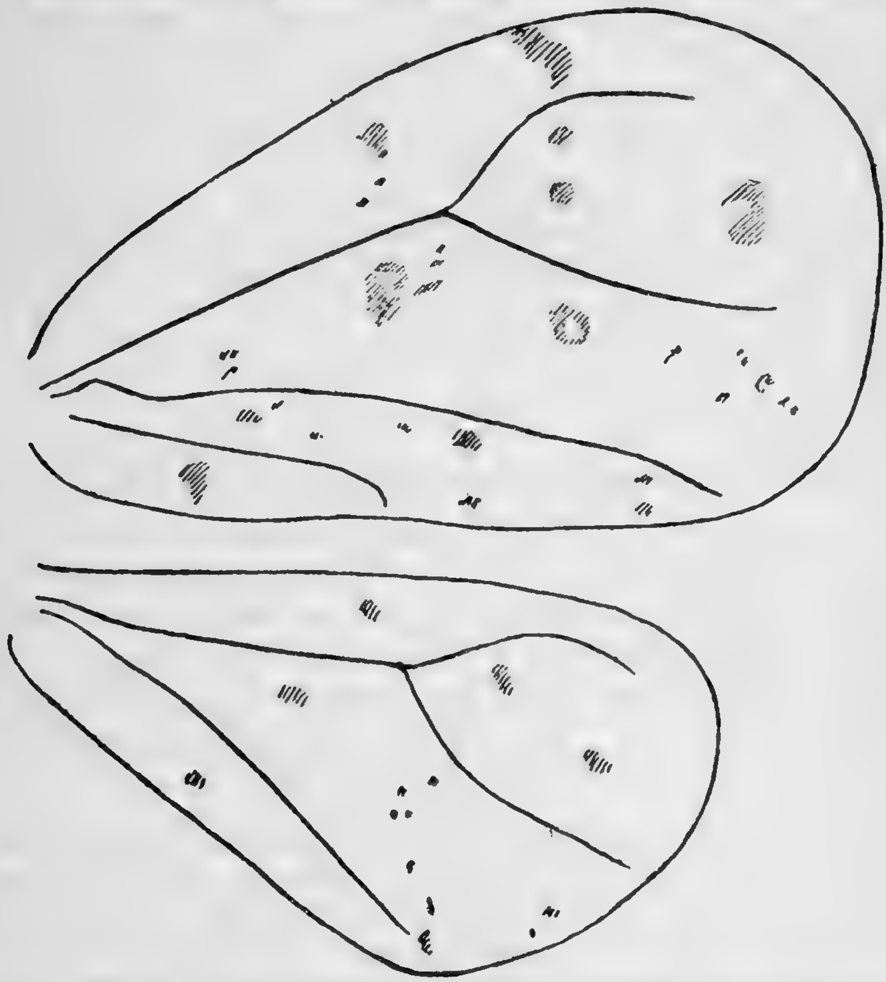


FIG. 10.—Wings of *Aleurodicus conspurcatus*. (Redrawn from Enderlein.)

half ochraceous yellow. Abdomen very small and narrow (male), its last segment about two and one-half times as long as wide, penultimate segment about as long as it is wide, in the case of the female short and contracted. Final forceps of the male very long and attenuated, at its termination curved inward, about at the distance of three-fourths of the last segment. Penis in the shape of staff-like appendix at the base of the forceps and situated between them, very short (only about one-fourth the length of the forceps), thin, and erected in a perpendicular direction. Front margin of the head, viewed from above, forming a somewhat rounded rectangular angle.

Wings hyaline, powdered with white. Both the forewings and the hind wings provided with small, irregularly formed, brown spots that are sparsely scattered. Costa in the forewing fine, but distinct. Radial sector (*r*) in both wings strongly bent in the middle toward the exterior margin. In both wings the cubitus terminates in the hind corner of the exterior margin. Cubitus in the forewing is strongly sinuate at its base, but near its end it is only slightly undulated and sinuate. "Analis" in the forewing fine, but can be followed distinctly as far as its bouchare in the middle of the posterior margin, not present in the hind wing. Media and cubitus in both wings not quite reaching the margin of the wings, and the radial sector terminating quite a distance from the margin of the wings.

Length of the body, male 2.5 mm., female 2 mm.; length of abdomen, male 1.75 mm., female 1 mm.; length of forewings, male 2.5 mm., female 3 mm.; length of hind wings, male 2.1 mm., female 2.75 mm.; greatest expanse of forewings, male 1.5 mm., female 2 mm.; greatest expanse of hind wings, male 1.15 mm., female 1.5 mm.

Southern Brazil, Santa Catharina; 13 specimens.

Aleurodicus destructor Mackie.

(Pl. XIII, figs. 1–7; Pl. XIV, fig. 2.)

Aleurodicus destructor Quaintance, Mackie, Philippine Agricultural Review, vol. 5, p. 142 (1912).

Coconut leaves infested with this insect were received August 22, 1911, from Mr. G. E. Nesom, director of agriculture, Manila, P. I., with the statement:

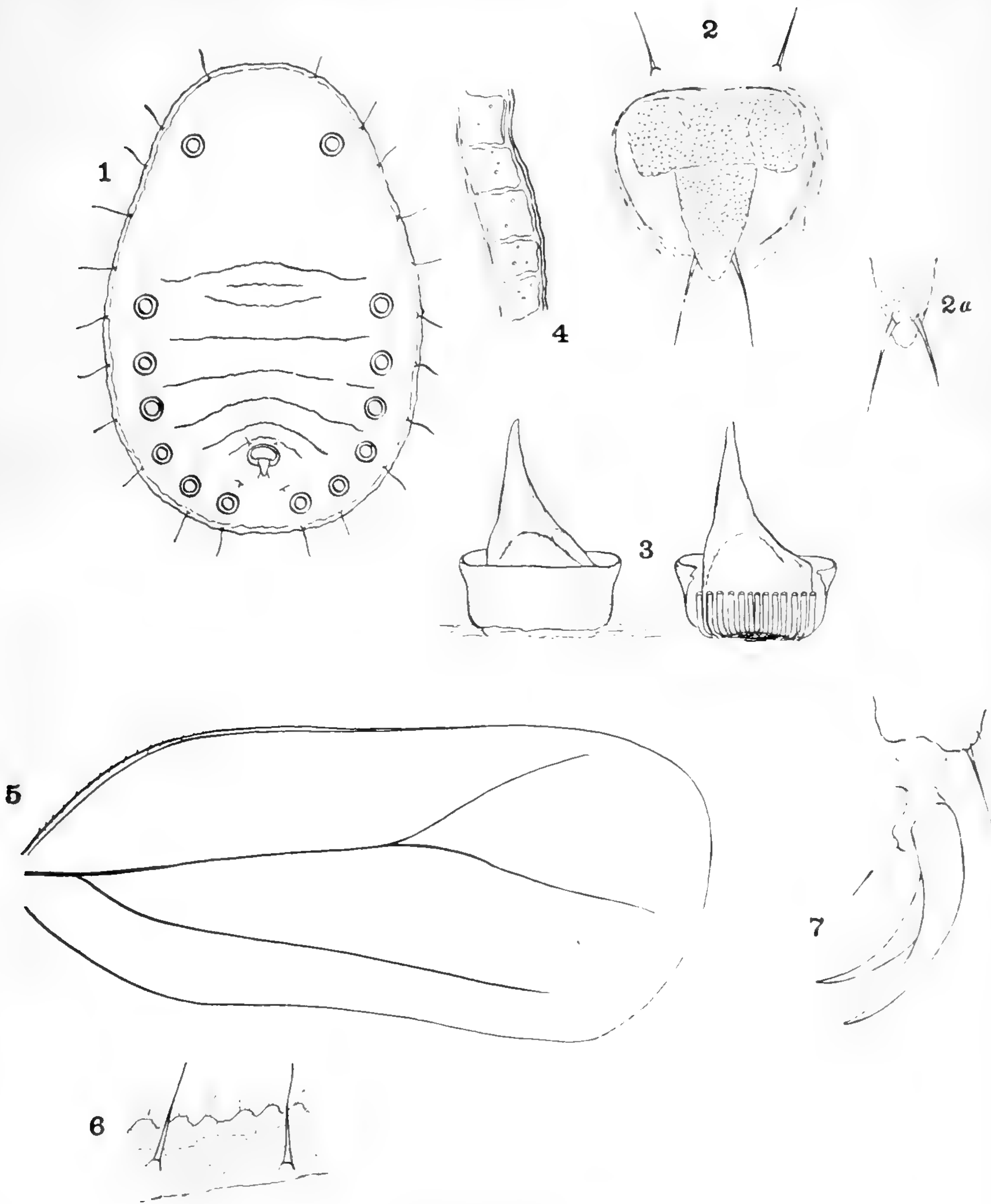
> This scale is often found upon the stems of young fruit and in some cases, due to their presence, the tree is unable to set fruit. According to the natives, trees infested with this insect often die. Many of the owners of coconut groves in the vicinity where this scale is prevalent are rather frightened, and seem to believe that if something is not done to check this insect their groves will be completely destroyed.

From the above it would appear that this insect is an important enemy of the coconut, exceeding, perhaps, in destructiveness its congener *cocois*, long known from the West Indies.

DESCRIPTION.

Egg.—About 0.31 mm. long, elongate in shape, yellow to brownish in color, dusted with powdered wax. Stalk short, eggs prostrate on leaf. Shell delicate, collapsing upon escape of larva, unmarked.

Pupa case.—Size 1.33 to 1.5 mm. long by 0.83 to 1 mm. wide, subelliptical to ovate in shape; some examples narrowed cephalad.



ALEURODICUS DESTRUCTOR.

Fig. 1.—Pupa case. Fig. 2.—Vasiform orifice of pupa case. Fig. 3.—Compound pore of pupa case. Fig. 4.—Margin of pupa case. Fig. 5.—Forewing of adult. Fig. 6.—Costal margin of forewing. Fig. 7.—Foot of adult. (Original.)

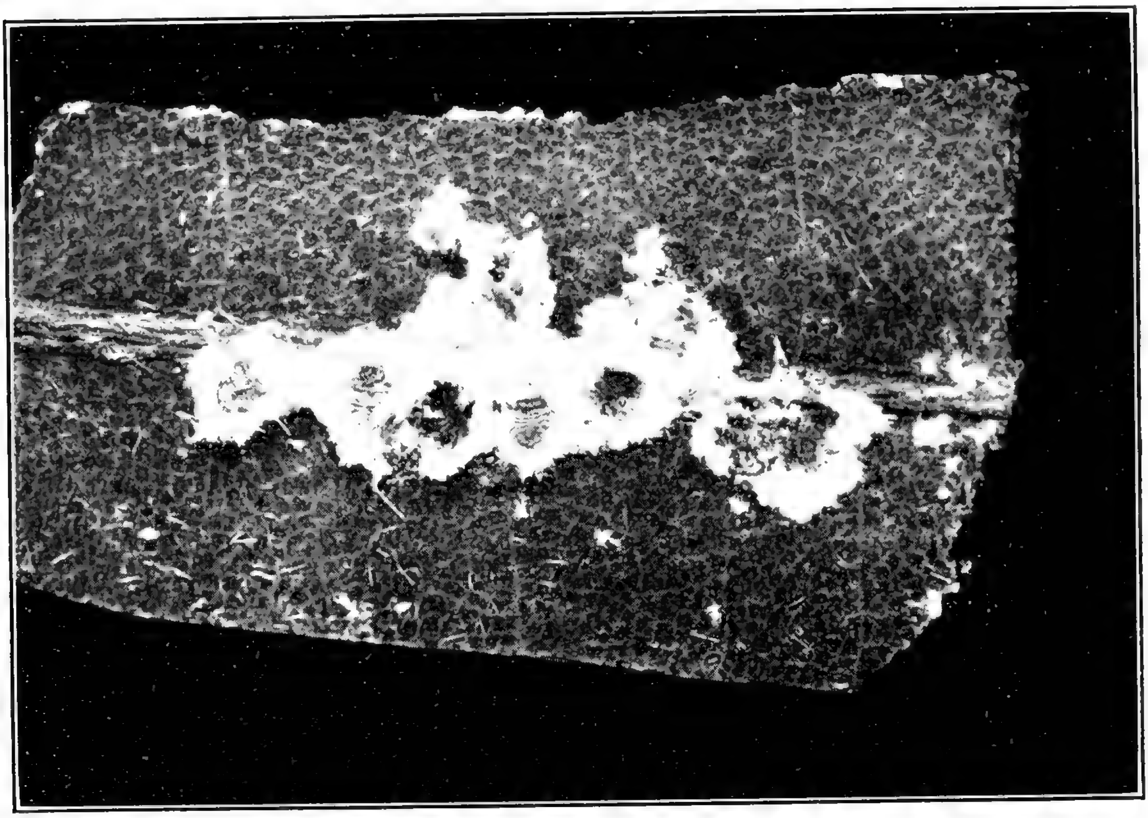


FIG. 1.—PUPÆ OF ALEURODICUS COCOIS ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)

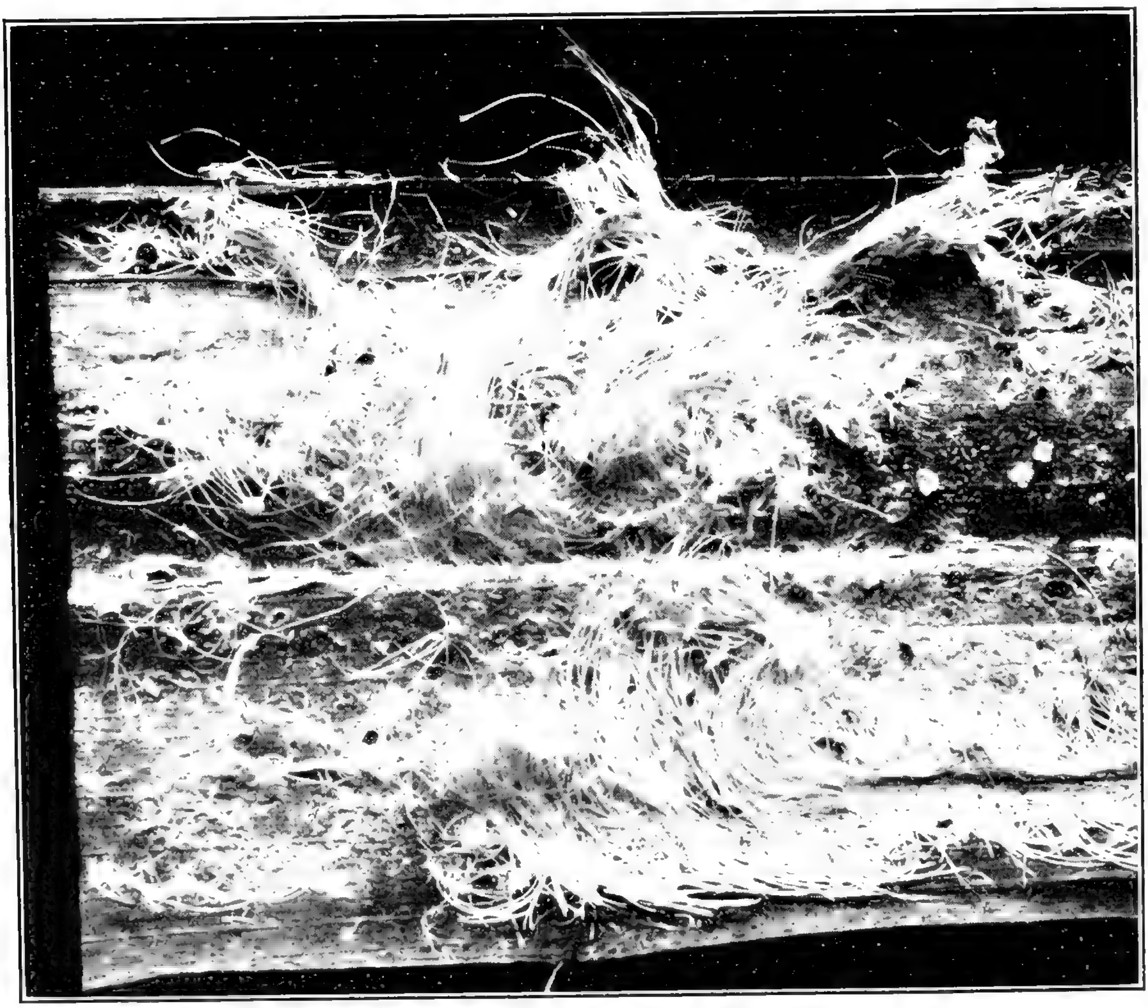
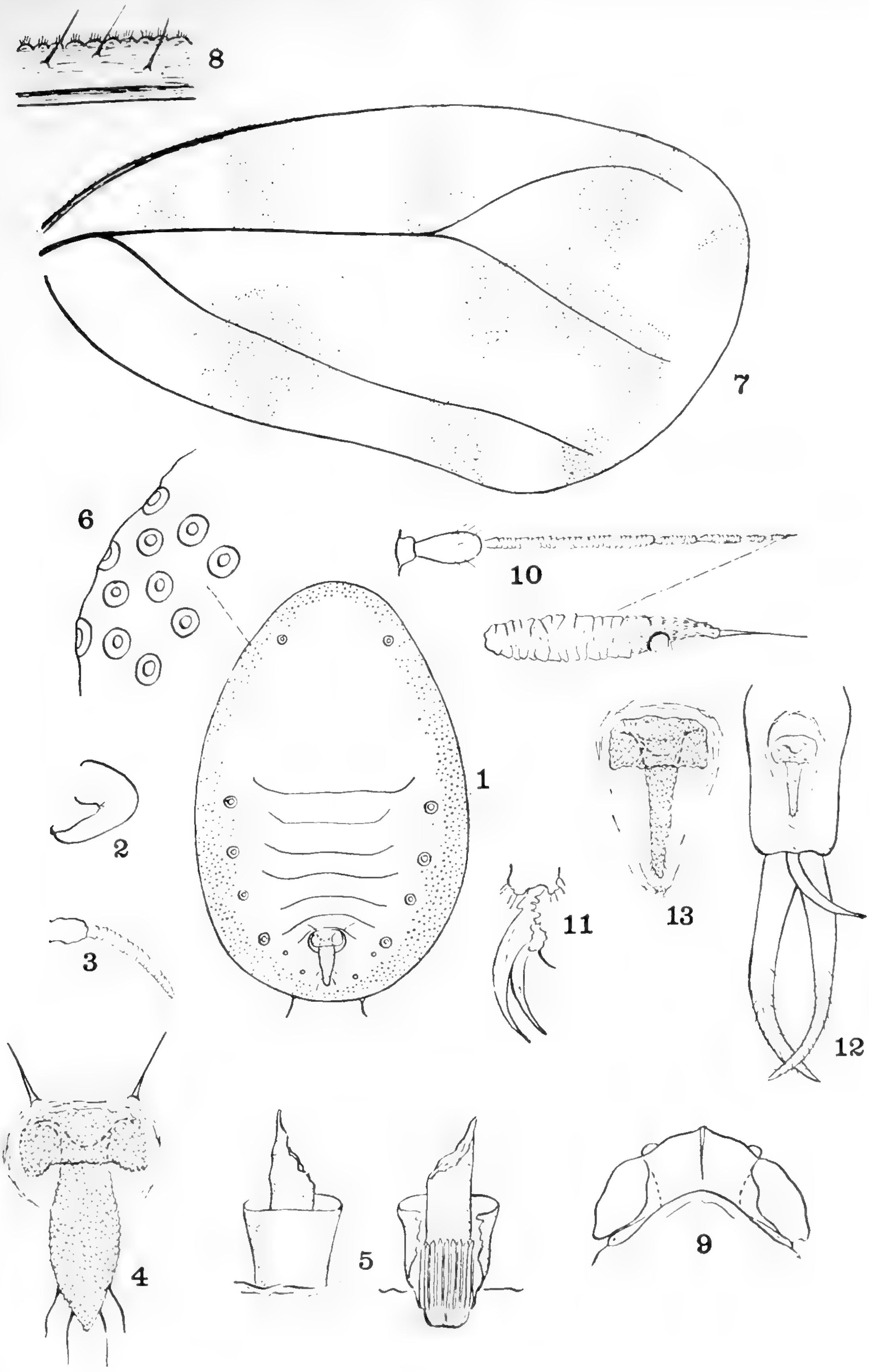
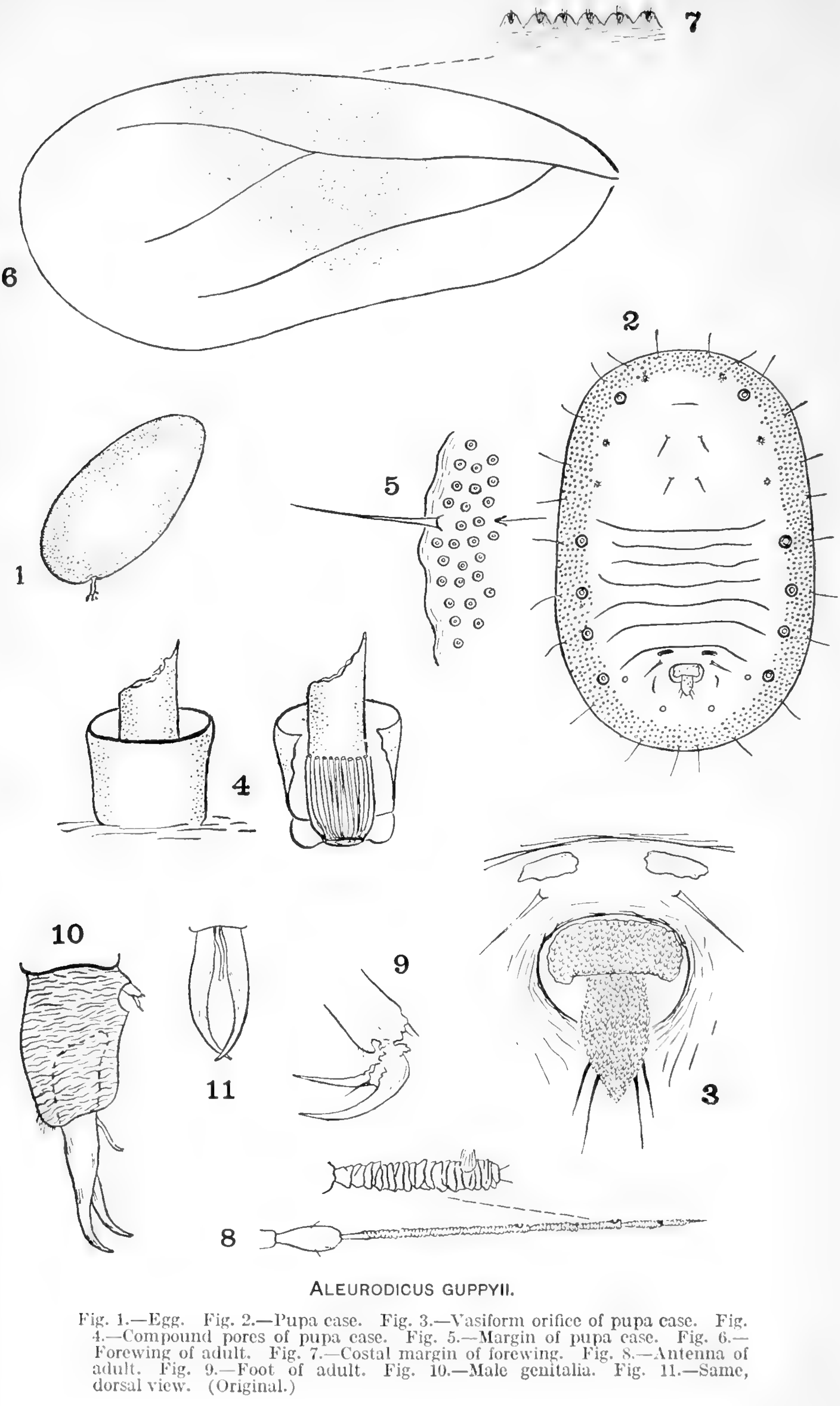


FIG. 2.—PUPÆ OF ALEURODICUS DESTRUCTOR ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)



ALEURODICUS DUGESII.

Fig. 1.—Pupa case. Fig. 2.—Leg of pupa. Fig. 3.—Antenna of pupa. Fig. 4.—Vasiform orifice of pupa. Fig. 5.—Compound pores of pupa. Fig. 6.—Margin of pupa. Fig. 7.—Forewing of adult. Fig. 8.—Costal margin of same. Fig. 9. Head of adult. Fig. 10. Antenna of adult. Fig 11.—Foot of adult. Fig. 12.—Male genitalia. Fig. 13. Vasiform orifice of adult. (Original.)



ALEURODICUS GUPPYII.

Fig. 1.—Egg. Fig. 2.—Pupa case. Fig. 3.—Vasiform orifice of pupa case. Fig. 4.—Compound pores of pupa case. Fig. 5.—Margin of pupa case. Fig. 6.—Forewing of adult. Fig. 7.—Costal margin of forewing. Fig. 8.—Antenna of adult. Fig. 9.—Foot of adult. Fig. 10.—Male genitalia. Fig. 11.—Same, dorsal view. (Original.)

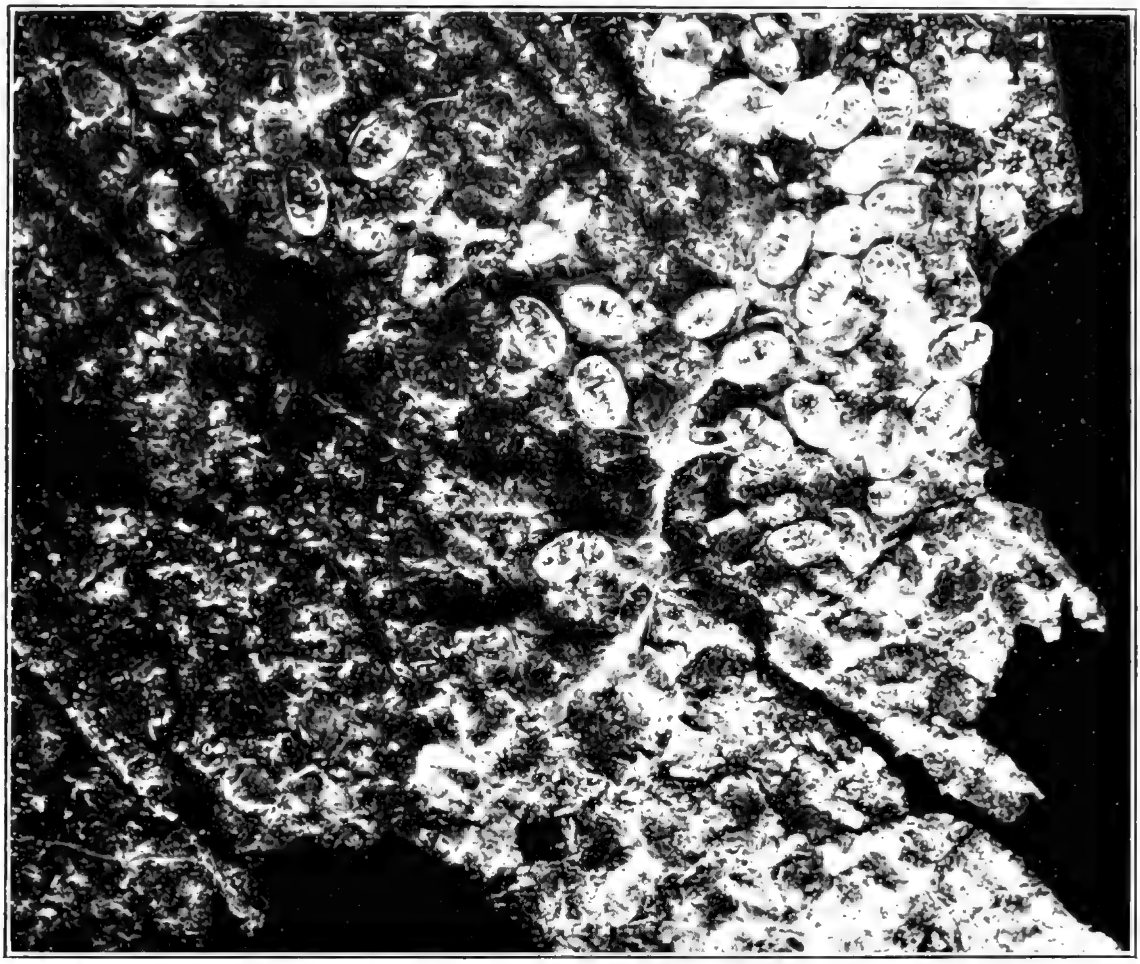


FIG. 1.—PUPÆ OF ALEURODICUS DUGESII ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)

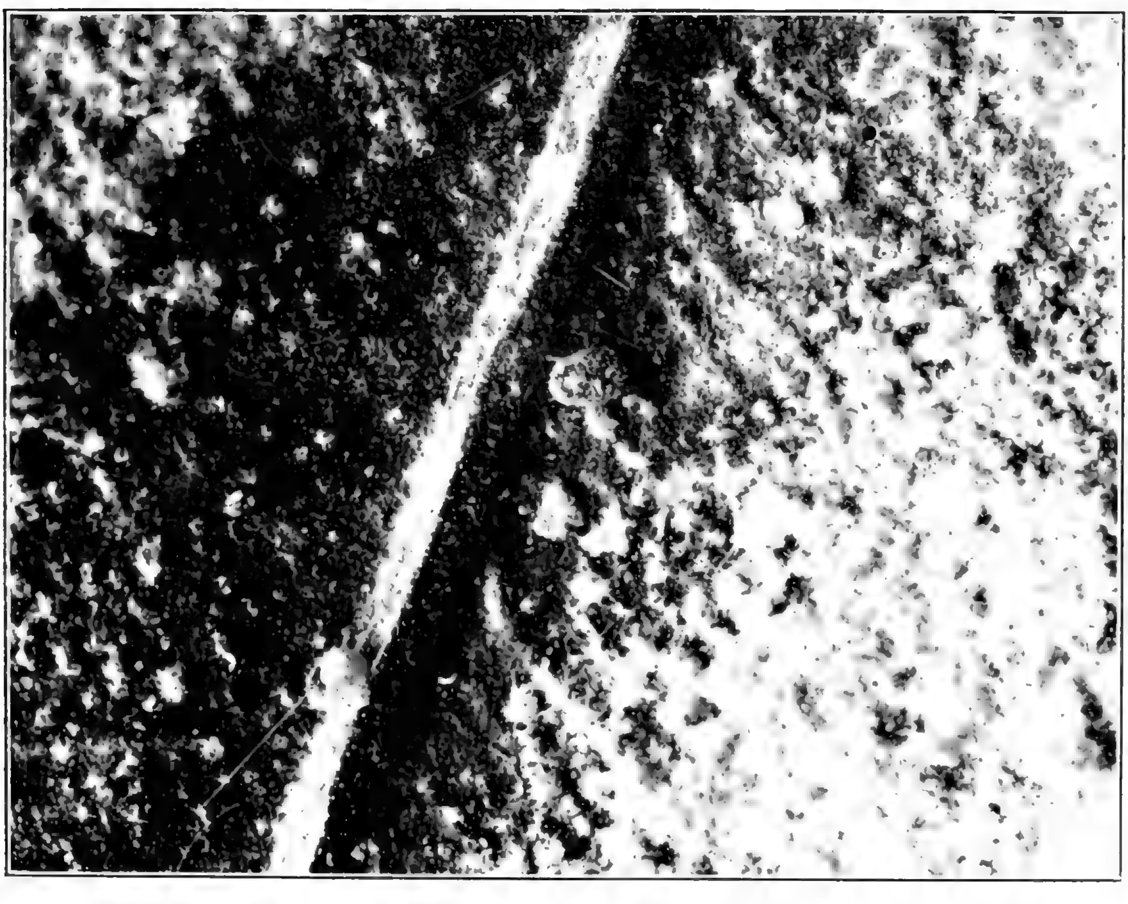


FIG. 2.—PUPÆ OF ALEURODICUS GUPPYII ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)

LEAF INFESTED WITH ALEURODICUS GUPPYII, SHOWING WAXY SECRETION OF PUPÆ.
(ORIGINAL.)

Dorsum but little convex, body segments quite distinct in the dried specimens (Pl. XIII, fig. 1). There is a very copious secretion of white wax covering the lower surface of the infested leaves and completely hiding the insects beneath (Pl. XIII, fig. 2). The wax rods, from the compound wax pores, are unusually long, attaining in more perfect specimens a length of from 12 to 15 mm. Generally, however, these rods are more or less broken and are intermingled with bands or plates of wax from the marginal wax tubes. There is a short vertical fringe of white wax often persisting on the leaf after the pupa case has disappeared.

The color is yellowish to brownish, some specimens, as seen under hand lens, being dark brown. The empty case is colorless. There is a narrow marginal rim composed of the short, squarish wax tubes, the incisions being shallow and acute (Pl. XIII, fig. 4). On the dorsum there are seven pairs of very conspicuous compound wax pores, six pairs on the abdomen about equally developed, and a pair on the cephalic region of about half the size of the former. From the marginal area all around arise a series of spines, 10 to 12 on a side, and there is a pair cephalad of the vasiform orifice.

Vasiform orifice subcordate, about as wide as long. Operculum subrectangular, about twice as wide as long. Lingula spatulate, rather short and broad, bearing a pair of spines (Pl. XIII, fig. 2). The rudimentary legs and antennæ are quite evident on the ventral surface, and exhibit the usual structures for the typical forms of this genus.

Adult.—A single imperfect male was found among the pupæ on the leaves. The wings are without markings (Pl. XIII, fig. 5).

This species, from the structure of the pupa case, suggests *neglectus*, common on *Anona* spp., guava, *Ficus*, etc., in the West Indies, but differs in that the wings are not spotted or banded, in the large size of the two caudal pairs of compound wax pores, and there are differences in the lingula. From *cocois* it differs in numerous particulars, as will be noted on comparison. This is the third species of this genus recorded from outside of tropical America, though it may have been introduced in the Philippines along with its food plant.

Type.—No. 14766, U. S. National Museum. Described from numerous eggs, pupæ in balsam mounts, and infested leaves.

Aleurodicus dugesii Cockerell.

(Pl. XV, figs. 1–13; Pl. XVII, fig. 1.)

Aleurodicus dugesii Cockerell, Can. Ent., vol. 28, p. 302 (1896).

Specimens of this species are in the Bureau of Entomology collection from several localities in Mexico, and on several different food plants, as follows: Oaxaca, on *Hibiscus;* Guanajuato, on *Anona* and

Hibiscus rosa-sinensis; Guadalajara, on *Hibiscus;* and on mulberry, locality unknown. The original description by Prof. Cockerell follows:

Length 1⅗ mm.; length of anterior wing, 2¼ mm.; its greatest breadth nearly 1½ mm. Pale grayish-ochreous, covered with white meal, abdomen beneath shining silvery. Wings white; upper wings iridescent, with markings similar to those of *A. ornatus*, but very pale gray and quite different in detail. There are four gray bands crossing the wings, of which only the third and fourth are joined by a longitudinal band. The first (basal) band bends abruptly inwards after crossing the main nervure, which branches so near the base of the wing that there are practically two nervures, the first gray band failing in the angle between them, but strong again beyond the second. Second gray band broad as far as the first nervure, just beyond it interrupted broadly, but continued as a large, nearly circular gray patch, the greater part of which is above the second nervure, which it meets at its fork; after that failing, but reappearing strongly a little way down the lowest branch of the nervure and thence passing downwards, becoming very faint. Fourth band broad, passing across the end of the fork, bent inwards, joining the continuation of the third band after the break, itself forking at its lower end. The curve of the fourth band leaves a white apical area in which there is a gray spot. There is also a gray spot at the tip of the second nervure.

The pupæ occur on the under sides of the leaves and are of the usual type—oval, flat, pale ochreous, with white mealy powder.

Habitat.—Guanajuato, Mexico, on *Hibiscus rosa-sinensis.* Sent by Dr. Alfred Dugès in great quantity. Dr. Dugès writes that it is also found on the large-leafed Begonia and other plants, and it does not appear to do them a great deal of harm. It is the first *Aleurodicus* described from Mexico, and is most nearly allied to the Jamaican *A. ornatus*, Cockerell. The genus now includes five species, all neotropical except the U. S. *A. asarumis* (Shimer, 1867).

DESCRIPTIVE REMARKS.

Egg.—About 0.3 mm. long; stalk short, from one side of end; color dusky; shell unmarked.

Pupa case.—Size rather variable, from 1.15 to 1.3 mm. in length, by 0.7 to 0.85 mm. in width. Ovoid or subelliptical in shape; brownish in color, as seen on leaf, varying to plumbeous in some specimens, probably parasitized. Case moderately convex, raised somewhat by a vertical fringe all around of white wax (Pl. XVII, fig. 1). Dorsum of case powdered with dirty white wax, and from the compound wax pores are produced the usual brittle glassy wax rods (Pl. XV, fig. 1).

Under microscope, empty case colorless, except the prominent lingula, which is dark brown. Abdominal segments distinct. Marginal fifth or sixth of case all around with many small round simple wax pores (Pl. XV, fig. 6). On dorsum also are seven pairs of compound wax pores, one on cephalic end and six on abdomen, the last two pairs being much reduced (Pl. XV, fig. 5). There is a pair of strong spines on caudal margin of case.

Vasiform orifice large, cordate, about as broad as long. Operculum short and broad, the caudal margin concave. Lingula very prominent, spatulate, dark brown in color, bearing distally two pairs of spines (Pl. XV, fig. 4). On ventral surface legs and antennæ are quite distinct.

Adult female.—Forewings about 2.4 mm. long by 1.3 mm. wide; legs long and slender. Hind tibia 0.9 mm. long; basal tarsal joint 0.23 mm. long, distal tarsal joint 0.14 mm. long.

