Pomona College Journal *of* Entomology

Volumes I and II
1909-1910

V.1 no.1 (Mr. 1909) - V.1 no.3 (Oct. 1909)
called Pomona journal of entomology

PUBLISHED QUARTERLY BY THE
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Claremont, California, U. S. A.

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Pomona Journal of Entomology

Volume I MARCH 1909 Number 1

APHIDIDAE OF SOUTHERN CALIFORNIA I

E. O. ESSIG.

Under this title we propose to make an extended series of studies on the plant lice found in Southern California, with the hope that they may eventually be gathered in a complete manual of the group for this region. Many of the earlier species and even generic references must of a necessity be merely tentative, all of our knowledge of the group in America being, so far, extremely fragmentary.

Lachnus californicus, n. sp.

WINGED VIVIPAROUS FEMALE.—Length 1.6 mm., width 0.5 mm., wing expansion 5.3 mm. Prevailing color—green, but individuals are found varying all the way between green and brownish-yellow. The eyes and abdominal dots are red. (Figure 1.)

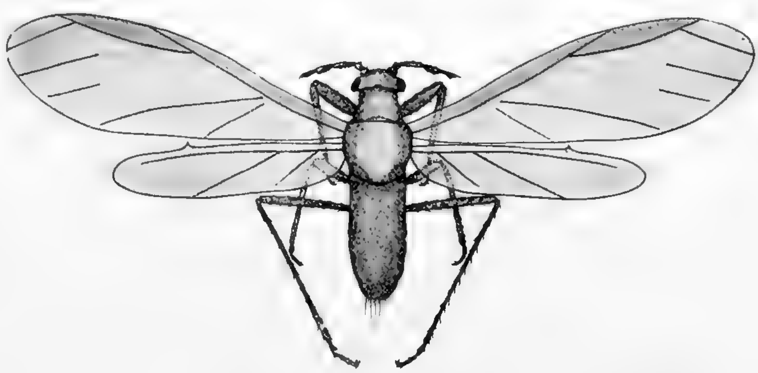


Figure 1. Lachnus californicus

Head—Short and nearly as wide as thorax, with short hair on frontal margin between the antennae. Compound eyes—large, round, red. *Antennae* (Figure 5, K) arise from no frontal tubercles, somewhat darker than the body, shorter than body 0.67 mm. long, six-jointed, hairy, with an apical nail-like process on the fifth article. The lengths of the respective articles are: I 0.07 mm., II 0.08 mm., III 0.26 mm., IV 0.13 mm., V 0.13 mm. The sensoria are distributed as follows: I and II none, III four large and one small cir-

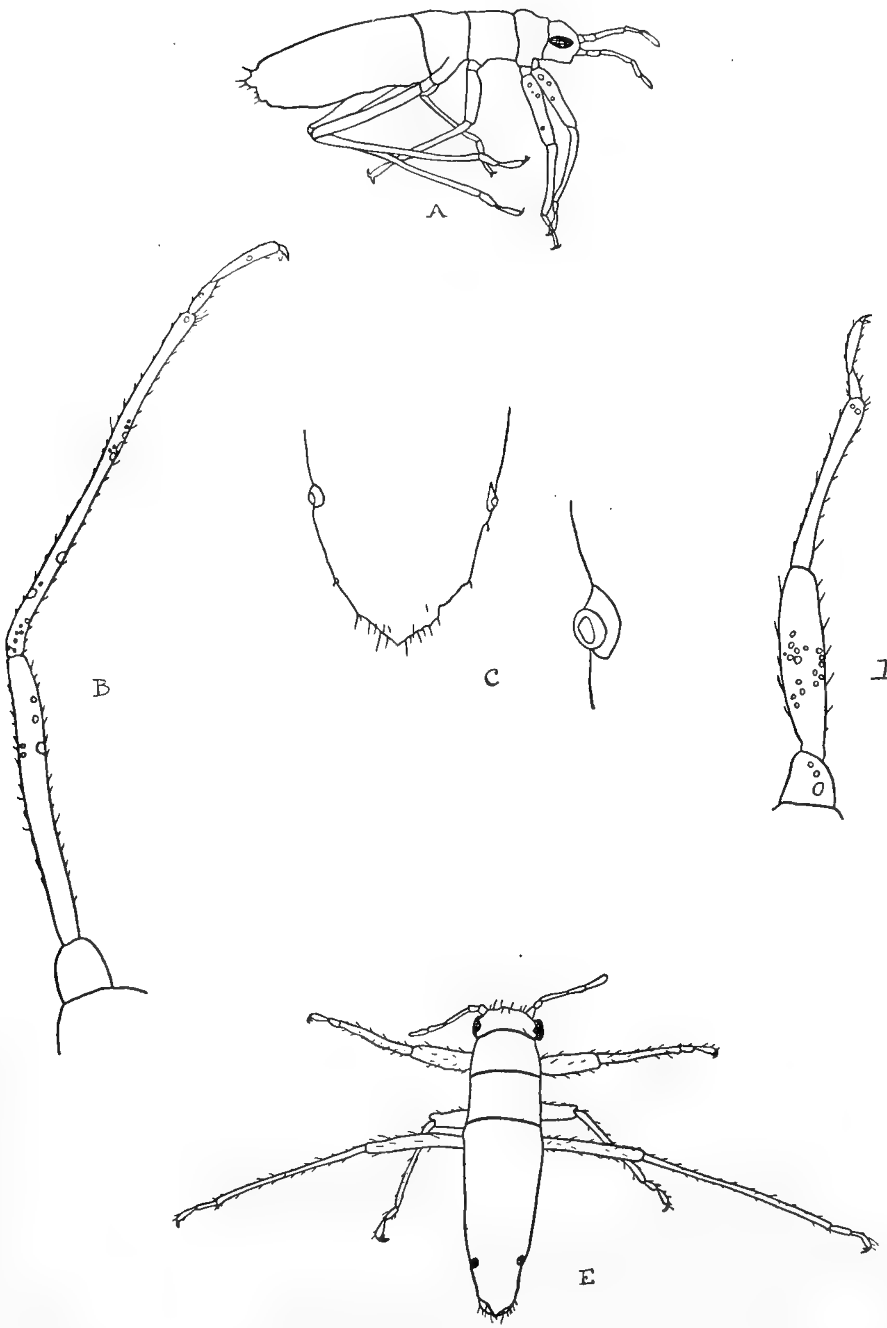


Figure 2. Lachnus californicus

cular, IV one large circular, V one terminal surrounded by five marginal—all in the apical process. *Pro-thorax*—lateral tubercles wanting. *Rostrum*—not half as long as the body. *Abdomen*—very indistinctly segmented and covered with numerous red dots. *Cornicles*—truncate, nearly obsolete. *Legs*—Hairy, very long, due to the enormous lengths of the tibia, and especially the tibia of the hind legs which are very long; they have no sensoria. The lengths of the tibia of the respective legs are: pro-thoracic 0.51 mm., meso-thoracic 0.57 mm., meta-thoracic 1.1mm. These long legs enable the aphid to move very rapidly. The hind legs are especially adapted for clinging to the slender pine needles along which it moves at a great rate. *Wings*—Entirely clear, *primary*—length 2.4 mm., width 0.75 mm. *Cubitus*—well defined. *Stigmal*—nearly straight, marking lower margin of a narrow distinct stigma. *Radius*—straight, extending from stigmal vein to margin. Of the third oblique only two remnants remain, showing that it was undoubtedly once forked. The first and

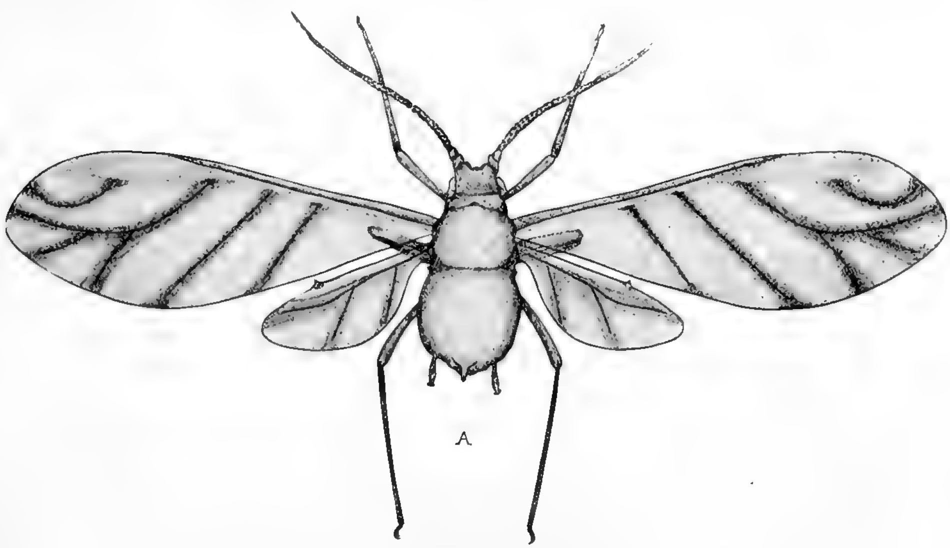


Figure 3. Rhopalosiphum violae

second obliques are straight. They arise together about the middle of the cubitus and extend to the margin. *Secondary*—length 1.63 mm., width 0.32 mm. Two discoidals. *Subcostal*—well marked and extending to tip of the wing. The *first discoidal* arises from the sub-costal near the base and extends nearly to the margin of the wing. The *second discoidal* arises from the sub-costal at a distance from the first discoidal equal to the distance from the first discoidal to the base of the wing and extends nearly to the margin. *Cauda*—rounded, slightly hairy. *Style*—obsolete.

Apterous Viviparous Female.—(Figure 2.) Length 1.6 mm., width 0.5 mm. Differs from the winged form as follows: On the antennae (Figure 5, I) the sensoria are distributed as follows: I and II none, III many large circular, IV four large circular, V one terminal surrounded by several marginal in the process. On the legs the sensoria are distributed as follows:

Pro-thoracic, three large circular on coxa, many smaller ones scattered along the femur; meta-thoracic, few on femur, many on tibia, one on the tarsi.

NYMPH OF APTEROUS VIVIPAROUS FEMALE.—These young are about one-seventh as large as the adult and are like them in color and form. The antennae (Figure 5, J) are four-jointed, about 0.3 mm. in length; with an apical nail-like process on the last article. The respective lengths of the articles are as follows: I 0.075 mm., II 0.15 mm., III 0.038 mm., IV 0.037 mm. There are no sensoria. The abdomen is more distinctly segmented than in the adult form. The rostrum is nearly as long as the body.

Common on some cultivated pines at Claremont, California, during the winter of 1908-09. Their presence would pass unnoticed except for beating the boughs which yields many specimens of this long-legged active species. Like certain other Lachnus it presents some strong affinities with the genus Schizoneura. It seems to find its nearest relative in *Lachnus agilis* Kalt., but differs in wing formation and other prominent features.

Rhopalosiphum violae, n. sp.

WINGED VIVIPAROUS FEMALE.—Length 1.4 mm., width 0.75 mm.. wing expanse 6.05 mm. Prevailing color—dark wine-red. Legs, antennae, cornicles, and style—pale brown. (Figure 3.)

Head—Nearly as broad as long; considerably narrower than thorax. Compound eyes—large with long terete (ocellar—?) tubercles just behind near the posterior border. *Antennae* (Figure 5, O) arise from large prominent frontal tubercles and are transversely scabrous with a basal nail-like process on article VI; are longer than the body, 2.34 mm., and are made up of six joints. The lengths of the respective articles are as follows: I 0.08 mm., II 0.05 mm., III 0.01 mm., IV 0.51 mm., V 0.46 mm., VI 0.84 mm. The sensoria are distributed as follows: I and II none, III large number—large and circular, IV four large circular, V one large circular on distal end, VI one large terminal and several smaller marginal in the process. There are several terminal sense hairs on tip of this article. *Rostrum*—half as long as the body. *Pro-thorax*—no distinct lateral tubercles. *Abdomen*—smooth. Cornicles—incrassate, almost clavate in form, 0.25 mm. long. *Legs*—slightly hairy, moderately long, without sensoria. *Wings—Primary,* length 2.65 mm., width 0.98 mm., veins well marked, broadly clouded along margins. The cubitus is distinct, separating off a broad well-defined stigma of trapezoidal shape. The radius is sharply curved. Of the three obliques, the third is twice forked, the second curves in slightly near the margin, the first is straight. *Secondary*—length 1.3 mm., width 0.51 mm. Have a well-defined *sub-costal* extending the entire length, with two discoidals. Of these the first arises from the sub-costal a third of its distance from the body, and the second arises from the sub-costal two-thirds of its distance from the body to the wing-tip. *Style*—prominent and somewhat upturned.