Adult male.—Essentially as in female, though tibia and tarsus are slightly longer in each case. Valves of forceps long, narrow, and strongly curved at tip (0.86 mm. in length).

Type.—No. 14764, U. S. National Museum.

Aleurodicus guppyii n. sp.

(Pl. XVI, figs. 1–11; Pl. XVII, fig. 2; Pl. XVIII.)

This species was received from Dr. F. W. Urich, Port of Spain, Trinidad, May 25, 1911, on *Rheedia latiflora* L. The large brown maculation on forewing of adult insect readily separates it from any form heretofore described. The insect infests the lower surface of the large leathery leaves of its host plant, principally the basal two-thirds (see Pl. XVIII). This area is more or less covered with a powdery white wax secreted from the abdomen of the adults, in which are embedded the immature stages.

DESCRIPTION.

Egg.—Size about 0.32 by 0.16 mm. Subelliptical in outline, the stalk very short, attached to one side of end of egg. Color on leaf brownish; lighter under transmitted light, without markings (Pl. XVI, fig. 1).

Pupa case.—Size rather variable, averaging about 1.13 by 0.70 mm. Elliptical in outline, the dorsum but little convex, though the case is prominently raised from the surface of the leaf by a vertical rim all around of white wax. Dorsum void of secretion, except the usual glassy wax rods from the compound wax pores. This secretion, however, is meager, the rods being short and fragmentary (Pl. XVI, fig. 2).

On leaf, under hand lens, the color is yellow or brownish-yellow; and under microscope yellowish white to darker. Margin of case with very light crenulations, but no distinct marginal rim. On the submarginal area, however, are innumerable closely set small pores, forming a broad band all around the case (Pl. XVI, fig. 5).

On the dorsum are seven pairs of compound wax pores (Pl. XVI, fig. 4), one pair on the cephalic region and four pairs on the abdominal region, and two pairs of smaller pores on anal segments; on caudal end of case there are two pairs of scalelike markings on the thorax, and a pair of simple pores near cephalic margin. Abdominal segments distinct.

From within the margin of case all around arises a series of slender spines, or setæ, about 12 on each side. There is a pair of minute setæ just cephalad of the vasiform orifice, and two pairs of setæ are present on the thoracic region.

Vasiform orifice (Pl. XVI, fig. 3) subcordate to subcircular, little longer than wide. Operculum subrectangular, concave on distal margin, almost twice as wide as long. Lingula as usual, spatulate, with two pairs of spines on distal end. Operculum and lingula minutely spinose. On ventral surface of case the legs are quite evident, terminating in a single, hooked claw. Antennæ as usual, two-jointed, the distal joint numerously ringed.

Adult female.—Length 1.9 to 2 mm. Forewing, length 2.60 mm., width 1.23 mm. Body and wings dusted with white wax, and there is a copious waxy secretion from ventral surface of abdomen of both sexes. General color of head and thorax dark brown to blackish, abdomen bright red; legs, margins of wings, wing veins, and antennæ reddish.

Eyes plumbeous, constricted, the smaller division below. Forewing (Pl. XVI, fig. 6) marked across the middle with a conspicuous, broad brownish band. This arises from the cephalic margin of the wing and extends caudad usually beyond the media well toward the caudal margin of wing. Hind wing without markings.

Antennæ as usual (Pl. XVI, fig. 8). Tibia of hind leg 0.8 mm. long; first tarsal joint 0.26 mm., second tarsal joint 0.13 mm. in length.

Adult male.—Length 1.3 mm.; valves of anal forceps 0.7 mm. long, curved, inserted in the cylindrical anal segment (Pl. XVI, figs. 10, 11). Forewing 2.1 mm. long by 0.95 mm. wide, marked as described for female. Hind wing unmarked. General color dusky to blackish, more or less covered with white waxy powder.

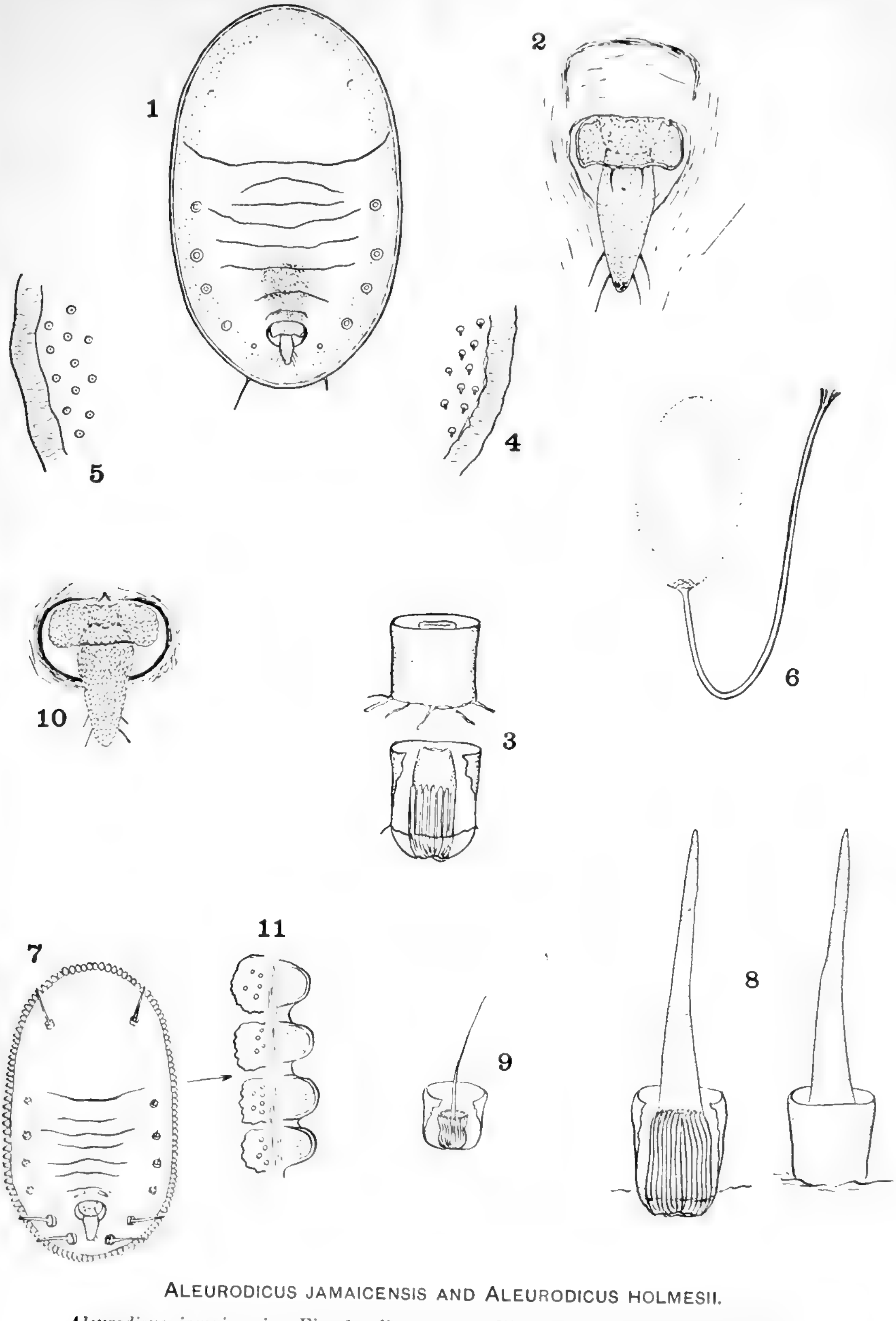
Type.—No. 14768, U. S. National Museum. Described from numerous eggs, pupæ, and adults of both sexes. Dedicated to Mr. P. L. Guppy.

Aleurodicus jamaicensis Cockerell.

(Pl. XIX, figs. 1–5.)

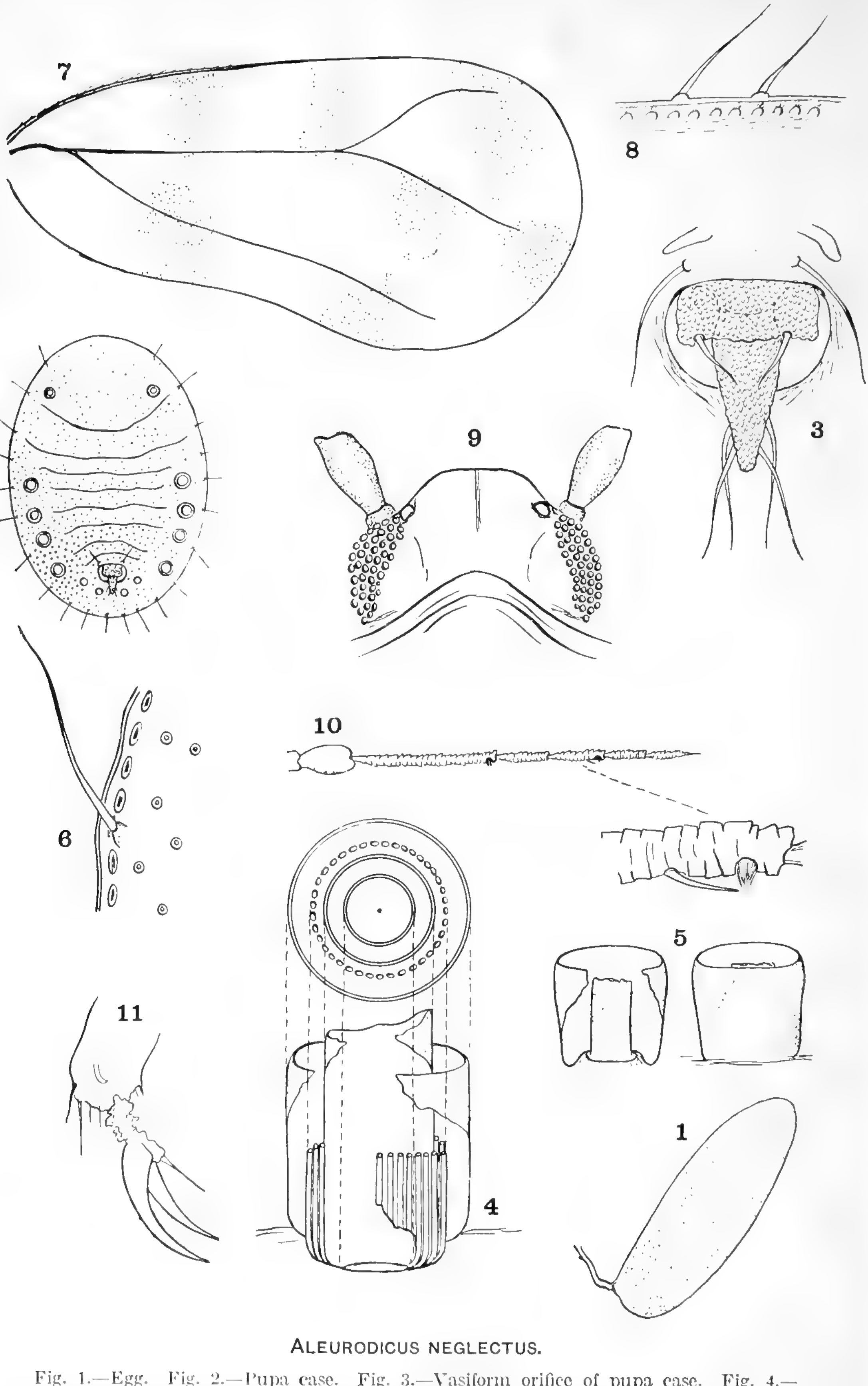
Aleurodicus jamaicensis Cockerell, Proc. Acad. Nat. Sci., Phila., vol. 54, p. 280 (1902).

The type of this species consists of a single parasitized pupa case in a balsam slide mount. From this scant material and the imperfect original description we are quite unable to obtain an adequate con-



ALEURODICUS JAMAICENSIS AND ALEURODICUS HOLMESII.

Aleurodicus jamaicensis: Fig. 1.—Pupa case. Fig. 2.—Vasiform orifice. Fig. 3.—Compound pores of pupa case. Fig. 4.—Margin of parasitized pupa case. Fig. 5.—Margin of normal case. *Aleurodicus holmesii:* Fig. 6.—Egg. Fig. 7.—Pupa case. Fig. 8.—Compound wax pores. Fig. 9.—Reduced compound wax pore. Fig. 10.—Vasiform orifice of pupa. Fig. 11.—Margin of case. (Original.)



ALEURODICUS NEGLECTUS.

Fig. 1.—Egg. Fig. 2.—Pupa case. Fig. 3.—Vasiform orifice of pupa case. Fig. 4.—Compound wax pore of pupa. Fig. 5.—Reduced compound wax pore. Fig. 6.—Margin of pupa case. Fig. 7.—Forewing of adult. Fig. 8.—Costal margin of same. Fig. 9.—Head of adult. Fig. 10.—Antenna of adult. Fig. 11.—Foot of adult. (Original.)

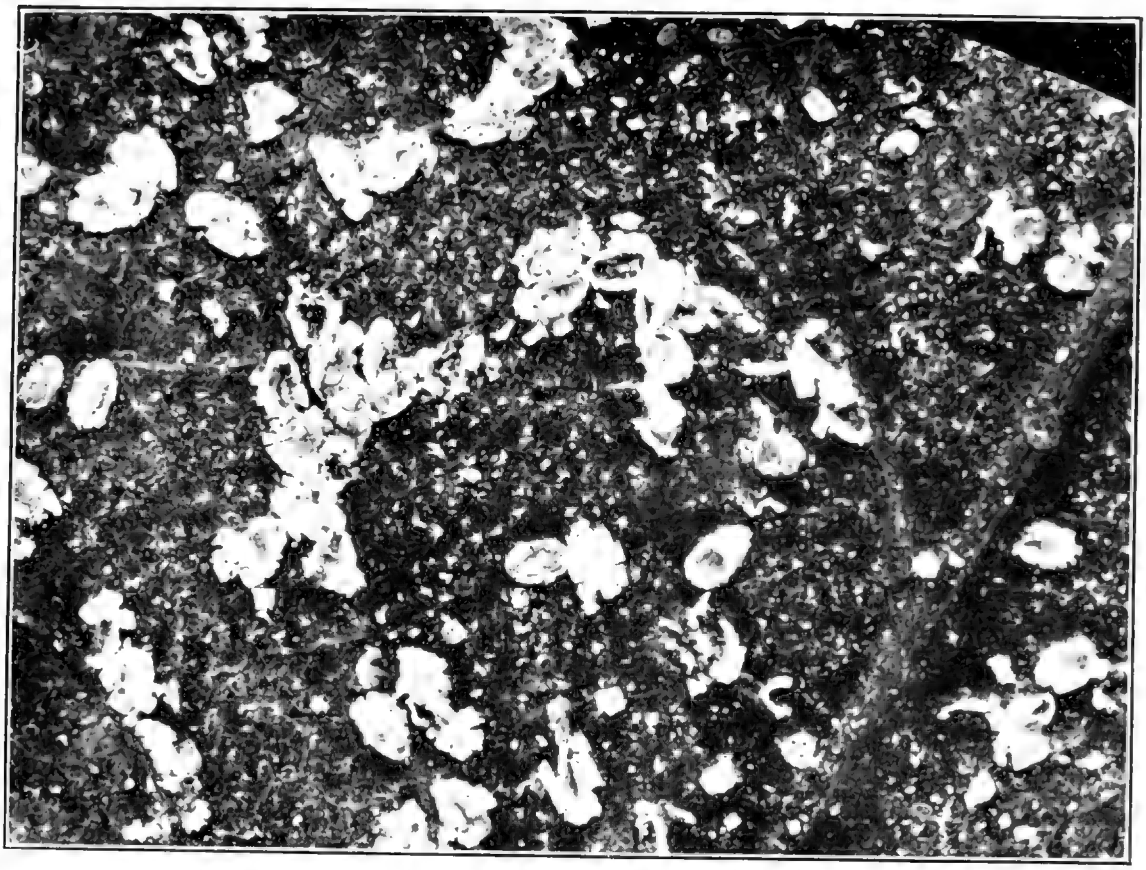


FIG. 1. ALEURODICUS HOLMESII: PUPÆ ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)

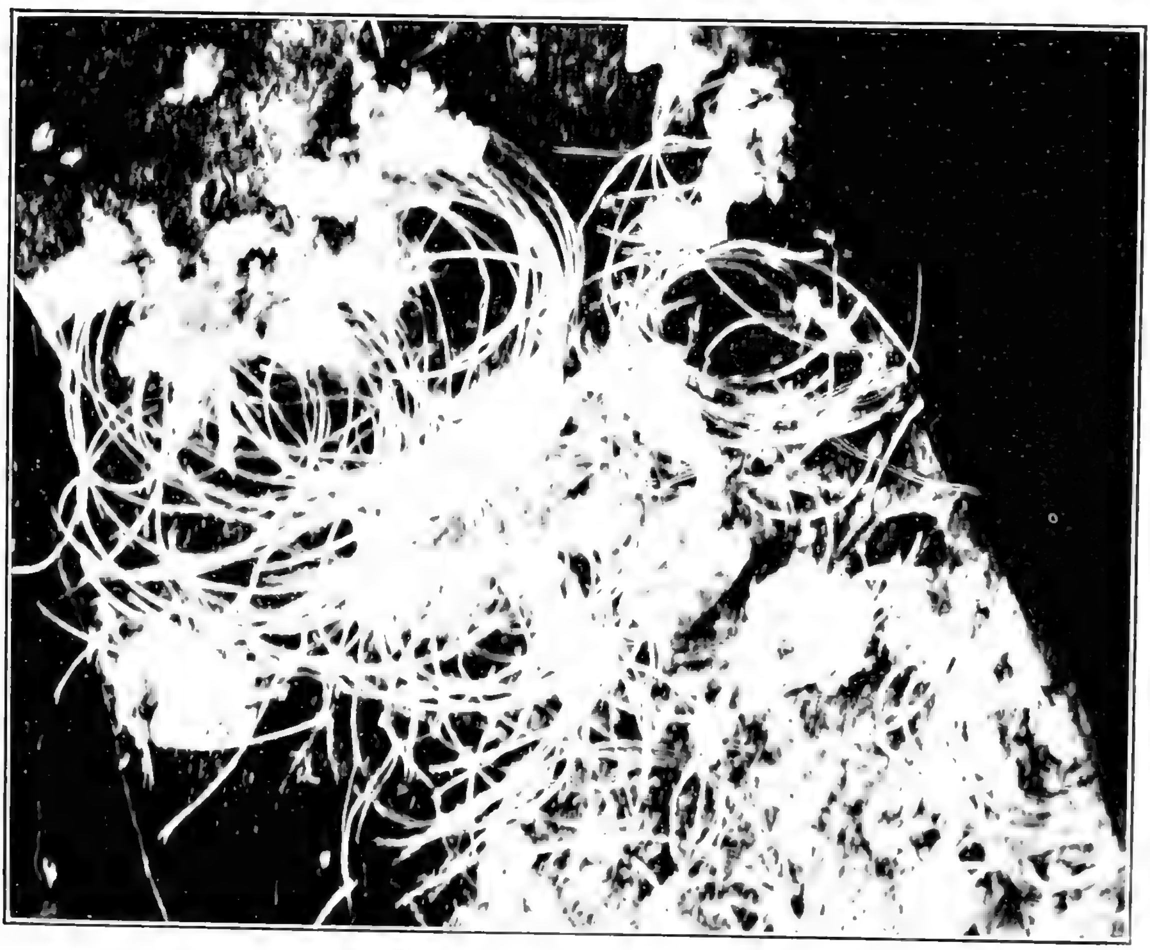


FIG. 2.—ALEURODICUS NEGLECTUS: PUPÆ ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)

ception of the characteristics of this form. Prof. Cockerell's description follows:

ORIGINAL DESCRIPTION.

Aleurodicus jamaicensis was collected by the writer at Kingston, Jamaica, in 1893. The pupa is small (hardly 1½ mm. long), with vertical walls, margin resembling that of *pulvinata;* color bright yellow, with a brownish dorsal cloud, and a diamond-shaped black patch just anterior to the vasiform orifice. Other characters shown in fig. 2.

DESCRIPTIVE REMARKS.

Pupa case.—Size 1.3 mm. long by 0.89 mm. wide. Color yellow, with dark brown markings as shown in the figure. There is a submarginal area all around marked with many simple wax pores which, in the present specimen, have mostly developed short, stout, spine-like structures, probably due to parasitism (see *coccolobæ*, p. 50). On the abdomen are five pairs of compound pores, the caudal pair being much reduced in size. (The usual cephalic pair is also probably present, but can not be verified in the specimen at hand.) Caudal margin of case with a single pair of spines. Margin entire. Vasiform orifice cordate, about as broad as long. Operculum short, about twice as broad as long, ends rounded; caudal margin coarsely sinuate and bearing a pair of spines. Lingula large, exserted, subspatulate, bearing distally two pairs of spines.

Type.—No. 14771, U. S. National Museum.

Aleurodicus holmesii (Maskell).

(Pl. XIX, figs. 6–11; Pl. XXI, fig. 1.)

Aleyrodes holmesii Maskell, Trans. N. Z. Inst., vol. 28, p. 435 (1895). Described as *Aleyrodes* by Maskell and transferred to *Aleurodicus* by Cockerell (Bul. 67, Fla. Agr. Exp. Sta., p. 644, 1903).

ORIGINAL DESCRIPTION.

Larva dull-yellow, elliptical, flattish; length about 1/80 in. Margin thickened, almost entire, the crenulations being very minute and confused. Dorsum bearing, on the thoracic region, six strong rather short spines; of these, two are median, the four others submarginal. In the earliest state there is no fringe, but in the latest stage there is a fragmentary short fringe of white wax.

Pupa-case dull-yellow, rather lighter colored than the larva; form elliptical, flattish, and rather thick; length about 1/25 in. Abdominal segments moderately distinct. Dorsum bearing a submarginal series of strong short spines; two of these on the cephalic region and four on the posterior abdominal region are large and conspicuous, the other eight (four on each side), on the thoracic region, are smaller. From these spines is produced a quantity of white waxy secretion, which is very fragmentary, often entirely absent; it scarcely ever seems to completely cover the dorsum. Margin very distinctly and conspicuously crenulated with large thick segments; these produce a fringe of closely-adjacent waxy tubes, which at first is flat, then becomes a rather thick ring or cushion, and at last becomes so thick as to raise the pupa somewhat high above the leaf, and then it seems as if resting on a very elegantly-fluted white wall; vasiform orifice subelliptical, with concave anterior edge and broadly rounded sides and end; operculum broad and short, the posterior edge concave; lingula very long, extended beyond the orifice, subcylindrical, with emarginate sides and compressed extremity, the end rugose, with four rather long and many very short setæ or hairs.

Adult form unknown.

Hab. in Fiji, on *Psidium* sp. My specimens were sent by Mr. R. L. Holmes.

The arrangement of the dorsal spines, and the peculiar lingula, will distinguish this species.

DESCRIPTIVE REMARKS.

The type of this species was unfortunately not in the Maskell collection. We have received, however, what is evidently the same insect from Mr. R. S. Woglum, of this bureau, collected at the Botanic Garden at Buitenzorg, Java, January, 1911, on a plant of the family Sapindaceæ, from which material we have drawn up the following description:

The larvæ and pupæ occur promiscuously over the underside of the leaves, though when few or moderately abundant they occur more along the midrib and larger veins. The surface of foliage on infested plants is more or less covered with the usual growth of "sooty fungus," nourished on the excretion from these insects.

Egg.—Size about 0.2 by 0.1 mm., subelliptical, the distal end pointed. As seen on leaf, dark-brown to blackish in color; many specimens iridescent, without markings. Stalk attached at basal end and about twice length of egg. Eggs scattered promiscuously over leaf and prostrate. In hatching the shell splits longitudinally in two equal parts, which are held together at base (Pl. XIX, fig, 6).

Larva (first stage).—Size about 0.26 by 0.153 mm., elongate elliptical in shape, though somewhat narrowed caudad. Around the margin is a short rim of white waxy secretion. Color on leaf light brown, under microscope light yellowish to whitish. Eye spots reddish, elongate, and often divided. Margin without evident crenulations, except a shallow and variable sculpturing on cephalic end. Dorsum uniform, without evident pores, but little convex. Margin all around with minute setæ, the two caudal pairs strongest. Vasiform orifice relatively large, cordate in outline, about as wide as long. Operculum half as long as orifice, the sides rounded. Lingula spatulate, little if at all extended, minutely spinose.

Pupa case.—Size about 1 by 0.53 mm., elliptical in outline, the dorsum little convex; case raised on a vertical rim, all around of white wax, apparently deflexed from the large wax tubes on margin of case. In addition to the above secretion the dorsum is covered with a plate of fused wax, through which project the compound wax pores, and the body segments are fairly well indicated (Pl. XIX, fig. 7). From the compound wax pores are produced rather short, brittle, glassy wax rods, usually much broken and lying over surface of leaf. Color on leaf dirty white to yellowish, the empty case clear white. There is no well-marked marginal rim. The margin bears all around conspicuous short wax tubes, broadly rounded distally (Pl. XIX, fig. 11). Abdominal segments moderately distinct, thoracic segments less so. On each side are six compound wax pores, a pair on cephalic region, and five pairs on abdominal region. From the center of each of the two caudal pairs of wax pores and from the cephalic pair arises a strong, brownish-colored process or spine, which is quite conspicuous and morphologically appears to correspond with the central rod-like process in the compound pores in other species of the genus.

This spine-like structure is also present in the remaining wax pores, though much reduced (Pl. XIX, figs. 8 and 9). There is a pair of minute spines on the caudo-lateral margin.

Vasiform orifice (Pl. XIX, fig. 10) subcircular in outline, the cephalic margin a straight line, a little wider than long. Operculum short, about twice as broad as long, cephalic margin straight, caudal margin broadly concave, and the ends rounded.

Lingula large, spatulate, somewhat narrowed at base, and bearing distally two pairs of spines. Operculum and lingula minutely setose.

On ventral surface of case legs and antennæ inconspicuous; legs short, conical, without claws. Antennæ short, subconical, ending in a spinulous process and apparently but one-segmented. These structures differ notably from those in typical forms of the genus, wherein the antennæ are two-jointed, the distal joint long and ringed, and each leg terminating in a single claw.

Adult.—Unknown.

Aleurodicus neglectus n. sp.

(Pl. XX, figs. 1–11; Pl. XXI, fig. 2.)

Guava leaves infested with this insect were collected by Mr. Albert Koebele, at Para, Brazil, in 1882, and forwarded to the Bureau of Entomology. Specimens of the same insect were also received from Robert Newstead on *Ficus bengalensis* and *Anona squamosa*, collected in Demerara in 1892. With the appearance of the description of *Aleurodicus anonæ* by Douglas in 1892,[20] the above two lots of material were erroneously referred to *anonæ* and so labeled and carried in the Bureau of Entomology collection, as was also a distinct and much larger species, with clear wings, *A. giganteus*, collected by Mr. Koebele December 28, 1882, at Pernambuco, Brazil.

The senior author in studying the forms of Aleyrodidæ in the bureau collection [21] accepted these determinations without critical examination of the material, and thus fell into the error of using the pupæ of *neglectus* and the adults of *giganteus* in characterizing *anonæ* in the table of species (l. c., p. 43), and these two species were confused in stating the geographical distribution and food plants of *anonæ* (p. 44). *A. neglectus* differs from *anonæ* in that the wings of the adult are spotted with dusky. In *anonæ* the wings are stated to be snowy white. *A. anonæ* differs from *giganteus* in its smaller size and in the shape and structure of the pupa case, notably the presence on the caudal region of the two pairs of reduced compound pores, quite absent in *giganteus*.

Aleurodicus neglectus was also received from H. Caracciola, Port of Spain, Trinidad, September 28, 1896, on *Anona reticulata;* and again, from Trinidad, June 7, 1907, on coconut, from Mr. O. W. Barrett. March 11, 1911, a further lot of material of this species was forwarded by Dr. F. W. Urich, Port of Spain, Trinidad, on *Anona squamosa.* The species is therefore known from Para, Brazil, and Trinidad, and from the following host plants: *Anona reticulata*, *A. squamosa*, *Anona* sp. (Brazil), and the coconut, *Cocos nucifera.*

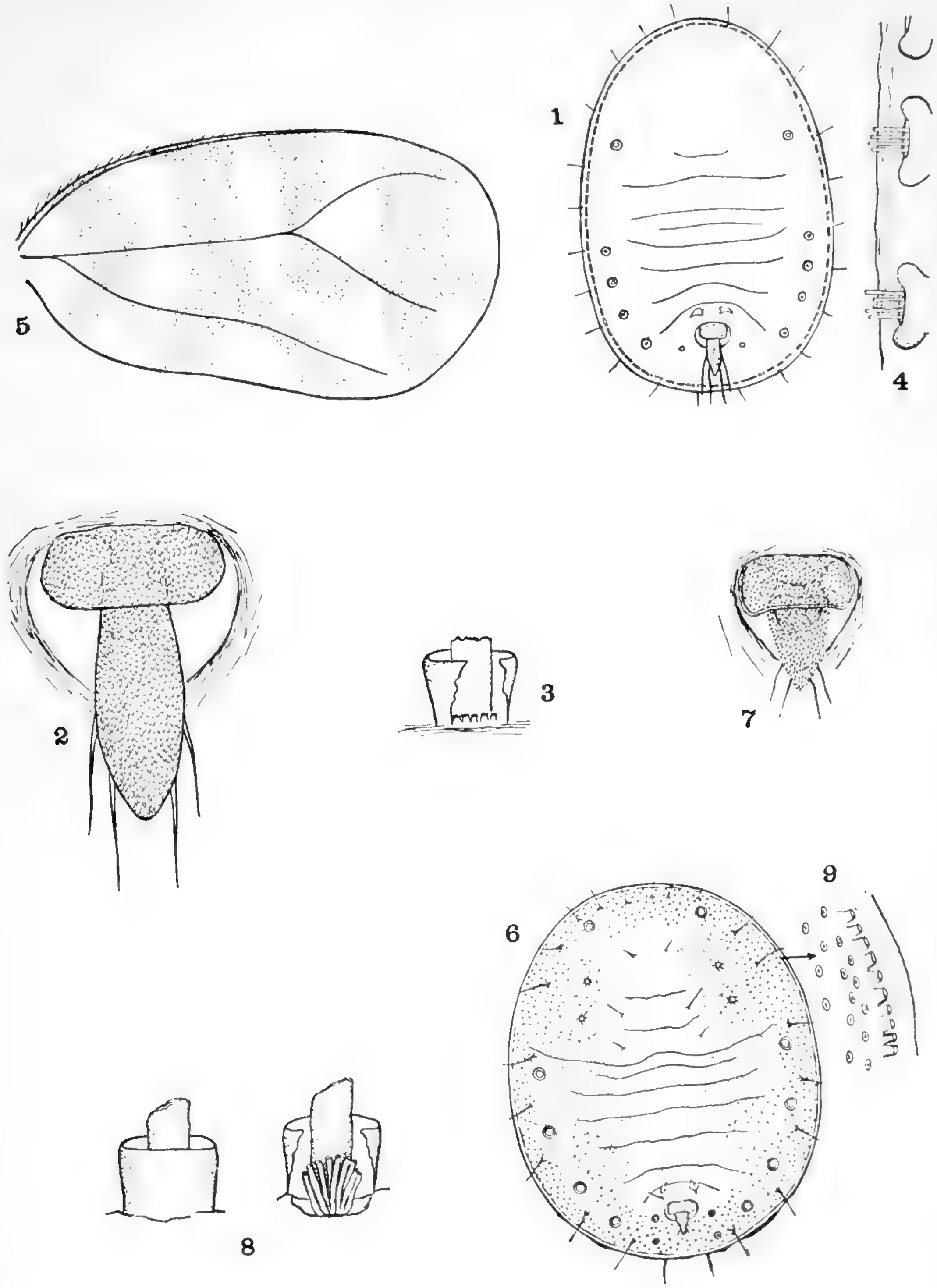
This insect and *A. destructor* on coconut from the Philippines are noteworthy on account of the large size of the compound wax pores of the pupa case and the rather elongate and distally narrowed lingula.

DESCRIPTION.

Egg.—Length 0.3 mm., light yellow, unmarked; stalk very short; egg lying prostrate on leaf (Pl. XX, fig. 1).

Pupa case.—Size about 1.3 by 0.92 mm., broadly elliptical in outline. Dorsum little convex, the body segments distinct (Pl. XX, fig. 2). There is a copious secretion in the form of more or less fluted bands or masses of white wax from the simple dorsal and submarginal wax pores, extending out on leaf all around, several times the width of the case. From the compound wax pores are produced the long glassy wax rods usual in the genus, but their length in this species is remarkable and very similar to *A. destructor.* The pupæ on the leaf are quite hidden under the large mass of wax, which renders them quite conspicuous. In the copious wax on the lower surface of the case the adults occur in numbers. There is evidenced a tendency to congregate along the midrib of the leaf, though individuals are also scattered over the general leaf surface (Pl. XXI, fig. 2).

The color of the case, denuded of wax, is yellowish to darker, some specimens varying to plumbeous. Margin of case apparently entire; just within margin all around is a closely set row of simple wax pores (Pl. XX, fig. 6) and similar pores are scattered generally over



ALEURODICUS ORNATUS AND ALEURODICUS PULVINATUS.

Aleurodicus ornatus: Fig. 1.—Pupa case. Fig. 2.—Vasiform orifice of pupa case. Fig. 3.—Compound pore of pupa case. Fig. 4.—Margin of case. Fig. 5.—Wing of adult. *Aleurodicus pulvinatus:* Fig. 6.—Pupa case. Fig. 7.—Vasiform orifice. Fig. 8.—Compound pore of pupa case. Fig. 9.—Margin of the case. (Original.)

the dorsum and from them is produced the waxy secretion before mentioned. On the dorsum of case are the usual compound wax pores (Pl. XX, figs. 4, 5) from which arise the long curling wax rods. In the present species the pores are unusually large, measuring 0.064 mm. in diameter. These pores occur as follows: Four pairs on the abdominal region, two pairs of smaller pores on the caudal end of case, and two on each side of the vasiform orifice. On the cephalic end of the case is also a pair, though they are somewhat smaller than the pores on the abdomen.

Within the margin of the case all around is a row of spines, 11 or 12 to each side. There is also a pair of spines just cephalad of the vasiform orifice.

Vasiform orifice (Pl. XX, fig. 3) subcordate; operculum rectangular, about half filling the orifice, the çaudal margin notched on each side, and bearing a pair of spines. Lingula exserted, elongate, and narrowed distally more than usual and with two indentures on each side near end, from each of which arises a strong, often curved spine. On the ventral surface the legs and antennæ are distinct.

Adult female.—Length of body about 1.7 mm. Length of forewing 2.27 mm.; width 1.15 mm. Antennæ (Pl. XX, fig. 10) seven-jointed, usual; third segment 0.26 mm. in length; hind tibia 0.81 mm. in length; first tarsal segment 0.2 mm. in length and distal segment about half as long.

Color rather uniformly yellow to darker, legs and antennæ paler, eyes greenish. Forewings (Pl. XX, fig. 7) of both sexes with dusky markings. Hind wings unspotted. Wing surface somewhat iridescent. Adults seem to occur promiscuously among the pupæ, more or less covered by the waxy secretion of the immature stages.

Type.—No. 14774, U. S. National Museum. Described from abundant material of infested foliage and eggs, pupæ, and adults in balsam mounts.

Aleurodicus ornatus Cockerell.

(Pl. XXII, figs. 1–4.)

Aleurodicus ornatus Cockerell, Ent. Mo. Mag., vol. 29, p. 105 (1893).

We know this species only from the type material in the U. S. National Museum (type No. 14773).

ORIGINAL DESCRIPTION.

The imago, from head to the tip of the wings, measures somewhat over 2 mm., and structurally agrees so well with the two known species of the genus, that I should not have ventured to bring it forward as new, were it not for the beautiful grey markings of the narrower upper wings. These markings, which distinguish the insect at a glance, consist of four broad, transverse gray bands, and a longitudinal band running from the outermost to the margin a little below the apex. On the upper half of the wing (i. e. above the central nervure) the bands are nearly straight and about equidistant, but they mostly enlarge about the middle of the wing, the third and fourth being joined by the inward prolongation of the longitudinal band. The third band is interrupted below its middle, and its lower part is joined to the second band, of which it appears an oblique branch. The true prolongation of the second band bends obliquely inwards, and is joined at one point to the first band. The second band is also joined to the first by a thin process in the region of the central nervure. For the rest, the insect is white, with the abdomen slightly yellowish. The larva is grey, with white secretion. The antennæ, legs, venation, glands of larva, etc., seem to be practically as in *A. anonæ*, and need not, therefore, be described.

DESCRIPTIVE REMARKS.

Pupa case.—Elliptical, about 1 mm. long by 0.84 mm. wide. Color under microscope yellow, darker centrally. Margin of case lightly crenulate. Dorsum little elevated, segments distinct (Pl. XXII, fig. 1). Just within margin of case all around is a series of wax pores, resembling somewhat in structure the compound wax pore, and secreting long slender wax rods (Pl. XXII, fig. 4). On caudal margin of case are two pairs of spines, and just within margin all around is a series of spines, the exact number of which can not be determined on account of the imperfect condition of the single pupa case in the type material. There are four pairs of the usual compound wax pores on abdomen and a pair on cephalic end of case (Pl. XXII, fig. 3).

Vasiform orifice broader than long, subcordate; operculum short, twice as broad as long. Lingula protruded and very long (0.15 mm. from base to tip), spatulate, with two pairs of strong spines at caudal end. The unusually large lingula resembles that of *dugesii*, though it is not dark in color as in that species (Pl. XXII, fig. 2).

Adult female.—Length of forewing about 2 mm.; width about 1 mm. Body reddish brown. Eyes reniform, plumbeous. Length of fore tibia 0.46 mm. Length of fore tarsus 0.27 mm., the segments subequal in length. Wings banded with dusky, as shown in Plate XXII, figure 5, and about as described by Prof. Cockerell.

Aleurodicus pulvinatus (Maskell).

(Pl. XXII, figs. 6–9.)

Aleurodes pulvinata Maskell, Trans. New Zealand Inst., vol. 28, p. 439 (1895).

In the Maskell collection of Aleyrodidæ loaned to the Bureau of Entomology by the New Zealand Institute are two examples of the pupa case of this species, in balsam slide mounts. This insect has in general the type of case of *cocois*, but presents distinctive differences. While originally described as an *Aleyrodes* by Maskell, its resemblance in structure to *Aleurodicus* was recognized by the describer, and it was later referred to this genus by Cockerell. The original description and remarks by Maskell follow:

Larva not observed.

Pupa-case dark orange, with two broad lateral longitudinal bands of dark-brown, which do not touch the margin, and which denote the inclosed insect. Form roundly elliptical, the cephalic extremity sometimes slightly depressed; dorsum slightly convex; abdominal segments moderately distinct. Length about 1/20 in. The dorsum bears, some distance within the margin, a series of twenty-two tubercular pores, glands or spinneret orifices. Of these, four on the extreme cephalic region are small, with simple circular orifices; the next two (one on each side), on a level with the rostrum, are large and conspicuous, consisting of a cylindrical tube with wide circular orifice; the next four (two on each side) on the median thoracic region are rather small, but larger than the anterior cephalic ones and have circular multiocular orifices; the next eight (four on each side) on the abdominal region are similar to two large ones near the rostrum; the last four (two on each side) near the abdominal extremity are about equal in size to the four on the cephalic region, and are simple. The margin is very finely striated, but not crenulated; and for some distance within it the dorsum is covered with great numbers of very small circular spinneret orifices, but these do not extend to the median dorsal regions. There is no fringe, properly speaking, but all the organs just described produce secretion as noticed presently. Vasiform orifice rather broader than long, the anterior edge slightly concave, the posterior edge broadly convex; operculum small, covering about one-third of the orifice, with both edges concave, the anterior very deeply, the posterior less, depressed; lingula very long, extending some distance from the orifice, roundly conical, with two rather long setæ near its end.

The spinneret tubes and orifices above mentioned secrete a large quantity of snow-white waxy threads closely felted, and also, scattered amongst these, several long straight glassy rods, which are very brittle; these rods, when closely examined, are seen to be very delicately fluted. The threads appear to be produced from the very numerous minute spinnerets, and the rods from the rows of larger tubes. It results from the absence of small spinnerets on the median dorsal regions that the pupa case in those parts is uncovered; consequently, it appears as if lying on a thick ring or cushion of cotton, from which fact I have derived its specific name.

On turning over the pupa case and dissolving the waxy matter, the rudimentary feet and antennæ are clearly visible; the feet are thick and short, the antennæ rather long, slender, and in the latest stage numerously ringed.

Adult form unknown; but from the appearance of the rudimentary wings in a late pupa examined, which was almost on the point of emerging when it died, I believe that the fore-wings will be dark and banded with dark-brown, or perhaps black.

Hab. In Trinidad, West Indies. My specimens were sent by Mr. F. W. Urich. I think the plant is *Jatropha* sp.

It has been necessary to be particular in describing and figuring the details of spinnerets, etc., in this species, on account of its similarity in some respects to three West Indian insects: *Aleurodicus anonæ*, Douglas and Morgan; *A. cocois*, Curtis, and *A. ornatus*, Cockerell. I have already, in my introductory remarks, mentioned that these and other authors employ frequently the term "larva" to denote indiscriminately what I take to be both the larval and the pupal states. Now, first, as to color: the "larva" of *A. anonæ* is said to be "ochreous," that of *A. cocois* (as far as I can make out) is similar; that of

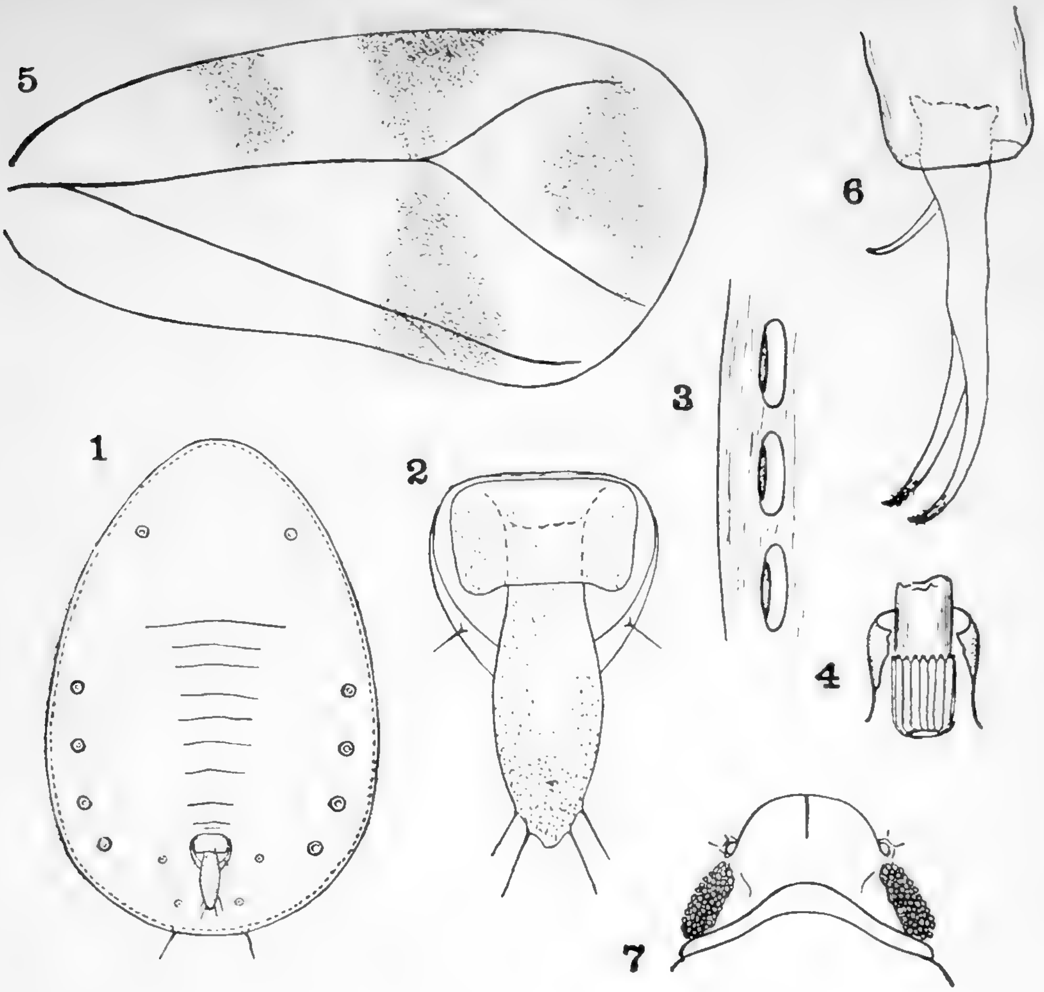
A. ornatus is "grey." No author mentions dark longitudinal brown bands, such as those which are so conspicuous in *A. pulvinata.* What is much more important, in *A. anonæ* Mr. Morgan gives fourteen "lateral infundibuliform compound spinnerets" and "secreting glands." *A. cocois* (ap. Riley and Howard) has also fourteen; *A. ornatus* has glands "practically as in *A. anonæ;*" but in *A. pulvinata* there are twenty-two of these organs. No author mentions minute dorsal spinnerets within the margin, such as those which are so extremely numerous in *A. pulvinata;* yet, as these appear to be certainly the producers of the ring of waxy threads, they are of importance. As regards the vasiform orifice and lingula, I find those of *A. anonæ* (which Mr. Morgan curiously terms the anus, colon, and ilium") and those of *A. cocois* not greatly dissimilar; in fact, they may be said to be practically identical. These organs are not mentioned for *A. ornatus.* In the figure 41B of *A. cocois* (Ins. Life, 1893, p. 314) the lingula of the adult female is shown as protruding considerably from the abdomen; probably this will also be the case in *A. pulvinata.*

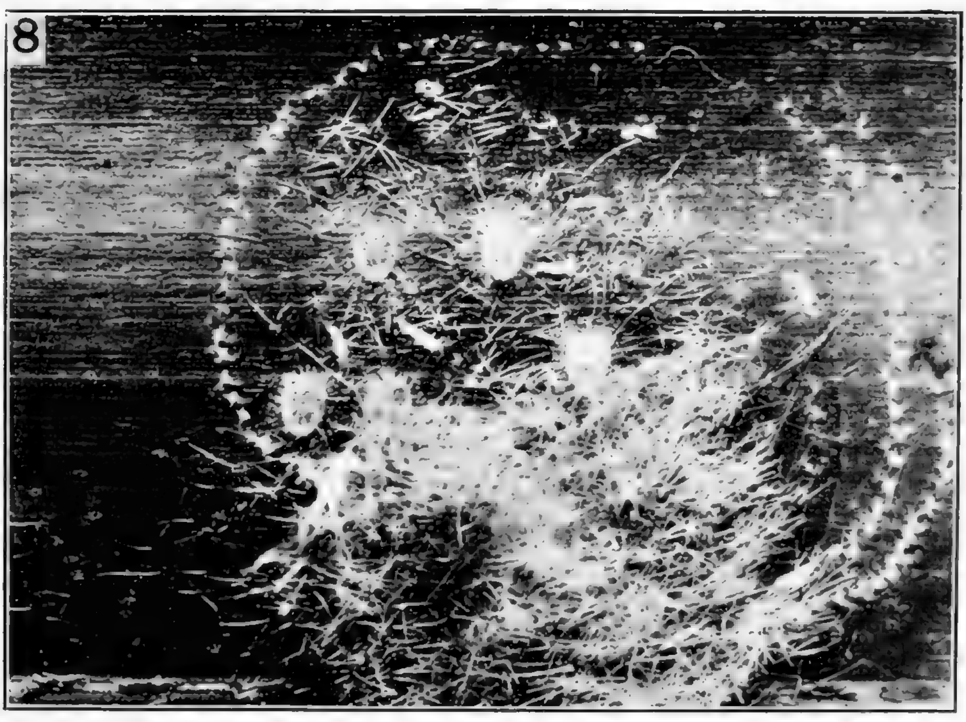
I believe that the wings of *A. pulvinata* will be not far removed from the darkly banded ones of *A. ornatus*, but in the face of the statement that the "larva" of that species is "grey," and in the absence of any further information, I shall not at present so identify the insect, nor shall I yet relegate it to the genus *Aleurodicus.*

DESCRIPTIVE REMARKS.

Pupa case.—Size 1.33 mm. long by 1.15 mm. wide; very roundly elliptical, but little convex (Pl. XXII, fig. 6). As described above, there are along each side two broad and irregular longitudinal bands of dark-brown color in the derm, and there is a light yellow or semi-transparent longitudinal band along the central dorsal area. We are unable to verify Maskell's description in reference to the "twenty-two tubercular pores, glands, or spinneret orifices." It seems clear that the tubercles of certain spines were mistaken for wax pores. On the type specimens the tubercular spines are to be made out with considerable certainty, a series all around case, well within the margin, 10 or 11 on each side, as shown in the figure. There is also a pair of spines on caudal end of case. There are seven pairs of compound wax pores (Pl. XXII, fig. 8), one on cephalic end, and on the abdomen are four pairs of large and two pairs of small pores. There is a pair of spines just cephalad of the vasiform orifice, and three pairs on the thoracic region toward the median line. Also on the thorax are two pairs of stellate, transparent spots. The margin of case is entire. Just within margin all around is a closely set row of minute tubular wax pores resembling those in *cocois.* Also as in *cocois*, there is on the submarginal area all around a broad band of minute simple wax pores.

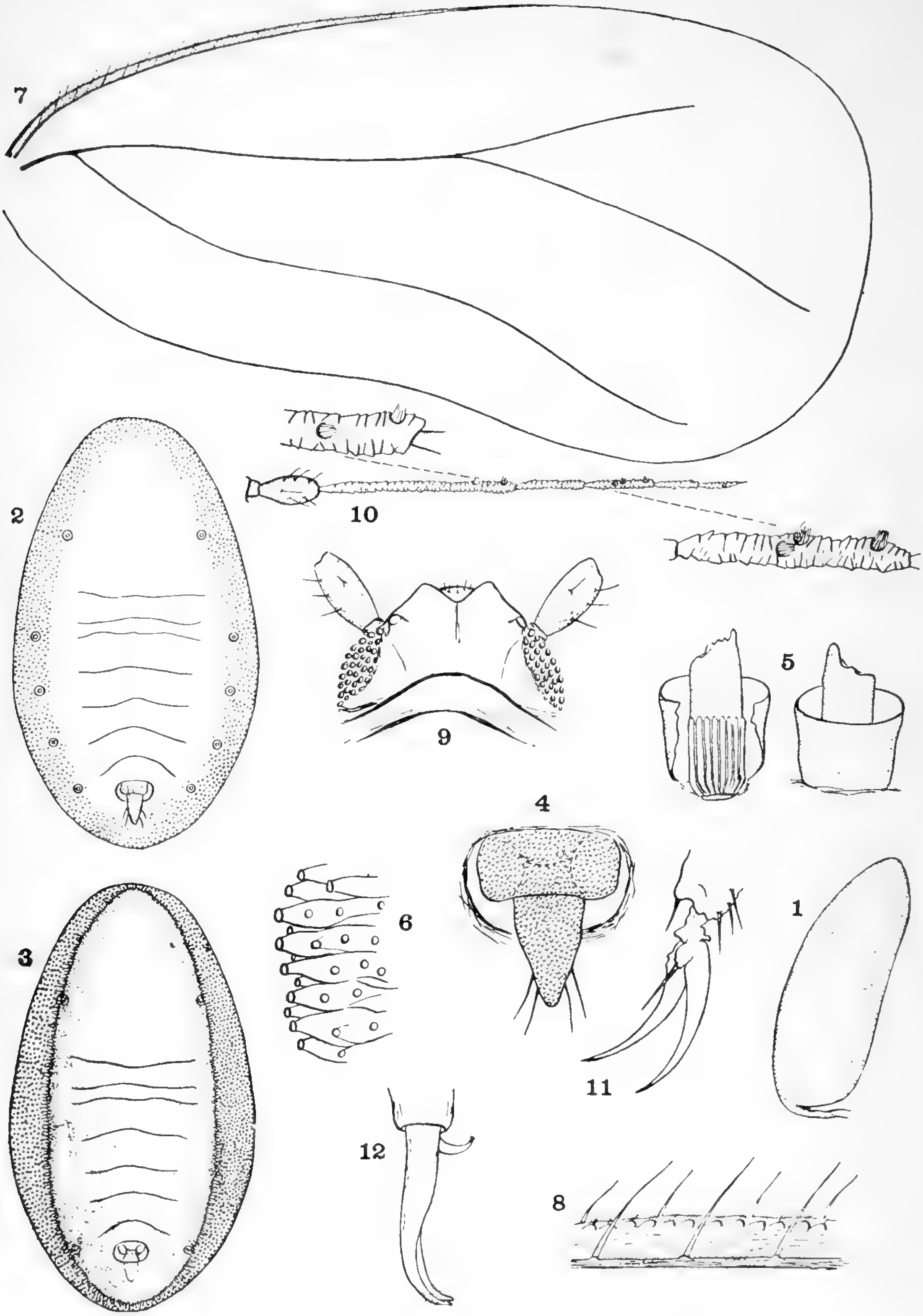
Vasiform orifice (Pl. XXII, fig. 7) broadly cordate, broader than long, cephalic margin straight. Operculum considerably broader than long, anterior margin straight, sides rounded, caudal margin concave and minutely setose, bearing distally two pairs of spines.





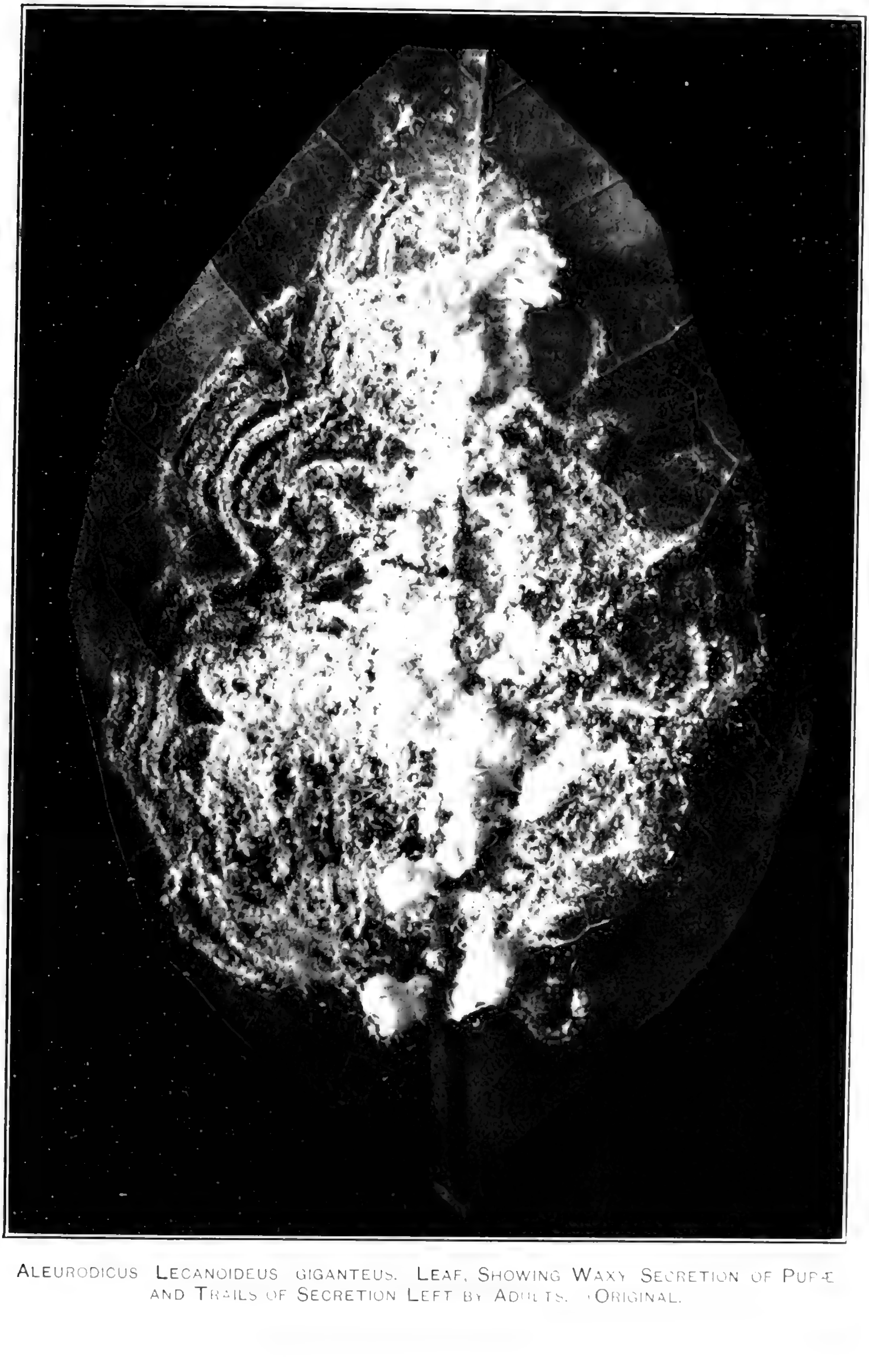
ALEURODICUS TRINIDADENSIS.

Fig. 1.—Pupa case. Fig. 2.—Vasiform orifice. Fig. 3.—Margin of pupa case. Fig. 4.—Compound wax pore. Fig. 5.—Forewing. Fig. 6.—Claspers of male. Fig. 7.—Head of adult. Fig. 8.—Pupæ on leaf, showing waxy secretion of pupæ and trails of wax left by adults. (Fig. 1-7, original; fig. 8, from Urich.)



ALEURODICUS (LECANOIDEUS) GIGANTEUS.

Fig. 1.—Egg. Fig. 2.—Pupa case, dorsal view. Fig. 3.—Pupa case, ventral view. Fig. 4.—Vasiform orifice of pupa case. Fig. 5.—Compound pore of pupa case. Fig. 6.—Margin of pupa case. Fig. 7.—Forewing of adult. Fig. 8.—Costal margin of forewing. Fig. 9.—Head of adult. Fig. 10.—Antenna of adult. Fig. 11.—Foot of adult. Fig. 12.—Male genitalia. (Original.)



ALEURODICUS LECANOIDEUS GIGANTEUS. LEAF, SHOWING WAXY SECRETION OF PUPÆ AND TRAILS OF SECRETION LEFT BY ADULTS. (ORIGINAL.)

Aleurodicus trinidadensis n. sp.

(Pl. XXIII, figs. 1–8.)

Specimens of this insect were received from Dr. F. W. Urich, Trinidad, on March 27, 1912. The pupæ are similar to those of *dugesii* and *ornatus* in that they possess a very prominent lingula. The adults, however, are nearer to those of *cocois*.

DESCRIPTION.

Pupa (Pl. XXIII, fig. 1).—Color yellowish; empty case transparent, with very faint shadings around the base of some of the compound wax pores. These pores are arranged in seven pairs, one thoracic pair and six abdominal. The two caudal pairs are reduced. The spinnerets of the compound pores (Pl. XXIII, fig. 4) are extended into rods which are about half the length of the outer cup and the central process protrudes some distance from the opening of the pore. Margin (Pl. XXIII, fig. 3) entire and just within it, all around, a series of disc-like pores. Vasiform orifice (Pl. XXIII, fig. 2) subcordate in outline, the anterior margin straight, and the laterocaudal "fold" armed on each side with a bristle. Operculum rectangular, transverse, with the caudal margin slightly indented. Lingula very large and exserted, the distance from the anterior margin of the orifice to the tip of the lingula being about twice the longest diameter of the operculum. Both lingula and operculum are setose and the former is armed with four spines. Shape elliptical, broadest slightly caudad of middle. Size 1.36 mm. by 0.928 mm. On the leaf the waxy secretion does not present a thick mass, but is composed of a large number of distinct waxen rods, many of which become broken (Pl. XXIII, fig. 8). The marginal fringe is composed of a series of fine distinct waxen rods.

Adult.—Color yellowish, the abdomen and appendages of some specimens tinged with reddish. Eyes dark brown. Forewings marked with four dusky areas as illustrated in Plate XXIII, figure 5. The intensity of these markings varies considerably and in some specimens they are hardly noticeable. In others the two dusky areas on either side of the radial fork become united into a band. Hind wings unmarked, excepting a shaded margin sometimes present along the proximal portion of veins. Vertex (Pl. XXIII, fig. 7) rounded; claspers of the male (Pl. XXIII, fig. 6) long and narrow, with the tips sometimes dusky. Penis short, slightly curved.

Forewing 1.9 by 0.96 mm.; of female 1.6–2.08 mm.; of male 2.16 mm.; claspers from base to tip 0.64 mm.; last abdominal segment 0.56 mm.; penis 0.288 mm.

Type.—No. 14777, U. S. National Museum. Described from specimens in balsam and dry specimens on infested foliage. Taken on coconut.

Subgenus LECANOIDEUS n. subgen.

Insects with the characters of the subgenus *Aleurodicus*, excepting that the vertex of the adult is bilobed and the lateral margin of the pupa case is deflexed, curving under the ventral surface. The pupæ are devoid of the reduced compound pores near the vasiform orifice. Lingula of pupa usually exserted; that of adult narrow and included.

Type, *giganteus* n. sp.

Species of Subgenus Lecanoideus.

A. Pupa case large and broad, with the anterior pair of compound pores near cephalic extremity .... *mirabilis.*

B. Pupa case elongate, with the anterior pair of compound pores a considerable distance from the cephalic extremity .... *giganteus.*

Aleurodicus (Lecanoideus) giganteus n. sp.

(Pl. XXIV, figs. 1–12; Pl. XXV.)

This aleyrodid was collected by Mr. Albert Koebele at Pernambuco, Brazil, December 28, 1882. The host was not stated by Mr. Koebele, but appears to have been a species of *Ficus*. As stated with reference to *A. neglectus*, the present species was also carried in the Bureau of Entomology collection as *anonæ* Douglas, and this latter was thus erroneously listed from Pernambuco, Brazil. This is the largest species of the genus thus far recorded, although a much larger member of the family, *Udamoselis pigmentaria* (p 25) from South America, has been described by Enderlein,[18] with a wing length of 5.5 mm. and a body length of 7 mm.

DESCRIPTION.

Egg.—Elongate, about 0.4 mm. long. Stalk short; eggs lying prostrate on leaf, on which they are scattered promiscuously; brownish in color and without markings (Pl. XXIV, fig. 1).

Pupa case.—Length from 1.5 to 1.85 mm. Width 0.9 to 1 mm.; elongate, somewhat narrowed at each end. Convex, the sides deflexed in mature specimens, resembling a lecanium scale (Pl. XXIV, figs. 2, 3). Pupæ are covered by a very abundant secretion of white wax, of a generally flocculent appearance (Pl. XXV). Examined more particularly, there will be observed a group of vertical columns considerably higher than the case is wide, from the abdominal region of the dorsum, very compact at the base, but separating more or less into separate bundles distally. This secretion appears to arise from the abdominal segments, extending completely across the dorsum, from the compound wax pores on each side. Also in this columnar type of secretion are found the glassy wax rods from the compound wax pores which in this species are comparatively slender and short.

There is also a copious secretion of minute cottony wax threads, from a broad submarginal zone or band of small simple pores completely around the case. From the margin or edge of the case there is a secretion from the tubular wax pores (Pl. XXIV, fig. 6) which extends downward, more or less, under the pupa case in the form of an amorphous wax plate. The color is brownish to very dark brown. Some specimens, however, have a distinctly reddish color, though such individuals are comparatively few. The empty case is very light brown, without distinctive color markings.

The dorsum and margin of case are without spines. On each side of the abdominal region are four compound wax pores (Pl. XXIV, fig. 5) and a pair of similar though smaller pores occurs on the cephalic end of case. The two pairs of small compound pores present on the caudal end of the case, in many members of the genus, are absent in this species.

Vasiform orifice (Pl. XXIV, fig. 4) subcordate, considerably wider than long. Operculum about twice as wide as long, the basal corners rounded, the caudal margin somewhat concave.

Lingula large, exserted, spatulate in shape, bearing toward distal end two pairs of spines. On ventral surface, legs and antennæ very evident; basal segment of leg large, subglobose. Distal segment of leg longer than basal, finger-like, ending in a single curved claw.

Adult female.—Length from head to tip of abdomen about 2.75 mm.; length of forewing 3.50 to 3.75 mm.; width 1.70 to 1.75 mm. (Pl. XXIV, figs. 7 and 8); length of hind tibia about 1.23 mm.; length of basal segment of tarsus 0.32 mm.; length of distal segment 0.16 mm.

Color of body and head light brownish, the legs and antennæ paler; wings white, without markings, more or less dusted with powdery wax. Ventral surface of body of the insect with light flocculent wax apparently secreted from the abdomen. Some leaves show paths or trails of white wax, evidently made by the adults during the course of their movements (see Pl. XXV). Eyes of the usual constricted form. Antennæ about 1 mm. in length; segments I and II about equal in length to segment VI; segments VI and VII subequal; segment III about one-sixth shorter than segments IV to VII, inclusive (Pl. XXIV, figs. 9–12).

Male.—Having the general appearance of the female. Genital valves long and slender, penis short and curved near distal end.

Type.—No. 14767, U. S. National Museum. Described from abundant material of eggs and pupæ on leaves, and adults on card points, and all of these stages in balsam mounts.

Aleurodicus (Lecanoideus) mirabilis Cockerell.

(Pl. XXVI, figs. 1–5; Pl. XXIX, fig. 1.)

Aleurodicus mirabilis Cockerell, Psyche, vol. 8, p. 225 (1898); idem, p. 360 (1899).

ORIGINAL DESCRIPTION.

Pupa (late larva?) $1\frac{2}{3}$ mm. long, after boiling transparent and colorless, except some brown stains in the thoracic region. Mouth-parts distinct and well formed; rostral loop short; legs present, very stout, with small, hooked claws. Form oblong, quite elongate, with a border densely dotted with round glands; anteriorly this border is very narrow, and at the extreme hind end it ceases, but all along the sides it is extremely broad. The cephalic portion of the insect, the hind end, and the lateral margins within the border, are also densely dotted with glands. Abdomen distinctly segmented, but the segmentation does not extend to the border. On each side of the abdomen are four curious large glandular processes, of the type of those in *A. holmesii* Mask. Lingula trowel-shaped, extending considerably beyond the broad operculum; at each side of the base of the lingula is an angular prominence. The general type of these parts is that of *A. pulvinata* Mask., but while the lingula is equally long, it is in our insect gently bowed out at the sides; and the two bristles at the end of the lingula in *mirabilis* are not nearly so long as in *pulvinata*.

Externally the insect appears as a large mass (5 to 10 mm. long) of snow-white cottony tufts, irregularly disposed, from the midst of which spring many very long curved white threads. The pupa itself is entirely covered.

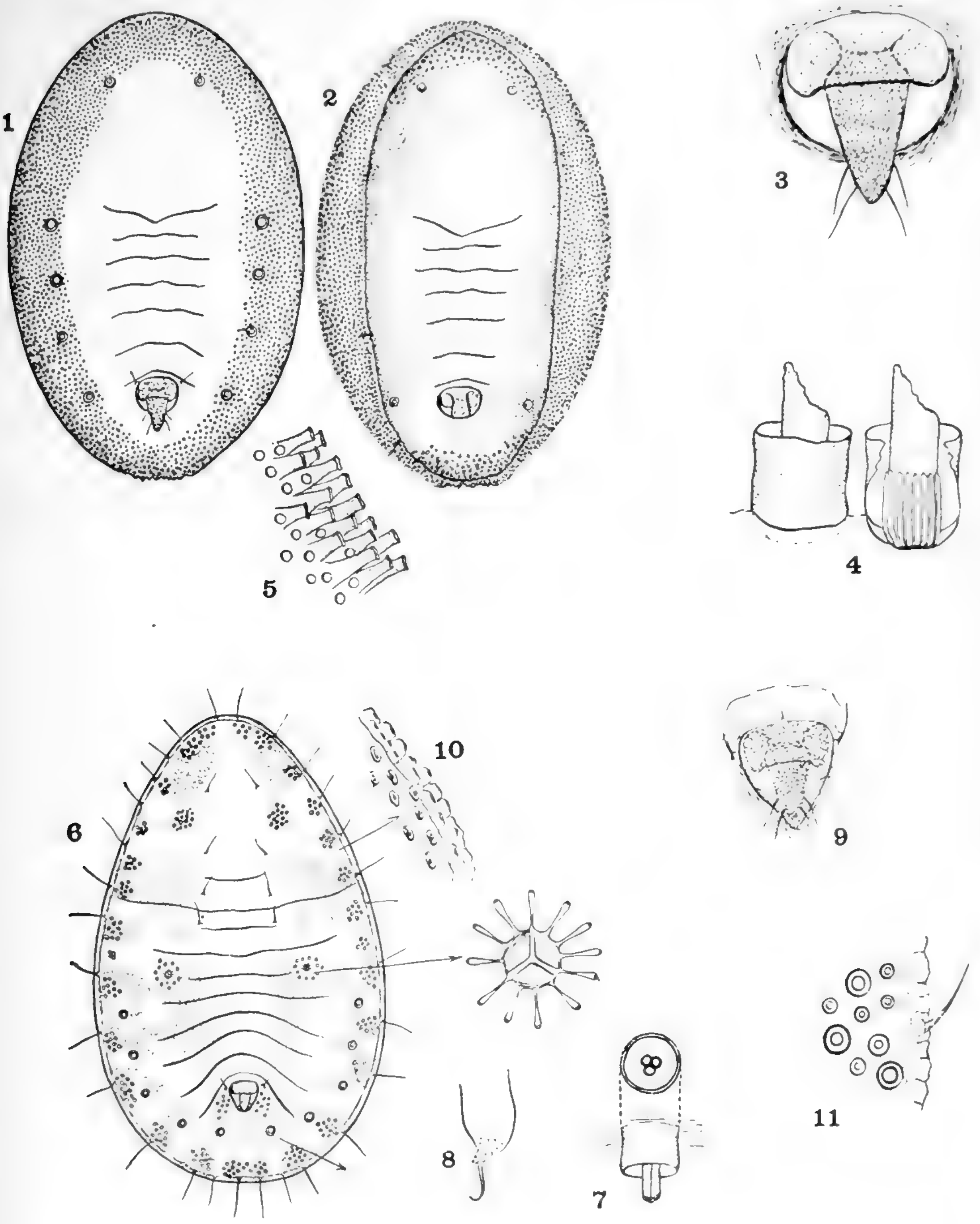
Hab.—Boca del Usumacinta, Tabasco, Mexico, July 8, 1897, on "Laurel," which is not our plant of that name (Townsend) Div. Ent. 7984. This remarkable insect resembles *Aleurodicus* in several respects; when all its stages are known, it will probably be referred to a new genus.

Prof. C. H. T. Townsend found this species in quantity at Minatitlan, Mexico, April 25, 1898, on the underside of *Anona* leaves. Fortunately, he secured a single ♂ adult, which shows that the insect belongs to *Aleurodicus*. The anterior wings are slightly over 2 mm. long and about $1\frac{1}{3}$ mm. broad; white, with two very pale gray bands; the first crossing the wing just before the fork of the median vein, but interrupted for a space below the vein; the second a dilute transverse cloud not far from the apex of the wing. Body about 2 mm. long, exclusive of the forceps, which are about $\frac{3}{4}$ mm. Color of body and legs very pale yellow; base of abdomen white; thorax between wings light orange. Antennæ orange at the middle; eyes pale greenish, not divided. Easily known from *A. anonæ* Morgan, by the markings on the wings of the adult, and the lingula longer than the operculum in the pupa.

Type.—No. 14770, U. S. National Museum.

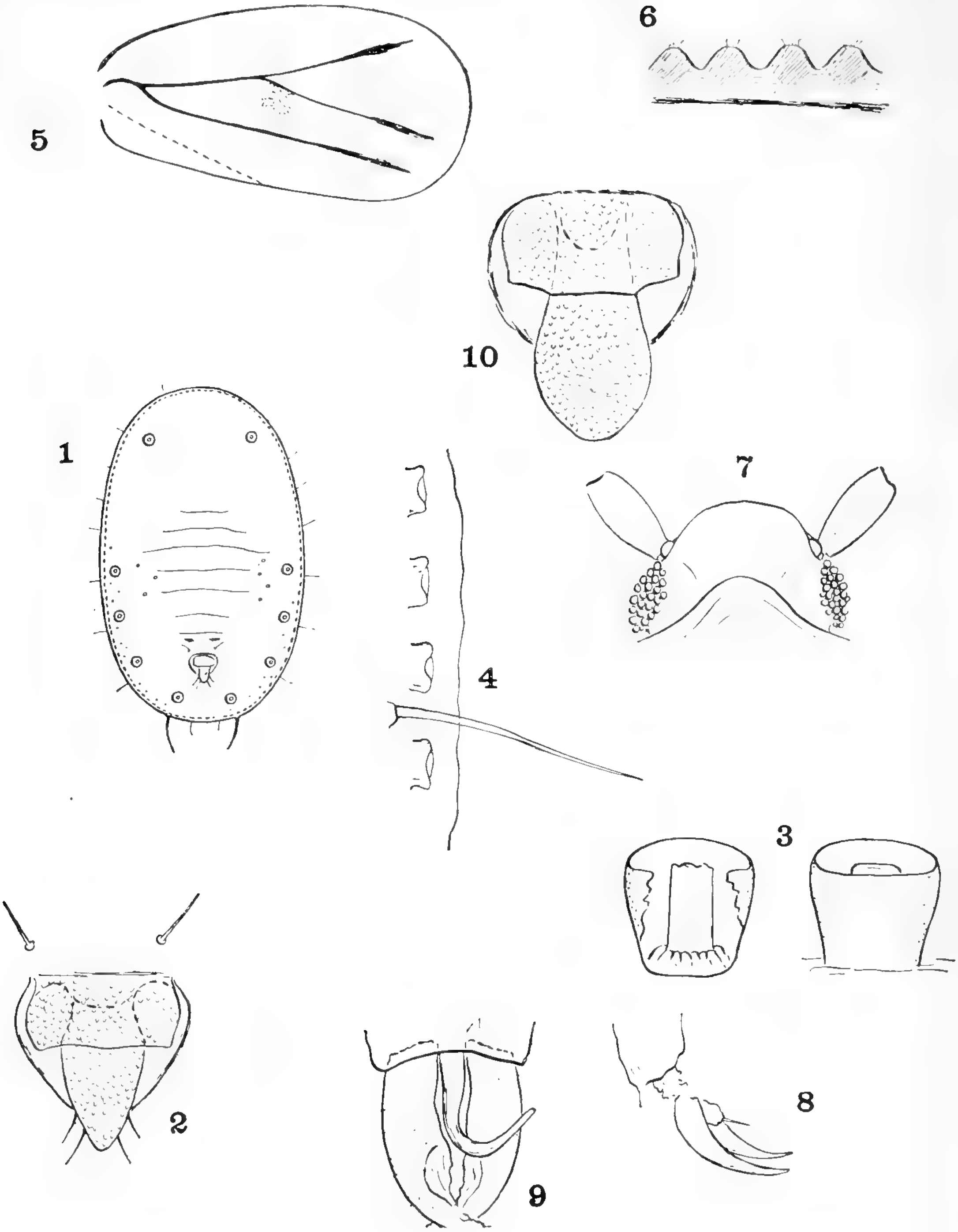
DESCRIPTIVE REMARKS.