APTEROUS VIVIPAROUS FEMALE.—Length 1.2 mm., width 0.70 mm. Differs from winged form as follows: No sensoria and fewer sense-

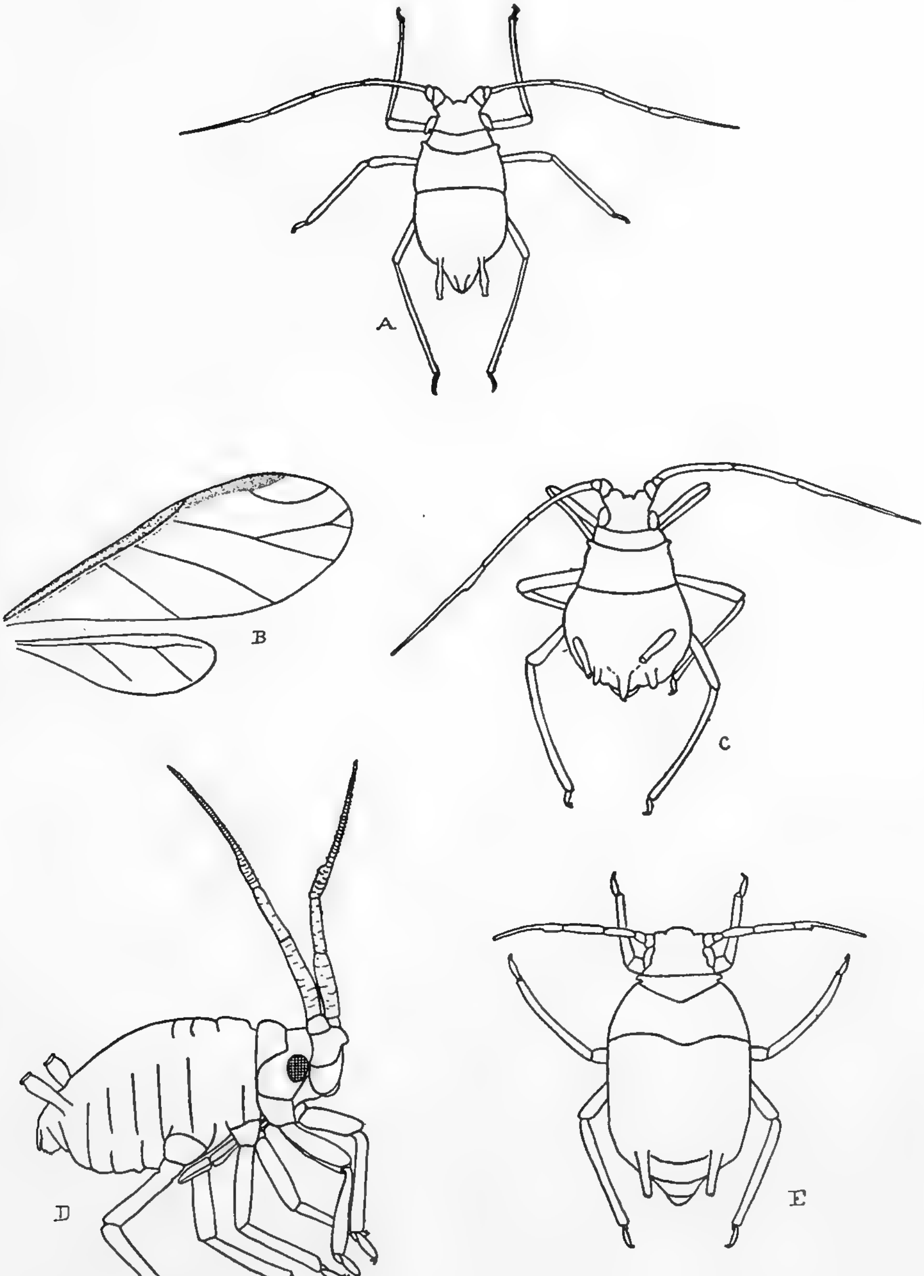
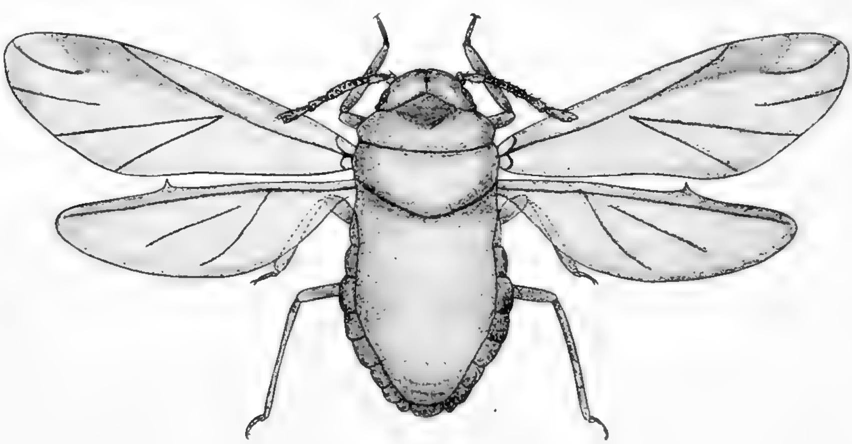


Figure 4. Rhopalosiphum violae

hairs on the antennae (Figure 5, N). The cornicles are usually longer, in this case being 0.27 mm. in length. In one individual there were two distinct tubercles arising from the abdomen just outside of the cornicles. (Figure 4, A and C.)

Nymph of Apterous Viviparous Female.—These young are about one-sixth the size of the adult and are like them in most respects. In color they are somewhat lighter in shade—the eyes, however, are very dark. The antennae are made up of but five joints, the fifth being very long, with basal nail-like process. All of the articles except the first two are transversely scabrous. They have no sensoria. The rostrum is longer than the body. The cornicles are short, stout, and clavate in form. The style is obscure. (Figure 4, D.)

Taken from the lower side of leaves of the common cultivated blue violet at Claremont, Calif., Nov. 12, 1908. In no case were they found in any considerable numbers on any single plant, but occurred in twos and threes on a leaf.



B

Figure 6. Pemphigus radicicola

Rhopalosiphum violae (form ?)

On the same plants and mingled with the wine-colored forms described above are found numerous green individuals, both winged and apterous, which differ in some characters supposedly of generic value. Possibly one or other of the forms may be a migrant generation. Although these two forms are closely associated on the same leaves of the cultivated blue violet, there is a chance that the green forms are a different species after all. With the coming of the spring broods this can be ascertained more definitely. In the meantime a full description of the green form is here given.

Winged Viviparous Female.—Length 1.69 mm., width 0.8 mm. Prevailing color—dark green. *Legs*—lighter. *Thorax*—darker. (Figure 4, B.) *Head*—Nearly as broad as long, and considerably narrower than the

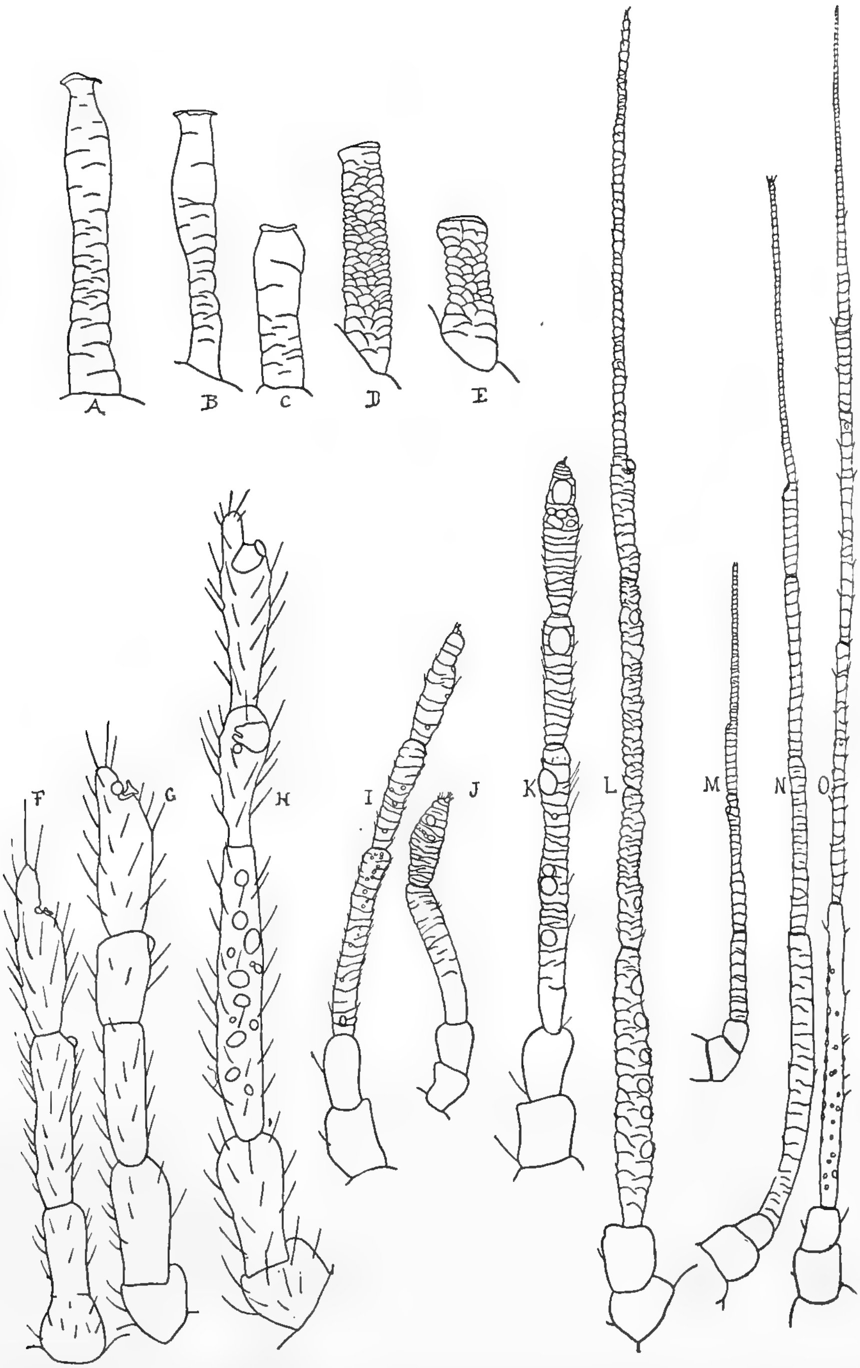


Figure 5. A, B, C, Rhopalosiphum violae; D, E, R. violae (form ?); F, G, H. Pemphigus radicicola; I, J, K, Lachnus californicus; L, M, Rhopalosiphum violae (form ?) N, O, Rhopalosiphum violae.

thorax. Compound eyes—large and dark, with long terete (ocellar?) tubercles just behind near the posterior border. Antennae (Figure 5, L) arise from large frontal tubercles, are six-jointed, 1.83 mm. long, transversely scabrous, with a basal nail-like process on the sixth article. The lengths of the respective articles are as follows: I 0.07 mm., II 0.09 mm., III 0.4 mm., IV 0.22 mm., V 0.3 mm., VI 0.75 mm. The sensoria are distributed as follows: I and II none, III row of six large circular, IV one large circular near middle, V one large circular near distal end, VI one large terminal surrounded by several small marginal in the process. *Pro-thorax*—with distinct lateral tubercles. *Rostrum*—half as long as body. Abdomen covered with numerous short tubercles. *Cornicles*—cylindrical, 0.25 mm. long, and transverself scabrous.

Wings—Clear. *Primary*—length 2.24 mm., width 0.83 mm. *Cubitus*—well defined. *Stigma*—long and slender. *Radius*—sharply curved. The third oblique is twice forked. (In this form the second fork of the third oblique is much nearer the margin than in the wine-red form.) The first and second obliques are straight and extend to the margin. *Secondary*—length 1.12 mm., width 0.37 mm. They have well defined subcostal extending to the tip of the wing and two discoidals. The first discoidal joins the sub-costal at a distance of one-third and the second discoidal joins it at two-thirds distance from base to wing-tip. *Style*—prominent, conical, hairy.

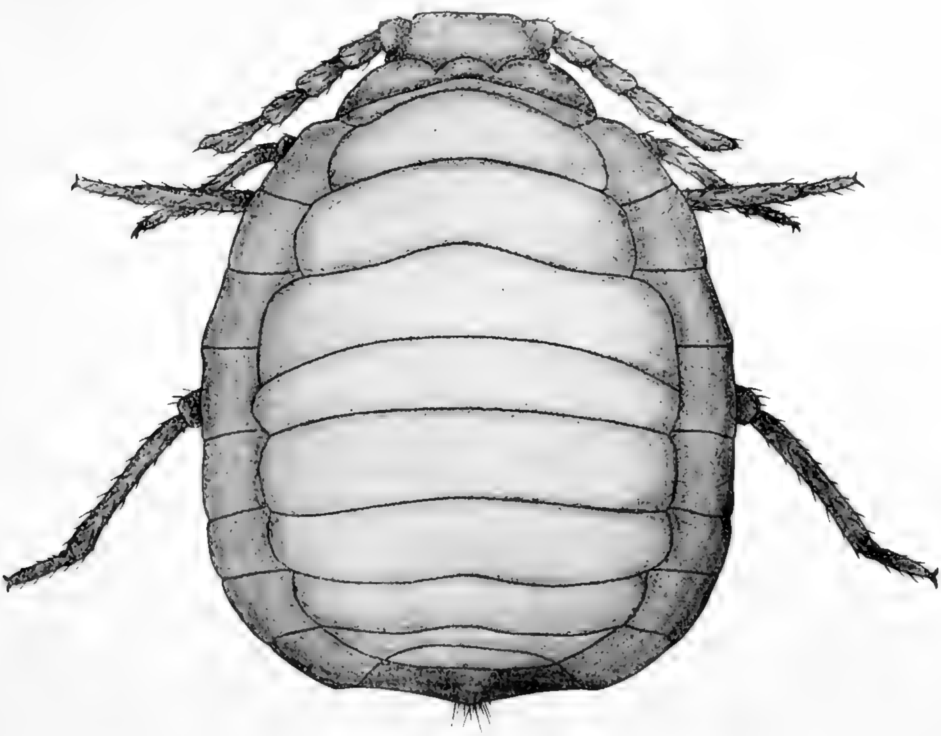
Apterous Viviparous Female.—Length 1.67 mm., width 0.78 mm. Differs from winged form as follows: The distribution of the sensoria (Figure 5, M) is as follows: I, II, III and IV none, V one large circular near the distal end, VI one large terminal in the nail-like process. Sense-hair—few. Cornicles ..21 mm. long. (Figure 4, E.)

It will be noted that the pro-thoracic tubercles of this green form ally it apparently to the genus Macrosiphum. It is, however, for the present left with *Rhopalosiphum violae.*

Pemphigus radicicola, n. sp.

Winged Viviparous Female.—Length 1.9 mm., width 0.8 mm., wing expanse 4.6 mm. Prevailing color—dark brown. *Thorax* and *antennae*—somewhat darker. *Legs*—lighter. *Shape*—nearly cylindrical. (Figure 6.)

Head—Short, broader than long. Vertex bisected by a distinct suture. Narrower than thorax. Compound eyes—large, with prominent terete (ocellar?) tubercles just behind near the posterior border. *Antennae* (Figure 5, H) do not arise from frontal tubercles; five-jointed; 0.85 mm. long; with an apical nail-like process on last article. The lengths of the respective articles are as follows: I 0.06 mm., II 0.12 mm., III 0.38 mm., IV 0.12 mm., V 0.17 mm. The distribution of the sensoria is as follows: I and II none, III many large and small circular ones, IV one large terminal and one large marginal near the proximal end, V one large cup-shaped terminal surrounded by several irregular marginals in the process. *Pro-thorax*—without lateral tubercles. *Rostrum*—half as long as body. *Abdomen*—very distinctly segmented along sides. Breathing spiracles along sides are very prominent, and raised on small tubercles. *Cornicles*—wanting. *Legs*—short, hairy, without sensoria. *Wings*—sub-hyaline, the veins lightly pigmented along margins. *Primary*—length 1.9 mm., width 0.67 mm. *Cubitus*—well defined. *Stigma*—short and broad, nearly trapezoidal in shape. *Radius*—curved. The third oblique presents but two straight remnants near the margin. A slight vein-trace shows a connection to form the forks. The first and second obliques arise from the same point near the cubitus and fork towards the margin. *Secondary*—length 1.5 mm., width 0.47 mm., with two discoidals. The first and second discoidals arise from the same point on the sub-costal about one-third its length from the wing base and extend nearly to the margin. The first curves away from the base while the second oblique curves towards the base of the wing. *Cauda*—rounded and hairy. *Style*—wanting.



A

Figure 7. Pemphigus radicicola

Apterous Viviparous Female.—Length 1.42 mm., width 1.19 mm. Differs from the winged form as follows: Prevailing color—mealy-white, sometimes shading off into a gray. The eyes are very dark.

Head—Without bisecting suture, nearly straight across frontal margin. Compound *eyes*—round, very small *antennae* (Figure 5, G)—lengths of the articles as follows: I 0.06 mm., II 0.13 mm., III 0.16 mm., IV 0.09 mm., V 0.18 mm.—total length 0.62 mm. The sensoria are distributed as follows: I, II and III none, IV one large circular near distal end, V one large cup-shaped terminal surrounded by several marginals in the process. *Abdomen*—deeply segmented. (Figure 7.)

Nymph of Viviparous Apterous Female.—These young are about one-tenth as large as the adult, and resemble them in most respects. The body is very hairy. The *antennae* (Figure 5, F) are longer than the body, very hairy, four-jointed, 0.53 mm. long (nearly as long as in adult), with an apical nail-like process on last article. The comparative lengths of the articles are as follows: I 0.05 mm., II 0.09 mm., III 0.19 mm., IV 0.19 mm. The sensoria are distributed as follows: I and II none, III one large circular near distal end, IV one large cup-shaped terminal surrounded by several marginal in process. *Rostrum*—longer than body. *Abdomen*—slender compared with adult.

This aphid was first taken at Santa Paula, Calif., Nov. 1, 1908, where it occured in considerable numbers on the roots of *Amaranthus retroflexus*. At Claremont it occurs in great numbers on the roots of *Solanum douglasii*. For several months I was unable to obtain winged specimens, which led me to place it in the genus Tychea. Late in January were obtained the winged form which showed it to belong to the genus Pemphigus.

NOTES ON COCCIDAE I

E. O. ESSIG.

Aspidiotus hederae

IVY SCALE, OLEANDER SCALE, LEMON PEEL SCALE.

Perhaps there is no other scale in this locality which utilizes more plants for food than this one. From the various names given it we may conclude as to the principal host plants. It is found very thick on English Ivy. There are few such plants in this district which are not infested with it. So to many it is known as Ivy Scale. But on oleander it seems to thrive best. Not infrequently we find it so thick as to completely cover the entire surface of the leaf. It is found on many of the domesticated plants in the gardens and seems to feed on almost anything. In this county it has done little or no damage because as yet it has not taken to the citrus trees. However, this is not the case in all other localities. Figure 8 shows this scale infesting a lemon. This and many other specimens were obtained from P. E. Smith, Horticultural Commissioner of Ventura County. The picture tells the story. There it is known as the Lemon Peel Scale, and is a very bad pest. Perhaps it may never be so here, but who knows? It takes a long time to reveal all the characteristics of some of the scales. In new localities they may struggle along for years before they become acclimatized and do any damage. Because this insect has done no harm here to the citrus industry in the past is no proof that it will never do so. Anyway its record in other places stamps it as an unwelcome visitor.

Chrysomphalus citrinus

YELLOW SCALE.

The opinion has generally been held by most entomologists that when an armored scale once settled and secreted her shell, she never moved again from her resting-place. A very interesting thing has just come to notice in regard to the yellow scale, which may throw some new light upon this question. After examining countless numbers of leaves infested with this scale it appears that the adult scale does move to a slight degree, in some cases almost an inch, between the time she first secretes her shell until death. Where this scale feeds no one can fail to notice the light yellow traces produced upon the leaf. In not a few cases there is left a distinct scar along the middle

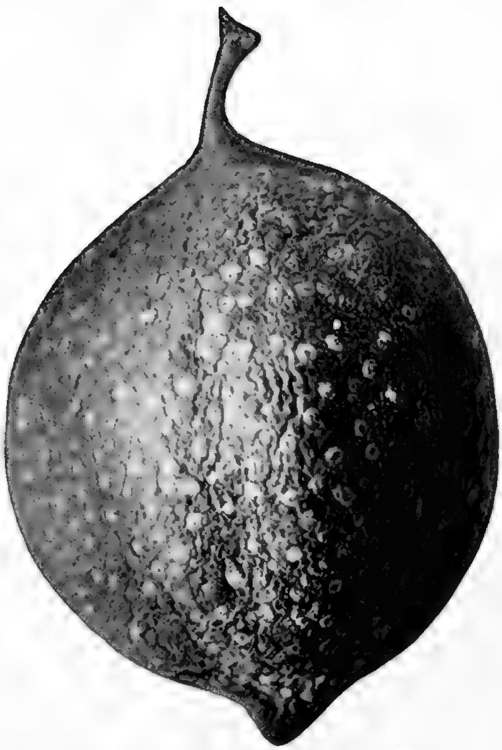


Figure 8. Aspidiotus hederae on lemon

of the trace, probably due to thrusts of the beak. The evidence seems to show that after the scale has sapped a portion of the leaf, it is able to pull out its rostrum and thrust it into the adjacent cells, and thus move slowly along. This is necessarily a slow process, as is shown by the fact that the longest traces are less than an inch in length, and that these traces represent months of the life of the scale.

There is no other supposition tenable, for it is certain that the rostrum of a scale cannot be so manipulated as to penetrate such distances. Many of the traces cross the midrib ,and extend for some distance on both sides, —others are half circles,—all going to show that the scale must have actually moved, leaving the yellow trace of withered tissue behind her. A similar though not so well defined a movement, is observable in the red scale.

Saissetia oleae

BLACK SCALE.

At this season of the year we find on the citrus trees only young black scale. The last eggs were hatched out before November and only the hollow shell of the mothers remain. But on the roots of night-shade, (Solanum douglasii) we find a different state of affairs. Figure 9 shows all stages of the female scale. This may furnish a ready and constant supply of scale in all orchards not free from this plant. Fumigation will not kill the scale because of their position beneath the surface of the soil, and in no case have I found a scale in the ground parasitized by the Scutellista. They apparently do not attack these root forms, so that control of the Black Scale by this insect is impossible so long as night-shade is allowed to grow under the orange and lemon trees. The farmers have evidently failed to realize the importance of this fact, for night-shade is plentiful in and about every orchard. Even in the best-kept orchards the plants are not uprooted, but cut off near the surface. In such cases new sprouts are continually appearing, furnishing a direct communication between the uninjured scale on the roots and the lower branches of the trees. Thus the scale propagates on the roots regardless of any amount of fumigation and supplies new broods for the orchards. Due to the protection of the soil the breeding continues throughout the winter as well as in the summer.

Not only is Black Scale found on the night-shade, but upon many other plants in the gardens, and especially in the rocky waste places or "washes" near many of the citrus groves. It is to the last condition which I wish to refer and particularly to the Rhus or Sumac which grows abundantly in all of these waste places. One need not examine closely to find Black Scale upon this plant at great distances from the citrus groves and often in great abundance. Sumac should not be allowed to grow near an orchard because it serves

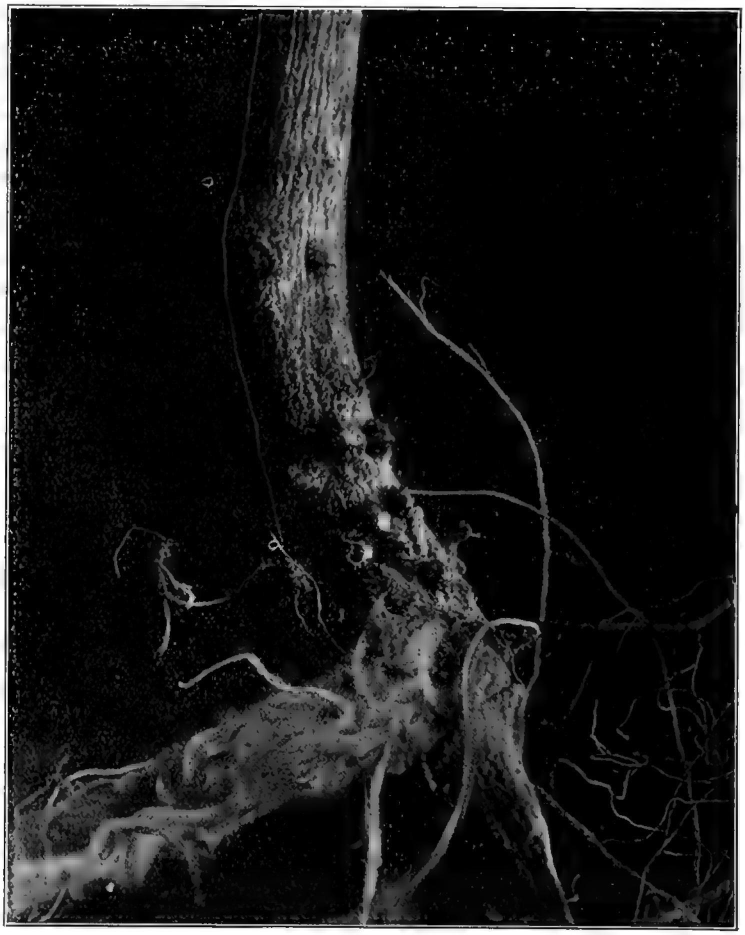


Figure 9. Saissetia oleae on roots of Solanum douglasii

as constant breeding places for scale, and it is in one sense useless to fumigate an orchard so surrounded without also fumigating or destroying the Sumac growing near by.

Icerya purchasi

COTTONY CUSHION SCALE, FLUTED SCALE, WHITE SCALE.

In regard to this scale, attention should be called to the peculiar way in which it secretes honey-dew.