This insect in structure of pupa case closely resembles *giganteus*. The dotted border to which reference is made by Prof. Cockerell is really the deflexed portion of case, seen through the derm above, the margin resembling a suture in the derm (Pl. XXVI, figs. 1, 2). In general shape the case resembles a lecanium scale. There are four pairs of the usual compound wax pores on the abdomen, and a similar pair on the cephalic end (Pl. XXVI, fig. 4). The true margin is



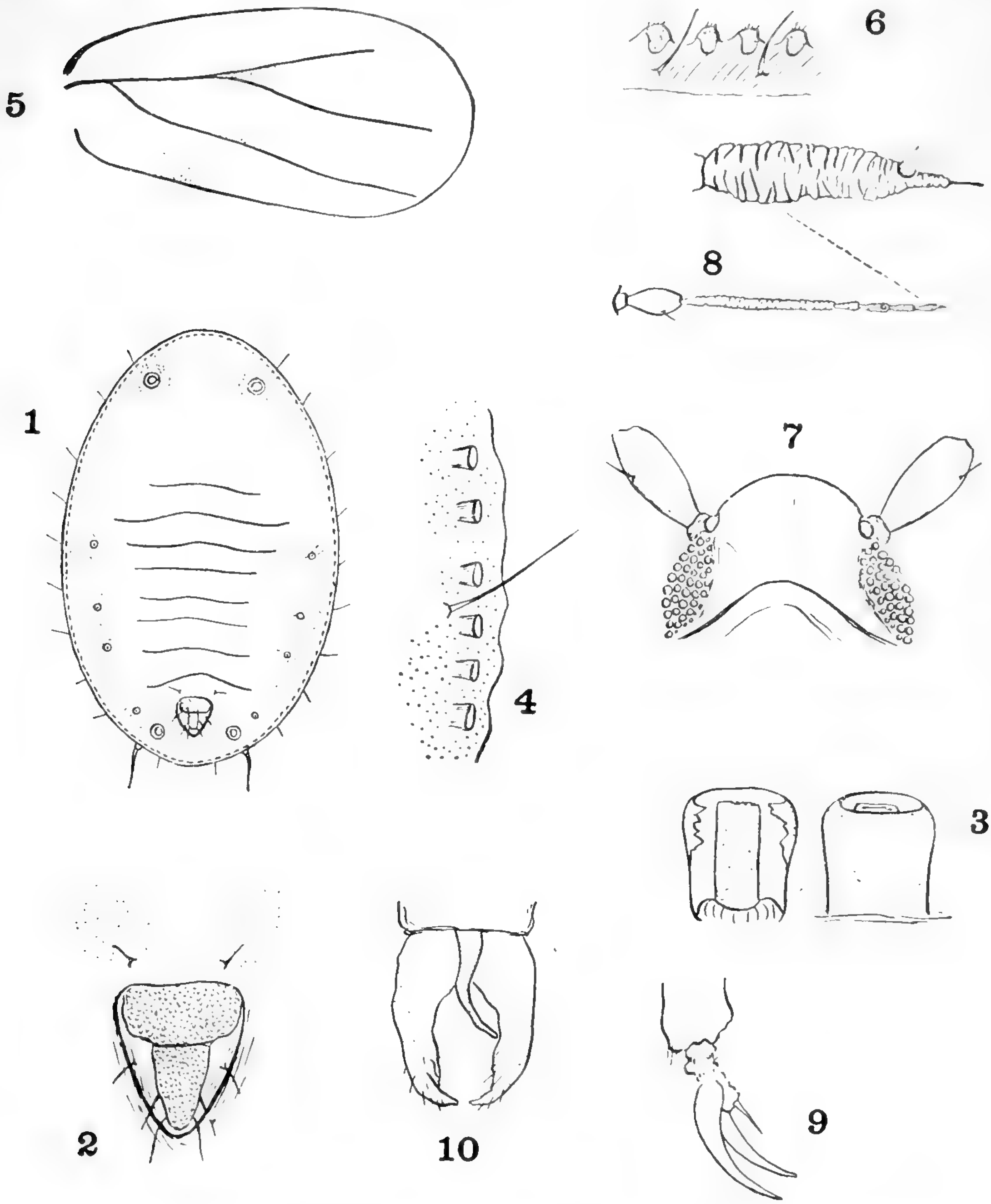
ALEURODICUS (LECANOIDEUS) MIRABILIS AND ALEURODICUS (METALEURODICUS) ALTISSIMUS.

Aleurodicus (Lecanoideus) mirabilis: Fig. 1.—Pupa case, dorsal view. Fig. 2.—Pupa case, ventral view. Fig. 3.—Vasiform orifice of pupa case. Fig. 4.—Compound wax pores of pupa case. Fig. 5.—Margin of case. *Aleurodicus (Metaleurodicus) altissimus:* Fig. 6.—Pupa case. Fig. 7.—Compound wax pore of pupa case. Fig. 8.—Foot of pupa. Fig. 9.—Vasiform orifice of pupa case. Fig. 10.—Margin of pupa case. Fig. 11.—Marginal pore patch. (Original.)



ALEURODICUS (METALEURODICUS) CARDINI.

Fig. 1.—Pupa case. Fig. 2.—Vasiform orifice of pupa case. Fig. 3.—Compound wax pore of pupa case. Fig. 4.—Margin of case. Fig. 5.—Forewing of adult. Fig. 6.—Costal margin of forewing. Fig. 7.—Head. Fig. 8.—Foot of adult. Fig. 9.—Male genitalia. Fig. 10.—Vasiform orifice of adult. (Original.)



ALEURODICUS (METALEURODICUS) MINIMUS.

Fig. 1.—Pupa case. Fig. 2.—Vasiform orifice of pupa case. Fig. 3.—Compound wax pores of pupa case. Fig. 4.—Margin of pupa case. Fig. 5.—Forewing of adult. Fig. 6.—Costal margin of forewing. Fig. 7.—Head of adult. Fig. 8.—Antenna. Fig. 9.—Foot of adult. Fig. 10.—Male genitalia. (Original.)

FIG. 1.—ALEURODICUS (LECANOIDEUS) MIRABILIS: PUPÆ ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)

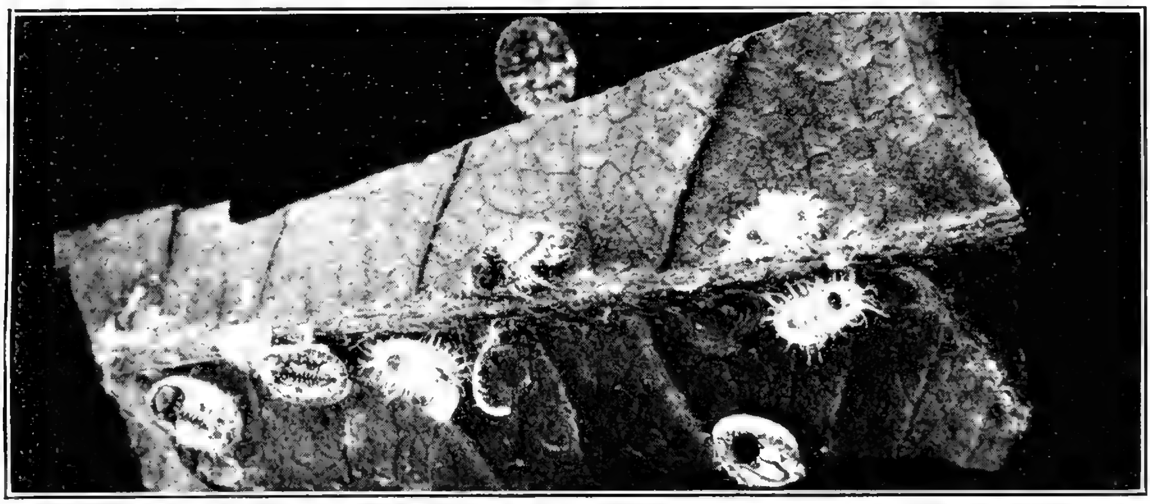


FIG. 2.—ALEURODICUS (METALEURODICUS) ALTISSIMUS: PUPÆ ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)

FIG. 3.—ALEURODICUS (METALEURODICUS) MINIMUS: PUPÆ ON LEAF, SHOWING WAXY SECRETION. (ORIGINAL.)

folded under the case and ends in a series of closely set, superimposed wax tubes (Pl. XXVI, fig. 5). Vasiform orifice (Pl. XXVI, fig. 3) broadly cordate, considerably wider than long. Operculum short and broad. Lingula large, protruded, arrow-shaped, with two pairs of spines, distally. On ventral surface, legs and antennæ very evident. Basal segment of legs large, subglobose; distal segment longer than basal, finger-like, ending in a single strongly curved claw; antennæ long, numerously ringed as usual.

Adult.—The adult we have not seen. It differs from *giganteus* in being smaller, and in the wing markings as described by Cockerell.

Subgenus **METALEURODICUS** n. subgenus.

Forewing with the venation of *Aleurodicus*, but with radius$_1$ much longer; antennæ and feet similar to *Aleurodicus;* vertex rounded; claspers of male short and thick; penis rather long; pupa case with compound wax pores, but these are different from those of *Aleurodicus*, being of the type illustrated in Plate XXVI, figure 3; lingula of vasiform orifice of pupa setose, short, included, and armed with four spines; that of adult broad, large, and exserted. Size small.

Type, *minimus* Quaintance.

Species of Subgenus Metaleurodicus.

A. Abdomen of pupa case with five pairs of equal sized compound pores and on cephalo-median portion of abdomen a stellate structure surrounded by simple pores ---------- *altissimus.*

B. Abdomen of pupa case with five pairs of compound pores of which the caudal are the largest; forewing with a dark macula within the radial fork ---------- *minimus.*

C. Abdomen of pupa case with four pairs of compound pores; forewing with a dark macula below the radial sector ---------- *cardini.*

Aleurodicus (Metaleurodicus) altissimus (Quaintance).

(Pl. XXVI, figs. 6–11; Pl. XXIX, fig. 2.)

Aleurodes altissima Quaintance, Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 20, (1900).

Original Description.

Larva.—Size about 0.89 by 0.52 mm.; yellowish white. A series all around of about 30 setæ. On dorsum are 5 pairs of moderately developed setæ, a pair on cephalic segment, a pair on each of the thoracic segments, and a pair at vasiform orifice. Margin of case slightly crenulated. On the dorsum a few pores may occur somewhat promiscuously, and there are a few groups of pores around the margin. This stage in many respects approaches quite close in structure to the pupa-case.

Pupa-case.—Size about 1.79 by 1.26 mm.; subovate, narrowed cephalad. Color of young pupæ, yellowish to white, and usually without other coloration. In more mature examples the color may vary from whitish to those more or less mottled with brownish, with extreme cases almost uniform brownish black, though in these latter cases such examples have plainly been parasitized, and this color may have resulted from this fact. Typically, this brownish coloration occurs in dashes, from the outer margin inward, varying distances, and more or less radially. Along the dorsi-meson there is a more or less clear longitudinal central stripe, with an interrupted stripe of dark brown on each side, these latter varying considerably in extent and distinctness. In well-marked specimens the radial wedge-shaped dashes may extend quite into these subdorsal bands of dark brown.

Pupa-case, when young, with moderately rounded keel, otherwise flat; at length becoming somewhat convex, and raised on an unusually high vertical fringe of white wax. There is no lateral fringe, but just within the margin all around there is a series of groups of waxen rods. These rods arise from groups of from usually 22 to 26 circular pores. Each bundle of rods is surrounded with a rather short cylinder of wax, forming a sheath at base. Individually, the rods are rather small, glistening white, and inclined to curl at tip. These wax bundles vary considerably in length, but are, as a whole, short, curling outward and downward from the case. Along central dorsal region is a broad and somewhat matted secretion of wax extending from vasiform orifice to cephalic end and covering the rounded keel. On each side of this central dorsal secretion is a curved and narrower secretion extending from just laterad of vasiform orifice to cephalic end. These three dorsal lines of wax may be much interrupted transversely, particularly in younger examples, but in older cases each is usually continuous.

There is a very narrow marginal rim and the margin of case is minutely crenulated. Just within the margin all around is a series of rather long and slender tubercled setæ, about 30 in all, or 15 on each side. The pores of the submarginal groups are rather small, simple, and circular. These may vary considerably in number in the different groups, and an occasional pore occurs outside of group. These groups of pores are usually in the brownish coloration extending in from the margin. There is usually a group of very small pores on each side of vasiform orifice, and a very pretty group on each side of the second abdominal segment. This consists of an irregular circle of small pores with a central rotate figure. The usual series of brownish colored compound pores with cylindrical rim and central rod are present, though comparatively small. On caudal end 4 of these pores occur in almost a transverse row, caudad of orifice, and from this 3 extend cephalad on each side to about the fourth abdominal segment.

Vasiform orifice cordate, about as wide as long. Operculum subrectangular, about twice as wide as long. Lingula large, broad, spatulate shaped, extending quite to caudal margin of orifice and bearing the usual two pairs of subterminal setæ. Margin of orifice extended upward all round, but more pronounced caudad, into a thin and somewhat fluted rim. Operculum and lingula minutely setose or punctured. On the ventral surface the reduced legs and antennæ are quite distinct.

Adults unknown.

When the adult is discovered it will very likely prove to be an *Aleurodicus*.

Collected by Mr. C. H. T. Townsend, July, 1897, at San Francisco del Peal, Tabasco, Mexico, on a plant called "Palo de Gusano." Div. Ent., No. 7979. Described from numerous pupa cases.

Type.—No. 14763, U. S. National Museum.

Aleurodicus (Metaleurodicus) cardini Back.

(Pl. XXVII, figs. 1–10.)

Aleurodicus cardini Back, Can. Ent., vol. 44, pp. 148–151 (1912).

Dr. Back's original description is as follows:

Egg.—About 0.26 mm. long, width about 0.076 mm. Elongate oval, uniformly pale yellowish, unmarked. Pedicel short; egg lying prone on leaf, often entirely surrounded and concealed by fluffy waxen secretions of the adult. Eggs laid without regard to arrangement on leaf.

Larva.—Crawling first instar. Length about 0.319 mm., width about 0.12 mm. Elongate oval, pale yellowish white in color without darker markings or waxen secretions. Thirteen pairs of marginal spines, short, the posterior two pairs longer; a fourteenth pair located on venter near margin on cephalic end of case. Spine on lower side of distal third of antennæ and terminal spine of antennæ proportionately longer and more distinct than in *A. citri* or *A. nubifera.*

Pupa case.—Length about 0.94 mm., width about 0.64 mm. Subelliptical, elevated on a vertical marginal waxen fringe. Color yellowish to yellowish white, after emergence empty case whitish, semitransparent; parasitized specimens appear blackish either throughout or in spots. Margin entire, without pattern of any sort; near margin is a series of wax pores. On venter near margin are eighteen or twenty inconspicuous bristles seen only with high magnification; of these, three pair, one cephalic, and two caudad, are more conspicuous. On dorsum nearer the margin than center are five pairs of round, well-defined compound pores, four pairs on abdominal segments and one pair on cephalic region. Cephalad of vasiform orifice is a pair of minute bristles. Vasiform orifice elongate cordate, about 0.09 mm. wide at base, and about 0.1 mm. long from base of operculum to tip of lingula; cephalic margin straight, caudal and [end] evenly rounded. Operculum subelliptical nearly one-half as long as orifice. Lingula broad, extending well beyond caudal end of orifice, on distal fourth which usually lies beyond caudal end of orifice with two pairs of comparatively long setæ. Rudimentary legs and antennæ as usual.

From wax pores on dorsum, there may be frequently seen protruding white glistening waxen rods which frequently break off and fall about the pupæ as in *P. perseæ.* The dorsal surface of case usually becomes, especially towards maturity, well dusted with a thin coating of white secretions, and at times a very narrow, downwardly directed marginal fringe may be seen outside the vertical fringe.

Adult.—Length, ♂, about 1.16 mm.; forewing, ♀, 1.39 mm. by 0.62 mm.; length *hind femur*, 0.26 mm. Length hind tibia, 0.35 mm.; length hind tarsi, 0.18 mm.; length claws, 0.08 mm.; ♀ proportionately larger. Yellow, covered with whitish waxen secretion; eyes red, not divided, but distinctly constricted. A line extending along side of head, interrupted by upper portion of compound eye, the lateral callosities of prothorax, indistinct traces along suture of proximal segments of abdomen, and portions of vasiform orifice, all blackish. Wings beautifully iridescent, with deep violescent reflections, a small prominent round brownish spot about 0.06 mm. in diameter on each fore and hind wing just behind the posterior distal branch of vein, usually enveloping vein but never filling the angle between veins as shown in *A. mimos* [*minima*] (Tech. Bull. 8, Div. Ent., Dept. Agric., Pl. VI, fig. 6), wings otherwise unmarked. Antennæ seven-jointed, the comparative lengths of the various segments as follows: Segments $\frac{1}{25}$, $\frac{2}{6}$, $\frac{3}{137}$, $\frac{4}{8}$, $\frac{5}{1.5}$, $\frac{6}{2.5}$, $\frac{7}{2.4}$.

Segments 3 to 7 show usual corrugations; segment 7 with constriction on distal half at which point is borne a distinct bristle.

Habitat.—Type material collected at Havana and Santiago de las Vegas, Cuba, in November, 1910, by the writer.

Food plant.—Guava, *Psidium guajava radii.*

Type.—Type material in collection of the U. S. D. A., Bureau of Entomology, and in that of the writer.

This species is really distinguished by its iridescent wing on which the spots described stand out prominently. It differs superficially from *iridescens* in having a spot on the hind wings and in color of pupa case; from *minima* it differs in having no appreciable clouding of wings other than the spots described, in shape and location of the spots, and in the pupa case having but five instead of seven pairs of wax pores. The darkened portions of the vasiform orifice appear as a dark spot on the untreated adult. In crawling about the leaf, the female leaves behind a line of fine fluffy waxen secretion rubbed from a tuft of the same developing on the underside of her abdomen. Frequently her path can be distinctly followed by the aid of these lines of secretions. In mating, the sexes head in the opposite direction, and in this respect differ from those species of *Aleyrodes* that have come under the observation of the writer.

This species becomes quite abundant on the guava at times, and when not parasitized becomes a nuisance. In November, 1910, it was causing noticeable blackening of the foliage at Santiago de las Vegas. The species is, however, heavily parasitized by a hymenopterous parasite and the red fungus (*Aschersonia aleyrodis*) which the writer found generally present on affected leaves. Prof. Patricio Cardin, for whom this species is named, sent the writer specimens in May, 1911, over 90% of which had been parasitized by a hymenopterous parasite. This is the species of white fly figured by Cook and Horne as an undetermined aleyrodid on guava (Pl. XV, fig. 41, Bull. 9. Estacion Central Agronomica de Cuba), and beyond doubt is that referred to in the Primer Informe Anual of the same station as "Guagua a mosca blanca de la guayabo." Cook and Horne (l. c., p 31), say that *Aleyrodes howardi* is the species referred to, but in this they are apparently mistaken, as the writer has not found *howardi* except very rarely on guava. While *howardi* was generally present on orange trees close by, this species was found only on guava.

DESCRIPTIVE REMARKS.

Pupa case.—Form elongate oval; length 0.896 mm.; width 0.616 mm. Dorsum with five pairs of large compound pores with reduced spinnerets (Pl. XXVII, fig. 3). Scattered on the surface of the dorsum are also found a number of minute clear areas, resembling pores. Dorsal margin entire; just within it all around is a row of large simple wax pores (Pl. XXVII, fig. 4). On the caudal extremity, opposite the two caudal compound pores, is a pair of large hairs. Along the margin all around and apparently on the ventral surface is a row of small spines, there being about nine to a side. A pair of small setæ is inserted just cephalad of the vasiform orifice. This orifice is subcordate in outline, with the cephalic margin straight. The operculum is almost rectangular in shape, with the caudal margin wavy. The lingula is somewhat spatulate, slightly exserted, and armed with four long hairs. Both operculum and lingula are setose.

The color is a light greenish brown.

Adult.—The adults are greenish yellow in color. The vertex is shaded on either side with dusky. The compound eyes are brownish-black and the ocelli clear and surrounded by a conspicuous Indian-red area. The thorax is marked with black, which is arranged in more or less broken transverse bands, which sometimes appear as mere spots. Abdomen generally unmarked. Vasiform orifice with the operculum and lingula blackish. Forewings (Pl. XXVII, fig. 5) shaded all over with dusky, giving the wing a smoky look excepting a line representing the cubitus, which is clear, unshaded. Near their tips the veins R_1, R_s, and M are somewhat swollen and clouded, and just at the radial fork below R_s there is a conspicuous dark spot.

The radial forks in the wing are very long, the length of R_s being half as long again as the distance between the radial fork and the insertion of the media. The antennæ are absent from the specimens at hand.

Male: Length 1.12 mm.; length of forewing 1.1 mm.; width 0.56 mm.; claspers (Pl. XXVII, fig. 9) 0.14 mm.; hind tibiæ 0.32 mm.; greatest width of genital segment 0.16 mm.

Female: Length 1.4 mm.; length of forewing 1.4 mm.; width 0.672 mm. Lingula of vasiform orifice very large, exserted, and rounded (Pl. XXVII, fig. 10).

Aleurodicus (Metaleurodicus) minimus Quaintance.

(Pl. XXVIII, figs. 1–10; Pl. XXIX, fig. 3.)

Aleurodicus minima Quaintance, Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 47 (1900).

ORIGINAL DESCRIPTION.

Pupa-case.—Size about 1.17 by 0.71 mm., subelliptical, many specimens are somewhat narrowed cephalad. Case usually widest across region of second abdominal segment. Color yellowish, varying to brownish. Empty case semi-transparent, except for the irregular brown coloration on margin, and at the dorsal pores. Margins slightly crenulated, with very shallow indentures between the lateral wax tubes. There is no marginal rim. Just within the margin, all around, is a closely set row of short disk-like tubercles or papillæ, from which is produced a fringe of almost straight, tapering, glassy waxen rods from one-third to one-half as long as pupa-case is wide. On the more central dorsal region a light mealy waxen exudation may occur. Pupa-case slightly raised from surface of leaf by vertical fringe of wax, which usually remains attached to leaf on removal of dried specimens. On the dorsum, nearer the margin than center, is a row on each side of seven round and well-defined compound pores. Considered transversely, these occur in pairs; a pair on cephalic segment; a pair on metathorax; three pairs along the abdominal segments, and two pairs in the region latero-caudad of the vasiform orifice. The caudal pair is somewhat the largest, with the cephalic pair next in size; the rest are subequal. These pores, individually, consist of a cylindrical, brownish-colored rim with a central, white, rod-like structure. On cephalic margin of case is a pair of setæ and a pair on the caudo-lateral region, a seta on each side. There is a pair of small, tubercled setæ just within caudal margin. Around the margin, just within the submarginal series of papillæ, is a row of small tubercled setæ, usually from 24 to 28 in all.

Vasiform orifice elongate-cordate; about three-fourths as broad as long; cephalic margin straight, caudal end bluntly rounded. Operculum subelliptical, cephalic margin straight, about one-third as long as orifice. Lingula usual, broad, extending quite to caudal end of orifice, bearing two pairs of setæ distally. On ventral surface, rudimentary feet and antennæ quite distinct.

Adult ♂.—Length, about 0.86 mm.; fore-wing, 1.1 by 0.52 mm.; length of hind tarsus, 0.21 mm.; length of hind tibia, 0.38 mm.; length of hind femur, 0.26 mm.; color, yellowish white, with dorsum of thorax brownish. Eyes reddish, undivided, though with a pronounced constriction. Joint 1 of antennæ short, not one-half the length of second. Joint 2, narrow at base, truncate at distal end, widest centrally. Joint 3 long, longer than remaining joints together, distal joint ending in an attenuated process, bearing a terminal seta. Anterior tarsus about three-fourths length of posterior. Distal tarsal joint of first pair legs two-thirds length of distal joint of mentum. Wings slightly clouded around margin and with a very dilute oblique transverse band centrally; at fork of distal branch of vein is a pronounced spot of brownish-black coloration, otherwise wings without spots. Margins of wings and the veins somewhat yellowish. Genitalia quite short for this genus; valves short and stout.

Adult ♀.—Unknown.

This species approaches in some particulars quite close to Cockerell's *iridescens*, but it is much smaller, and the pupa-case differs in several particulars. It is quite similar also to Shimer's *asarumis*. His description is so meager that it will hardly be possible to locate his species unless, peradventure, the type has been preserved.

Specimens received by the Division of Entomology at Washington, January 28, 1889, on "Guayaba," from A. Busck, Bayamon, Puerto Rico. Mr. Pergande remarks that quite a large number of the insects (pupæ?) had been killed by a very curious fungus. Div. Ent. No. 8422. Pupa-case described from numerous specimens; adult ♂ from two specimens.

Type.—No. 14769, U. S. National Museum.

Aleurodicus lacerdæ (Signoret).

Aleyrodes lacerdæ Signoret, Bul. Soc. Ent. France (6) vol. 8, p. lxiii (1883).

This species, from the preliminary description given by Signoret, appears to be an *Aleurodicus*. It is impossible, however, from his remarks to place it definitely. Cotypes are supposed to exist in this country, but so far we have been unable to locate them. We therefore place the species here and quote his description.

ORIGINAL DESCRIPTION.

J'ai l'honneur, par l'entremise de notre collègue M. L. Fairmaire, de faire passer sous les yeux de la Société des feuilles de l'*Anona sylvatica* couvertes d'une sécrétion d'aspect cotonneux, ressemblant à de l'amiante et qui m'ont été envoyées par M. Antonio de Lacerda. Cette sécrétion abundante est due à la réunion d'un grand nombre d'*Aleurodes* soit à l'état de larve, soit à l'état d'insecte parfait. J'indique les deux, car je pense que ces deux états contribuent à cet amas de sécrétion par l'examen même de la forme particulière des diverses lamelles; les unes présentent comme des rubans, les autres comme des filaments, d'autres enfin de simples fils. L'insecte parfait est du double plus grand que l'*Aleurodes chelidonii*, jaunâtre, aves des macules brunes sur le prothorax; l'abdomen, entièrement jaune dans le mâle, offre deux plaques d'aspect particulier dans la femelle, celle-ci présentant un amas cotonneux d'aspect nacré et de forme bilobé de chaque coté de l'abdomen et sécrété par les deux plaques rouges de l'extremité de l'abdomen. Devant donner une description complète de cette intéressante espèce, que je nommerai *A. lacerdæ*, je me contente de présenter aujourd'hui ces feuilles vraiment extraordinaires car si l'on connaît déjà des espéces du genre *Aleurodes* sécrétant des matières ne se sont présentées en aussi grande quantité.

[Translation.]

I have the honor, through the agency of our colleague, Mr. L. Fairmaire, of exhibiting to the Society some leaves of *Anona sylvatica* covered with a cottony secretion resembling amiantus and which have been sent to me by Mr. Antonio de Lacerda. This abundant secretion is due to the union of a large number of *Aleurodes*, either larvæ or adults. I mention the two, for I think from the examination of the peculiar form of the various wax plates that both states contribute to this mass of secretion; some of these appear like ribbons, others like filaments, and still others like simple threads. The mature insect is twice as large as *Aleurodes chelidonii*, yellowish, with brown maculations on the prothorax; the abdomen, entirely yellow in the male, shows, in the female, two peculiar looking plates; this presents on each side of the abdomen a bilobed cottony mass, pearly in appearance and secreted by the two red plates at the extremity of the abdomen. Before giving a complete description of this interesting species, which I will name *A. lacerdæ*, I am contenting myself in presenting to-day these really extraordinary leaves, for, although species of the genus *Aleurodes* which secrete such material are already known, they do not show it in such great abundance.

Aleurodicus phalænoides (Blanchard).

(Fig. 11.)

Aleurodes phalænoides Blanchard, in Gay's Historia Física de Chile, Zool., vol. 8. p. 319 (1852).

This insect, so far as we know, has not been observed since it was described in 1852, and the description is too meager to show definitely its position. The form and venation of the wing as shown in fig. 11 are, however, those of *Aleurodicus*. The vertex, on the contrary, appears to be that of *Dialeurodicus*. When rediscovered, therefore, the insect may prove to fall in a genus older than *Aleurodicus*, but for the present we place it in that genus and quote herewith the original description:

ORIGINAL DESCRIPTION.

A. tota testaceo-rufa, antennis pedibusque pallidoribus; elytris albis opacis fasciolis duabus interruptis maculaque apicis pallide fuscis; alis totis albis. Long. corp., 1 lin.; extens. alar., 3¼ lin.

Cuerpo enteramente de un testáceo bermejo y más ó menos salpicado de blanco. Elitros muy grandes, ópacos y adornados de dos fajas transversales interrumpidas en el medio y hacia la punta por una mancha alargada de un color moreno muy claro. Patas pálidas, lo mismo las antenas.

Este insecto es algo común en Santiago sobre las hojas del Parqui y principia á manifestarse en el mes de enero. Copiaremos aquí le que hemos notado en nuestro diario sobre este animalito.

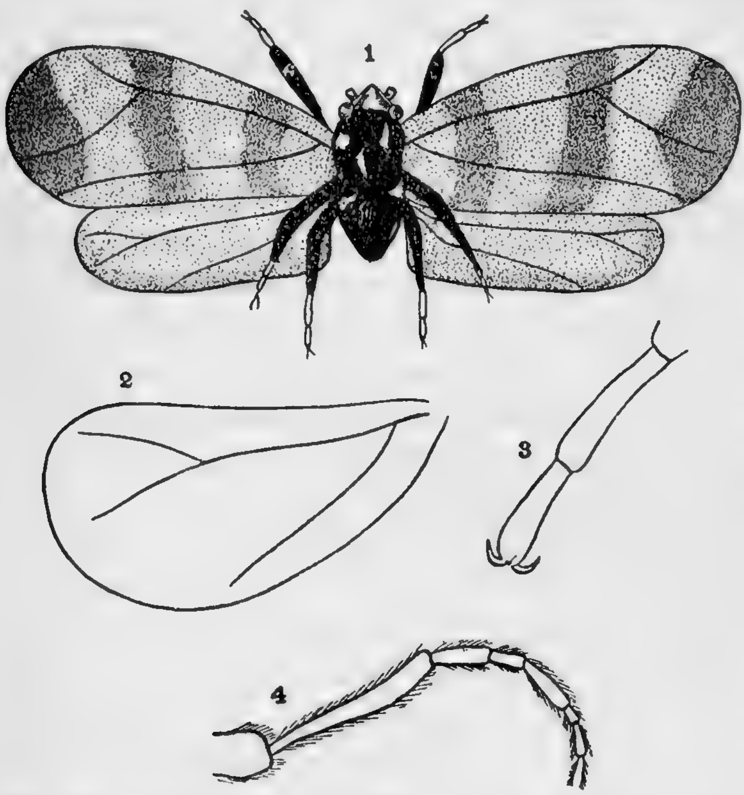


FIG. 11.—*Aleurodicus phalænoides: 1,* Adult insect; *2,* fore wing of adult; *3,* tarsus of adult; *4,* antenna of adult (Redrawn from Blanchard.)

En la parte inferior de las hojas nuevas del Parqui (Cestrum parqui), se observa una especie de mancha de un verde ligeramente azulenco sembrada de muchos huevecitos perfectamente separados unos de otros, de (p. 320) forma ovalar, de color de tierra, alcanzando apenas un dozavo de líneas de diámetro. Poco después estos huevos cambian de color, vuelvense negruzcos con puntitos blancos, y observados entonces con un lente de augmento se ve que con hembras adornadas con seis puntos dispuestos en dos filas, tres en cada una. Dichos puntos pequeños y algonados grendecen á la par del animal, primeramente extendiéndose del lado de la márgen que sobrepasan para formar una especie de membrana petañosa y recortada á modo de *Bissus* y en seguida hacia al centro, confundiéndose entonces uno con otro para dar lugar á una masa informe, blanquista, algodonada y sembrada de pequeñasgotitas de un licor azucarado, muy apeticido de las hormigas que las visitan con mucha frecuencia. Los machos, provistos de grandes alas, se mantienen quietos, ó si le mueven, cambian rara vez de hojas, pero meneando el arbusto, vuelan con precipitación y á poca distancia, por no poder sostener largo tiempo el vuelo. Paran principalmente debajo de las hojas y son bastante comunes en la estacion del verano.

[Translation.]

Body entirely of a brownish testaceous and more or less variegated with black. Elytra very large, white opaque, and ornamented with two transverse bands interrupted in the middle apically with a large spot of very clear yellow. Feet pallid, like the antennæ.

This insect is rather common in San Diego on the leaves of parqui (*Cestrum parqui*) and infests this plant principally during the month of January. We reproduce here what we have noted about this little animal in our diary.

On the lower portions of the leaves of parqui a peculiar kind of spot was observed of light iridescent green, covered with many perfect eggs separated from each other, of oval form, earth color, measuring about one-twelfth of a line in diameter. A little later these eggs changed color, becoming blackish with white points, and we then observed with a magnifying glass that they were females ornamented with six dots arranged in two series, three in each one. These little dots bearing cotton threads vary with the size of the animal, extend from the side of the margin which they pass beyond to form a reticulated membrane like that of *Bissus*, and after that run to the center, uniting there with each other to form an irregular mass, whitish, covered with cotton threads, and showing little drops of sweetish liquid very acceptable to the ants which visit them very frequently. The males, provided with large wings, are sedentary, for if they move they rarely leave the leaf, but on jarring the bush they fly precipitately a little distance, but are not able to sustain flight for a long time. They generally inhabit the underside of the leaf and are rather common in summer.

Genus **PARALEYRODES** Quaintance.

Forewing with the radial sector and a small rudiment of the media retained; cubitus sometimes faintly indicated by a fold; vertex rounded; antennæ of four segments, of which the third is the longest; claspers of male short and stout; penis bilobed; paronychium of the foot represented by a long stout spine. Pupa case with a number of large compound wax pores of the type illustrated in Plate XXX, fig. 3; vasiform orifice with a very long, setose, spatulate, exserted lingula, which is armed with four long spines. Size small.

Type, *perseæ* Quaintance.

This genus is the most specialized one in the subfamily and represents the greatest reduction in wings and antennal segments. The two species may be separated as follows:

Species of Paraleyrodes.

A. Wings unmarked; thorax of pupa case with two stellate structures on the caudal part; two anterior pairs of abdominal compound pores often reduced ---------- *urichii*

B. Wings shaded with dusky; thorax of pupa without stellate structures; anterior abdominal pores normal ---------- *perseæ*

Paraleyrodes perseæ (Quaintance).

(Plate XXX, figs. 1–9.)

Aleurodes perseæ Quaintance, Tech. Ser. 8, Bur. Ent., U. S. Dept. Agr., p. 32. (1900.)

Paraleyrodes (*Aleurodicus*) *perseæ*,[a] Tech. Ser. 12, Bur. Ent., U. S. Dept. Agr., p. 170. (1909.)

The description of the species originally published in 1909 follows:

Egg.—Elliptical, size about 0.24 mm. by 0.12 mm., with stalk unusually long; smoky in color, the shell smooth; eggs deposited promiscuously in the white, flocculent secretion of the adults.

Larva, first stage.—Size about 0.338 mm. by 0.18 mm., subelliptical, very slightly narrowed caudad; yellowish white, with more or less rectangular spots of orange in the abdominal regions, eye-spots reddish. There is a fringe all around of white wax; on the margin, cephalad of eyes, are six setæ, and on lateral margins of thoracic region are three on each side. On caudal margin are six setæ, the middle pair of which is considerably longer than others. On ventral surface, just within margin, all around, is a series of sparsely set, small, tubercled setæ. Legs and antennæ well developed. Vasiform orifice practically as in pupa-case.

Pupa-case.[b]—Size about 0.86 mm. by 0.53 mm. Subelliptical in shape, with slightly undulate outline. Color, under hand lens, yellowish brown; empty pupa-case colorless, very fragile, soon falling from the leaf. On the margin, all around, is a fringe of more or less curled, short, white wax ribbons, and over the case and adjacent leaf area are many fragments of white wax rods, of variable length, profusely produced from the seven pairs of dorsal compound pores, which are situated, a pair on cephalic end and six pairs on the abdominal segments, the cephalic two pairs of which are smaller and nearer the median line. The margin, or rim, of each compound pore is thickened, and from within the cup there arises a rather large, fluted, cylindrical tube, extending upward about one-half its length beyond the rim of cup. Within tube, at base, is a short conical elevation. The entire structure is brownish in color. Dorsum void of well-developed setæ, save a pair just within caudal margin. A pair of minute setæ occurs on margin near caudal end of case. There is, however, just within margin on case, all around, a row of brownish-colored, tubercled setæ. Vasiform orifice subcordate (fig. 35, *c*), about as long as wide. Cephalic margin straight, coinciding with cephalic margin of operculum. Operculum subrectangular, the lateral margins somewhat rounded; considerably wider than long and with caudal margin almost straight. Lingula relatively large,

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[a] Extended and corrected from Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 32 (1890).

[b] In the description of the waxy secretion, as originally given (l. c.), this was described as follows:

"There is a profuse dorsal exudation: First, a rather short, downward-curving fringe of pearly white wax, all around, arising from just within margin and curling outward and downward over margin to near surface of leaf. This fringe is hardly continuous but is more or less split apart into ribbons or bands. Second, more dorsally curving columns. These occur in a triangle, one on each side and one at end. These columns of white wax are about as high as pupa-case is wide. The pupa-case is almost obscured by this exudation, when viewed from above."

According to Doctor Morrill's observations the secretion, as above described, is abnormal to this species and is due to the effect of parasitism. Of many specimens examined by him, showing the secretion of this character, all were found to be parasitized; and, on the other hand, this type of secretion was never found on pupa-cases not attacked by parasites. The normal secretion therefore is as described in the text.

particularly distally, where it becomes broadly spatulate; longer than orifice, and bearing distally two pairs of setæ. Abdominal segments moderately distinct. Rudimentary feet and antennæ very evident.

Adult.—Body of living specimens buff or pinkish in color, marked with white. Wings whitish, but clouded with dusky. These are held almost flat along the dorsum, and do not meet along the middle line. A copious amount of flocculent white wax is secreted, which becomes scattered over the leaf surface, the sluggish adults resting in little depressions here and there in the waxy covering. Antennæ peculiar and apparently of but four joints, due to the evident coalescence into two joints of the ringed segments 3 to 7. In the forewing there is a single vein, as in *Aleyrodes*, with a rudimentary branch or fold near basal fifth and a very obscure rudimentary vein at very base of wing. Hind wings with but a single vein. Genitalia in male forcipate, penis bifurcate. Claws long and slender, with central spinous process. In female, length of body, 0.8 to 0.9 mm.; length of forewing, 0.8 to 0.9 mm.; width of forewing, 0.3 to 0.38 mm.; length of antenna, 0.38 to 0.45 mm.; length of hind tibia, 0.25 to 0.3 mm. Male proportionately smaller.

Food plants.—Orange, *Persea carolinensis*, persimmon (?), avocado pear. On orange this insect infests the older leaves, rarely or never occurring on the new growth as is the case with *Aleyrodes citri.*

Doctor Howard has given to the parasite of this species, reared by Doctor Morrill, the manuscript name *Encarsia variegatus.*

Type.—No. 14775, U. S. National Museum.

Paraleyrodes urichii n. sp.

(Pl. XXXI, figs. 1–10.)

Received May 25, 1911, from Dr. F. W. Urich, Trinidad. The host is a species of *Pithecolobium*, and there were also present on the leaves two undescribed species of *Aleyrodes*. *P. urichii* differs from *perseæ* in its larger size and in having clear white wings, whereas in the latter species these are clouded.

DESCRIPTION.

Pupa case.—About 0.73 mm. long by 0.51 mm. wide; regularly elliptical in outline. (Pl. XXXI, fig. 2). As seen on leaf under hand lens (parasitized specimens only are available), the dorsum is quite convex, and the case is prominently raised from the leaf by a vertical fringe all around of white wax. Dorsum of case covered by a layer of dirty white wax, through which the compound wax pores and body segments may be fairly discerned. From the compound wax pores are produced the usual brittle wax rods, though this type of secretion in the present species is evidently meager. From the margin of case all around is a fringe of white wax more or less broken up into bands or ribbons, extending outward and downward, nearly or quite touching the surface of the leaf.

Under the microscope the color of the nonparasitized individual is yellow. The empty case is colorless. Parasitized specimens appear darker.

Within the margin of dorsum of case all around is a series of spines, 12 or 13 on each side. Margin faintly crenulate (Pl. XXXI, fig. 5) though the marginal wax tubes are very obscure. On the dorsum are seven pairs of compound wax pores—one pair at cephalic end of case and six pairs on abdominal region. The two cephalic pairs of the abdominal series are about one-half the size of the others and nearer the median line; in these pores the cup is short, reaching scarcely above derm of case. The spinnerets occur in a circle at base of cup, and are not vertically extended into tubes as in many species of *Aleurodicus*. The central process is well developed and is broken up into some 8 or 10 separate rods (fig. 4). Mesad of each of the first and second pairs of abdominal wax pores is a group on each side of simple wax pores. Cephalad of each of the pores of the first pair of abdominal wax pores is an indistinctly stellate structure. These simple pores and stellate structure are discernible only in the colorless empty case.

Vasiform orifice (Pl. XXXI, fig. 3) broadly cordate, about as broad as long. Operculum about one-half length of orifice, broadly convex on caudal margin, the sides rounded. Lingula large, spatulate, partly exserted, bearing distally two pairs of spines, and minutely setose. On ventral surface rudimentary feet and antennæ very evident.

Adult female.—Body about 0.85 mm. long. Color yellow; legs and antennæ paler; wings white, unmarked (Pl. XXXI, figs. 6, 7). Forewing about 0.8 mm. long by 0.33 mm. wide; rudimentary media arising from R_s about basal one-sixth of length of wing. Length of hind tibia 0.3 mm.; tarsal joints of hind legs subequal in length, together measuring about 0.17 mm. Antennæ (Pl. XXXI, fig. 9) four-jointed, about 0.46 mm. long, joint III considerably exceeding joint IV in length. Claws (Pl. XXXI, fig. 10) long, slender, with spinous paronychium.

Male.—Not seen.

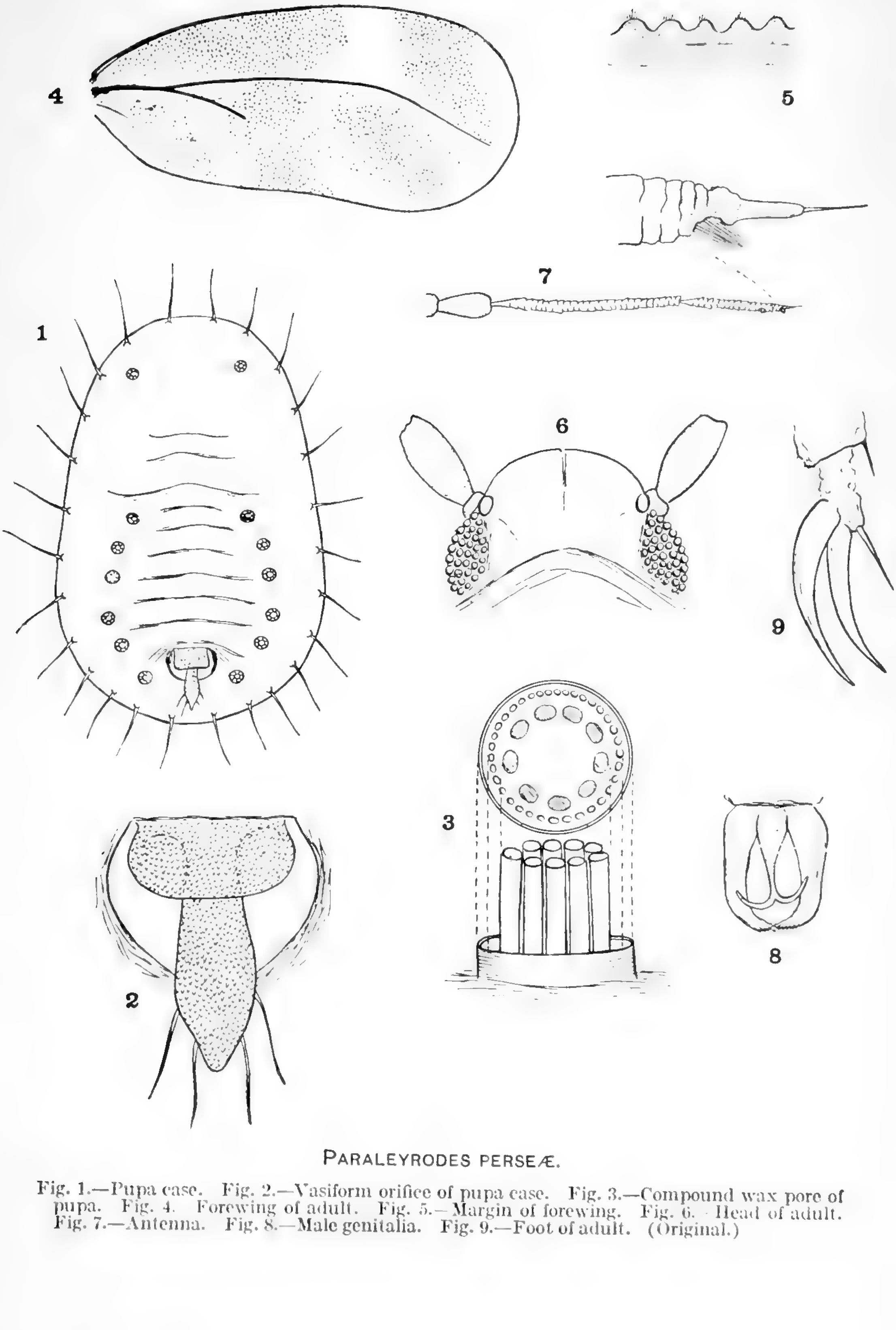
Type.—No. 14776, U. S. National Museum. Described from several parasitized pupæ on leaves, numerous normal and parasitized pupæ in balsam mounts, and several adult females in balsam mounts.

III. Subfamily Aleyrodinæ.

In the members of this subfamily the media of the forewing is lost, but the cubitus is retained as a distinct vein in most genera. The radial sector forms the main vein of the wing, and radius $_1$ may or may not be present. No compound pores are present in the pupa case, and the paronychium is broad and hairy.

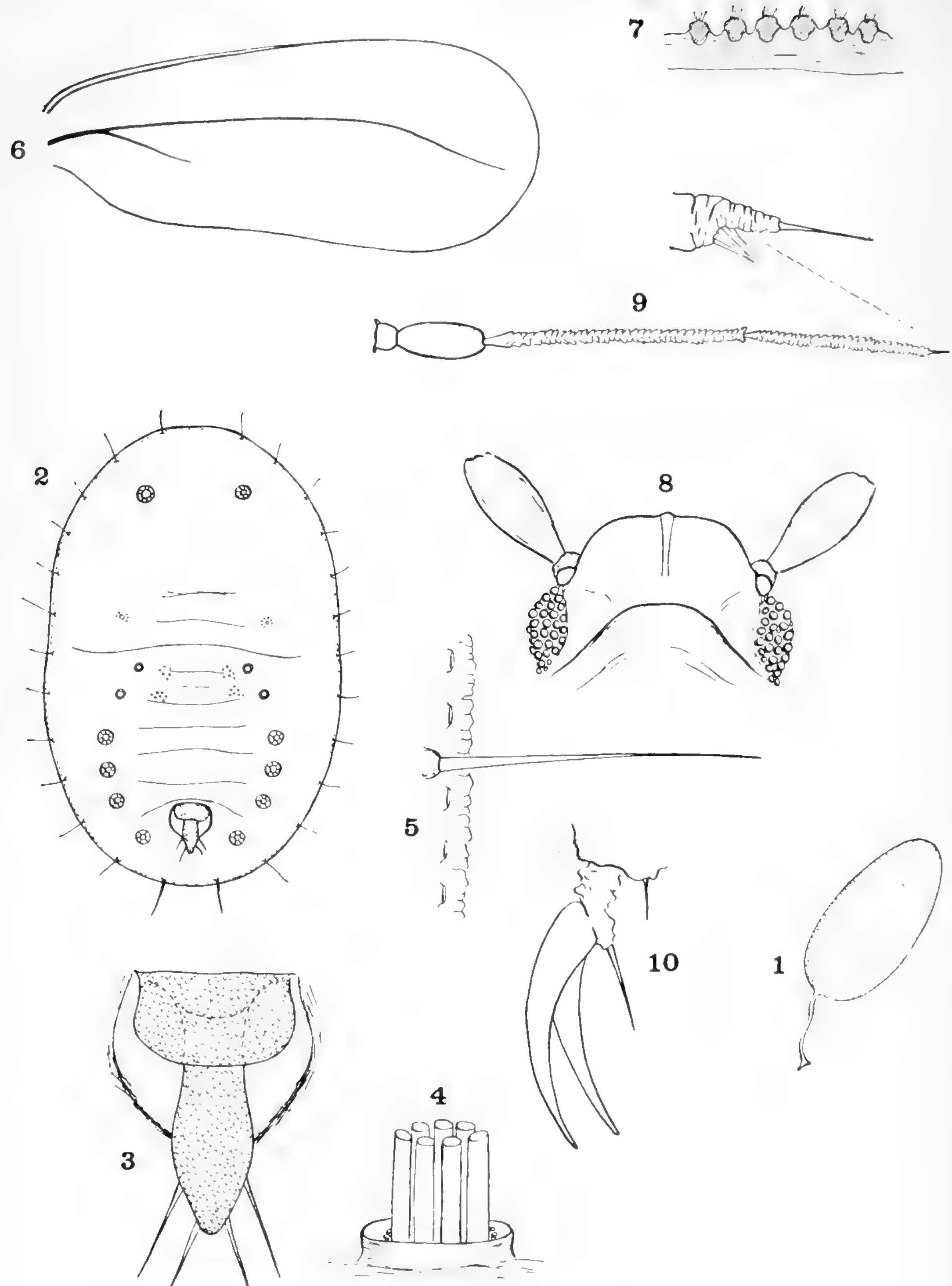
Genera of the Aleyrodinæ.

A. Forewing with radius $_1$, radial sector, and cubitus present----*Aleurochiton.*
B. Forewing with only radial sector and cubitus present----------*Aleyrodes.*
C. Forewing with only radial sector present--------------------*Neomaskellia.*



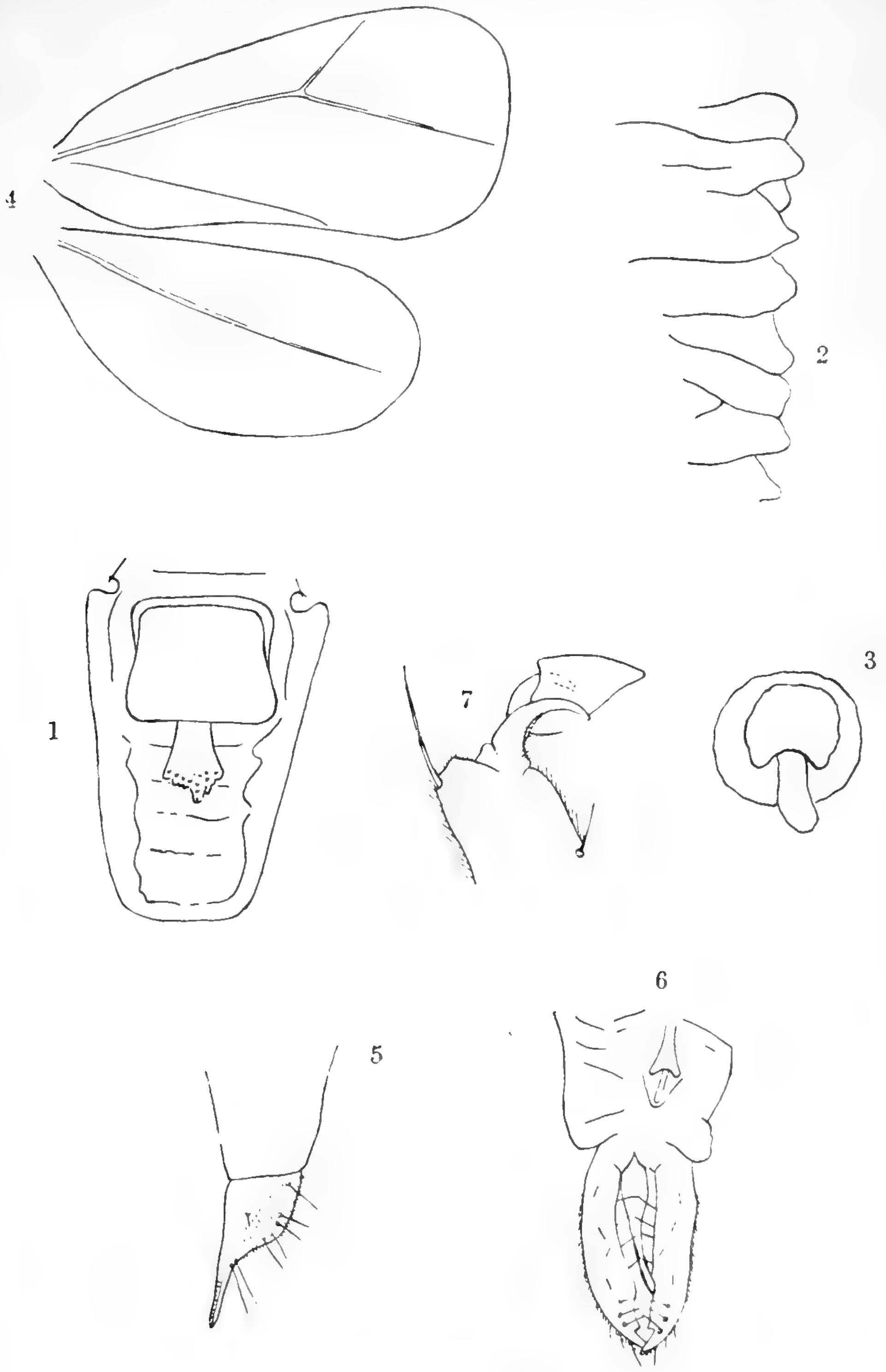
PARALEYRODES PERSEÆ.

Fig. 1.—Pupa case. Fig. 2.—Vasiform orifice of pupa case. Fig. 3.—Compound wax pore of pupa. Fig. 4. Forewing of adult. Fig. 5.—Margin of forewing. Fig. 6. Head of adult. Fig. 7.—Antenna. Fig. 8.—Male genitalia. Fig. 9.—Foot of adult. (Original.)



PARALEYRODES URICHII.

Fig. 1.—Egg. Fig. 2.—Pupa case. Fig. 3.—Vasiform orifice of pupa case. Fig. 4.—Compound wax pore of pupa case. Fig. 5.—Margin of case. Fig. 6.—Forewing of adult. Fig. 7.—Costal margin of forewing. Fig. 8.—Head of adult. Fig. 9.—Antenna of adult. (Original.)



ALEUROCHITON ACERIS.

Fig. 1.—Vasiform orifice of pupa case. Fig. 2.—Margin of case. Fig. 3.—Vasiform orifice of adult. Fig. 4.—Wings of adult. Fig. 5.—Female genitalia. Fig. 6.—Male genitalia. Fig. 7.—Claw. (Redrawn from Tullgren.)

Genus ALEUROCHITON Tullgren.

Forewing with radius $_1$, the radial sector, and the cubitus retained; vertex rounded; antennæ of seven segments, of which the third is the longest; claspers of male of medium length and thickness; paronychium very large and hairy. Pupa case with no compound pores, but the dorsum crowded with simple ones. Lingula of vasiform orifice short, setose, and included; orifice surrounded by a differentiated area.

Type, *aceris* Geoffroy.

This genus is the most primitive in the Aleyrodinæ, and from it no doubt *Aleyrodes* arose by the reduction of radius $_1$. It contains only two species, which may be separated as follows:

SPECIES OF THE GENUS ALEUROCHITON.

A. Paronychium in adult spatulate; vasiform orifice of pupa case large and subrectangular in outline .... *aceris.*

B. Paronychium in adult long, blade-like, and hairy; vasiform orifice of pupa case subcordate in outline .... *forbesii.*

Aleurochiton aceris (Geoffroy).

(Pl. XXXII, figs. 1–6.)

Chermes aceris ovatus Geoffroy, Hist. Abr. des Insectes, p. 509 (1764).
Aleurodes aceris Barensprung, Zeitschrift f. Zool., p. 176 (1849).
Aleurochiton aceris Tullgren, Ark. f. Zool., Bd. 3, No. 26, p. 15 (1907).

ORIGINAL DESCRIPTION.

Cette petite espèce est assez aplatie & ovale. Elle est d'un brun clair, & a dans son milieu une bande longitudinale brune foncée, aux deux côtés de laquelle sont des bandes de couleur blanche cendrée. Elle se trouve sur les feuilles de l'érable du côté du revers de la feuille.

Tullgren's description is the only complete one for this species that has appeared, and we quote it in full:

IMAGO.

Farbenzeichnung.—Die Exemplare, die dieser Untersuchung zu Grunde liegen, waren ein und halbes Jahr in Alkohol aufbewahrt. Sie sind alle einfarbig gelb, aber an der Spitze des Rostrums braunschwarz. Die Augen sind schwarzrot und die Flügel einfarbig weiss.

Morphologische Merkmale—Weibchen.—Länge 1.79 mm. Kopf ohne Mittelfurche, von der Seite gesehen 1½ mal so lang als breit. Augen lang und schmal nierenförmig, ungeteilt. Punktauge gross und deutlich, tangiert fast den Oberrand des Auges.

Die Antennen sind kürzer als Kopf und Thorax zusammengelegt. Das zweite Glied ist breit birnförmig, länger als das halbe dritte Glied. Dies ist 0.241 mm. lang; länger als die folgenden zusammen. Glied IV 0.048 mm., V 0.075 mm., VI 0.058 mm. und VII 0.051 mm. lang. Die Glieder III–VII sind alle fein querunzelig und kurz behaart. Das siebente Glied an der Spitze mit einem feinen, ziemlich langen Borstchen. Die Glieder III, V–VII, mit kleinen Geruchsorganen.

Rostrum 3-gliederig. Das dritte Glied doppelt so lang und ein wenig schmäler als das zweite. Alle Glieder fein behaart und mit einzelnen kurzen Börstchen.

Scutellum triangelförmig, mit Längsfurche.

Die Beine sind ziemlich lang. Tibia I, 0.46 mm., II, 0.53 mm., III, 0.75 mm. lang. Metatarsus I, 0.189 mm., II. 0.172 mm., III, 0.214 mm. lang. Die Glieder besonders fein behaart und mit mehr oder weniger distinkt reihenförmig geordneten Stacheln. Tibia III wie bei *Al. proletella, fragariæ* u. s. w. Klauen 2, kurz und so lang wie das Apikalborstchen des Tarsus. Das Paronychium gross, blatt- oder spatenförmig erweitert, fast doppelt so lang als die Klauen.

Flügel wie bei *Al. proletella* gerandet. Länge 2.2 mm., Breite 1.1 mm. Die Mittelrippe Gleich hinter der Mitte gegabelt. Die Rippenzweige erreichen den Flügelrand. Die Submedianrippe lang und fein. Die Mittelrippe der Hinterflügel vollkommen einfach.

Abdomen gross, oval. Die vier Ventralplatten feiner retikuliert als bei z. B. *Al. proletella.* Das Operculum der Analöffnung ebenso lang wie breit, am Hinterrande ausgerandet; die Lingula von der Länge des Operculums. Die Genitalanhänge scharf zugespitzt.

Männchen.—Die Analöffnung kleiner mit längerem, schmälerem und mehr ausgerandetem Operculum. Der Penis ist nur wenig aufgebogen. Die Genitalanhänge schwächer gebogen, am Ende klauenförmig zugespitzt und unter der Spitze mit einem kleinen, scharfen Zahn. Die Spitze trägt einige lange Börstchen.

Das *Puparium* gewölbt, eiförmig, am Vorderrande quer und am Hinterrande ein wenig ausgerandet. Die Rückenseite ist fast vollständig von einer weissen Wachskruste bekleidet. Nur die Analöffnung und zwei Flecken vorn sind immer nackt. In der Kruste sind auch feine Risse, die die Segmentgrenzen mehr oder weniger markieren. Wird die Kruste weggenommen, ist das Puparium braun, fein körnig und von einer unregelmässigen, netzförmigen Struktur, die von feinen, eingedrückten Linien verursacht wird. Die Segmentgrenzen sind nur längs der Mitte der Dorsalseite deutlich. Der Rand ist krenuliert. Längere und gröbere Börstchen fehlen vollständig. Dagegen sind eine Menge von kurzen und feinen Haaren über die ganzen Rückenfläche ausgestreut. Die Analöffnung liegt in einer langgestreckten, fast triangelförmigen Vertiefung. Das Operculum, das ziemlich stark gewölbt ist, ist ungefähr quadratisch. Die Lingula, die nur wenig sichtbar ist, ist an der Spitze breiter und mit feinen Zähnen bewaffnet. Ihr fehlen vollständig die langen für die Aleurodes Arten charackteristischen Börsten. Länge c. 1.7 mm., Breite c. 1.3 mm.

Entwickelte Tiere habe ich bei Släfringe in der Provinz Östergötland gefunden (2, VI; 1905); Puparia waren auf Ahornblättern auf dem Experimentalfelde bei Stockholm sehr allgemein (Nov. 1906).

[Translation.]

IMAGO.

Color.—The specimens which are here described had been preserved in alcohol for about a year and a half. Their color is entirely a uniform yellow. The end of the rostrum is brownish black. The compound eyes are blackish red, and the wings are of a uniform white color.

Morphological characteristics—Female.—Length 1.79 mm. Head without median suture; viewed from the side, one and one-half times as long as wide. Compound eyes long and reniform, not divided. Ocellus large and distinct, very nearly touching the upper margin of the compound eye.

The antennæ are shorter than the combined length of head and thorax. The second joint is broadly pyriform in shape; it exceeds in length the half of the third joint. The length of the third joint is 0.241 mm., longer than all the succeeding joints combined. Joint IV 0.048 mm.; joint V 0.75 mm.; joint VI 0.058 mm.; joint VII 0.051 mm. in length. Joints III–VII are all provided with fine crosswise wrinkles and with short hairs. The seventh joint is provided at its terminus with fine bristles that are rather long. Joints III, V–VII have small sensory organs.

Rostrum three-jointed. The third joint twice as long and a little more contracted than the second. All the joints provided with fine hairs and with short scattered bristles.

Scutellum triangular, provided with a longitudinal suture.

The legs are rather long. Tibia: Joint I 0.46 mm.; II 0.53 mm.; III 0.75 mm. in length. Metatarsus: Joint I 0.189 mm.; II 0.172 mm.; III 0.214 mm. in length. The joints provided with very fine hairs and with spines that are more or less distinctly arranged in rows. Third joint of the tibia more or less like that in *Aleurodes proletella*, *fragaria*, etc.; it has two claws, short and of the same length as the apical bristles of the tarsus. The paronychium is large, extended in spatulate or foliate shape, almost twice as long as the claws.

Wing bordered as in *Al. proletella.* Length 2.2 mm. Width 1.1 mm. The middle vein forked behind the middle. The main branch reaches the wing border. The submedian vein is long and delicate. The middle vein of the hind wing is unbranched.

Abdomen large, oval. The four ventral plates more finely reticulated than in *Aleurodes proletella.* The operculum of the anal aperture is as long as it is wide; its posterior margin sinuate. The lingula as long as the operculum. The genital appendages sharply pointed.

Male.—The anal aperture is smaller, the operculum is longer, more contracted, and more strongly sinuate. The penis is only slightly bent upward. The genital appendages are not so decidedly curved; their terminus is pointed with shape of a claw, and below the end there is a small sharp tooth. The terminus is provided with a few long bristles.

The puparium is arched, oval, slightly sinuate at the posterior margin, and also sinuate across the anterior margin. The dorsal side is almost completely covered with a white waxy crust. Only the anal aperture and two spots near the anterior margin are always naked. There are fine rents in the waxy crust, which more or less define the limits of the segments. If the crust is removed, the puparium appears brown, fine grained, and of an irregular reticulated structure, which is caused by fine lines that are impressed on the body. The limits of the segments are distinguishable only along the middle of the dorsal side. The margin is crenulate. There are no long and robust bristles present. On the other hand, there is a great number of short fine hairs scattered over the whole surface of the dorsum. The anal aperture lies in a long, extended, almost triangular pit. The operculum is strongly arched and approximately rectangular. The lingula is scarcely visible, broadening out at the end, and provided with fine teeth. The long bristles which are characteristic of the various species of Aleurodidæ are entirely wanting in this case. Length approximately 1.7 mm., width about 1.3 mm.

I have found adult specimens of this insect at Slafringe in the Province of Ostergotland, Sweden (June 2, 1905). Puparia were very common on the maple leaves of the experimental field near Stockholm (Nov., 1906).

Aleurochiton forbesii (Ashmead).

(Pl. XXXIII, figs. 1–9.)

Aleurodes acceris Forbes, 14th Rept. Ill. State Ent., p. 110 (1884); Bul. 45, U. S. Nat. Mus., p. 294 (1893).

ORIGINAL DESCRIPTION.

I have noticed for several years, a peculiar bark louse upon the leaves of the maple, but have not bred it until the present year. The fully developed pupal scale is oval in general outline, somewhat lyrate, broadest posteriorly, contracted in front of the middle. Margins entire, surface densely granulated. The color is chocolate, mottled with white, the white varying in amount and tending to form three transverse bands. The central segmented area is usually irregularly mottled with white, and a quadrate patch, including the vent, is almost always brown; but, otherwise, the color may vary from nearly uniform brown to almost white. Outline sometimes slightly emarginate posteriorly. Length, .095 of an inch; greatest width, .045; width at anterior fourth, .036.

The imago is pale yellow throughout; legs and abdomen pale; wings milky white; rostrum black at the extreme tip; veins yellowish; first joint of the antennæ scarcely longer than wide, the remaining joints filiform, the second nearly as long as the four following and about four times as long as the first, the fourth longer than the third, the third and fifth about equal, the sixth fusiform.

At Tamaroa, in southern Illinois, soft maple trees were found badly infested by this bark louse, but elsewhere it has occurred in only trivial numbers. There are apparently two broods of this species in a year, scales collected in August, 1883, emerging April 10 to 24, 1884, and others, collected during the present summer, emerging August 4. From these larvæ several hymenopterous parasites belonging to the genus *Elaptus* escaped September 6, the species of which is apparently new.

Elaptus aleurodis, n. s. Plate XI, fig. 6. Female. Length .03 of an inch; the head .005 inch; front wings .032 of an inch long and .001 inch wide; posterior wings .0032 inch wide at the widest point; antennæ as long as the head and whole body; scape stout, arcuate, rising to the top of the head, about as long as the three following joints, nearly smooth, as is also the second joint; remaining joints densely pilose; the club not jointed, as long as the three joints preceding; first joint obconic, second about the same length but narrower. Color black, surface shining, abdomen alutaceous, head and thorax punctured, antennæ yellow, legs entirely yellow, femora and tibiæ of the middle and posterior legs black, their tarsi yellow.

Described from three specimens bred from *Aleurodes aceris*.

In 1893, Dr. W. H. Ashmead pointed out (Bul. 45, U. S. Nat. Mus., p. 294) that Forbes's name was preoccupied by *aceris* Geoffroy, a European species, and proposed for this species the name *forbesii.*

In his excellent paper "Uber einige Arten der Familia Aleurodidæ" (Arkiv fur Zoologi, Bd. 3, No. 26, p. 15, 1907), Dr. Tullgren has shown that the European species (*aceris* Geoffroy) really represents a new genus, for which he proposed the name *Aleurochiton.* The general similarity of the pupa case of *forbesii* to that of *aceris* suggested that the two forms were closely related if not identical, which supposition was the more strengthened for the reason that they have similar food plants. Although *forbesii* is fairly common on maple in the eastern United States, it is only recently that we have had opportunity to examine the adults of this insect. During the summer of 1910, Dr. C. W. Hooker secured the adults in some numbers at Cranmoor, Wis., and also the following season, at Vienna, Va. Our species proves to belong to *Aleurochiton*, but appears to be distinct from *aceris* Geoffroy, as will be seen from the description which follows:

Aleurochiton forbesii is fairly common on *Acer rubrum*, *A. saccharinum*, and *A. dasycarpum*, ranging from Georgia to New York, north into Canada and west to Wisconsin, Illinois, and Missouri. So far as we are aware the insect has never been so abundant as to cause injury to its host plants. The European member of the genus, however, has recently attracted attention by its injuries as shown by Mr. Max Wolf in a lengthy article "Ein Beitrag zur Kentniss von *Aleurochition aceris* Geoffroy," etc., in "Centrallblatt fur Bakter, Parasiten Kunde, U. Infektions Krankheiten, Bd. 26, April, Zweite Abteilung, 1910, page 643.

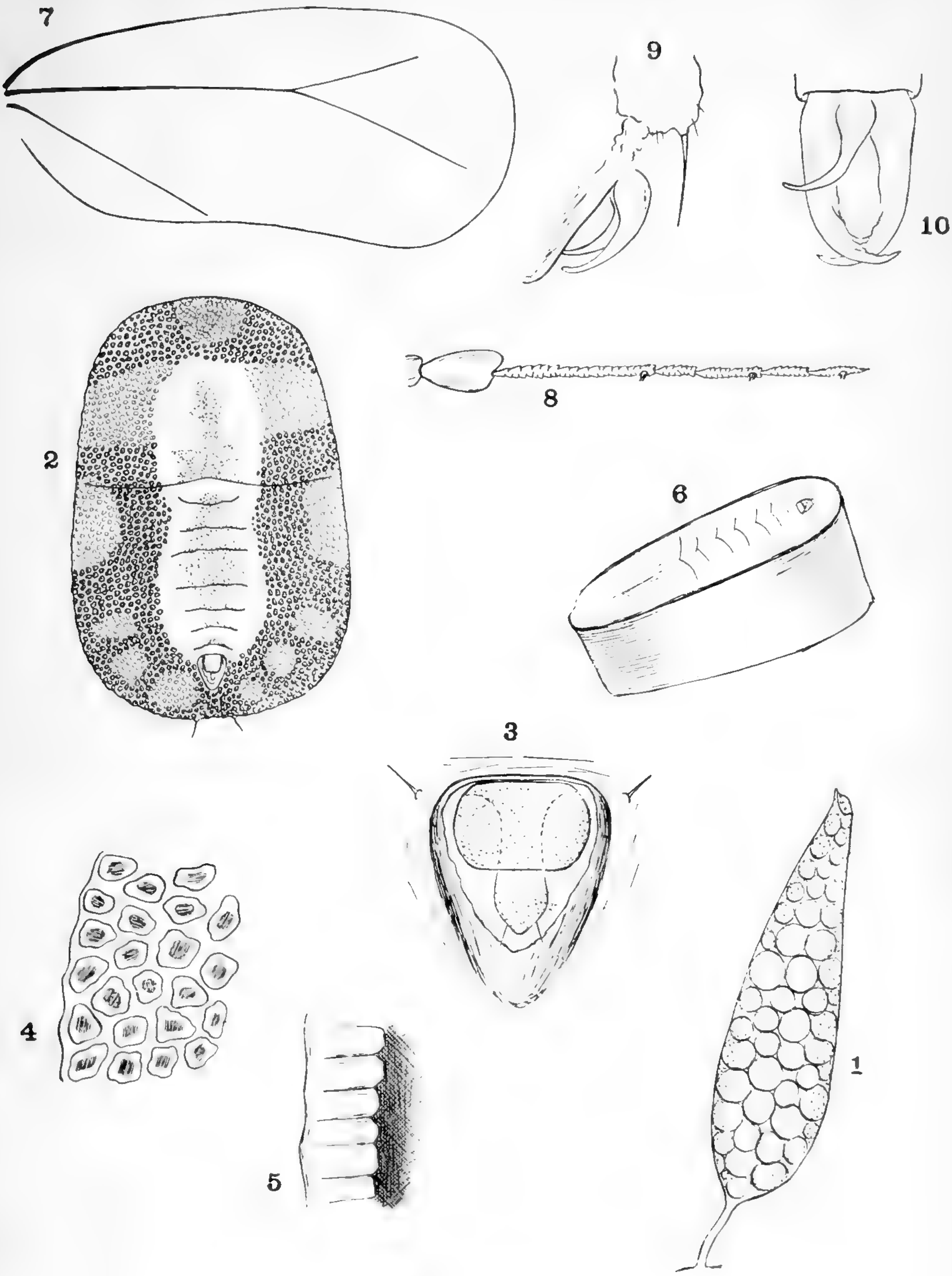
DESCRIPTIVE REMARKS.

Egg.—Length about 0.24 mm. exclusive of stalk. Fusiform in shape, not quite one-third as wide as long; stalk about one-fourth length of egg. Color white, without markings, though the globular contents are plainly visible: stalk dark brown, attached a little to one side.

Pupa case.—Size about 1.45 by 1 mm.; seen from above ovoid in outline, narrower cephalad, the dorsum almost flat; vasiform orifice depressed. Case raised on a relatively high vertical fringe of dirty white wax, which varies in height according to age, in mature specimens reaching as high as two-thirds diameter of case (Pl. XXXIII, figs. 2 and 6). Dorsum covered with a plate of dirty white wax of a granular structure, the vasiform orifice being naked and the body segments more or less evident. There is a shallow and broad longitudinal depression in the wax plate, with an evident central keel. Denuded of wax plate, and examined under microscope, the outer third of dorsum all around is seen to be of a coarsely granular structure, which is absent on the more central dorsal disk. (Pl. XXXIII, fig. 4.) The granular structures or markings in the derm vary greatly in size and outline, and are apparently wax-secreting in function. Margin of case deflexed (Pl. XXXIII, fig. 5), ending in a rim all around of large wax tubes, which may be seen through the derm above; apparent margin of case crenulate, due to granulations above mentioned; on caudal margin there are three pairs of spines of which the central pair is strongest; color variable. Mature specimens in the fall are generally dark brown and blackish, with large, irregular, semitransparent spots in the derm, usually three on caudal end, three on cephalic end, and one on each side. There is also usually a similar spot just cephalad of vasiform orifice, and one on the first and second abdominal segments near median line. In the latitude of Washington, and probably elsewhere, there are two broods of pupæ each season; the insect winters in the pupal condition on the fallen leaves. Pupæ of the first or early summer brood are almost colorless and do not show the dark coloration above mentioned.