Upon a young orange tree in the laboratory thousands of the young were propagated. These settled usually (Figure 10) along the midrib of the dorsal and ventral surfaces of the leaf. At an early stage, a week after birth, the young began to secrete honey-dew in considerable quantities, and also numbers of very delicate waxy filaments. Along these latter the subsequent honey-dew passes and collects at the tips in the form of clear transparent globules. The wax filaments vary from a half inch to three inches in length, and are so frail that the slightest disturbance of any kind would detach them, and yet they are able to support quite a large drop of honey-dew. Upon the

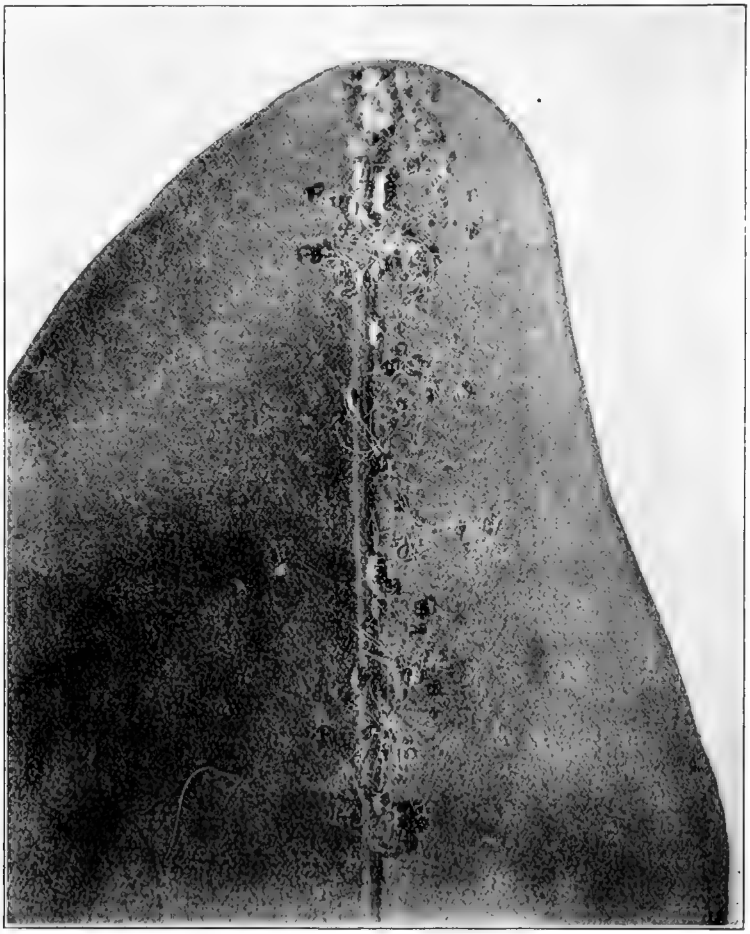


Figure 10. Young Icerya purchasi on orange leaf

dorsal surface of the leaves these filaments extend in a very confused state, same appearing to be independent of the large globules of honey-dew shown in the accompanying cut. The confusion is due to the fact that the filaments not being able to hang down as they are excreted, drop over and are shoved along the surface of the leaf. The honey-dew, passing out along these filaments, collects in the large transparent globules shown in the figure. Those globules isolated, are so, simply because the delicate waxy threads have been blown away.

Such a state of affairs cannot exist in open air because of the disturbances in the trees caused by wind, for even the slightest breath will blow them all away.

THE RED SCALE

(Chrysomphalus aurantii Mask)

A. J. COOK.

If we except the water problem, and possibly that of fertilizers and cultivation, no question more concerns the growers of citrus fruits than that of scale insects. Success demands their control and that often involves great expense. At present, there are four or five of these insects that are seriously destructive in Southern California: the yellow scale, the black scale, the purple scale, the mealy bug and the red scale. So blighting is the work of these insects, and so difficult and expensive their control that it is exceedingly important to eradicate them, if possible, when localized, and to quarantine rigorously against them, when absent. All scale pests, when numerous, are very harmful to the plants on which they feed. The red scale is perhaps the most to be dreaded, as from the great variety of its food plants, it becomes very difficult and expensive to successfully fight it. Its enemies have not in the past been able to hold it in check, or prevent its spread. We are fortunate, in our immediate locality, Claremont, in that we do not number this red scale among the obstacles to success. It is, however, close to us on three sides. If we are wise, we will not only keep it out, but will insist that the few colonies, known to be near us, be fought to the death. Right action in this matter means a tremendous saving to our citrus fruit growers. (Figure 11.)

FAMILY OF SCALE INSECTS—COCCIDAE.

A word about this family of insects that includes the scale insects and the mealy bugs is desirable. The females are always wingless, though both sexes are scale-like in form at first, while the mature male is always possessed of two wings. Like the Aphids, or plant lice, and the Aleyrodids or white flies, they belong to the Homopterous division of the true bugs or Hemiptera. In this sub-order the wings are much alike, and all are quite similar from end to end. All insects in this order are pre-eminent for their sucking habits. Their rostrum or beak is made up of needle-like mouth-parts and modified specially for piercing and sucking.

SUB-FAMILIES OF COCCIDAE.

There are several sub-families of coccids, three of which greatly interest our orchardists. The females of Dactolypinae or mealy bugs preserve the form of the very young throughout life, and are always active. They secrete a waxy covering that serves to protect them, and often crawl into crevices and even into the earth and so are difficult to combat. Their habit of movement throughout life, makes their spread more easy and rapid. They are seriously destructive.

The second sub-family, Coccinae, are unarmored, and so when we touch the scale, we touch the insect. We are familiar with these in the black scale, the frosted scale and the soft brown scale. The absence of armor or a separate scale to shelter them makes their destruction more easy.

The third sub-family Diaspinae, has a separate scale which consists of a central projecting portion, made up of exuviae or cast skins of the young or larval insect, and a flatter border, a secretion, which is gray or brown. We are familiar with these in the red, yellow, purple, greedy and lemon-peel or ivy scale. This protection makes their destruction more difficult; hence the in-

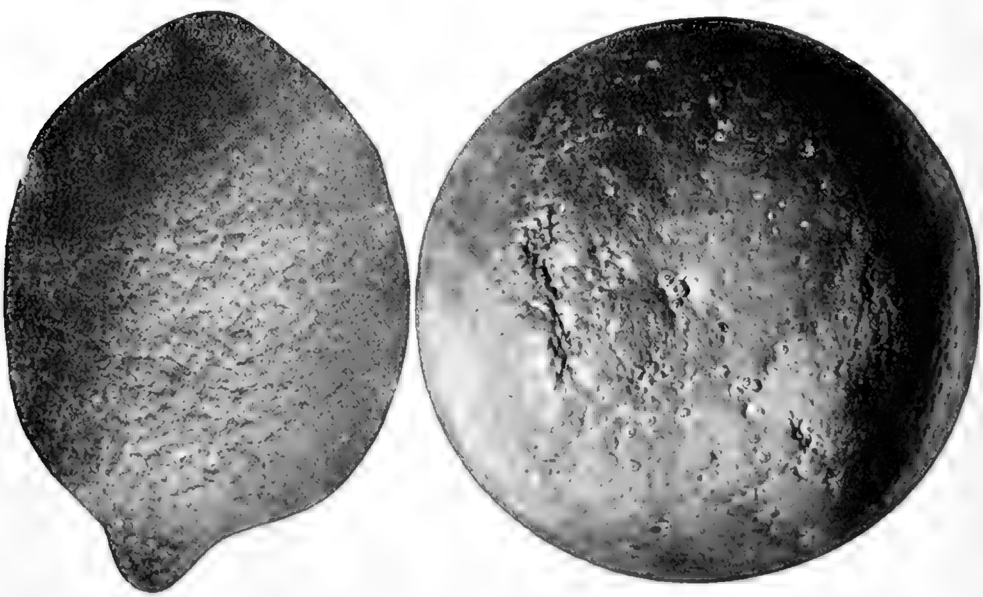


Figure 11. Chrysomphalus aurantii on lemon and orange

creased dosage for red and purple scale when we fumigate. In both these last two sub-families, the young insects soon become anchored, by their long beaks, and so move but little, though the Coccinae can, and upon occasion do so move till quite late in their development. With the first moult the Diaspinae lose their feet and antennae, and the motion that they seem to make must be largely through their rostrum or beak.

REPRODUCTION OF THE COCCIDS.

Many scale insects, like the black and purple scale, are oviparous, that is they are egg-laying. These are likely to be more regular or periodic in their appearance, and so we may find most all eggs, or young, or mature, at one and the same time. This, of course, is favorable to their destruction, as we can plan to fight them, while they are all young and more easily killed. In our warm climate, this regularity is likely to disappear. Other scale insects, like the red, the yellow and the soft brown, are ovoviviparous, that is, no eggs are ever laid, but the insects are born alive, and are active at once. We are likely to find these in all stages of growth and development at any day or week of the year. Of course, this makes their destruction the more difficult.

NATIVITY OF THE RED SCALE.

China has been claimed as the original habitat of the red scale. This may or may not be true. The fact, however, as we shall see, that it feeds on a great variety of food plants, has resulted in its being spread all over the earth, so that now it is found on all continents, in New Zealand, Hawaii, and many other islands. This fact is important, as it makes their introduction into

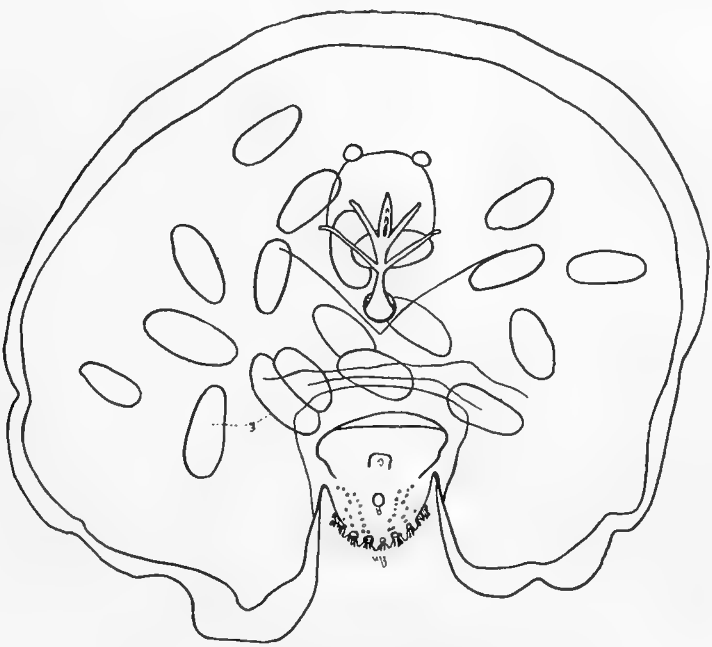


Figure 12. Female of Chrysomphalus aurantii

new localities more easy and probable. We are not surprised then to learn that this pernicious scale is in every county of Southern California. Localities, like Claremont, that are free from its ravages, should spare no effort to keep it out; those not so fortunate, should, for self-interest and good of neighbors alike, be equally active to exterminate the pest in their orchards. Of course, this is very difficult, when the insects have become thoroughly distributed.

DESCRIPTION AND LIFE HISTORY.

The scale of this species is very minute, hardly larger than a small pinhead, approximately circular if covering the female, and slightly elongate, in the male. It is sufficiently transparent to show the insect beneath, and so, at first, is centrally yellow, and later brown or red, while about the margin it is gray. The thorax of the female is much broader than the abdomen, and reaches around and projects back of the latter, so that the insect appears to be deeply lobed behind. Figure 12 shows a greatly enlarged view of the female.

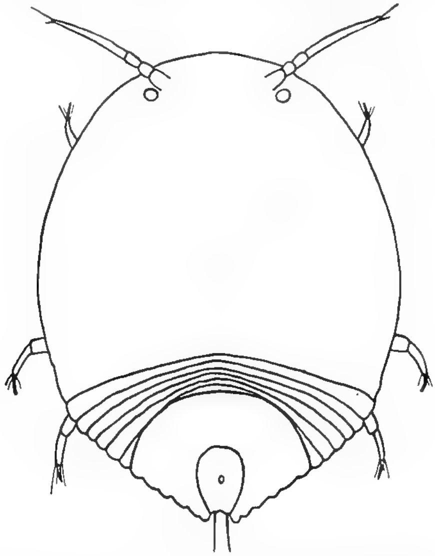


Figure 13. Young of Chrysomphalus aurantii

The markings of the anal plate, or last segment of the abdomen, as with all scale, is characteristic of the species. The figure shows the eggs and young which may often be seen through the semi-transparent crust of the insect. Early (Figure 13) the legs, eyes, antennae and mouth-parts may be seen, but all of these, excepting the mouth-parts disappear with the first moult. The

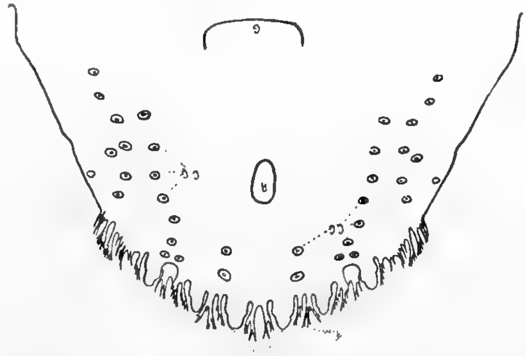


Figure 14. Pygidium of Chrysomphalus aurantii

head and thorax are closely joined, and back of these is the abdomen, which in this species consists of four segments. The last segment, the pygidium, is marked with plates and lobes, (Figure 14), which are necessary often to identify species, and can only be studied by use of the compound microscope.

The form and position of the six lobes at the end of this last segment, are shown in Figure 14, as also the spine-like plates which fringe the segment. The reproductive and anal openings are often visible, while the genital glands or spinnerets—the centred circles—are grouped and arranged as seen in the figure. The paragenital glands are not found in the red scale.

The male when mature, as with all coccids, has two wings. This and its form make it curiously different from the female, or from its earliest self, while it is yet under the sheltering scale. (Figure 15.)

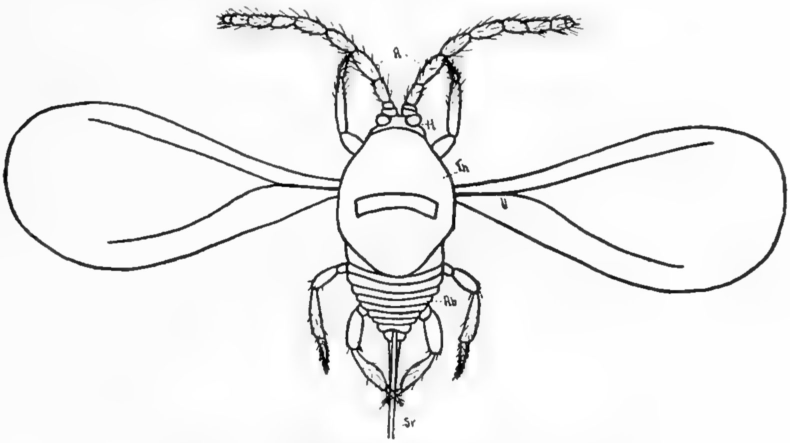


Figure 15. Male of Chrysomphalus aurantii

The life history is as follows: The young may be produced in broods of from twelve to seventeen each, and are being born continuously for several days. We never see eggs except in the abdomen of the partially transparent female, as the young are born alive. We see then that there may be several generations each year, and that they are enormously prolific.