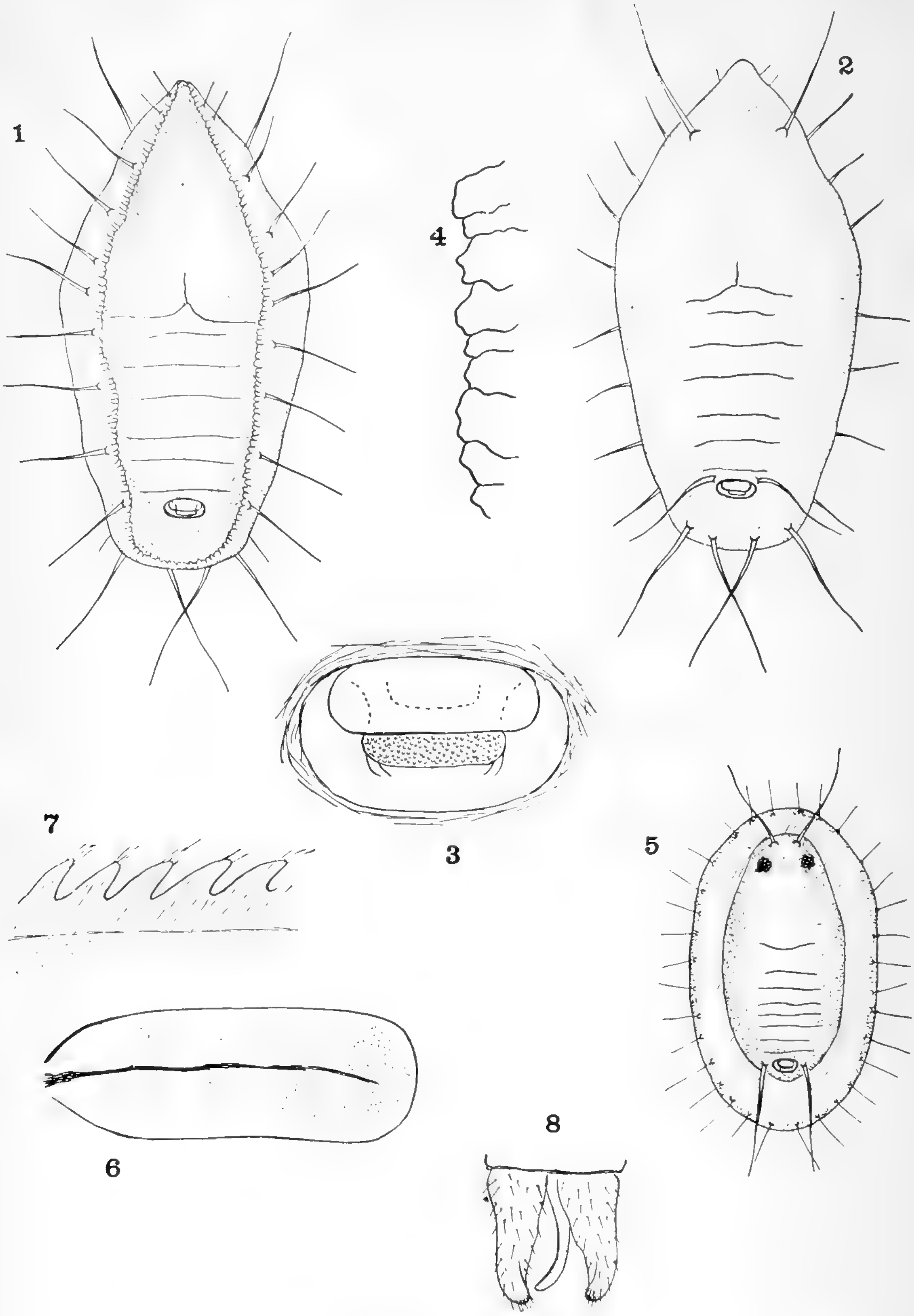
Vasiform orifice (Pl. XXXIII, fig. 3) small, cordate, not quite as wide as long; sides and caudal margin rounded; lingula not extended beyond orifice, spatulate, the basal portion unusually thick and stout, minutely setose, and bearing distally a pair of spines. Extending caudad to margin of case from orifice is a broad and widening depression or furrow. On ventral surface the stubby, rudimentary legs are easily discernible; they are two-jointed, disk-like at tips.

Adult (*female*).—Length about 1.5 mm.; length of forewing (Pl. XXXIII, fig. 7) 1.7 mm.; width 0.8 to 0.9 mm.; length of hind tibia 0.66 mm.; length of basal tarsal joint 0.15 mm.; length of distal tarsal joint 0.107 mm.; antenna (fig. 8) 0.42 mm. long; third joint 0.16 mm. long; joints IV to VII inclusive 0.2 mm. in length; joint II subpyri-



ALEUROCHITON FORBESII.

Fig. 1.—Egg. Fig. 2.—Pupa case. Fig. 3.—Vasiform orifice of pupa case. Fig. 4.—Margin of case and edge of dorsum. Fig. 5.—Margin of case, ventral view. Fig. 6.—Pupa case, showing box-like nature. Fig. 7.—Forewing of adult. Fig. 8.—Antenna. Fig. 9.—Foot of adult. Fig. 10.—Male genitalia. (Original.)



NEOMASKELLIA COMATA.

Fig. 1.—Pupa case, dorsal view. Fig. 2.—Same, ventral view. Fig. 3.—Vasiform orifice of pupa case. Fig. 4.—Margin of pupa case. Fig. 5.—Larva. Fig. 6.—Forewing of adult. Fig. 7.—Costal margin of forewing. Fig. 8.—Male genitalia. (Original.)

form; joints III to VII slender, numerously ringed; joints IV and VI, and V and VII subequal in length; compound eyes reniform; large ocellus almost touching the compound eye near its upper margin.

General color of body yellow; legs and antennæ paler; wings white, unmarked; venation typical for *Aleurochiton;* abdomen of gravid females large, distended with equally developed eggs, as many as 50 having been counted in one instance.

The so-called paronychium (Pl. XXXIII, fig 9) is blade-like, considerably longer than claws, and fringed on lower edge with hairs. In *aceris* this structure is spatulate and almost twice length of claws.

Adult (*male*).—A single specimen only of this sex is at hand; general structure as in female; genitalia forcipate (Pl. XXXIII, fig. 10), the valves rather short and stout, strongly curved at tip; penis enlarged at base and strongly curved.

Described from numerous pupæ on leaves, and pupæ, adult females, and one male in balsam mounts.

Genus **ALEYRODES** Latreille.

Forewing with radial sector and cubitus retained and a very small rudiment of the media rarely present (Pl. I, fig. 11); antennæ variable, of seven segments, sometimes the third longest, sometimes the seventh; vertex rounded; paronychium of moderate length and hairy; claspers of the male usually short and thick. Pupa case with no compound pores, but with or without simple pores variously arranged; orifice variable, showing several different types.

Type, *proletella* Linné. This genus is the original one and upon it the family was erected. At present a great variety of forms are here included which, when carefully studied, will no doubt, as previously mentioned, necessitate the breaking up of the genus.

Genus **NEOMASKELLIA** n. gen.

Forewing with radial sector only present; antennæ of seven segments, of which the third is the longest; claspers of the male short, very hairy, and psyllid-like. Pupa case without compound wax pores and apparently few simple ones, but with numerous prominent spines; vasiform orifice of pupa case short, broad, and included.

Type, *comata* Maskell.

This genus is erected to include a species with the most reduced wing venation known in the family and with the claspers of male somewhat more primitive than the usual type. It would appear to be an early offshoot from the *Aleurochiton* branch.

Neomaskellia comata (Maskell).

(Pl. XXXIV, figs. 1–8.)

Aleurodes comata Maskell, Trans. New Zealand Inst., vol. 28, p. 426 (1895).

Among Maskell's types are examples of the species described by him as *Aleurodes comata*. In examining these we find the species very different from other *Aleyrodes* and therefore describe and figure it in this connection. Maskell's original description is as follows:

ORIGINAL DESCRIPTION.

Eggs yellowish-brown, elliptical; length about 1/130 in.; peduncle rather short.

Larva yellow, somewhat thick, flattish, regularly elliptical; length about 1/55 in. Dorsum bearing four longish fine hairs, of which two are on the cephalic region and two close to the vasiform orifice. Margin entire, not thickened, bearing a row of rather long, strong hairs, sixteen on each side, and two shorter ones at the abdominal extremity. Rudimentary eyes dark-red, tubercular, may be made out. Vasiform orifice broad, short, subelliptical; operculum short, transversely divided; lingula obsolete.

Pupa-case yellow; elliptical; length about 1/25 in. The dorsal four hairs as in the larva, and there is usually a small quantity of dorsal white meal. Abdominal segments indistinct. Margin with wide shallow crenulations; marginal hairs as in the larva. Vasiform orifice, operculum, and lingula as in the larva. On turning over the pupa-case the rudimentary feet, antennæ, &c., are clearly visible.

Adult of general normal form; length of body about 1/30 in. Head and thorax dark-yellow. Abdomen lighter yellow. Genitalia brown. Wings narrow, grey; nervure straight; the basal branch very short, almost obsolete; margins of wings minutely serratulate, each serration bearing a minute spine; on the anterior edge of the hind wing are four very fine hairs. The fore-wing bears four faint brownish patches difficult to distinguish; they form almost two transverse bands, but do not seem to meet at the nervure. Genitalia of male and female normal; each arm of the forceps of the male bears a few short hairs.

Hab. in Fiji, on a gramineous plant unknown to me. My specimens were sent by Mr. R. L. Holmes.

"This species may be distinguished by the marginal and dorsal hairs of the larva and pupa. Something similar may be seen in *A. citri*, Riley and Howard, as figured in Insect Life, 1893, p. 219, but that species has four cephalic and four posterior long dorsal hairs; its wings are immaculate, and the adult male bears remarkable tufts of wax on the abdomen; the serrations of the wing margins are also different."

DESCRIPTIVE REMARKS.

The larva (Pl. XXXIV, fig. 5) is sufficiently characterized by Maskell.

Pupa case.—Size 0.88 mm. by 0.4 mm. Elongate oval, with attenuated cephalic portion (Pl. XXXIV, figs. 1, 2). Edge of the case deflexed and armed with sixteen long spines and two pairs of small cephalic ones. Margin irregularly crenulate or dentate (Pl.

XXXIV, fig. 4). Dorsum armed with four pairs of very long spines, one pair on cephalic portion, one pair inserted before the vasiform orifice, and two pairs near the caudal margin. Vasiform orifice elliptical and transverse. Operculum of the shape indicated in Plate XXXIV, figure 3, its greatest width being 0.03 mm. The exposed portion of the lingula is short, setose, and armed with two pairs of spines.

Adult male.—The type slides of this species are dissections and of the adults only the wings and claspers are represented. The forewing (Pl. XXXIV, fig. 6) is 0.68 mm. long and 0.24 mm. wide, and is of almost an equal width throughout. The radial sector only is present, and it is irregularly thickened. Maskell figures another vein in the wing, but in the types it does not exist and the wing is also of a different form from other species in *Aleyrodes*. The costal margin is armed with curved teeth on which are small hairs (Pl. XXXIV, fig. 7). The claspers (Pl. XXXIV, fig. 8) are unique. They are short, thick, hairy, and psyllid-like. The penis is almost equal in length to the claspers and slightly curved.

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7. Notes on some *Aleyrodes* from Massachusetts, with description of new species. (*a*) Psyche, April, 1903. (*b*) Tech. Bul. No. 1, Mass. Agr. Exp. Sta., pp. 31–33 (1903).
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21. Tech. Ser. 8, Bur. Ent., U. S. Dept. Agr. (1900).

TECHNICAL SERIES, NO. 27, PART II.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY.
L. O. HOWARD, Entomologist and Chief of Bureau.

CLASSIFICATION OF THE ALEYRODIDÆ.

PART II.

BY

A. L. QUAINTANCE,
In Charge of Deciduous Fruit Insect Investigations,

AND

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CONTENTS.

ILLUSTRATIONS.

PLATES.

CLASSIFICATION OF THE ALEYRODIDÆ—PART II.

INTRODUCTION.

The present paper deals with the subfamily Aleyrodinæ and, with Part I, completes the classification of the family. It has not been feasible to treat at this time the species of this subfamily in the manner followed in Part I. Monographic reports of the respective genera of the Aleyrodinæ are, however, now under way and will be issued as rapidly as practicable.

Students of the Aleyrodidæ are well aware that the original and typical genus *Aleyrodes* had come to include a rather heterogeneous assemblage of forms. This fact was indicated some years ago by Prof. T. D. A. Cockerell in his paper, "Classification of the Aleyrodidæ,"[1] in which several subgenera were proposed, as *Dialeurodes*, *Tetraleurodes*, etc. From the writers' studies of these insects it appears to them that *Aleyrodes* Latreille should be restricted to those species essentially like *proletella* L., the type species, and that other genera should be erected to include the remaining forms. This they have attempted to do, as set forth in the following pages.

Unfortunately the Aleyrodidæ are as yet largely known only from the pupal stage, a condition due to their mode of life. A comprehensive classification based on the study of the adults would not, therefore, be possible for many years to come. In the generic diagnoses given herewith it has been necessary to place importance on the characters of the so-called pupa case, as has long been the practice in describing species of this family. In the majority of the genera proposed the adult stage of one or more species, however, is known, and so far as data at hand indicate, adult characters confirm the grouping of species followed, as based on the characters of the pupa case.

The writers regret that there should be so many species (14 in number) which they are unable to assign satisfactorily to any genus by reason of inadequate descriptions, or failure of authors to describe in sufficient detail those characters of most value in generic determinations. It is much to be desired that descriptions of Aleyrodidæ be made as complete and full as possible.

It should be added that careful examinations have been made of the types or cotypes of species described by Maskell, Bemis, Quaintance, Britton, Morrill, Back, Kuwana, and Kotinsky, and of most of those described by Cockerell.

[1] Proc. Acad. Nat. Sci., Phila., p. 279 (1902).

GENERA OF THE ALEYRODINÆ.

I. Forewing of adult with radius$_1$ present as a distinct vein .... *Aleurochiton.*
II. Forewing of adult without radius$_1$.
A. Pupa case without a submarginal row of papilla-like pores, and with dorsal disk not separated from submarginal area.
1. Pupa case with thoracic tracheal folds present.
a. Thoracic tracheal folds ending on or near the margin in a more or less circular pore.
(1) Vasiform orifice relatively small and roundly subcordate, operculum almost filling orifice and obscuring lingula .... *Dialeurodes.*
b. Thoracic tracheal folds ending in a comb of teeth.
(1) Vasiform orifice relatively small and transversely rounded, the operculum almost entirely filling it ..... *Aleuroplatus.*
(2) Vasiform orifice subcordate, acute caudad, the operculum filling about two-thirds of orifice and leaving caudal portion of lingula exposed .... *Dialeurodoides.*
2. Pupa case with thoracic tracheal folds not evident.
a. Vasiform orifice situated in a pit or depression which is usually transversely ribbed or furrowed.
(1) Operculum transversely rectangular, small, the knobbed extremity of the lingula visible caudad of it ..... *Pealius.*
b. Vasiform orifice not situated in a pit.
(1) Vasiform orifice triangular, very elongate, operculum small and transversely elliptical, lingula long and visible for fully half its length caudad of operculum .... *Bemisia.*
(2) Vasiform orifice subcordate, with cephalic margin straight.
(*a*) Adults with antennæ of seven segments, of which III is the longest, IV–VII being subequal ... *Aleyrodes.*
(*b*) Adults with antennæ of seven segments, of which VII (in male) is much the longest, being as long as the remaining ones together .... *Aleurocybotus.*
(3) Vasiform orifice small, roundly subcordate, or subcircular.
(*a*) Lingula long and distally knobbed, extending caudad from orifice for one-third to one-half of its length. *Aleurotulus.*
(*b*) Lingula short and obscured by the operculum, which almost entirely fills the orifice.
* Dorsum with several series of prominent spines; margin with very distinct teeth .. *Aleurocanthus.*
* Dorsum without such series of prominent spines.
** Dorsum with a central ridge or trachea-like elevation, the orifice situated on its caudal extremity; margin with a double series of teeth, the outer series lighter in color than the inner. Wax not abundant. *Aleurotrachelus.*
** Dorsum without such a central trachea-like structure, but usually with several pairs of prominent spine-like hairs. Wax secretion very abundant, flocculent, or woolly. *Aleurothrixus.*
(4) Vasiform orifice transversely rectangular; operculum similar, very short; lingula broad and short, truncate caudad. *Neomaskellia.*

B. Pupa case with a submarginal row of papilla-like pores and with the dorsal disk not separated from the submarginal area.
   1. Vasiform orifice subcordate, with anterior margin straight.
      a. Thoracic folds visible and ending in a comb of teeth; operculum nearly filling the orifice and obscuring the lingula. *Aleuroparadoxus.*
      b. Thoracic tracheal folds not distinct; lingula visible caudad of operculum, lobed.................................*Asterochiton.*

C. Pupa case usually without a row of submarginal papillæ and with the dorsal disk distinctly separated from the submarginal area by a suture-like line or depression.
   1. Dorsum covered with a large number of mammiform pores..*Aleurotithius.*
   2. Dorsum without large mammiform pores.
      a. Vasiform orifice rounded or cordate, elevated, and not surrounded by a lobed or palmate area......................*Tetraleurodes.*
      b. Vasiform orifice subcordate, surrounded by a definite lobed area with a channel extending caudad.................*Aleurolobus.*

Genus DIALEURODES (Cockerell) n. gen.

(Pl. XXXV, figs. 1–14; Pl. XLVI, fig. 1.)

Pupa case variable in size, elliptic to subcircular in outline; color usually yellowish, varying in some species to brownish; margin of case toothed, the wax tubes irregular in outline and but little developed; submarginal area not separated from dorsal disk; dorsum without papillæ or pores; tracheal folds evident, in some species very conspicuous, terminating on margin of case in a pore, the folds often showing dotlike, linear, or polygonal markings; wax secretion absent or very scant. Vasiform orifice relatively small, transversely oval or subcircular, with or without comb of teeth on inner lateral and caudal margins; operculum large, mostly filling the orifice and obscuring the lingula.

Adult with one flexure in radial sector of forewing and no trace of media. Antennæ of seven segments, sègment VII not distinctly shorter than segments IV, V, and VI, but usually longer than these. Sexes about equal in size, the claspers of male with a few prominent spines.

Type, *citri* Riley and Howard.

SPECIES OF THE GENUS DIALEURODES.

D. citri (Riley and Howard), Insect Life, vol. 5, p. 219 (1893). (Southern United States; Chile (?); China; India; Japan, etc.)
   Syn.: *aurantii* Maskell.

D. citrifolii (Morgan), Spec. Bul. La. Agr. Exp. Sta., p. 70 (1893). (Southern United States; Cuba; Mexico.)
   Syn.: *nubifera* Berger.

D. eugeniæ (Maskell), Trans. New Zealand Inst., vol. 28, p. 430 (1895). (India.)

D. fijiensis (Kotinsky), Bul. 2, Div. Ent., Board Comm. Agr. & Forestry, Hawaii, p. 100 (1907). (Fiji.)

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D. struthanthi (Hempel), Ann. Mag. Nat. Hist. (7), vol. 7, p. 387 (1901). (Brazil.)
D. tokyonis (Kuwana), Pomona Journ. Ent., vol. 3, no. 4, p. 622 (1911). (Japan.)

Genus ALEUROPLATUS n. gen.

(Pl. XXXVI, figs. 1–6.)

Pupa case usually flat, medium to large in size, oval to subcircular in outline, often notched on cephalo-lateral margins; color yellowish, or more usually dark brown to blackish, many species variously dotted with darker markings; margin toothed, wax tubes moderately developed, incisions shallow; submarginal area not separated from dorsal disk; dorsum without prominent pores or papillæ, though some species show many minute porelike structures; thoracic tracheal folds evident, terminating on margin of case in a comb of teeth from which may arise pencils of wax, differing in color from the more or less amorphous wax surrounding the case and secreted by the marginal wax tubes. Vasiform orifice small, transversely rounded and almost filled by the operculum, which hides the lingula.

Adult with radial sector of forewing showing a single flexure; no spur of media.

Type, *quercus-aquaticæ* Quaintance.

Species of the Genus Aleuroplatus.

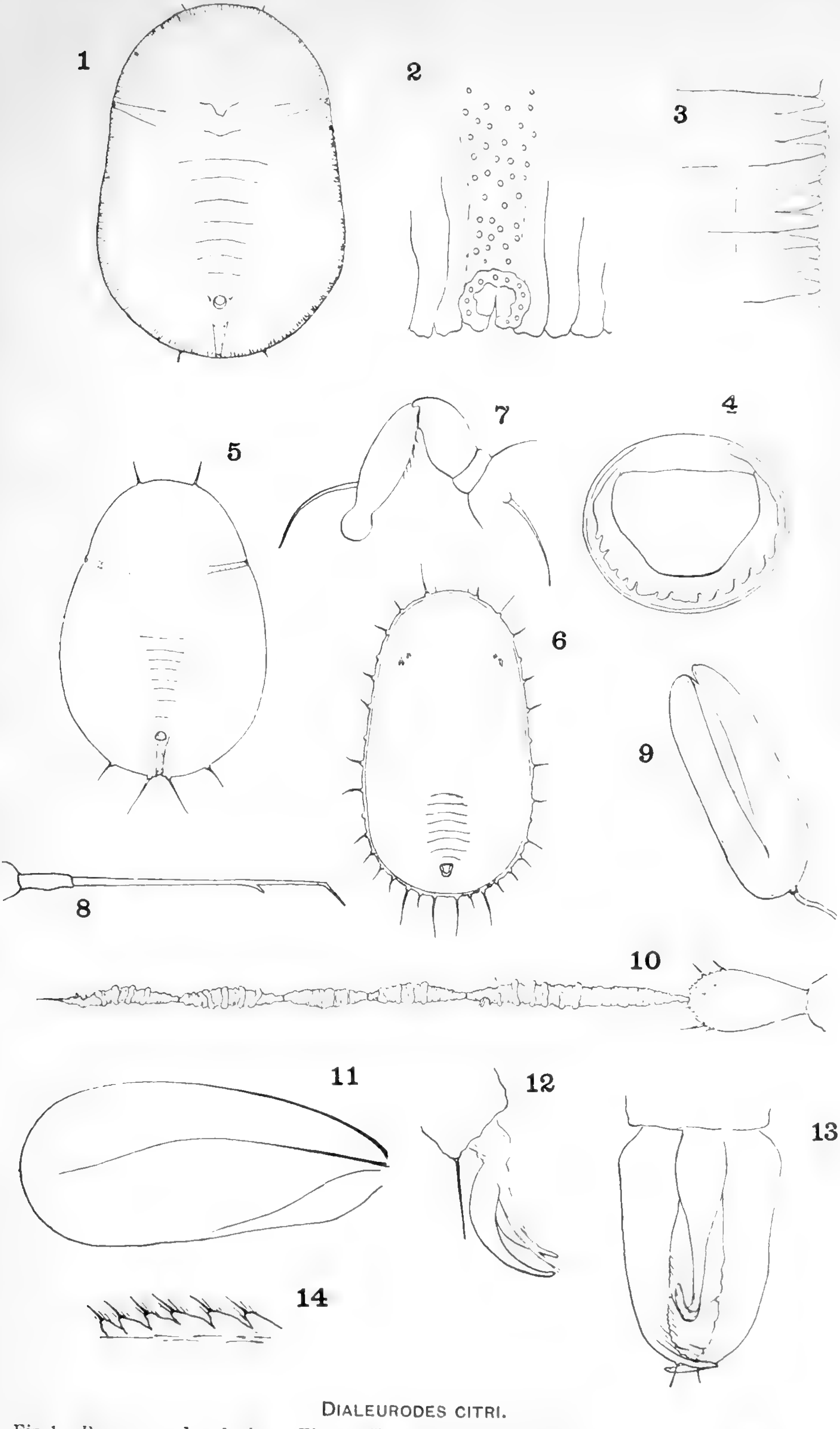
A. alcocki (Peal), Journ. Asiat. Soc. Bengal, vol. 72, p. 74 (1903). (India.)
A. cockerelli (Ihering), Rev. Museu Paulista, No. 2, p. 393 (1897). (Brazil.)
A. coronata (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 22 (1900). (California.)
A. euryæ (Kuwana), Pomona Journ. Ent., vol. 3, no. 4, p. 625 (1911). (Japan.)
A. gelatinosus (Cockerell), Canad. Ent., vol. 30, p. 264 (1898). (New Mexico; California.)
A. hoyæ (Peal), Journ. Asiat. Soc. Bengal, vol. 72, p. 78 (1903).
A. quaintancei (Peal), Journ. Asiat. Soc. Bengal, vol. 72, p. 78 (1903). (India.)
A. quercus-aquaticæ (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 35 (1900). (Florida.)
A. vinsonioides (Cockerell), Psyche, vol. 8, p. 225 (1898). (Mexico.)

Genus DIALEURODOIDES n. gen.

(Pl. XXXVII, figs. 7–11.)

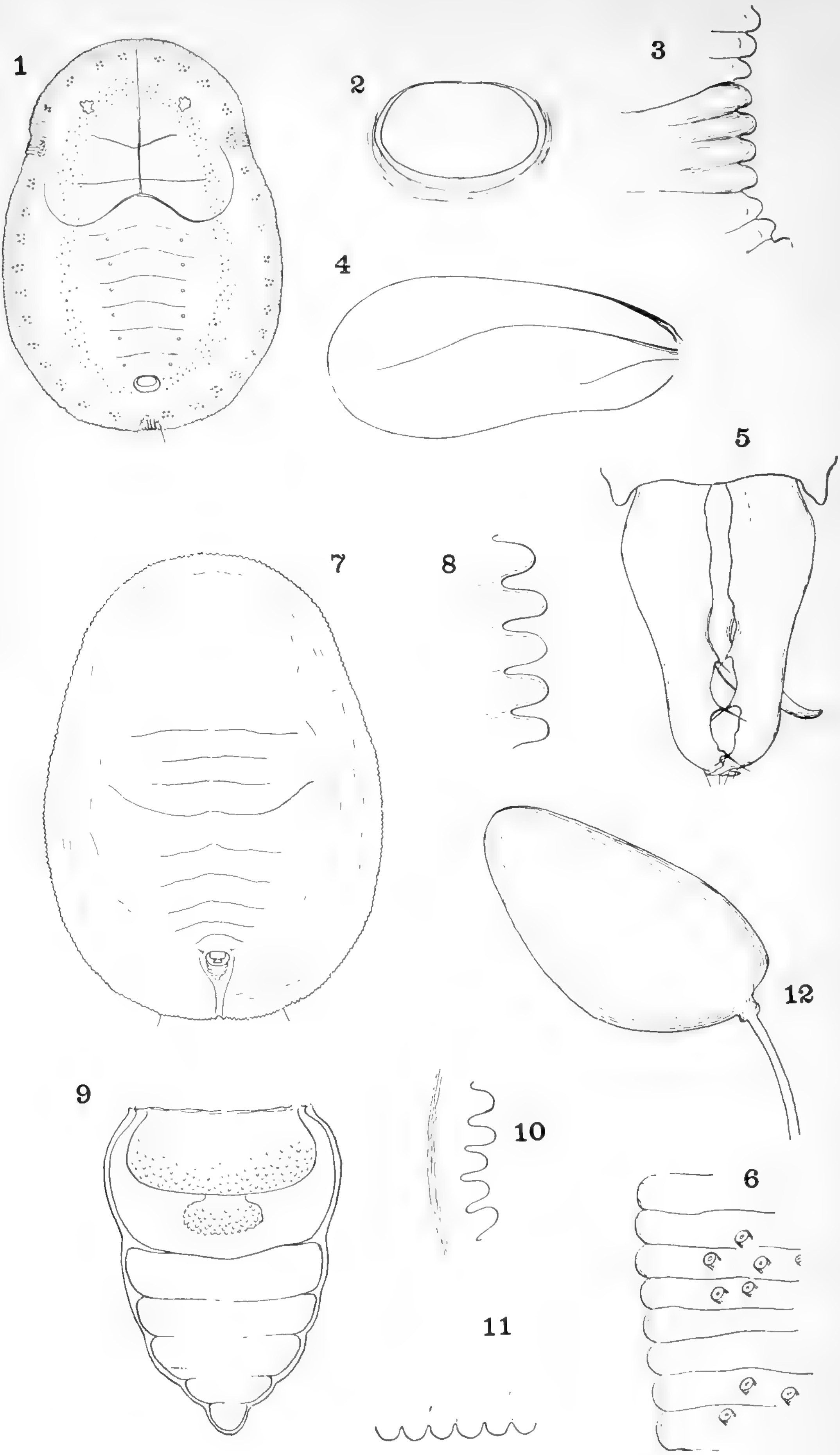
Pupa case of medium size, subelliptic to subcircular in outline, usually yellowish or brownish in color; margin of case toothed, the wax tubes but little developed; submarginal area not separated from dorsal disk; dorsum without papillæ, though well developed pores may be present; tracheal folds present; wax secretion scant or absent. Vasiform orifice subcordate, rather acute caudad; operculum about half filling the orifice, leaving lingula exposed.

Type, *aureus* Maskell.



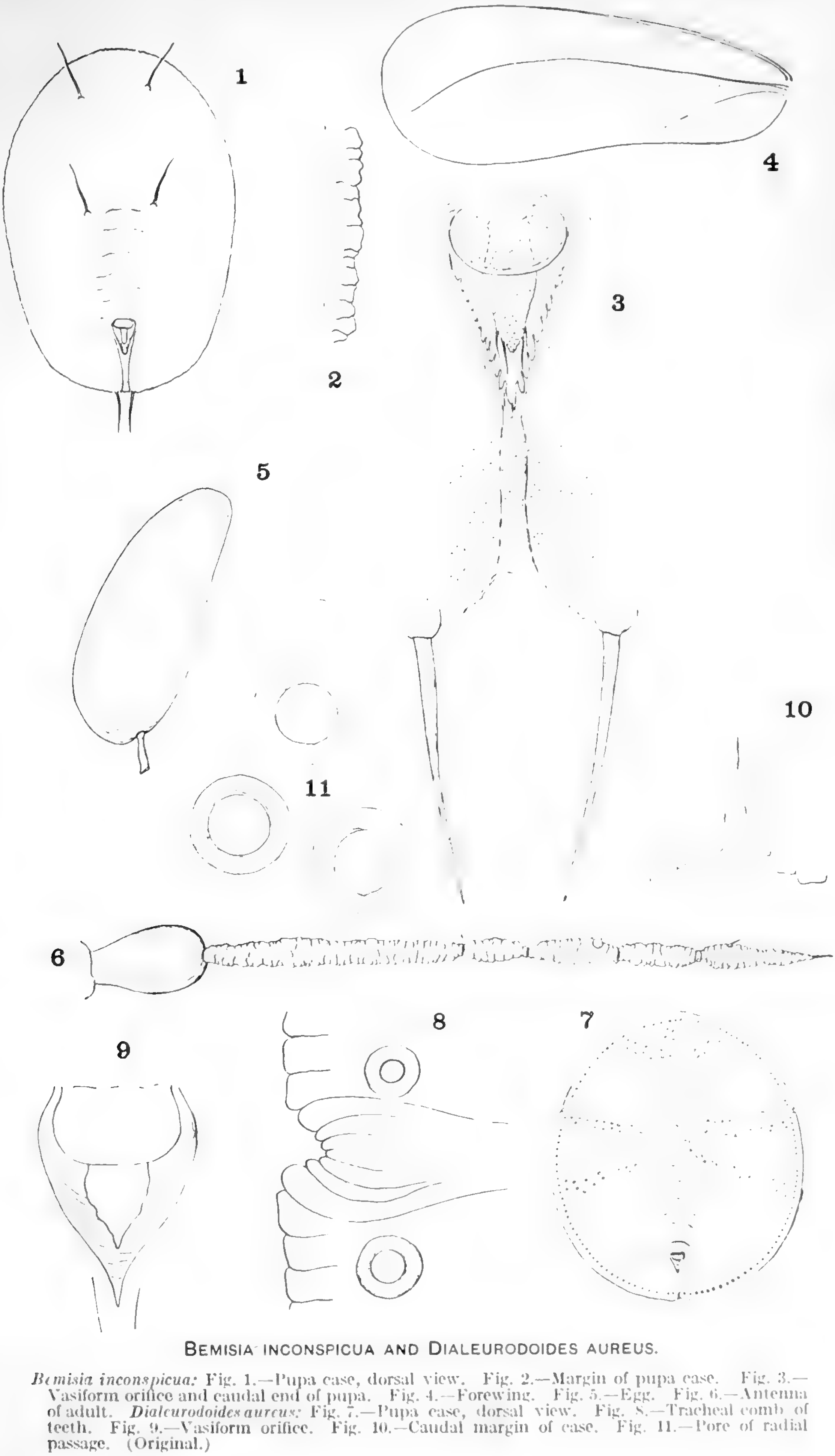
DIALEURODES CITRI.

Fig. 1.—Pupa case, dorsal view. Fig. 2.—Thoracic tracheal fold and pore. Fig. 3.—Margin of case. Fig. 4.—Vasiform orifice of pupa case. Fig. 5. Larva, third instar. Fig. 6.—Larva, first instar. Fig. 7.—Leg of larva, first instar. Fig. 8.—Antenna of larva, first instar. Fig. 9.—Egg. Fig. 10.—Antenna of adult. Fig. 11. Wing. Fig. 12.—Claw of adult. Fig. 13. -Male genitalia. Fig. 14.—Margin of forewing. (Original.)



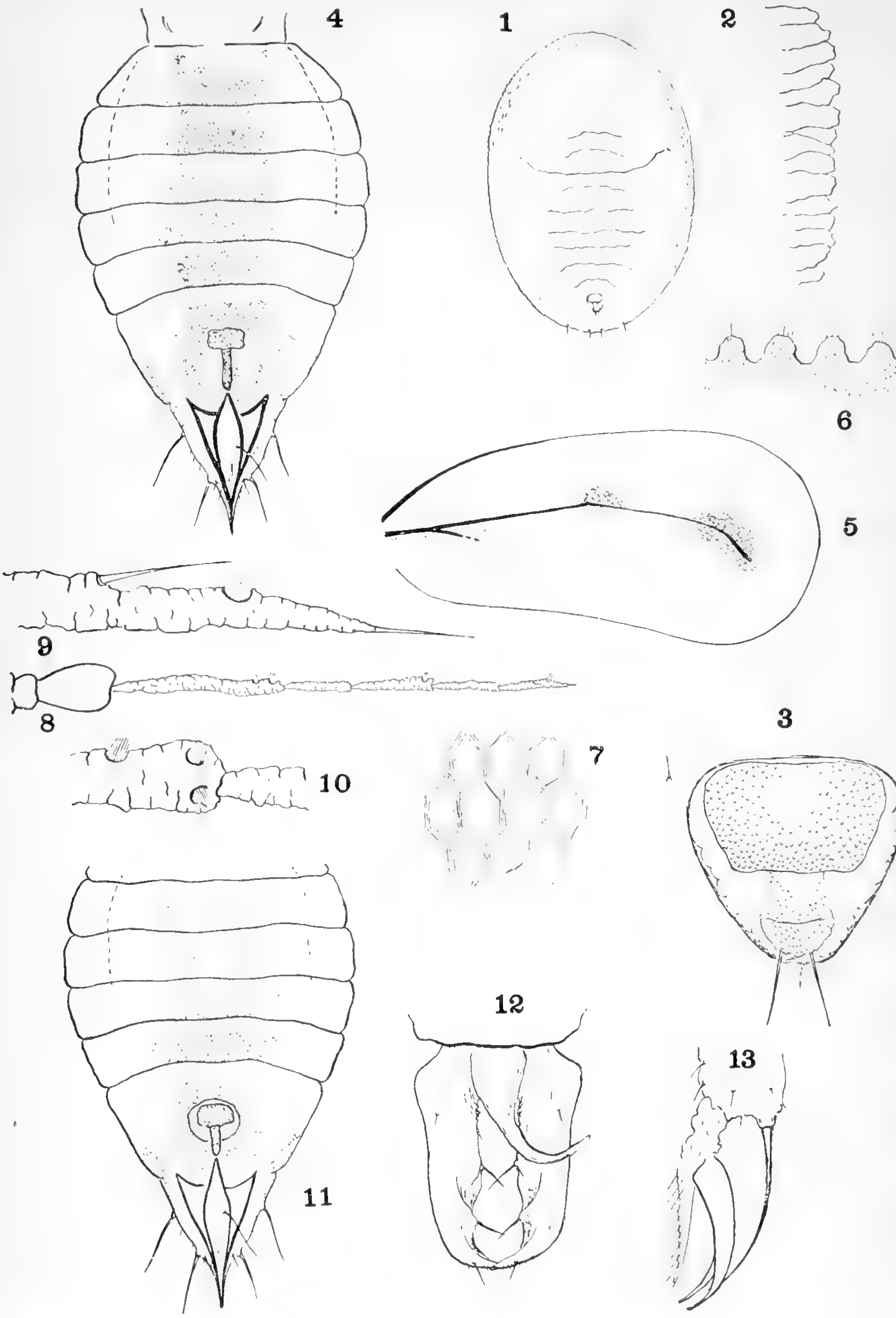
ALEUROPLATUS QUERCUS-AQUATICÆ AND PEALIUS MASKELLI.

Aleuroplatus quercus-aquaticæ: Fig. 1.—Pupa case, dorsal view. Fig. 2.—Vasiform orifice. Fig. 3.—Thoracic tracheal comb of teeth. Fig. 4.—Forewing. Fig. 5.—Male genitalia. Fig. 6.—Margin of pupa case. *Pealius maskelli:* Fig. 7.—Pupa case, dorsal view. Fig. 8.—Margin of pupa case. Fig. 9.—Vasiform orifice. Fig. 10.—Thoracic tracheal comb of teeth. Fig. 11.—Caudal comb of teeth. Fig. 12.—Egg. (Original.)



BEMISIA INCONSPICUA AND DIALEURODOIDES AUREUS.

Bemisia inconspicua: Fig. 1.—Pupa case, dorsal view. Fig. 2.—Margin of pupa case. Fig. 3.—Vasiform orifice and caudal end of pupa. Fig. 4.—Forewing. Fig. 5.—Egg. Fig. 6.—Antenna of adult. *Dialeurodoides aureus:* Fig. 7.—Pupa case, dorsal view. Fig. 8.—Tracheal comb of teeth. Fig. 9.—Vasiform orifice. Fig. 10.—Caudal margin of case. Fig. 11.—Pore of radial passage. (Original.)



ALEYRODES SPIRÆOIDES.

Fig. 1.—Pupa case, dorsal view. Fig. 2.—Margin of pupa case. Fig. 3.—Vasiform orifice of pupa case. Fig. 4.—Abdomen of female, dorsal view, showing typical marking. Fig. 5.—Forewing. Fig. 6.—Margin of forewing. Fig. 7.—Details of maculation of forewing. Fig. 8.—Antenna of adult female. Fig. 9.—Terminal distal segment of female, antenna greatly enlarged. Fig. 10. Distal portion of third segment of male. Fig. 11.—Abdomen of female, dorsal view, showing variation in marking. Fig. 12.—Genitalia of male. Fig. 13.—Claw. (Original.)

SPECIES OF THE GENUS DIALEURODOIDES.

A. aureus (Maskell), Trans. New Zealand Inst., vol. 22, p. 174 (1889); ibidem, vol. 2, p. 215 (1879). (New Zealand.)
A. fagi (Maskell), Trans. New Zealand Inst., vol. 22, p. 175 (1889). (New Zealand.)
A. simplex (Maskell), Trans. New Zealand Inst., vol. 22, p. 175 (1889). (New Zealand.)

Genus PEALIUS n. gen.

(Pl. XXXVI, figs. 7–12; Pl. XLVI, fig. 5.)

Pupa case medium in size, elliptic in outline; color variable; margin of case toothed, the wax tubes well developed; submarginal area not separated from dorsal disk; dorsum without papillæ or pores; thoracic tracheal folds not discernible, though there is a distinct furrow from vasiform orifice to caudal end of case. Vasiform orifice situated in a pit, which is more or less pyriform in outline and transversely ridged, the outline of the orifice being subrectangular; operculum subrectangular, short, filling about half the orifice; lingula short, the distal extremity visible caudad of operculum, flattened and knobbed. Named for the late H. W. Peal.

Type, *maskelli* Bemis.

SPECIES OF THE GENUS PEALIUS.

P. bengalensis (Peal), Journ. Asiat. Soc. Bengal, vol. 72, p. 70 (1904). (India.)
P. hibisci (Kotinsky), Bul. 2, Div. Ent., Board Comm. Agr. & Forestry, Hawaii, p. 96 (1907). (Hawaii.)
P. kelloggi (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 499 (1904). (California.)
P. maskelli (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 524 (1904). (California.)

Genus BEMISIA n. gen.

(Pl. XXXVII, figs. 1–6.)

Pupa case varying much in size, elliptic or oval in outline, broadest across the thorax; color usually pale yellowish; margin toothed, the wax tubes irregular in size and shape; submarginal area not separated from dorsal disk; dorsum without papillæ or pores; thoracic tracheal folds sometimes faintly visible. There is a distinct furrow present, extending from the vasiform orifice to the caudal extremity of the case. Vasiform orifice triangular, long and narrow; lingula long and less than half covered at the cephalic extremity by the short operculum.

Adult with one flexure in radial sector of forewing and no spur of media. Antennæ of seven segments, of which the third is the longest, the remaining distal ones being subequal. Named for Florence E. Bemis.

Type, *inconspicua* Quaintance.

SPECIES OF THE GENUS BEMISIA.

B. berbericola (Cockerell), Journ. N. Y. Ent. Soc., vol. 4, p. 207 (1896). (New Mexico.)

B. decipiens (Maskell), Trans. New Zealand Inst., vol. 28, p. 428 (1895). (Australia.)

B. giffardi (Kotinsky), Bul. 2, Div. Ent., Board Comm. Agr. & Forestry, Hawaii, p. 94 (1907). (Hawaii.)

B. inconspicua (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 29 (1900). (Florida.)

B. leakii (Peal), Journ. Asiat. Soc. Bengal, vol. 72, p. 87 (1903). (India; Fiji.)

B. religiosa (Peal), Journ. Asiat. Soc. Bengal, vol. 72, p. 67 (1903). (India.)

Genus ALEYRODES Latreille.

(Pl. XXXVIII, figs. 1–13; Pl. XLVI, fig. 6.)

Pupa case small to medium in size, elliptic in outline; color usually yellowish or brownish; margin of case toothed, the wax tubes irregular in outline and rather poorly developed; submarginal area not separated from dorsal disk. There are no well developed papillæ or pores as in *Asterochiton*, though minute pores may be present in some species. Tracheal folds not discernible; wax secretion usually absent. Vasiform orifice subcordate, the operculum about half filling the orifice; lingula included within the orifice, but visible caudad of the operculum; the distal extremity setose and armed with a pair of spines.

Adult with two flexures in radial sector of forewing, and media with a very short spur; forewings usually with faint patches of dusky coloration on flexures of radial sector. Antennæ of seven segments, of which the third is the longest, the distal ones being subequal; segments imbricated. Sexes nearly equal in size; claspers of male with a few spines.

Type, *proletella* L.; example, *spiræoides* Quaintance.

SPECIES OF THE GENUS ALEYRODES.

A. akebiæ Kuwana, Pomona Journ. Ent., vol. 3, no. 4, December, p. 622 (1911). (Japan.)

A. amnicola Bemis, Proc. U. S. Nat. Mus., vol. 27, p. 514 (1904). (California.)

A. asarumis Shimer, Trans. Amer. Ent. Soc., vol. 1, p. 281 (1867). (Pennsylvania.)

Syn.: *acteæ* Britton.

A. aureocincta Cockerell, Journ. N. Y. Ent. Soc., vol. 5, p. 42 (1897). (New Mexico.)

A. brassicæ Walker, Cat. Homopt. Brit. Mus., p. 1092 (1852). (Europe.)

A. capreæ Signoret, Ann. Soc. Ent. France (4), vol. 8, p. 384 (1867). (France.)

A. cerata Maskell, Trans. New Zealand Inst., vol. 28, p. 425 (1895). (New Zealand.)

A. cotesii Maskell, Trans. New Zealand Inst., vol. 28, p. 427 (1895). (Baluchistan.)

A. fernaldi Morrill, Psyche, vol. 10, p. 83 (1903). (Massachusetts; Connecticut.)

A. fragariæ Walker, List Homopt. Brit. Mus., p. 1092 (1851); also Ann. Soc. Ent. France (4), vol. 8, p. 383 (1867). (England; France.)

A. lactea Zehntner, Mededeeleng Proefstat. Oost-Java, n. s. 37, p. 34 (1897); also Arch. Java Suikerind., vol. 7, p. 459 (1897). (Java.)

A. lauri Signoret, Ann. Soc. Ent. France, pt. 2, p. 158 (1881). (Greece.)

A. loniceræ Walker, Cat. Homopt. Brit. Mus., p. 1092 (1852). (Europe.)

A. prenanthis Schrank, Fauna Boica, vol. 2, p. 147 (1801). (Germany.)

A. proletella Linné, Syst. Nat. (ed. 10), p. 537 (1758). (Europe.)

A. pruinosa Bemis, Proc. U. S. Nat. Mus., vol. 27, p. 491, pl. 2, fig. 8 (1904). (California.)

A. pruinosa var. *euphorbiara* Cockerell, Ent. News, vol. 22, p. 462 (1911).

A. pyrolæ Gillette & Baker, Bul. 31, Colo. Agr. Exp. Sta., Tech. Ser., p. 125 (1895). (Colorado.)

A. quercus Signoret, Ann. Soc. Ent. France (4), vol. 8, p. 384 (1867). (France; England.)

A. ribia Douglas, Ent. Monthl. Mag., vol. 24, p. 265 (1888); ibidem, p. 255 (1899). (England.)

A. rubi Signoret, Ann. Soc. Ent. France (4), vol. 8, p. 382 (1867). (France.)

A. rubicola Douglas, Ent. Monthl. Mag. (2), vol. 2, p. 322 (1891). (England.)

A. schizuokensis Kuwana, Pomona Journ. Ent., vol. 3, no. 4, December, p. 620 (1911). (Japan.)

A. spirææ Douglas, Ent. Monthl. Mag. (2), vol. 5, pp. 73, 154 (1894). (England.)

A. spiræoides Quaintance, Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 36 (1900).

A. xylostei Westhoff, Jahresb. zool. westfäl. Verein, p. 61 (1886). (Germany.)

A. youngi Hempel, Ann. Mag. Nat. Hist. (7), vol. 8, p. 385 (1901). (Brazil.)

Genus **ALEUROCYBOTUS** n. gen.

(Pl. XXXIX, figs. 5–8.)

Pupa case of medium size, very narrow and elongate; margin toothed, the wax tubes very poorly developed; submarginal area not separated from dorsal disk; dorsum without papillæ or pores, though there is present a row on each side of median area of abdomen, a series of irregular pits; tracheal folds not discernible; secretion usually present as a short rim of wax, elevating case from leaf. Vasiform orifice subcordate, the lingula included within the orifice, but its extremity visible caudad of the operculum.

Adult with a single flexure in radial sector of forewing and no trace of media. Antennæ of male with segment VII as long or longer than the other segments combined.

Type, *graminicolus* Quaintance.

Species of the Genus Aleurocybotus.

A. graminicolus (Quaintance), Canad. Ent., vol. 31, p. 89 (1899). (Florida.)

Genus **ALEUROTULUS** n. gen.

(Pl. XL, figs. 1–9.)

Pupa case small, elliptic to slightly oval, flat. Color yellowish; margin of case toothed, the wax tubes not prominent; submarginal area not separated from the dorsal disk and there are no papillæ or pores; tracheal folds faintly evident. Vasiform orifice subcordate, somewhat rounded; operculum smaller, similar but shorter in proportion, occupying about two-thirds of the orifice; lingula long, usually protruding considerably beyond orifice, ligulate, its protruding extremity knobbed and setose.

Adult with one flexure in radial sector of forewing and no spur of media. Antennæ of seven segments, of which the third is the longest; segment VII considerably longer than IV, V, or VI.

Type, *nephrolepidis* Quaintance.

SPECIES OF THE GENUS ALEUROTULUS.

A. nephrolepidis (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 29 (1900). (Pennsylvania, in Conservatory.)
Syn.: *extraniens* Bemis.

A. filicium (Goeldi), Mittheil. schweiz. ent. Ges., vol. 7, p. 248 (1886). (Brazil; Rio de Janeiro; Kew Gardens.)

Genus ALEUROCANTHUS n. gen.

(Pl. XXXIX, figs. 9–11; Pl. XLVI, fig. 3.)

Pupa case medium in size, subelliptic in outline, usually dark brown or black in color; margin of case toothed, the wax tubes very prominent; submarginal area not separated from dorsal disk; dorsum without papillæ or pores, though bearing many heavily chitinized spines variously arranged; tracheal folds usually not discernible, though evident in a few species; wax secretion usually present as a narrow fringe from marginal wax tubes. Vasiform orifice small, rounded or subcordate in outline, situated on a tubercle-like projection of dorsum; operculum similar in shape and almost entirely filling it, obscuring the lingula.

Adult with one flexure in radial sector of forewing and no spur of media; wings usually blotched or shaded. Males much smaller than females.

Type, *spiniferus* Quaintance.

SPECIES OF THE GENUS ALEUROCANTHUS.

A. bambusæ (Peal), Journ. Asiatic Soc. Bengal, vol. 72, p. 85 (1903). (India.)

A. banksiæ (Maskell), Trans. New Zealand Inst., vol. 28, p. 423 (1895). (Australia.)

A. calophylli (Kotinsky), Bul. 2, Div. Ent. Board Comm. Agr. & Forestry, Hawaii, p. 98 (1907). (Fiji.)

A. citricolus (Newstead), Mitteil. aus dem zool. Mus. in Berlin, vol. 5, pt. 2, p. 173 (1911). (East Africa.)

A. hirsutus (Maskell), Trans. New Zealand Inst., vol. 28, p. 434 (1895). (Australia.)

A. nubilans (Buckton), Indian Mus. Notes, vol. 5, p. 36 (1900). (India.)

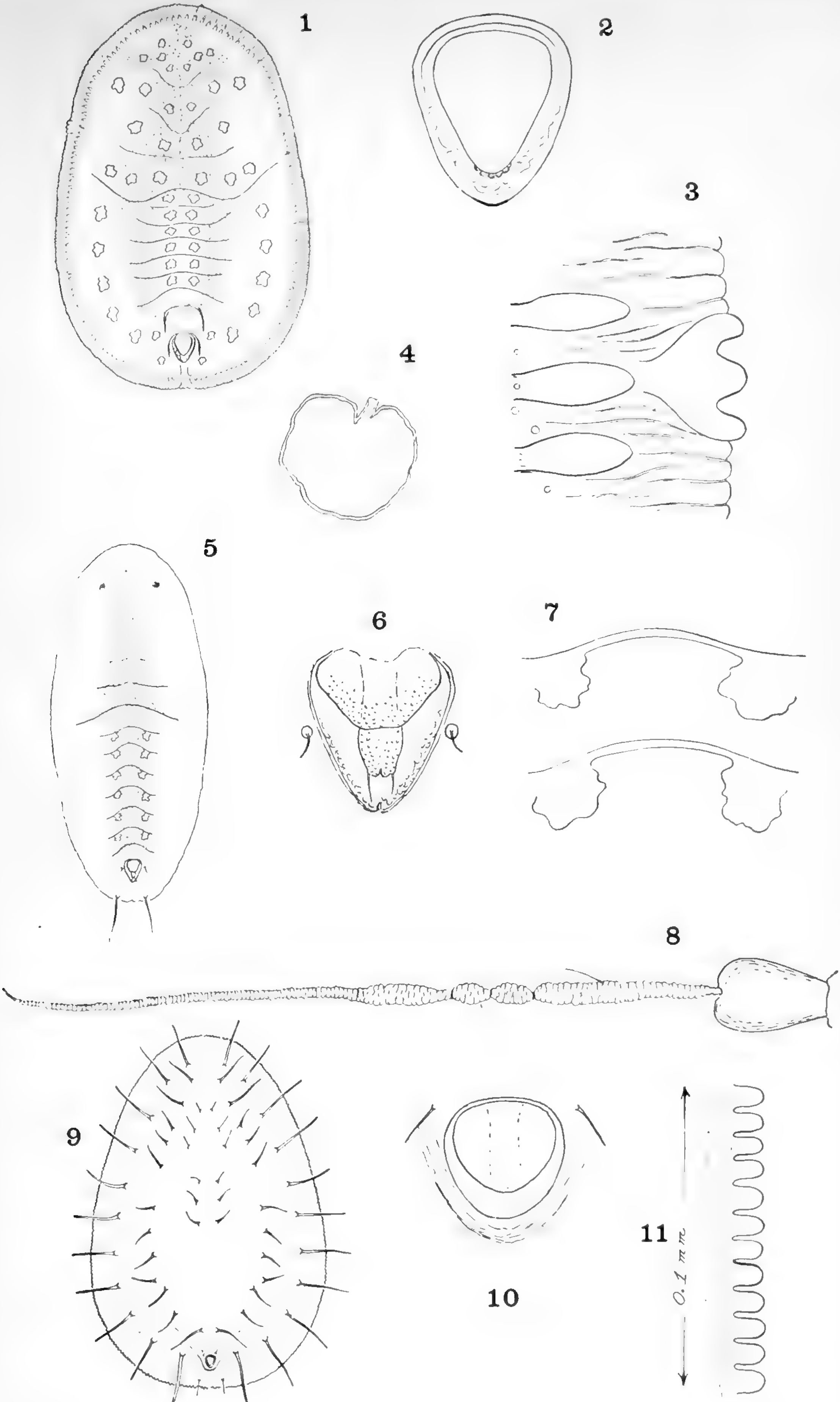
A. piperis (Maskell), Trans. New Zealand Inst., vol. 28, p. 438 (1895). (Ceylon.)

A. spiniferus (Quaintance), Canad. Ent., vol. 34, p. 63 (1902). (Java.)

A. spinosus (Kuwana), Pomona Journ. Ent., vol. 3, no. 4, p. 626 (1911).

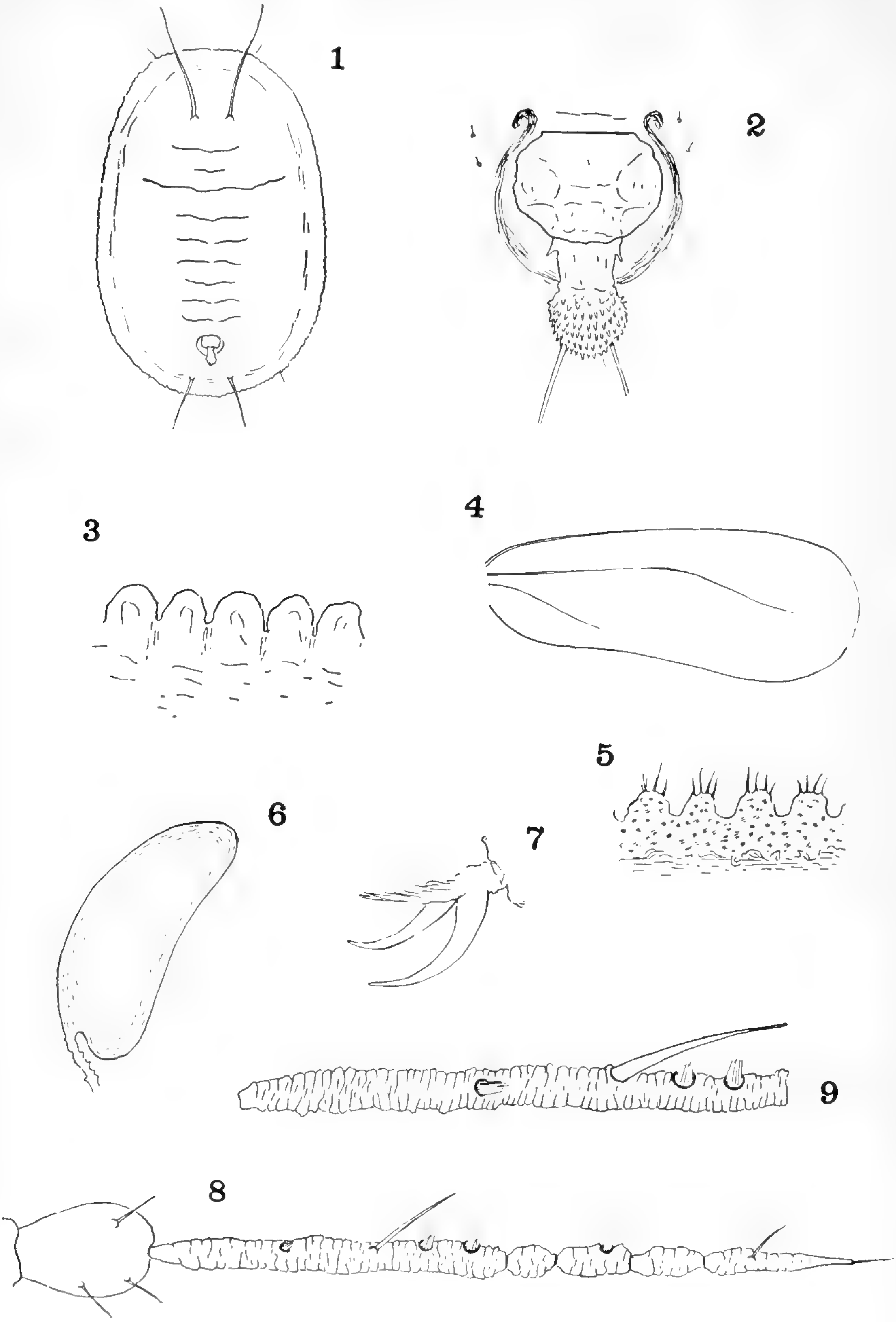
A. signatus (Maskell), Trans. New Zealand Inst., vol. 28, p. 447 (1895). (Australia.)

A. voeltzkowi (Newstead), Quarterly Journ. Liverpool, vol. 3, p. 12 (1908). (Madagascar.)



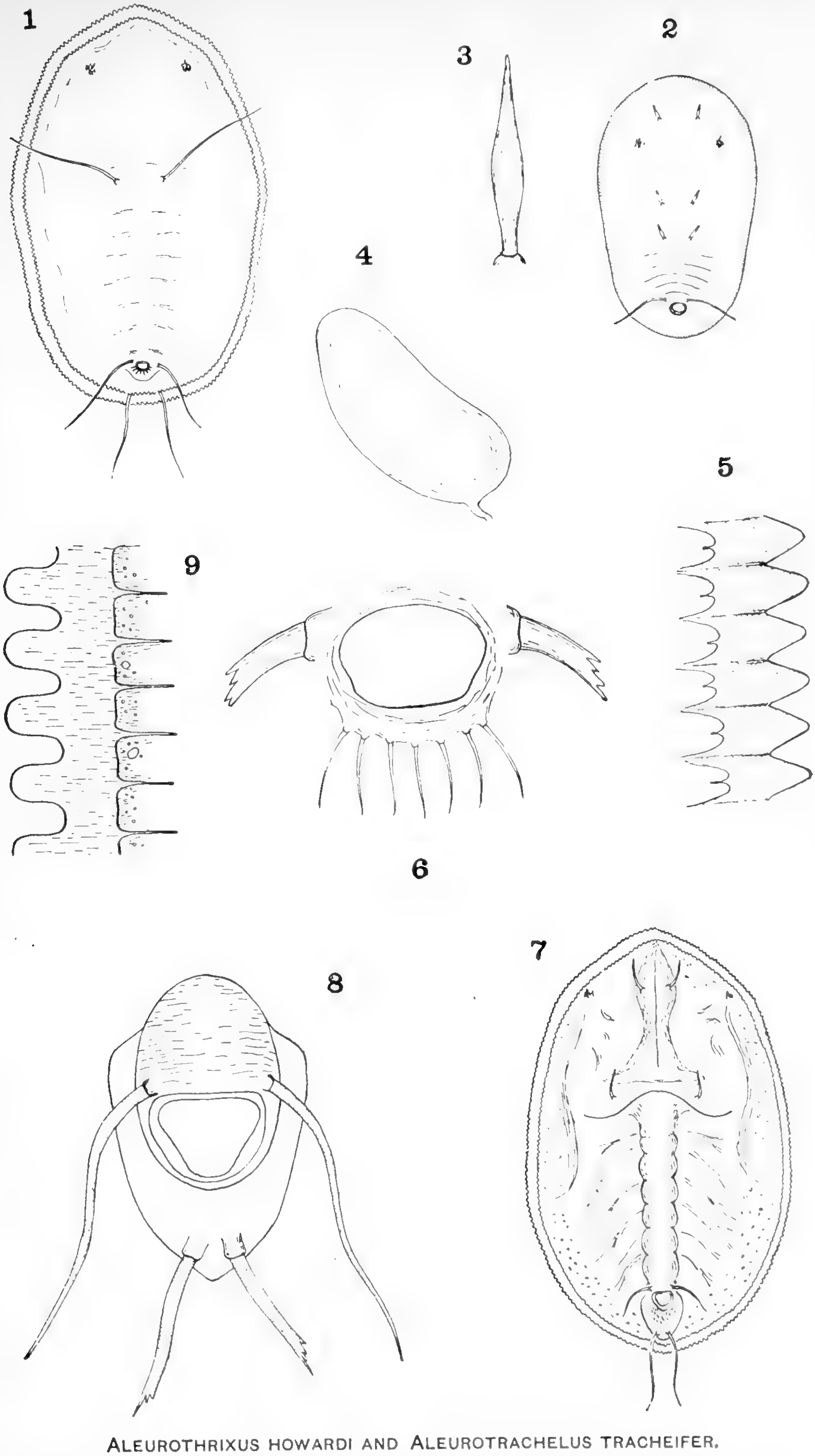
ALEUROPARADOXUS IRIDESCENS, ALEUROCYBOTUS GRAMINICOLUS, AND ALEUROCANTHUS SPINIFERUS

Aleuroparadoxus iridescens: Fig. 1.—Pupa case, dorsal view. Fig. 2.—Vasiform orifice. Fig. 3.—Margin of pupa case, showing thoracic tracheal comb. Fig. 4.—Dorsal pore of pupa case, much enlarged. *Aleurocybotus graminicolus:* Fig. 5.—Pupa case, dorsal view. Fig. 6.—Vasiform orifice. Fig. 7.—Irregular opening on dorsum of abdomen of pupa case. Fig. 8.—Antenna of adult male. *Aleurocanthus spiniferus:* Fig. 9.—Pupa case, dorsal view. Fig. 10.—Vasiform orifice. Fig. 11.—Margin of pupa case.



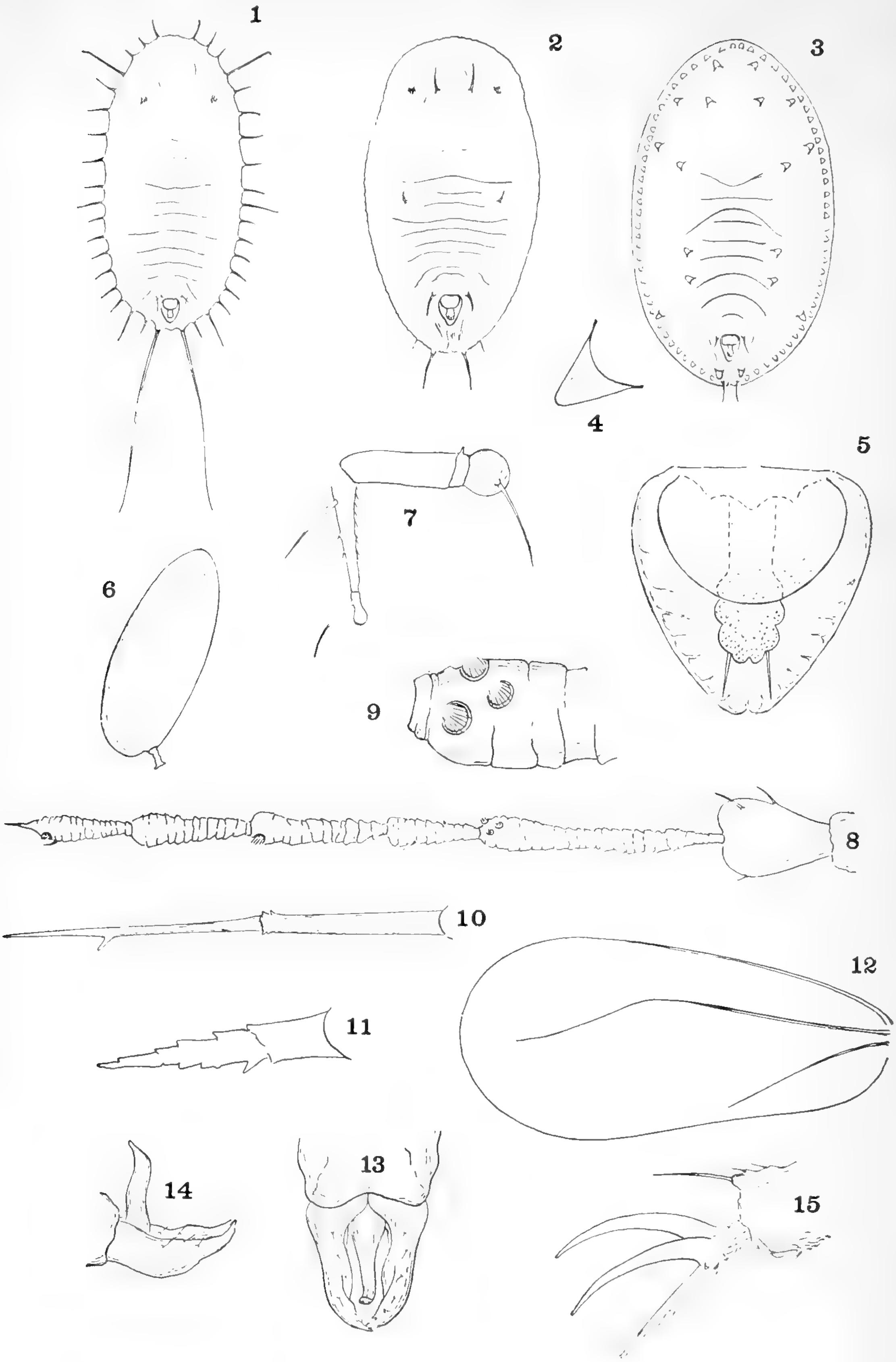
ALEUROTULUS NEPHROLEPIDIS.

Fig. 1.—Pupa case, dorsal view. Fig. 2.—Vasiform orifice. Fig. 3.—Margin of pupa case. Fig. 4.—Forewing. Fig. 5.—Margin of forewing. Fig. 6.—Egg. Fig. 7.—Claw of adult. Fig. 8.—Antenna of adult male (?). Fig. 9.—Third segment of antenna of male. (Original.)



ALEUROTHRIXUS HOWARDI AND ALEUROTRACHELUS TRACHEIFER.

Aleurothrixus howardi: Fig. 1.—Pupa case, dorsal view. Fig. 2.—Larva, first instar. Fig. 3.—Sword-shaped spine of first-instar larva. Fig. 4.—Egg. Fig. 5.—Margin of pupa case. Fig. 6. Vasiform orifice. *Aleurotrachelus tracheifer:* Fig. 7.—Pupa case, dorsal view. Fig. 8.—Vasiform orifice. Fig. 9.—Margin of pupa case. (Original.)



ASTEROCHITON VAPORARIORUM.

Fig. 1.—Larva, first instar. Fig. 2.—Larva, second instar. Fig. 3.—Pupa case, dorsal view. Fig. 4.—Papilla of pupa case. Fig. 5.—Vasiform orifice. Fig. 6.—Egg. Fig. 7.—Leg of larva, first instar. Fig. 8.—Antenna of adult. Fig. 9.—Distal end of third segment of antenna. Fig. 10.—Antenna of larva, first instar. Fig. 11.—Antenna of larva, second instar. Fig. 12.—Fore-wing. Fig. 13.—Genitalia of male, dorsal view. Fig. 14.—Genitalia of male, lateral view. Fig 15.—Claw of adult. (Original.)

Genus **ALEUROTRACHELUS** n. gen.

(Pl. XLI, figs. 7–9; Pl. XLVI, fig. 4.)

Pupa case mostly of medium size, elliptic in outline, the cephalic margin somewhat pointed; color brown to blackish; margin of case with a double row of teeth, the wax tubes well developed; submarginal area not separated from the dorsal disk; dorsum without pores or papillæ, though body sutures are very prominent and along each side near center there is a prominent fold. Along median line of dorsum is a trachea-like ridge, terminating cephalad in an arrow-shaped figure and caudad in the vasiform orifice. Tracheal folds not discernible; wax secretion usually present as a fringe from marginal wax tubes, Vasiform orifice small, broadly cordate; operculum similar in shape. obscuring the lingula.

Type, *tracheifer* Quaintance.

Species of the Genus Aleurotrachelus.

A. camelliæ (Kuwana), Pomona Journ. Ent., vol. 3, no. 4, p. 625 (1911).
A. croccatus (Maskell), Trans. New Zealand Inst., vol. 28, p. 428 (1895). (Australia.)
A. fumipennis (Hempel), Psyche, vol. 8, p. 394 (1899). (Brazil.)
A. limbatus (Maskell), Trans. New Zealand Inst., vol. 28, p. 436 (1895). (Australia.)
A. parvus (Hempel), Psyche, vol. 8, p. 395 (1899). (Brazil.)
A. tracheifer (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 38 (1900). (Mexico.)
A. trachoides (Back), Canad. Ent., vol. 44, p. 151 (1912). (Cuba.)

Genus **ALEUROTHRIXUS** n. gen.

(Pl. XLI, figs. 1–6; Pl. XLVII, fig. 4.)

Pupa case medium to small in size, elliptic; margin sometimes angled; color variable, ranging from yellow to blackish; margin of case with double row of teeth, the wax tubes well developed; submarginal area not separated from dorsal disk; dorsum without papillæ or pores, but bearing along median line a few pairs of long, spinelike hairs; tracheal folds not discernible; wax secretion usually copious, flocculent or woolly, secreted by marginal wax tubes. Vasiform orifice small, transversely elliptic; lingula obscured by the operculum, which nearly fills the orifice.

Adult with one flexure in radial sector of forewing and no spur of media. Antennæ of seven segments, of which III is the longest. Sexes nearly equal in size.

Type, *howardi* Quaintance.

Species of the Genus Aleurothrixus.

A. aëpim (Goeldi), Mittheil. schweiz. ent. Ges., vol. 7, p. 250 (1886). (Brazil.)
A. floccosus (Maskell), Trans. New Zealand Inst., vol. 28, p. 432 (1895). (Jamaica; Mexico.)
A. horridus (Hempel), Psyche, vol. 8, p. 394 (1899). (Brazil.)

A. howardi (Quaintance), Tech. Ser. 12, Bur. Ent., U. S. Dept. Agr., p. 91 (1907). (Cuba; Florida.)

A. interrogationis (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 510 (1904). (California.)

Genus NEOMASKELLIA Quaintance and Baker.

(Tech. Ser. 27, Pt. I, Pl. XXXIV, figs. 1–8.)

Species of the Genus Neomaskellia.

N. comata (Maskell), Trans. New Zealand Inst., vol. 28, p. 426, (1895). (Fiji.)

N. bergii (Signoret), Ann. Soc. Ent. France (4), vol. 8, p. 395 (1867). (Isle of Mauritius; Java; Fiji; Levuka; Rena; Manila, Philippine Islands.
Syn.: *sacchari* Maskell.

Genus ALEUROPARADOXUS n. gen.

(Pl. XXXIX, figs. 1–4; Pl. XLVI, fig. 2.)

Pupa case medium in size, elliptic in outline, margin toothed, the wax tubes only moderately developed; submarginal area not separated from dorsal disk; just within margin a series of papilla-like pores and dorsum with numerous large irregular pores; tracheal folds present, terminating on margin in a comb of teeth; wax secretion brittle glass-like rods from the submarginal papillæ and a secretion from the dorsal pores. Vasiform orifice subcordate or triangular, the operculum similar in outline, obscuring the lingula.

Adult with a single flexure in radial sector of forewing and no spur of media. Antennæ seven-segmented; III the longest; distal segments subequal. Sexes nearly equal in size.

Type, *iridescens* Bemis.

Species of the Genus Aleuroparadoxus.

A. iridescens (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 487 (1904). (California.)

Genus ASTEROCHITON Maskell.[1]

(Pl. XLII, figs. 1–15; Pl. XLVII, fig. 2.)

Pupa case medium to small in size, elliptic, usually elevated from the leaf by a palisade of white wax; color variable, ranging from whitish to dark brown; margin of case toothed, the wax tubes moderately developed; submarginal area not separated from dorsal disk; submarginal area with a row of, or a number of, large papillæ or pores; thoracic tracheal folds rarely distinguishable; usually a distinct furrow from vasiform orifice to caudal margin of case; wax secretion a series of brittle, glassy rods from dorsal papillæ or pores and a

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[1] Maskell erected this genus with his *lecanioides* as type and placed it in the Coccidæ. He later described a species, *papillifer*, indicating that his *lecanioides* was in part a synonym of this. The name *lecanioides*, however, should have been used for the species. We have examined the type of *papillifer* in the Maskell collection and find the species to be nothing other than *vaporariorum* Westwood. This latter species, therefore, becomes the type of the genus.

palisade of white wax elevating case from leaf; vasiform orifice subcordate, usually notched on caudal end; operculum transversely elliptic, about half filling the orifice; lingula spatulate, the distal extremity exposed caudad of operculum, lobed, and usually armed with two prominent spines.

Adult usually with one flexure in radial sector of forewing and no trace of media excepting in freshly emerged specimens. Antennæ of seven segments, segment III the longest, IV to VI subequal; segments imbricated. Sexes nearly equal in size.

Type, *vaporariorum* Westwood.

SPECIES OF THE GENUS ASTEROCHITON.

A. abutiloneus (Haldeman), Amer. Journ. Sci. & Arts, vol. 9, p. 108 (1850). (Eastern United States; Pennsylvania to Florida.)
Syn.: *fitchi* Quaintance.

A. ambrosiæ (Cockerell), Canad. Ent., vol. 42, p. 370 (1910). (Colorado.)

A. asplenii (Maskell), Trans. New Zealand Inst., vol. 22, p. 173 (1889). (New Zealand.)

A. coryli (Britton), Ent. News (Phila.), vol. 18, p. 337 (1907). (Connecticut.)

A. diasemus (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 516 (1904). (California.)

A. dubius (Heeger), Beitr. Naturg. Ins., p. 223 (1858). (Austria; Germany.)

A. erigerontis (Maskell), Trans. New Zealand Inst., vol. 28, p. 429 (1895). (Mexico.)

A. floridensis (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 26 (1900).

A. glacialis (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 518 (1904). (California.)

A. hutchingsi (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 532 (1904). (California.)

A. immaculatus (Heeger), Beitr. Naturg. Ins., p. 1 (1855). (Europe.)

A. madroni (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 507 (1904). (California.)

A. merlini (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 512 (1904). (California.)

A. morrilli (Britton), Ent. News (Phila.), vol. 18, p. 340 (1907). (Connecticut.)

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A. phillyreæ (Haliday), The Ent. Mag., vol. 2, p. 119 (1834). (Europe.)

A. rolfsii (Quaintance), Canad. Ent., vol. 31, p. 90 (1899). (Florida.)

A. ruborum (Cockerell), Journ. N. Y. Ent. Soc., vol. 5, p. 9 (1897). (Florida.)

A. sonchi (Kotinsky), Bul. 2, Div. Ent. Board Comm. Agr. & Forestry, Hawaii, p. 97 (1907). (Hawaii.)

A. tentaculatus (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 494 (1904). (California.)

A. vaporariorum (Westwood), The Gardener's Chronicle, p. 852 (1856). (Thought to be a native of Brazil; now quite generally distributed.)
Syn.: *nicotianae* Maskell.
Syn.: *papillifer* Maskell.
Syn.: *lecanioides* Maskell.

A. variabilis (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 39 (1900). (Florida.)

A. vitrinellus (Cockerell), Ent. News (Phila.), vol. 14, p. 241 (1903). (Mexico.)

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A. waldeni (Britton), Ent. News (Phila.), vol. 18, p. 339 (1907). (Connecticut.)