The red scale works on all of our citrus trees, on the rose, apple, peach, apricot, and other rosaceous trees, on fig, olive, many palms, sago palm, oak, willow, euonymus, and not a few weeds. I have seen a stem of castor bean so thickly covered with the red scale, as to hide the stem absolutely from sight.

THE YELLOW SCALE.

The Yellow scale is so closely related to the red scale, that scientists regard it as a sub-species, only. It is *Chrysomphalus aurantii citrinus*. The scale is less convex, not so regular at the margin, less distinctly red in color, slightly more transparent, and the female adheres more tenaciously to the scale, than does the female of the red scale. The most obvious characteristic of the yellow scale, is that it rarely works on the twigs, but only on the leaves and fruit, while the red scale anchors and sucks from twigs, leaves and fruit. The yellow scale is more prone to change its position on the leaves, and so is more likely to be indicated on the foliage, by yellow spots. While the yellow scale is not generally regarded as so serious an enemy of the citrus grower as the red scale, yet in many cases it is an enemy of no mean rank. Orchards near here are badly injured by the yellow scale.

PARASITES AND PREDACEOUS INSECTS.

As yet no parasitic or predaceous insect has served to appreciably lessen the number or work of the red scale in our orchards of Southern California. This is not true of the yellow scale, as the golden Chalcid has in many places seemed sufficient to hold that species in check. As suggested above, the yellow scale about Claremont is not controlled by its insect enemies. This greater freedom from attack by parasites of the red scale, is another important difference between these two species, which in general are so closely similar. While we should strive to secure parasites that would be as efficient to destroy this red scale as is *Novius* (*Vedalia*) *cardinalis* to combat the cottony cushion scale, yet we must not withhold fumigation until some enemy is found that will control the scale. We can never afford to allow our orchards to be victimized by these devitalizing sappers.

PRACTICAL SUGGESTIONS.

The fact that the red scale is armored, and exists at all times, and in all stages of growth, makes its destruction very difficult. It requires nearly or quite double the black scale dosage and about as much cyanide as does the purple scale, if we would secure complete extermination. At times, even when we are so thorough, it may be wise, to give a second fumigation as soon as we can learn, by examination, that the first fumigation was not entirely effective. The tents must be gas proof, and should remain over the trees for a full hour. They should also in all cases of fumigation, be marked as directed by the Department of Agriculture, that there may be no guess work, and so no possible mistake in determining the amount of cyanide to be used in each case.

As is true of all scale insects, all weeds that may harbor the scale should be kept entirely from the precincts or neighborhood of the orchard. Clean culture, except in winter, when the best success demands that a good cover crop of legumes be grown, must be practiced. In case of red and purple scale, it is wise to gather and burn the fallen fruit. On fallen leaves scale insects soon die, but they live a long time on fruit.

HINTS ON FUMIGATION.

Fumigation for black scale may best be done, when all the scale are hatched and still quite young. For our locality this is October and November, though when necessary this may extend from September 1st to February 1st. As there are more or less black scale in all our citrus and deciduous orchards, this is a good time to treat any scale, as we then kill both the black and the other as well. It is not wise, however, in case the red scale, the purple scale, or the mealy bug are found to be introduced into any region, to wait for autumn, but to fumigate at once. They are all very prolific, and are easily scattered by wind, bird or insect, so immediate extermination should be the watchword, as soon as their presence is discovered. To delay treatment is costly and dangerous, and makes the orchard a menace to all others in the region. For the red, the yellow, and the purple scale, it is fortunate if we can fumigate in summer just after all the fruit is gathered, as then we have only the scale on the leaves and twigs to combat; but as we would hasten if fire was nearing dynamite so we must not delay if we discover red scale in our orchards. For the purple scale and for the mealy bug, double the black scale dosage is required, and for the red and yellow scale it may be economy to hit as hard. The Woglum system of marking the tents and amount of cyanide to be used, must be followed. There is no excuse now for any guess work. The loss suffered by our growers in the past, by faulty guess work and too slight dosage, has been enormous. Nor is it enough, as we have been doing, to simply fumigate our citrus trees. We must look after every tree, shrub and plant that harbors the scale in question.

May I, in closing, emphasize four vital points, the observance of which, in the past would have saved hundreds of thousands of dollars to our orchardists; and the observance of which can and must save, in the future, fortunes to our people. First we must have thorough inspection, that every orchardist shall know just the condition of his orchard. Secondly, we must have a sufficient dosage, that will always kill the scale, though the tree is a little burned at times. Third, we must have fumigation by the block system, and thus save the necessity of fumigating oftener than once in three or four years. Lastly, the Exchanges must do the work, as this alone will insure that the scale will always be "hit hard." Absolute thoroughness is the Golden Rule in fumigation.

PLANT LOUSE PARASITES I

(Fam. Braconidae, Subfamily Aphidiinae.)

C. F. BAKER

Various rearings of these very beneficial insects in California, together with ample series taken in general collecting has made it necessary to work up our material and indicate the new forms. A table of all the genera, adapted from Ashmead and Szepligeti, is given here to guide western students.

A. Abdomen round, the oviduct curved beneath it.
  B. First cubital and first discoidal cells confluent. — *Monoctonus* Hal.
  BB. First cubital and first discoidal cells separated. — *Toxares* Westw.
AA. Abdomen lanceolate; oviduct not curved beneath it.
  B. Wings with three cubital cells. — *Ephedrus* Hal.
  BB. Wings with less than three cubitals.
    C. First cubital and first discoidal cells separated. — *Praon* Hal.
    CC. First cubital and first discoidal cells confluent or wanting.
      D. Discoido-cubital cell closed.
        E. Metanotum much humped. — *Coelonotus* Forst.
        EE. Metanotum not much humped.
          F. Radius much elongated, enclosing more than two-thirds of the radial area. — *Aclitus* Forst.
          FF. Radius shortened, enclosing hardly one-third of the radial area. — *Aphidius* Nees
      DD. Discoido-cubital cell open.
        E. Radius wholly wanting. — *Paralipsis* Forst.
        EE. Radius at least in large part, distinctly present.
          F. With a transverse cubital vein. — *Lysiphlebus* Forst.
          FF. Without transverse cubital veins.
            G. Head longer than broad, strongly widened behind eyes. — *Dyscritus* Marshall
            GG. Head transverse.
              H. Second discoidal cell present. — *Diaeretus* Forst.
              HH. Second discoidal cell wanting.
                I. Metanotum not areolated. — *Adialytus* Forst.
                II. Metanotum areolated.
                  J. Radius reaching four-fifths of radial cell. — *Lipolexis* Forst.
                  JJ. Radius not reaching four-fifths of radial cell. — *Trioxys* Hal.

Genus **Ephedrus** Hal.

A. Legs and antennae piceous; body black. *californicus* n. sp.
AA. Legs honey yellow to rufous; antennae partly yellow basally; body piceous. *nevadensis* n. sp.

Ephedrus californicus n. sp.

Female: Length 2.25 mm. Black, polished, legs, antennae, and petiole, piceous, bases of tibiae yellowish. Antennae 12-jointed. Second abscissa of radius equaling first transverso-cubital and first abscissa of cubitus. ucandibles black.

Claremont, California. Coll. C. F. Baker.

Ephedrus nevadensis n. sp.

Female: Length 2 mm. Black, polished, abdomen and antennae piceous, legs all rufous. Antennae 12-jointed. Second abscissa of radius as long as first abscissa of cubitus, but longer than first transverse cubital. Mandibles rufous.

Male: Length 1.75 mm. Thorax also piceous. Legs all lemon yellow. Antennae 11-jointed, piceous, second and third joints honey yellow.

Ormsby County, Nevada. Coll. C. F. Baker.

Genus **Praon** Hal.

The two species described below have the color largely black and the sides of the petiole strongly divergent posteriorly.

A. First discoidal cell open. *nanus* n. sp.
AA. First discoidal cell closed. *occidentalis* n. sp.

Praon nanus n. sp.

Male: Length 1.75 mm. Black, shining, the legs including coxae and abdomen, pale rufous, the tarsi and abdomen towards tip, becoming piceous. Antennae piceous. Postmarginal and radial stumps and basal vein about equal in length, the distinct part of cubitus about twice as long. Second discoidal cell not distinctly closed.

Ormsby County, Nevada. Coll. C. F. Baker.

Praon occidentalis n. sp.

Female: Length 2 mm. Black, shining. Abdomen entirely testaceous, paler below. Legs including coxae, clear rufous. Antennae piceous, 18-jointed. First and second discoidal cells both distinctly closed. Subdiscoidal nervure not interstitial, but entering second discoidal cell at about one-third its length.

Ormsby County, Nevada. Coll. C. F. Baker.

Genus **Aphidius** Nees

All of the species described below are not black, but testaceous, and all but one have much yellow. In all, the face is largely yellow. In all, the subdiscoidal nervure is interstitial and does not touch the second discoidal cell.

A. Second abscissa of radius shorter than the transverse cubitus; a small species with almost the entire body and appendages concolorous testaceous. *delicatus* n. sp.

AA. Second abscissa of radius longer than the transverse cubitus; large species with yellow legs.

B. Part of sternum only, yellow; length 2 mm.

C. Antennae 19-jointed, first two articles yellow; all of face below antennae, yellow. *coloratus* n. sp.

CC. Antennae 20-jointed; first two articles testaceous; only the clypeus yellow. *coloratus* var. *ferruginosus* n. var.

BB. All of lower half of thorax yellow; length 2.5 mm. *pulcher* n. sp.

Aphidius delicatus n. sp.

Male: Length, 1.5 mm. Whole insect testaceous, abdomen and legs basally paler. Clypeus and mandibles yellow. Metanotum smooth, shining, with a delicate median carina which splits posteriorly, the branches diverging to posterior border; and on either side posteriorly with a large rounded sharply bordered pit. Apparently near to *Aphidius avenaphis* Fitch.

Ormsby County, Nevada. Coll. C. F. Baker.

Aphidius coloratus n. sp.

Female: Length 2 mm. Head and thorax piceous, abdomen testaceous, legs entirely, prothorax, mouthparts, all of face below antennae, and first two joints of antennae, yellow. Antennae 19-jointed, flagellum piceous. Metanotum smooth and shining, with a median carina which is split behind and encloses a small lozenge-shaped area which extends to posterior border; on either side of this latter area is a large sharply bordered pit.

Jeannette, Pa. Coll. H. G. Klages.

Aphidius coloratus var. **ferruginosus** n. var.

Female: Length 2 mm. Piceous to dark testaceous, petiole and hind margin of second segment pale. Legs sternum, and prothorax, yellowish to ferruginous. Clypeus and mandibles yellowish. Antennae 20-jointed, piceous, first two articles testaceous. Metanotum identical with that in the species.

Polk County, Wisconsin. Coll. C. F. Baker.

Aphidius pulcher n. sp.

Female: Length 2.5 mm. Head and thorax above, laterial margins of second tergiun, and discs of third, fourth and fifth terga shining piceous, the rest of abdomen, the sternum, pleurae and prothorax, ferruginous to yellowish.

Legs throughout, mandibles face, first article of antennae and tips only of second, honey yellow. Metanotum smooth and shining, with an undivided median carina and two large shallow pits behind.

Ormsby County, Nevada. Coll. C. F. Baker.

Genus **Diaeretus** Forst

Among several California species there is one common form which is quite different from any described eastern species, and which is as yet undescribed. It is nearest to *D. americanus* Ashm., but lacks any trace of cubitus, and has antennae far shorter than the body.

Diaeretus californicus n. sp.

Female: Length 2.5 mm. Black, shining, petiole and metanotum piceous, the latter with a strong median keel, which is split behind, the lateral faces posteriorly each with a large circular, bordered depression. Legs ferruginous, the hind coxae black. Antennae 14-jointed, piceous, the first two articles yellowish.

Reared from plant lice on wild mustard, at Claremont, California, and also taken commonly in general collecting.

Pomona Journal of Entomology

Volume I JUNE 1909 Number 2

STUDIES IN OXYBELIDAE I

C. F. BAKER.

Having been engaged for many years in the collection and study of material in this family, such results as have been obtained will now be published from time to time. A provisional table of the genera is presented herewith. Dr. Brauns has kindly sent a specimen of his South African *Oxybelomorpha.* It is evidently closely related to *Oxybelus,* but possesses mandibles deeply emarginate below. The sub-median cell is much shorter than the median, the transverse median nervure uniting with the median much before the origin of the basal nervure; but this condition occurs also among some of our American *Oxybelus.* The form of the scutellar armature in *Oxybelomorpha* is quite unique.

We have, in America, what we suppose to be true *Belomicrus,* separated as indicated in the following table. If our species are true *Belomicrus,* then the *Belomicrus capensis* of Brauns is not. Indeed I can see no reason why *capensis* should not be placed in true *Oxybelus,* as it has the spine and squamae of that genus and the characteristic metanotal sculpture which so well separates all true *Oxybelus* from the group that we have been calling *Belomicrus.* On the other hand, specimens of *Belomicrus Handlirschii* Brauns, and *Oxybelus ligula* Gerst., sent by Dr. Brauns, both belong to *Notoglossa.*

As we now know them, the Oxybelidae are best developed in North America and Europe, the few African species being quite anomalous in one way or another. Members of the family are common in Central and South America, but all of the many species of those regions which I have seen, belong in *Notoglossa.*

A. Metanotum with only fine sculpturing on the lateral faces, the lateral bounding carinae strongly crested above squamae approximate or coalescing behind, completely enclosing the post-scutellum, and without pointed limbs or angles; scutellum never carinate.