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Genus ALEUROTITHIUS n. gen.

(Pl. XLIII, figs. 1–16, Pl; XLVIII.)

Pupa case of medium size, elliptic in outline, yellowish to darker in color; margin toothed, the wax tubes but little developed; submarginal area separated from dorsal disk by an irregular row of small papillæ and marked by many suture-like lines; dorsal disk covered with patches of large mammiform papillæ; tracheal folds not discernible, wax secretion copious, of wool-like threads from the dorsal papillæ. Vasiform orifice broadly subcordate, the operculum about half filling it; caudal extremity of lingula exposed, lobed, and bearing a pair of spines.

Adult with one flexure in radial sector of forewing and no trace of media; antennæ of seven segments, of which the third is the longest, the four distal segments subequal. Ovipositor and labium extremely long.

Type, *timberlakei* Quaintance and Baker.

Species of the Genus Aleurotithius.

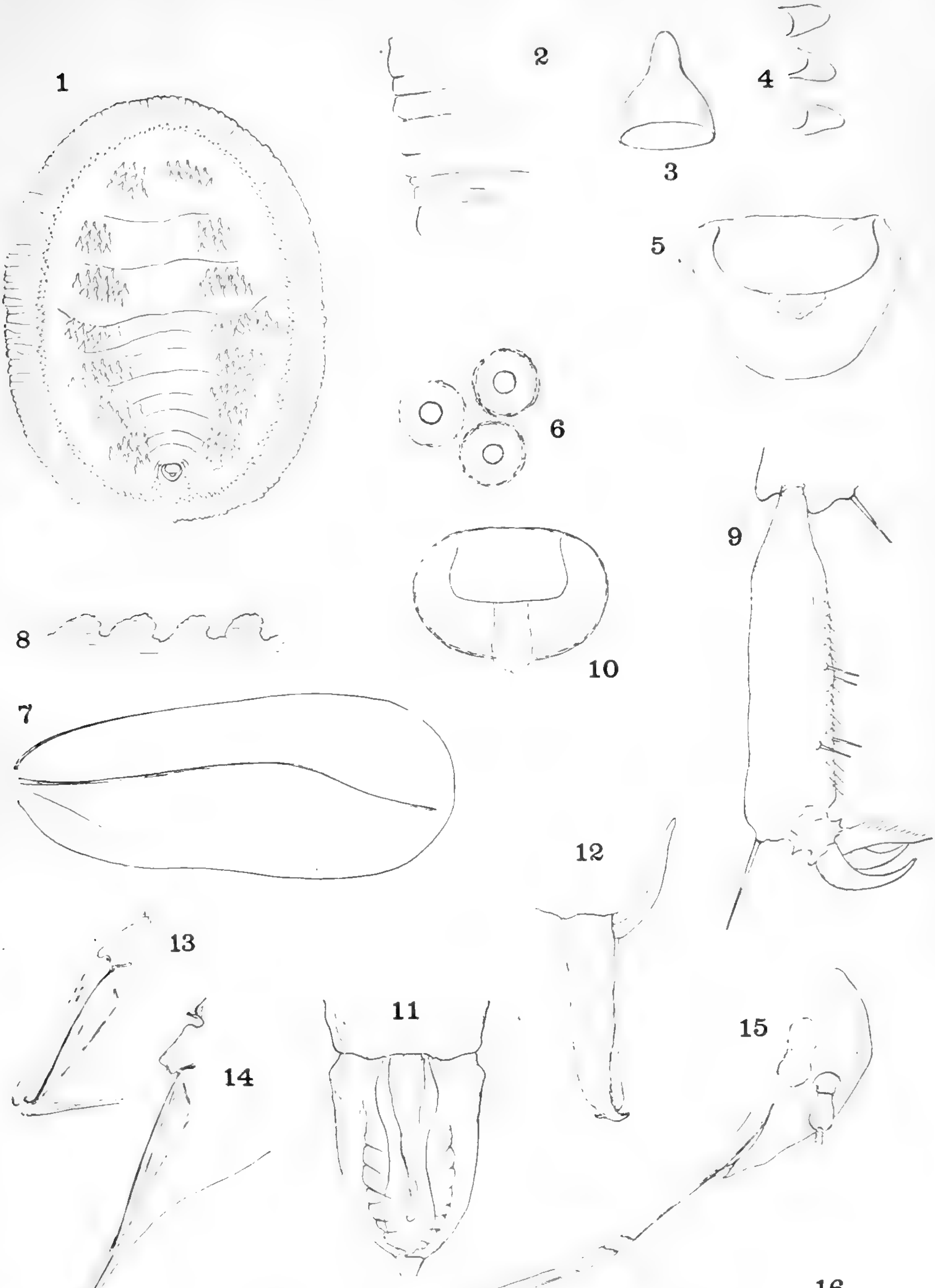
Aleurotithius timberlakei n. sp.

(Pl. XLIII, figs. 1–16; Pl. XLVIII.)

This species is represented in the collection by three lots of material. The first, Quaintance No. 8732, was collected by Mr. P. H. Timberlake, July 14, 1912, in the upper Sonoran Zone, San Jacinto Mountains, California. The second, Quaintance No. 8818, was forwarded by H. S. Smith and represents specimens collected by Mr. R. K. Bishop at Santa Ana, Cal. The third lot was sent by Mr. Bishop from Santa Ana, May, 1913. All specimens were collected on *Eriodictyon tomentosum*, commonly known as *Yerba santa*.

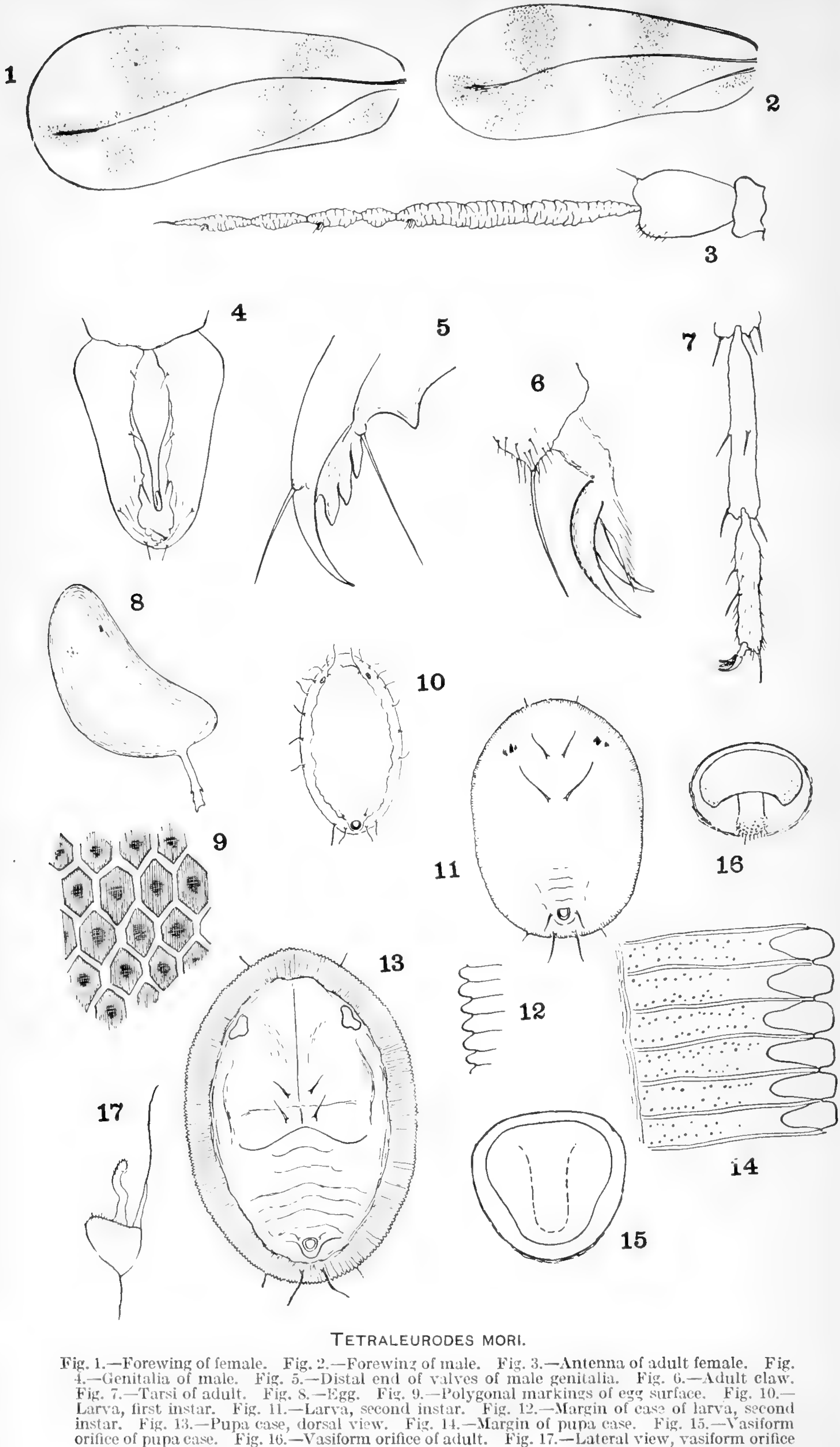
Pupa case (Pl. XLIII, fig. 1).—Size 1.008 by 0.72 mm.; shape elliptic; color pale yellowish. Submarginal area separated from dorsal disk by a series of small more or less conical papillæ (Pl. XLIII, fig. 4). Margin with the wax tubes as irregular teeth (Pl. XLIII, fig. 2) from which suture-like markings extend mesad across the submarginal area. Dorsum with the segments distinctly marked and possessing large numbers of prominent mammiform papillæ (Pl. XLIII, fig. 3). These are situated in groups on the subdorsal portions of the segments. Vasiform orifice (Pl. XLIII, fig. 5) broadly subcordate, with the anterior margin straight. Operculum similar in shape to the orifice and filling about one-third of it; distal extremity of the lingula exposed, and setose.

As seen on the leaf, there is a prominent rim of waxy secretion which elevates the case extremely from the leaf and there is an abundant dorsal secretion composed of more or less fused waxen rods from the mammiform papillæ.



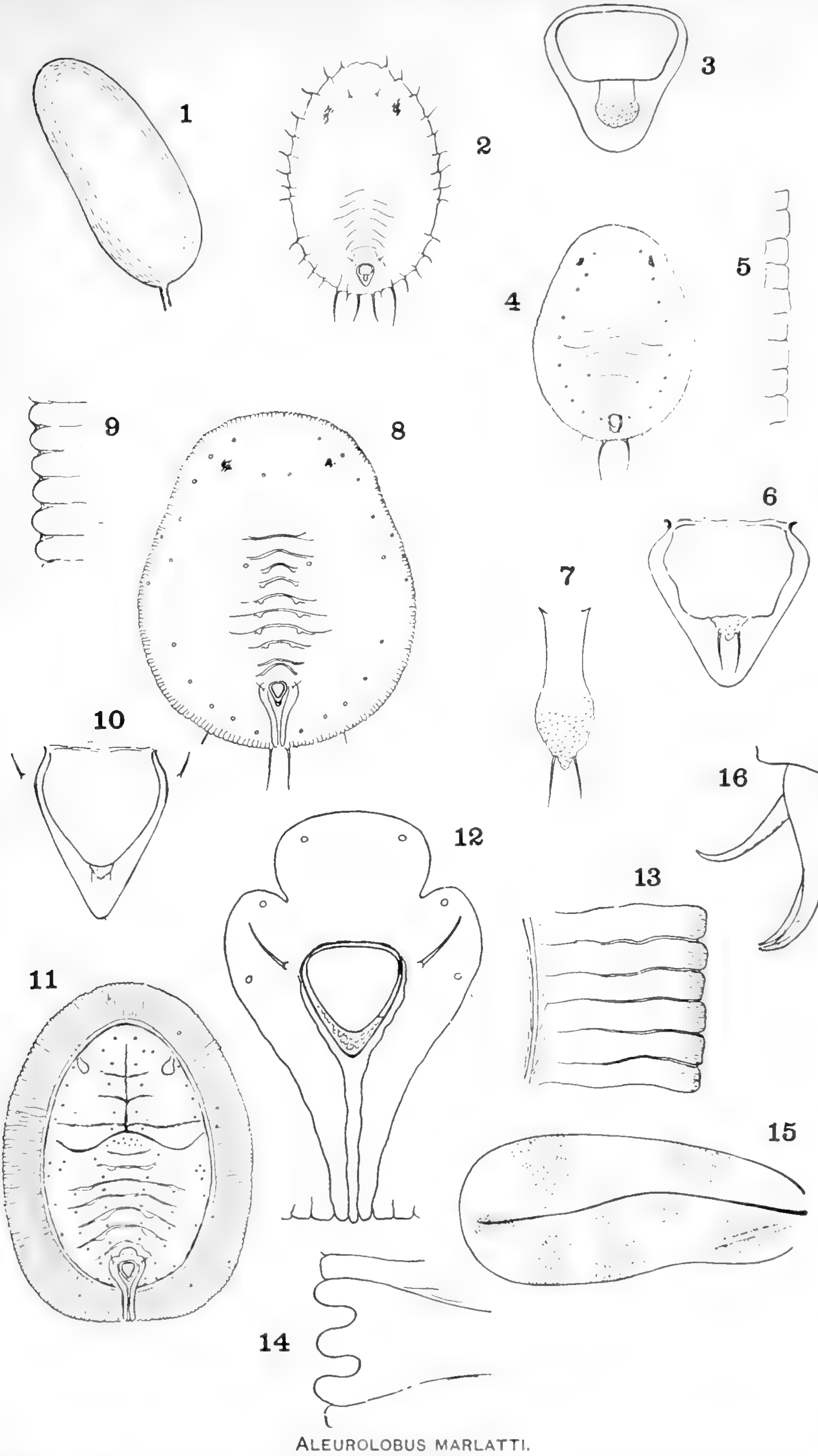
ALEUROTITHIUS TIMBERLAKEI.

Fig. 1.—Pupa case, dorsal view. Fig. 2.—Margin of pupa case. Fig. 3.—Dorsal papilla of pupa case. Fig. 4.—Papillæ of submarginal area of pupa case. Fig. 5.—Vasiform orifice. Fig 6.—Appearance of dorsal papillæ seen in dorsal aspect. Fig. 7.—Forewing. Fig. 8.—Margin of forewing. Fig. 9.—Distal segment of tarsus in claw of adult. Fig. 10.—Vasiform orifice of adult. Fig. 11.—Genitalia of male, dorsal view. Fig. 12.—Genitalia of male, lateral view. Fig. 13.—Ovipositor of female, showing ovipositor folded. Fig. 14.—Ovipositor of female with ovipositor extended. Fig. 15.—Mentum of adult. Fig. 16.—Antenna of adult. (Original.)



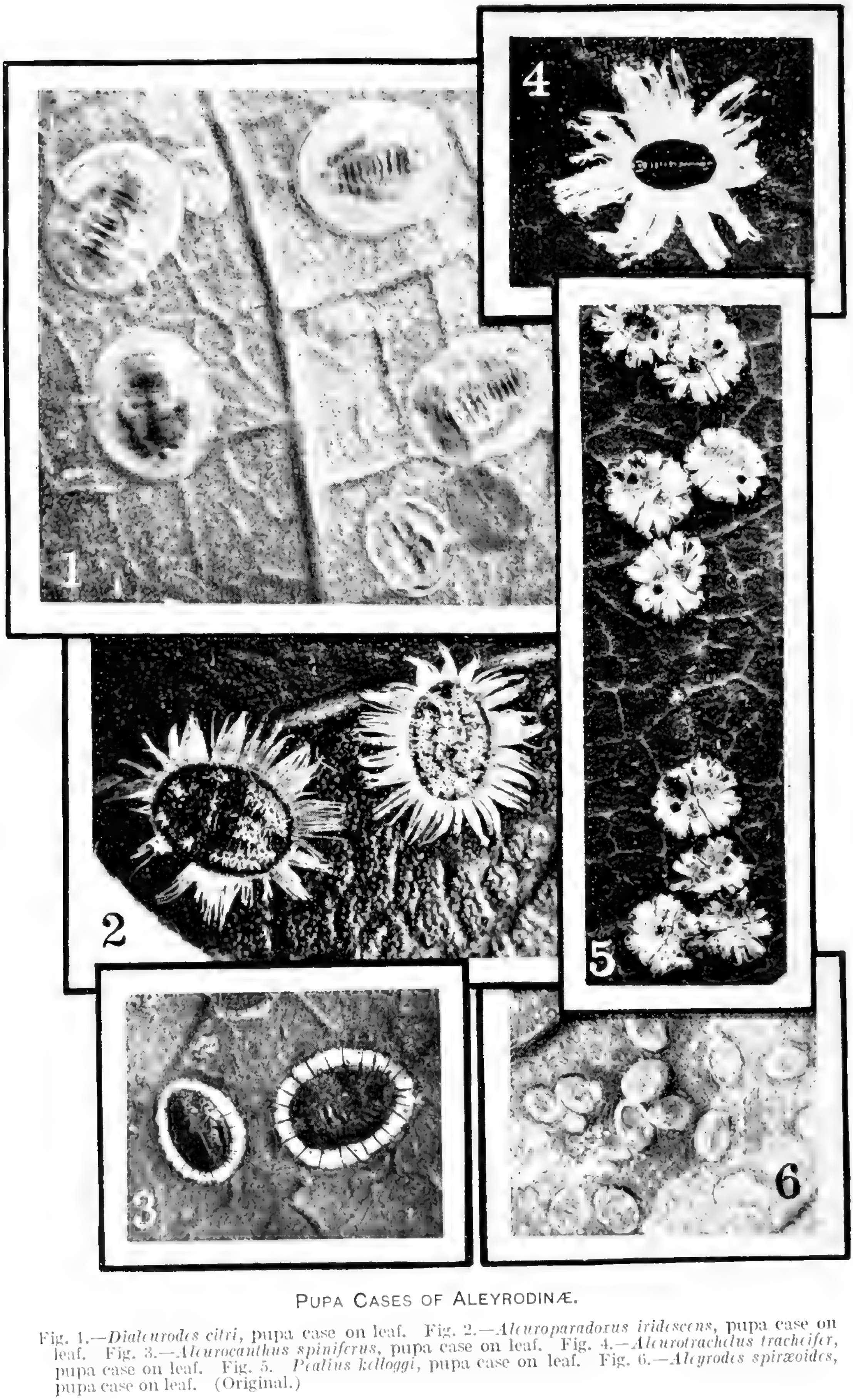
TETRALEURODES MORI.

Fig. 1.—Forewing of female. Fig. 2.—Forewing of male. Fig. 3.—Antenna of adult female. Fig. 4.—Genitalia of male. Fig. 5.—Distal end of valves of male genitalia. Fig. 6.—Adult claw. Fig. 7.—Tarsi of adult. Fig. 8.—Egg. Fig. 9.—Polygonal markings of egg surface. Fig. 10.—Larva, first instar. Fig. 11.—Larva, second instar. Fig. 12.—Margin of case of larva, second instar. Fig. 13.—Pupa case, dorsal view. Fig. 14.—Margin of pupa case. Fig. 15.—Vasiform orifice of pupa case. Fig. 16.—Vasiform orifice of adult. Fig. 17.—Lateral view, vasiform orifice of adult. (Original.)



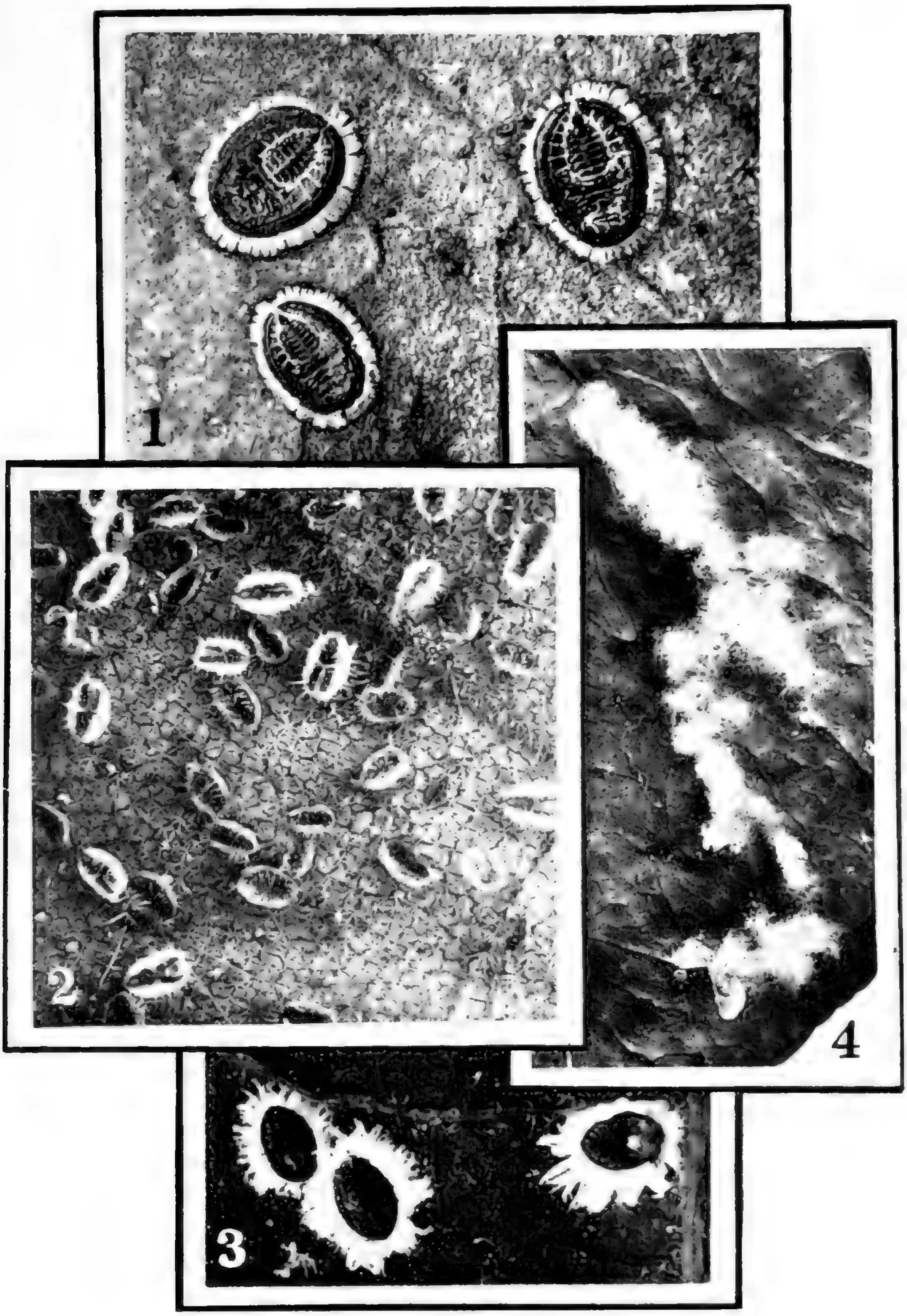
ALEUROLOBUS MARLATTI.

Fig. 1.—Egg. Fig. 2.—Larva, first instar. Fig. 3.—Vasiform orifice of larva, first instar. Fig. 4.—Larva, second instar. Fig. 5.—Margin of case of larva, second instar. Fig. 6.—Vasiform orifice of larva, second instar. Fig. 7.—Lingula of larva, second instar. Fig. 8.—Larva, third instar. Fig. 9.—Margin of case of larva, third instar. Fig. 10.—Vasiform orifice of larva, third instar. Fig. 11.—Pupa case, dorsal view. Fig. 12.—Vasiform orifice and surrounding trilobed area of pupa case. Fig. 13.—Margin of pupa case. Fig. 14.—Thoracic tracheal comb of teeth of pupa case. Fig. 15.—Forewing. Fig. 16.—Male genitalia, lateral view. (Original.)



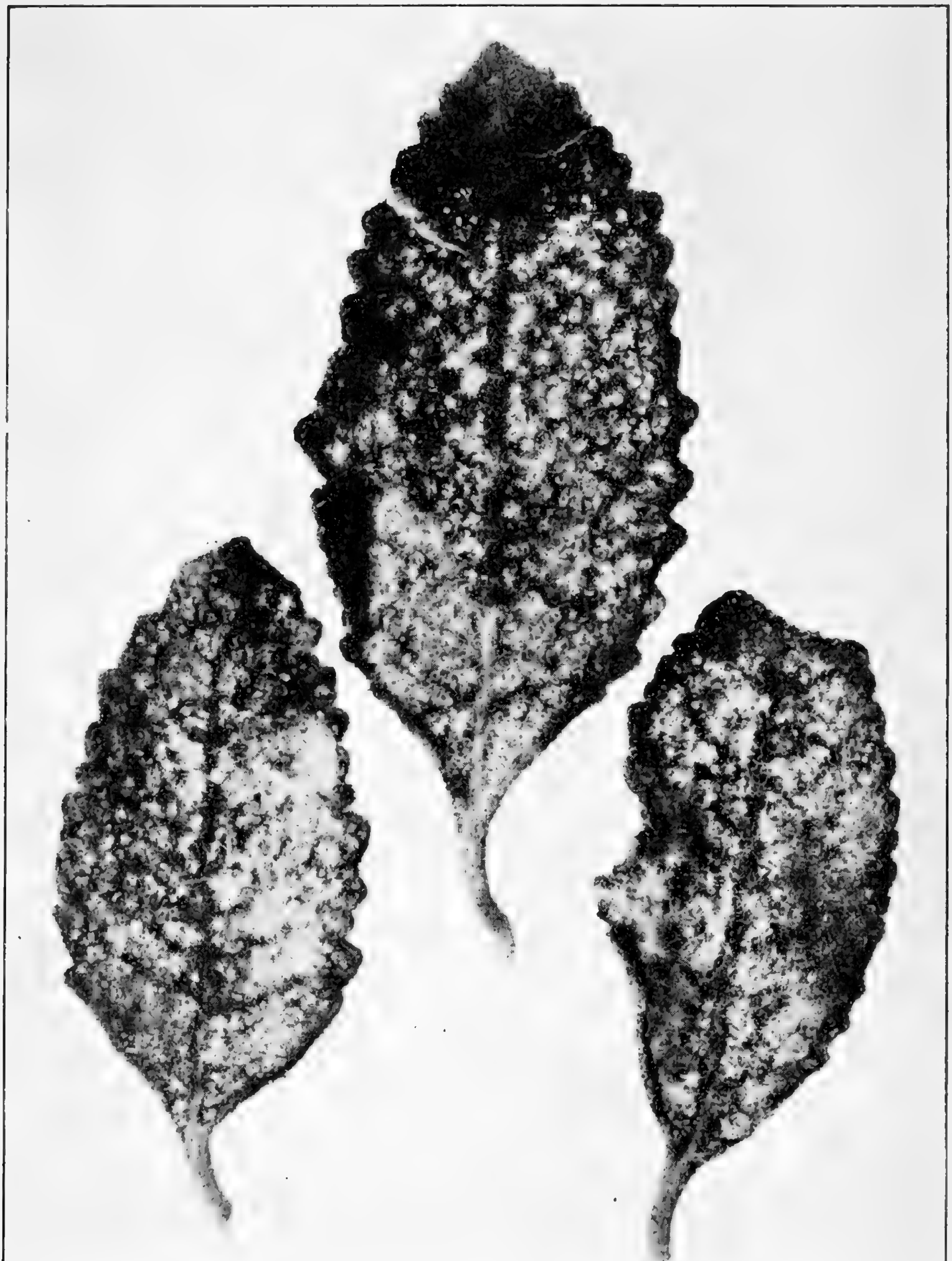
PUPA CASES OF ALEYRODINÆ.

Fig. 1.—*Dialeurodes citri*, pupa case on leaf. Fig. 2.—*Aleuroparadoxus iridescens*, pupa case on leaf. Fig. 3.—*Aleurocanthus spiniferus*, pupa case on leaf. Fig. 4.—*Aleurotrachelus trachoifer*, pupa case on leaf. Fig. 5. *Pealius kelloggi*, pupa case on leaf. Fig. 6.—*Aleyrodes spiræoides*, pupa case on leaf. (Original.)



PUPA CASES OF ALEYRODINÆ.

Fig. 1.—*Aleurolobus marlatti*, pupa case on leaf. Fig. 2.—*Asterochiton abutilonea*, pupa case on leaf. Fig. 3.—*Tetraleurodes mori*, pupa case on leaf. Fig. 4.—*Aleurothrixus howardi*, pupa case on leaf. (Original.)



ALEUROTITHIUS TIMBERLAKEI.

Aleurotithius timberlakei showing infestation of underside of leaves of *Eriodictyon tomentosum*. (Original.)

Adult female.—Length from vertex to tip of ovipositor with this organ folded 1.392 mm.; color brownish yellow, dusky on appendages; eyes and tip of labium dark brown. Forewing (Pl. XLIII, fig. 8) 1.52 by 0.64 mm., slightly shaded with dusky; radial sector in about the middle of the wing; margin (Pl. XLIII, fig. 9) armed with rounded teeth which appear to be devoid of hairs. Legs long, hind tibia 0.608 mm., hind tarsus, proximal segment 0.26 mm., distal segment 0.112 mm. Labium (Pl. XLIII, fig. 11) extremely long, particularly the distal segment, which is 0.384 mm., while the second segment is 0.08 mm. Ovipositor (Pl. XLIII, figs. 13, 14) extremely long and acute, usually carried folded (Pl. XLIII, fig. 13), in which position it measures 0.32 mm.; when extended, 0.608 mm. Antennal segments (Pl. XLIII, fig. 16) with the following proportional lengths: II, 0.067 mm.; III, 0.17 mm.; IV, 0.067 mm.; V, 0.075 mm.; VI, 0.0625 mm.; VII, 0.05 mm.; distal segments subcylindric, imbricated; III with a distal fringed sensorium and a stout spine; V and VII each with a circular fringed sensorium.

Adult male.—Similar to the female in general characters and color. Length 1.04 mm.; forewing 1.2 by 0.48 mm.; hind tibia 0.56 mm.; hind tarsus, proximal segment 0.192 mm., distal segment 0.096 mm.; labium with the distal segment 0.384 mm., and the second 0.08 mm. Claspers (Pl. XLIII, figs. 10, 15) somewhat straight, 0.208 mm. long, each clasper with a median longitudinal angle which is armed with a row of six or seven stout spines.

Type.—No. 1479, U. S. National Museum. Described from males and females in balsam mounts and pupa cases in balsam mounts and dry upon foliage. Quaintance No. 8830.

This species shows a remarkable adaptation to its host plant. The leaves of this plant, *Eriodictyon tomentosum*, are very hairy, so much so that aleyrodids with mouthparts of usual length could not feed upon them. In this species the mentum and setæ are much elongated, enabling the species to reach through the hairy covering and puncture the leaf tissue for food. Similarly the ovipositor is greatly elongated to enable the female to place its eggs directly on the leaf epidermis—the universal habit among species of this family.

Genus **TETRALEURODES** (Cockerell) n. gen.

(Pl. XLIV, figs. 1–17; Pl. XLVII, fig. 3.)

Pupa case variable in size, elliptic to broadly oval in outline, usually dense black in color; margin of case with distinct teeth, the wax tubes usually well developed; submarginal area separated from dorsal disk and conspicuously fluted by suture-like lines; dorsum without papillæ, though minute pores may be present; reniform "eye spots" often evident on cephalic portion of case; tracheal folds, as a rule, not discernible; wax secretion usually a more or less copious fringe from marginal wax tubes. Vasiform orifice small, subcordate, sometimes rounded; operculum similar in shape and almost entirely filling the orifice, obscuring the lingula; orifice usually elevated on a tubercle-like projection of the dorsum.

Adult with one flexure in radial sector of forewing and no trace of media. Antennæ of seven segments, of which the third is the longest. Sexes about equal in size.

Type, *perileuca* Cockerell; example, *mori* Quaintance.

SPECIES OF THE GENUS TETRALEURODES (Ckll).

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T. acaciæ (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 19 (1900). (California; Mexico.)

T. asparagi (Lewis), Journ. Quekett Microsc. Club (2), vol. 6, p. 88 (1895). (Natal.)

T. aucubæ (Kuwana), Pomona Journ. Ent., vol. 3, no. 4, p. 625 (1911). (Japan.)

T. corni (Haldeman), Amer. Journ. Sci. & Arts, vol. 9, p. 109 (1850). (Pennsylvania.)

T. dorseyi (Kirkaldy), Bul. 2, Div. Ent. Bd. Comm. Agr. & Forestry, Hawaii, p. 52 (1907). (California.)
Syn.: *quaintancei* Bemis.

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T. marginata (Newstead), Mitteil. aus dem zool. Mus. in Berlin, vol. 5, pt. 2, p. 172 (1911). (East Africa.)

T. melanops (Cockerell), Bul. 67, Fla. Agr. Exp. Sta., p. 665 (1903). (California.)

T. mori (Quaintance), Canad. Ent., vol. 31, p. 1 (1899). (Eastern United States.)

T. mori maculata (Morrill), Psyche, vol. 10, p. 81 (1903). (Massachusetts.)

T. mori arizonensis (Cockerell), Science Gossip, n. s., vol. 6, p. 366 (1900). (Arizona.)

T. nigrans (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 522 (1904). (California.)

T. perileuca (Cockerell), Bul. 67, Fla. Agr. Exp. Sta., p. 664 (1903). (California; Texas.)

T. plumosa (Quaintance), Tech. Ser. 8, Div. Ent., U. S. Dept. Agr., p. 33 (1900).

T. splendens (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 489 (1904). (California.)

T. stanfordi (Bemis), Proc. U. S. Nat. Mus., vol. 27, p. 508 (1904). (California.)

T. stellata (Maskell), Trans. New Zealand Inst., vol. 28, p. 442 (1895). (Australia.)

T. styphelix (Maskell), Trans. New Zealand Inst., vol. 28, p. 442 (1895). (Australia.)

T. ursorum (Cockerell), Canad. Ent., vol. 42, p. 171 (1910). (Colorado.)

Genus ALEUROLOBUS n. gen.

(Pl. XLV, figs. 1–16; Pl. XLVII, fig. 1.)

Pupa case of medium size, subelliptic to oval in outline; color usually dark brown to blackish; margin toothed, the wax tubes only moderately developed; submarginal area separated from dorsal disk and much fluted by suture-like lines; dorsum without papillæ, though minute pores may be present; tracheal folds evident in some species, though obscure or wanting in others; when present terminating on margin of case in a few specialized teeth; reniform "eye spots" usually present on cephalic portion of case; wax secretion usually present as a narrow fringe from marginal wax tubes, and sometimes on dorsum. Vasiform orifice subcordate; operculum similar in shape, almost filling the orifice, obscuring the lingula; orifice surrounded by a definite trilobed figure, the lobes of which form a channel from the orifice caudad to margin of case.

Adult with a single flexure in radial sector of forewing and no spur of media; wings usually marked with reddish. Antennæ of seven segments; in the female, III longest; in the male, VII often as long or longer than other segments together.

Type, *marlatti* Quaintance.

Species of the Genus Aleurolobus.

A. barodensis (Maskell), Trans. New Zealand Inst., vol. 28, p. 242 (1895). (India.)
A. longicornis (Zehntner), Arch. Java Suikerind., vol. 5, p. 381 (1897). (Java.)
A. marlatti (Quaintance), Canad. Ent., vol. 34, p. 61 (1902). (Japan.)
A. niger (Maskell), Trans. New Zealand Inst., vol. 28, p. 437 (1895). (Australia.)
A. simula (Peal), Journ. Asiat. Soc. Bengal, vol. 72, p. 81 (1903). (India.)
A. taonabæ (Kuwana), Pomona Journ. Ent., vol. 3, no. 4, p. 623 (1911). (Japan.)

UNPLACED SPECIES OF THE OLD GENUS ALEYRODES.

The writers have not been able satisfactorily to place the following species of the old genus *Aleyrodes* in any of the foregoing genera on account of inadequate descriptions. It is hoped that those familiar with these species will indicate their proper systematic position.

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A. avellanæ Signoret, Ann. Soc. Ent. France (4), vol. 8, p. 385 (1867). (France.)
A. carpini Koch, Die Pflanzenlaüse Aphiden, p. 327 (1857). (Europe.)
A. complanatum (Bärensprung) D'Alton & Burmeister, Zeit. f. Zool., vol. 1, p. 169 (1849); Spec. Bul. 88, Mass. Agr. Exp. Sta., p. 330 (1903). (Germany.)
A. euphorbiæ Loew, Verhandl. zool.-bot. Ges. Wien, vol. 17, p. 746 (1867). (Austria.)
A. filicicola Newstead, Mitteil. aus dem zool. Mus. in Berlin, vol. 5, pt. 2, p. 174 (1911). (East Africa.)
A. fraxini Signoret, Ann. Soc. Ent. France (4), vol. 8, p. 386 (1867). (France.)
A. gossypii Fitch, Third Rep. Nox. and other Ins. N. Y., p. 332 (1857). (Ningpo, China.)
A. goyabæ Goeldi, Mittheil. schweiz. ent. Ges., vol. 7, p. 248 (1886). (Rio de Janeiro, Brazil.)
A. jelinckii Frauenfeld, Verh. zool.-bot. Ges. Wien, p. 799 (1867). (France; Austria.)
A. tabaci Gennadius, Agricolt. Ellenica (Gennaio) (1889); also Targioni-Tozetti, Animali ed. Ensetti del Tobacco, p. 246 (1892). (Greece.)
A. tinæoides Blanchard, Hist. Fisica y Polit. de Chile, Zoologia, vol. 7, p. 320 (1840). (Chile.)
A. vaccinii Kunow, Ent. Nachr., vol. 6, p. 48 (1880). (Germany.)
A. zimmermanni Newstead, Mitteil. aus dem zool. Mus. in Berlin, vol. 5, pt. 2, p. 173.

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