Belomicrus Costa.

AA. Metanotum with very coarse sculpturing on the lateral faces, more so above, the lateral bounding carinae not strongly crested above; squamae never coalescing behind, always leaving apex of postscutellum free, and usually either with pointed limbs or angled margins; scutellum usually carinate.

B. Mandibles deeply emarginate beneath.

Oxybelomorpha Brauns.

BB. Mandibles not distinctly emarginate beneath.

C. Spine very narrow and entire at the slender tip; mandibles with a median tooth within; clypeus in male usually tridentate.

Oxybelus Latr.

CC. Spine broad and emarginate, or very broadly truncate at tip; mandibles without a median tooth within; clypeus in male usually 4 or 5-dentate.

Notoglossa Dahlb.

Genus **Belomicrus** Costa

The group of species referred to this genus are alike in having the puncturation of body fine, close, and remarkably uniform. They all have on the anterior two-fifths of mesonotum a very fine double median stria. The scutellum is always entirely without a median carina. The squamae are quite characteristic, not possessing either a lateral or a terminal tooth, and completely enclosing the postscutellum. The sculpturing of the metanotum is peculiar to the group; there are median and lateral carinae, the lateral being distinctly elevated above; the median fovea is of various shapes; the lateral faces are covered with numerous fine irregular oblique striae, and between these the surface is variously punctuate. The clypeus is usually stated to be simple in both sexes, but in the male of *cookii* it is tridentate. The lateral ocelli are said, in generic characterizations, to be as near to the median ocellus as to the eye margin or nearer, but in *colorata* for instance, they are nearer to the eye margin. A sharp groove extends from the upper part of the inner eye orbit to the lateral ocelli.

TABLE OF SPECIES.

A. Abdomen almost entirely reddish; funicle longer than the first flagellar article.

B. Length of postscutel and squamae together more than half the entire width.

colorata n. sp.

BB. Length of postscutel and squamae together much less than half the entire width.

cladothricis Ckll.

AA. Abdomen largely black; funicle as short or shorter than the first flagellar article.

B. Scape and all tibiae, of male, clear honey yellow.

cookii n. sp.

BB. Scape and all tibiae, of male, with large piceous spots on one side.

forbesii Robt.

Belomicrus colorata n. sp.

FEMALE: Length 5 mm. A large species with bright yellow markings, and a largely reddish abdomen, and related to *cladothricis.*

Clypeus truncate anteriorly, its disc subtuberculate, the raised portion naked, smooth, shining, and with a few large punctures; remainder of face covered with appressed silvery hair, which is thickest below. Antennae piceous above and sordid yellowish below, the funicle distinctly longer than the first flagellar article. Mandibles honey yellow at base to piceous at the simple tips. Lateral ocelli distinctly nearer to the eyes than to the median ocellus.

Pronotum honey yellow, except a spot at middle. Tegulae rufous. Mesopleura with the vertical groove broad, shallow, and ill defined. Postscutel yellow, and with its broad squamae longer than half the entire width, the squamae completely coalescing, the median posterior emargination is shallow and with a rounded apex. Median fovea of metanotum broader than long, the oblique striae on lateral faces distinct, but the puncturation very inconspicuous.

Legs with tips of femora, all of tibiae, and basal joints of tarsi honey yellow; the tarsi are piceous apically. Abdomen ferruginous, the first, second, and third tergites with posterior margins broadly yellow. Pygidium triangular, the width at base greater than the length.

This fine species was taken in Ormsby county, Nevada.

Belomicrus Cookii n. sp.

MALE: Length 4.75 mm. A medium-sized species with banded abdomen, without ferruginous except at tip, and related to *forbesii.*

Clypeus tridentate anteriorly; its disc not subtuberculate, entirely covered with the silky appressed pubescence of the face, and near the anterior margin transversely banded with yellow. The antennal scrobes are unusually large and deep. Antennae with honey yellow scape and sordid ferruginous flagellum, the funicle distinctly shorter than the first article of flagellum. Mandibles honey yellow at base to piceous at their simple tips. Lateral ocellus about as far from eye margins as from median ocellus. Pronotum with a broad, yellow, almost continuous band which reaches on to scapulae. Tegulae rufous. Mesonotum with the vertical groove distinct and sharply marked. Postscutel yellow, and with its squamae not longer than half the entire width at base, the squamae coalescing behind, the posterior emargination V-shaped.

Median fovea of metanotum triangular and twice as long as broad, the oblique striation on lateral faces very fine and the puncturation very distinct.

Legs with tips of femora, all of tibiae, and basal portion of tarsi honey yellow, the tarsi piceous apically. Abdomen black, the first to fifth tergites broadly banded posteriorly with very pale yellowish, the last two segments sordid ferruginous.

FEMALE: Clypeus truncate. Scape honey yellow only at tip, the remainder piceous. Abdomen with yellow bands on segments I to IV, but gradually fading out posteriorly, the last half of third segment, and the remainder of abdomen bright ferruginous. Pygidium broader at base than long, triangular, but the lateral margins incurved, the surface shining and with scattering coarse punctures.

This well marked wasp is common at Claremont, California, during the month of April. I have named it for Dr. A. J. Cook, the veteran head professor of Biology in Pomona College.

Belomicrus cladothricis Ckll.

This species is common about Claremont, California, during the early spring

Belomicrus forbesii Robt.

I have specimens of this species taken at Denver, Colorado, by Oslar.

NOTES ON CALIFORNIAN COCCIDAE II

E. O. ESSIG.

Erium lichtensioides Ckll.

This scale (Figures 16 and 17) occurs in considerable numbers on the stems and twigs of *Artemisia californica* in the wastes about Claremont. It is separated from *Pseudococcus* because of its globular form and the large fluffy, cottony sac

Figure 16. Erium lichtensioides

which encloses the scale body. The body is nearly round, smooth, and of a very dark purple color, as is also the body juice. The antennae are 7-articled and slightly hairy. The articles are short, the first and last being longest. The legs are very short and abortive.

So far as is known this scale has not been reported from this section before. It is easily recognized by the very large snow-white globular body-sac, which stand out in sharp contrast to the dark color of *Artemisia californica.*

Coccus longulus Dougl.

(Figure 21)

LONG SCALE.

Like many of the scales, this one has existed here for many years unnoticed, until of late its spreading has alarmed many of the citrus growers in this district. On March 26th, the College inspectors reported this scale in the orchard of Mr. W. Jones, but in no very great numbers. At the present date it is estimated that it has multiplied nearly 100% and is still increasing. The young forms have generally been confused with Soft Brown Scale, and were reported as such. The

Figure 17. Erium lichtensioides

external appearance (Figure 21) is as follows: on the dorsum is a distinct light-colored line, on either side of which and parallel to it, is a less distinct line.

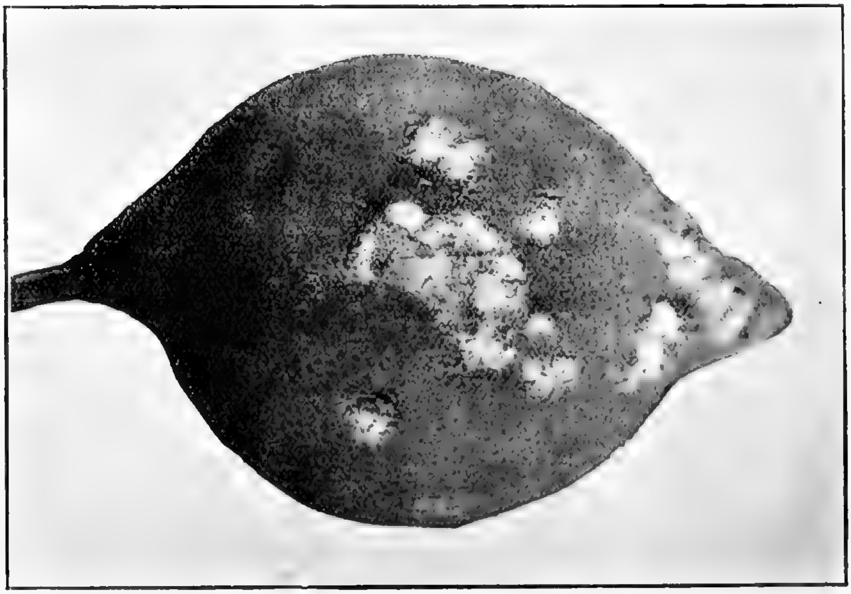
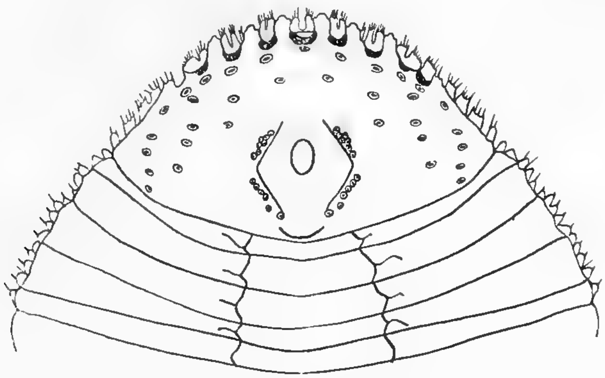


Figure 18. Parlartoria pergandii

Around the margins of the body is quite a wide colorless band extending half-way from the margin to the light median line on the dorsum. The general background color is a gray. The bodies are rather long, and may be so thick on the branches as to overlap so as to completely hide the surface of the branch. The antennae are 7-articled and small, as are also the legs.

The scale multiplies with wonderful rapidity, and so far as our examination goes, they are nearly free from parasites. They attack principally the younger shoots. Soft Brown Scale seems to limit its attacks by preference to the young trees, but this scale works as successfully on the old trees as on the young, but generally on the new growth. So far, it has been reported in only two orchards in any considerable numbers. Due to the fact that it is an unarmored scale, and so soft, it will probably not require any special fumigation dosage to rid the orchards of it. An ordinary Black-Scale dosage will do the work. But because of its ability to increase in such enormous numbers, care must be taken to rid the orchards of it before a great deal of damage has been done. Like most imported scales it has probably been struggling under changed climatic conditions, and is just beginning to thrive.



A

B

Figure 19. Parlatoria pergandii

Parlatoria pergandii, Comst.

(CHAFF SCALE.)

The female scale is irregularly elongated about 1 mm. in length, gray with darker marginal exuviae. The female body has three pairs of well-developed anal lobes (Figure 19), and a less developed fourth lobe resembling a papilla. Between the lobes and extending along the lateral margins are numerous hairs which arise from well-defined lateral lobes. There are four groups of circumgenital pores, the two upper groups usually having six, the two groups near cauda having seven. The whole body shows the segmentation very plainly.

The scale of the male is narrow and much smaller than the scale of the female. In color it is considerably lighter, with marginal exuviae a littlel darker. (Figure 20.)

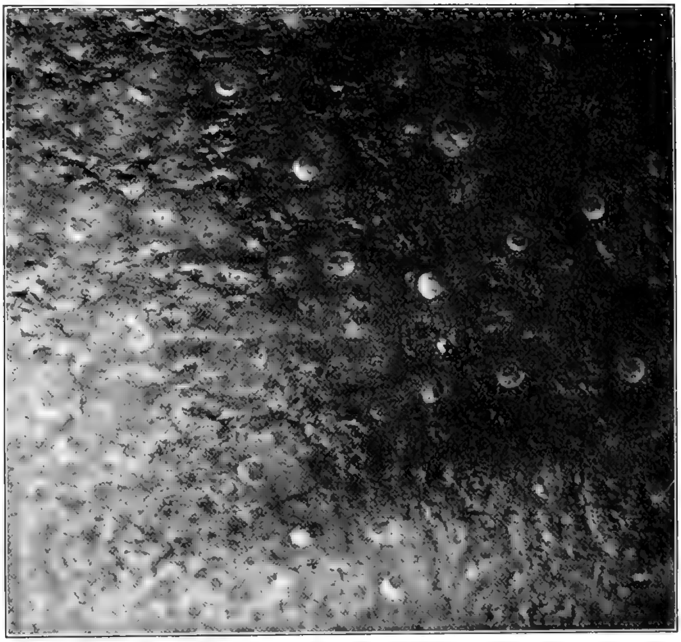


Figure 20. Parlatoria pergandii

This is more strictly a Florida scale, and is seldom found in California. Its color is so near that of the bark that infections are very difficult to find when only on the trunk or stems. However, it readily attacks the leaves and fruit so that it soon becomes very evident. Inspector C. H. Vary found this scale in great numbers infesting trunk (Figure 18), leaves, and fruit of a single orange tree in the very center of Pomona. It was promptly eradicated, for it was feared that it might do the damage here that it has done in Florida. Mr. E. K. Carnes reports this scale in only two districts in the State.

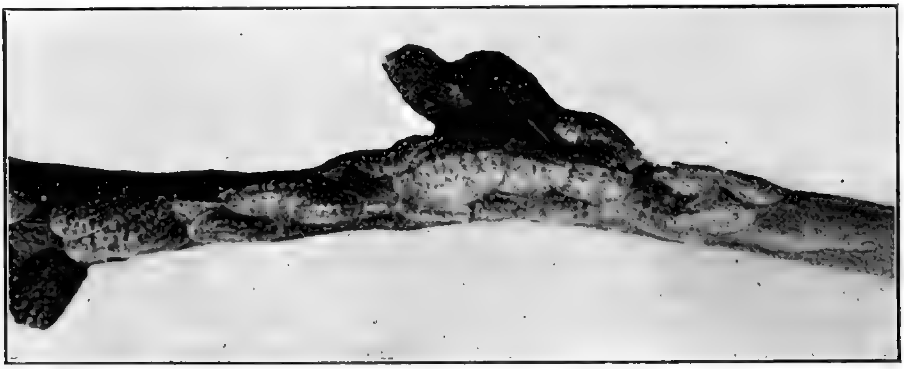


Figure 21. Coccus longulus.

THE GENUS PSEUDOCOCCUS IN CALIFORNIA

E. O. ESSIG.

The following study of this difficult genus is manifestly provisional. Much more material is needed to complete the work, and we should be glad to receive specimens of any species of the genus from any source. A synopsis of the females has been a great desideratum, and we have attempted to construct such a synopsis. It now includes all the known native species and most of the introduced forms, though there are some like *Pseudococcus calceolariae, P. affinis,* and *P. hymenocleae* recorded as having occurred in the State, which we have not yet seen. These insects are very variable in most of their characters, and minute differences in the antennal articles or bristle arrangement taken alone are not to be depended upon. So we have used only characters, or combinations of characters, which seem to us, *on the average,* to be good. For this reason in using the synopsis, care should be taken to examine numbers of specimens of any form, since even species having normally 8-articled antennae occasionally include specimens with only 7 articles or even with 9. We have not always used in the synopsis characters which we consider of greatest value in distinguishing the species, since we are limited always to the use only of described characters in those species we have not seen.

PROVISIONAL KEY TO FEMALES OF CALIFORNIA PSEUDOCOCCUS.

A. Third article of antennae about half the length of the last; spines of anal lobes usually much longer than circumanal spines; body with only powdery wax.

B. Antennae 7-articled and very small.

C. Antennae with very few hairs, article 4 shorter than 5; body slate colored. Under bark of *Artemisia californica.*
artemisiae n. sp.

CC. Antennae with normal number of hairs, article 4 longer than 5; body pinkish. Under bark of *Quercus agrifolia.*
agrifoliae n. sp.

BB. Antennae 8-articled, large, and normally haired.

C. Antennae with article 2 much longer than 3.

D. "Sides with rows of spinneret spine areas"; eggs enclosed in an egg-sac. On *Azalea.*
azaleae.

DD. Sides without rows of spine areas; eggs not enclosed in an egg-sac. On roots of *Solanum douglasii.*

solani.

CC. Antennae with article 2 sub-equal with 3, (either may be slightly the longer).

D. On leaves and in cracks of bark of *Quercus chrysolepis.* *quercus*

DD. On roots of *Eriogonum latifolium.*

maritimus.

AA. Third article of antennae three-fourths as long or longer than the last; spines of the anal lobes usually not longer than the circumanal spines, (*citri, sequoiae,* etc., excepted.)

B. Lateral margins of all segments with dark callouses bearing two to eight denticles; antennae 7-articled. On roots of *Ramona stachyoides.*

Phenacoccus ramonae n. sp.

BB. Lateral margins of segments without denticled callouses; antennae 8-articled.

C. Article 1 of antennae as long as 3 and longer than 2; spines of anal lobes as long as circumanal spines. On *Opuntia* and under the bark of *Sambucus glauca.*

obscurus n. sp.

CC. Article 1 of antennae shorter than either 2 or 3.

D. Anal wax appendages as long as entire body; spines of anal lobes much shorter than circumanal spines; on various cultivated plants.

longispinus.

DD. Anal wax appendages much shorter than the body.

E. Articles 2 and 3 of antennae sub-equalling 8; anal wax appendages about one-third length of the body.

F. Article 1 of antennae shorter than 5; viviparous.

G. Body wholly light yellow, thickly covered with mealy wax; secreting only a white cottony matter, on which the female rests. On the leaves of *Ramona polystachya.*

crawii.

GG. Body dark-olive, almost black, thinly covered with snow-white mealy wax; secreting a cottony sac which finally entirely encloses the female. On *Ephedra californica*.
ephedrae.

FF. Article 1 of antennae longer than 5; oviparous.

G. Body dull salmon-brown; eggs laid in a fluffy cottony mass. On *Cupressus macrocarpa, Thuja orientalis, Araucaria excelsa*.
ryani.

GG. Body lead-gray; eggs laid in an ovisac. On *Cupressus governiana, Libocedrus decurrens*.
andersoni.

EE. Article 2 of antennae distinctly shorter than 8; anal wax appendages much shorter than one-third length of body.

F. Article 3 of antennae shorter than 8.

G. Body yellow; eggs deposited in a cottony mass. On various cultivated plants.
citri.

GG. Body gray; eggs deposited in a definite ovisac.

H. Body with conspicuous lateral wax plates; female not at all enclosed in the ovisac. On *sequoia sempervirens*.
sequoiae.

HH. Body without conspicuous lateral wax plates; female completely enclosed in the ovisac. On *Cupressus macnabiana.*

dudleyi.

FF. Article 3 of antennae longer than 8; spines of anal lobes not longer than circumanal spines; eggs deposited in an ovisac. On *Cupressus macrocarpa.*

cupressi.

Pseudococcus artemisiae n. sp.

This species (Figure 22) is decidedly long and narrow in shape, varying from 1 to 6 mm. in length, and from 1-5 to 2 mm. in width. Due to the lack of covering,

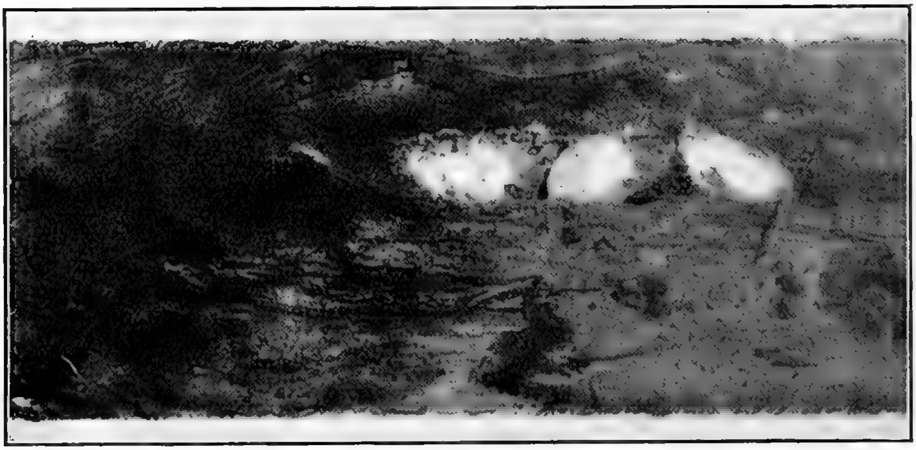


Figure 22. Pseudococcus artemisiae

which is but a very fine powdery wax, the segmentation of the body is very distinct. The body is slate colored, without distinct lateral or anal wax appendages. The female encloses herself in a thin cottony sac, and one such enclosed individual can be seen in the figure.

When boiled in K O H, the body becomes cardinal, while the legs and antennae remain transparently yellow.

The antennae are 7-articled (Fig. 23 H), the articles are short and in many cases wider than long. Article 3 is less than half as long as 8. The comparative lengths of the others may be seen in the cut. The mouth-parts are slender—the rostral loop, short. The legs (Fig. 24 H) are normal in length. The femur is longer than the tibia, the tarsus nearly as long as the tibia. The anal lobes (Fig. 25 H) are furnished with spines longer than the circumanal spines. The whole pygidium is rounded, and the segmentation indistinct; there are 3 denticles on either lobe, and few hairs on the body.

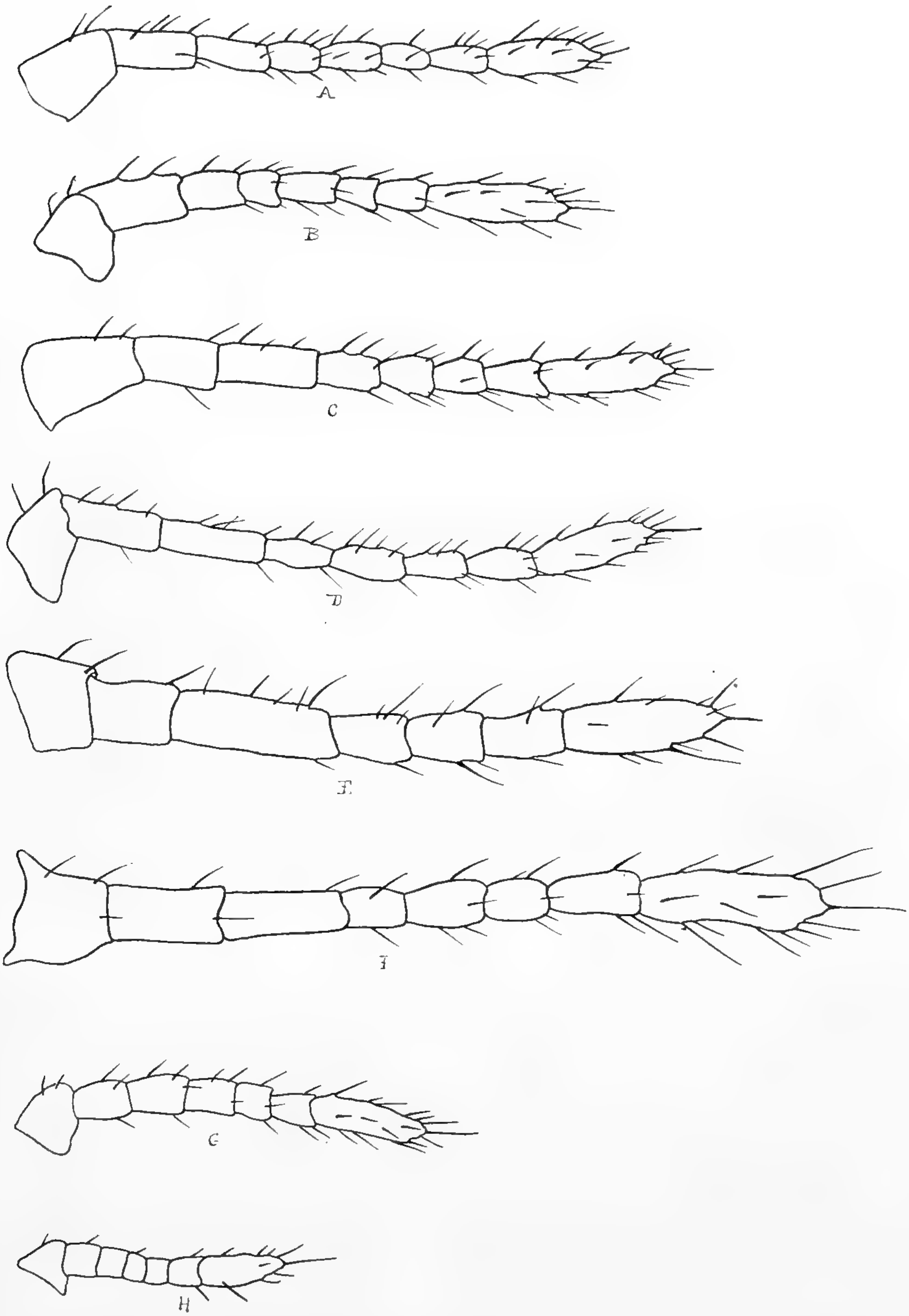


Figure 23. A, P. obscurus on Sambucus glauca; B, P. solani; C, P. obscurus on roots of Opuntia; D, P. longispinis; E, P. ramonae: F, P. citri; G, P. agrifoliae; H, P. artemisiae.

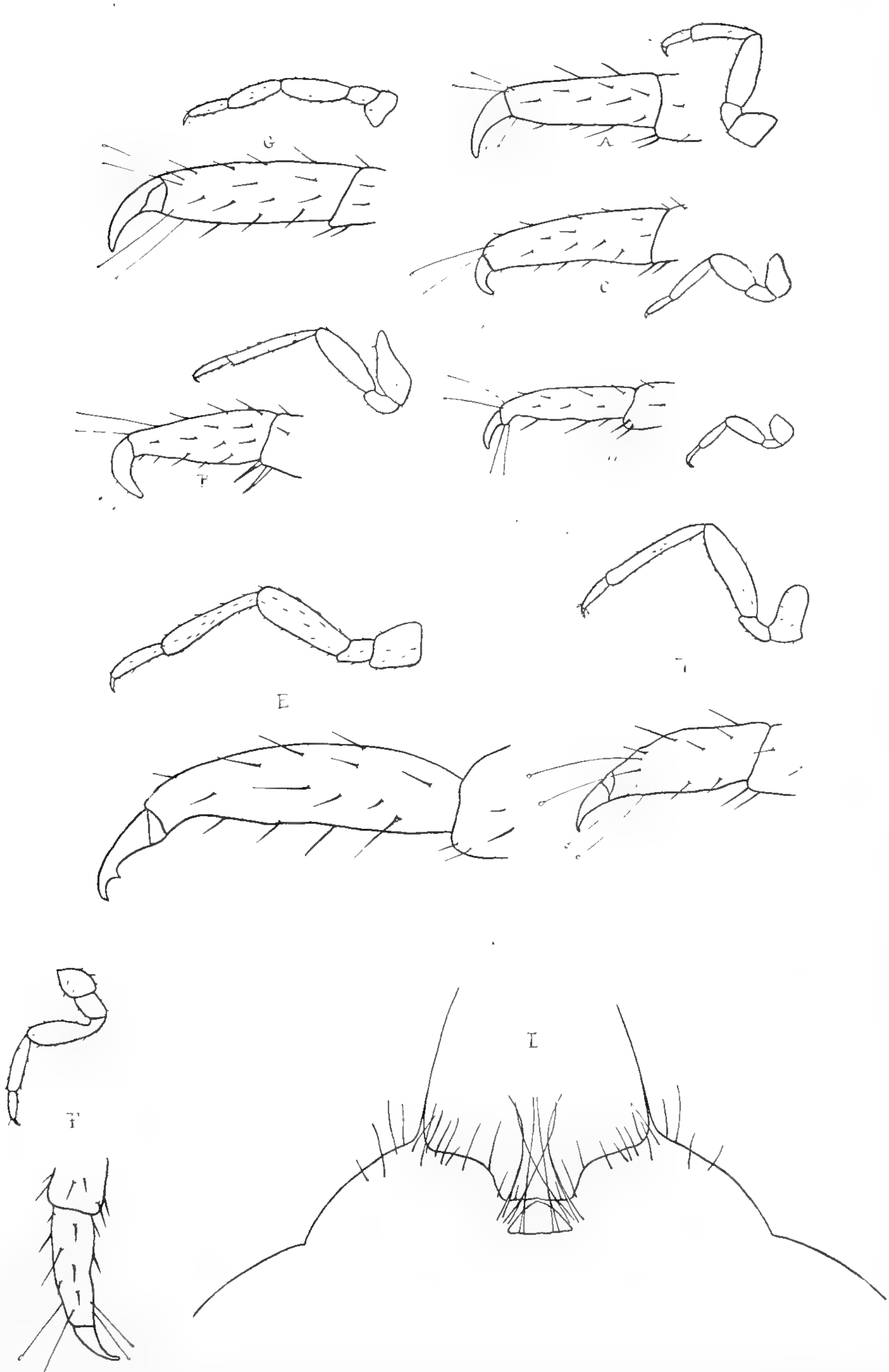


Figure 24. A, P. obscurus on Sambucus; B, P. solani; C, P. obscurus on Opuntia; D, P. longispinis; E, P. ramonae; F, P. citri; G, P. agrifoliae; H, P. artemisiae; I, P. obscurus: on Sambucus

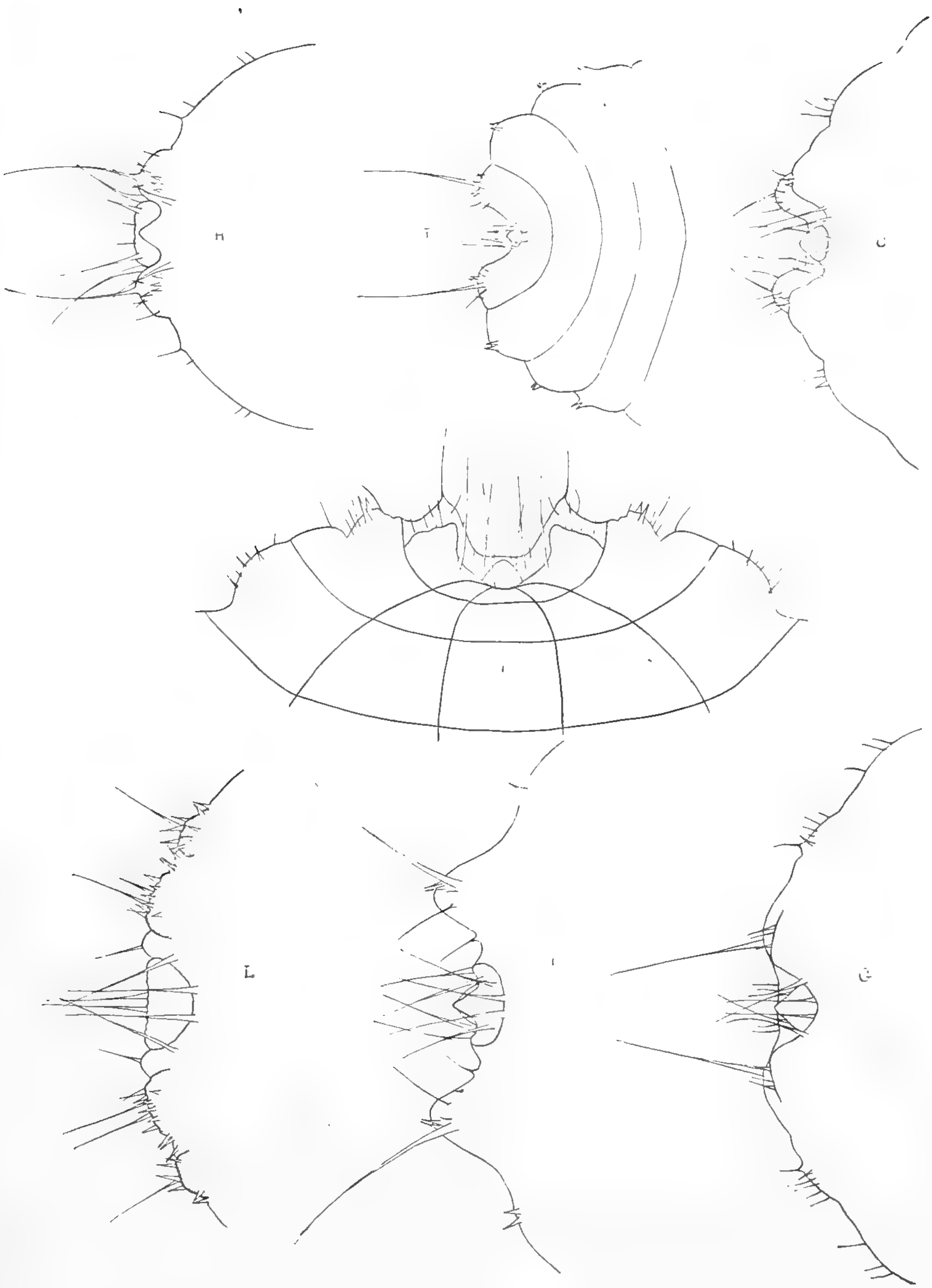


Figure 25. B, P. solani; C, P. obscurus on Opuntia; D, P. longispinis; E, P. ramonae F, P. citri; G, P. agrifolae; H, P. artemisiae

Pseudococcus agrifoliae n. sp.

This species occurs scatteringly under the bark of *Quercus agrifolia.* So far, it has been taken only in the locality of Claremont.

This species (Figure 26) is more or less oval in shape, although many may be found which are decidedly oblong. In length the body varies from 2 to 6 mm., and in width from three-fourths to nearly the length. The pink body, though nearly naked, is slightly covered with a fine white powdery wax, without distinct lateral or anal wax appendages.

When boiled in K O H, the body becomes cardinal—the antennae and legs remain light-yellow.

The antennae (Figure 23 G) are 7-articled—the third article being about half the length of the last. The comparative lengths of all the articles are shown in the illustration. The mouth-parts are long, reaching nearly to the middle coxae. The legs (Figure 24 G) are light brown, of medium length, and covered with

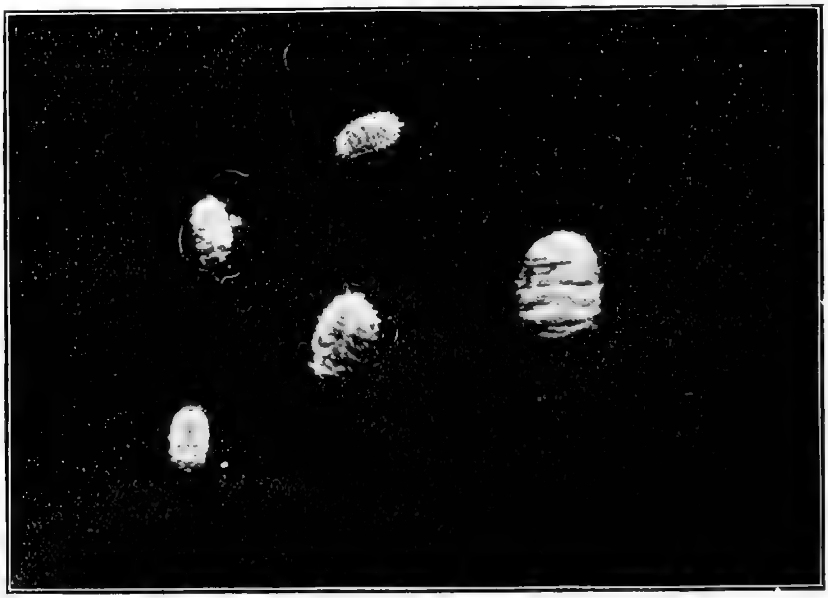


Figure 26. Pseudococcus agrifoliae

hair. See the cut for the comparative lengths of the different parts. The spines of the anal lobes (Figure 25 G) are twice as long as the circumanal spines. Each lobe is furnished with two ventral denticles. There is very little or no hair on the body.

This species lives beneath the bark and in the cracks of the bark of *Quercus agrifolia.* It was first taken by P. E. Smith at Santa Paula. It differs from *P. quercus* in the following:

P. quercus:—Body, greenish-brown; antennae, 8-articled; tarsus, one-third as long as tibia; host-plant, *Quercus chrysolepis*.

P. agrifoliae:—Body, pink; antennae, 7-articled; tarsus, nearly as long as tibia; host-plant, *Quercus agrifolia.*

Pseudococcus obscurus n. sp.

In form this species is very narrowly oblong. The body segmentation is very distinct. The length of the body varies from 2 to 6 mm., the width from 1 to 2 mm. The covering consists of a very thin, powdery wax, which does not hide the light-gray body of the insect. The lateral wax appendages are not distinct, while those of the anal segments, though short, are well defined.

When boiled in K O H, the body becomes cardinal—the legs and antennae remain a light-brown.

The antennae (Figure 23 C) are 8-articled, and normal in size and in the distribution of hair. Article 3 is three-fourths as long as the last. Article 1 is as long as 3 and longer than 2. The mouth-parts are short and stout; the rostral loop about half the length of the body. The legs (Figure 24 C) are short and stout. The coxa is as broad as long; the tibia is longer than the femur, and twice as long as the tarsus; the claw is short and well curved. The spines of the anal lobes are as long as the circumanal spines (Figure 25 C). The lobes are quite hairy, with two denticles on the inner margin of each. The body is nearly destitute of hair.

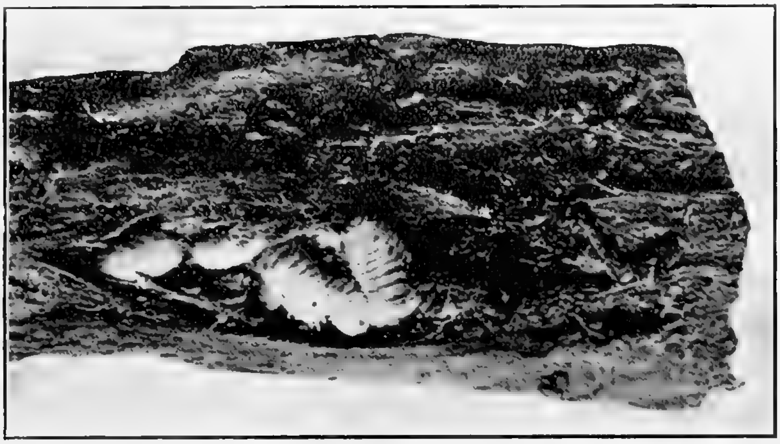


Figure 27. Pseudococcus obscurus on Sambucus glauca

The eggs are laid in loose cottony masses. The male is unknown.

This species was taken from the roots of *Opuntia* at the home of Mr. Meserve, County Horticultural Commissioner, on Boyle Heights, Los Angeles. In some ways it resembles *P. ryani*, but differs as the antennae shows in the following comparative table of the different articles beginning with the longest article first:
P. ryani:—8, 3, 2, 4, 1, 6, 5, 7.
P. obscurus:—8, 1, 3, 2, 4, 7, 5, 6.

A form taken at Santa Paula (Figure 27) from the bark of *Sambucus glauca* resembles *P. obscurus* closely enough to be the same species or a variety of it. The following cuts will point out some of the resemblances: Fig. 23 A; Fig. 24 A; Fig. 24 I.

It was first taken by County Commissioner P. E. Smith, of Santa Paula.

Phenacoccus ramonae n. sp.

The form (Figure 28) is distinctly oval, tapering slightly toward the anal end. The body varies from 4 to 6 mm. in length, and from 1 to 3 mm. in width. The covering is a snow-white cottony wax, which entirely hides the insect's body. The segmentation is very distinct. Along the median line of the dorsum there extends a well-defined ridge, on either side of which is a similar indistinct ridge parallel to it. On the margin of each segment is a stout waxy lateral plate, the two anal wax plates being twice as long as any of the rest, and much heavier. Beneath the covering the body is greenish-yellow. When treated with K O H the body becomes perfectly colorless and transparent, the legs and antennae remain brown.

The antennae (Figure 23 E) are 7-articled, long and rather stout. Article 3

Figure 28. Phenacoccus ramonae

is longer than 8. The comparative lengths of the remaining articles may be found in the cut. All of the articles are hairy. The mouth-parts are short and stout—the rostral loop, reaching nearly to the caudal end of the body. The legs (Figure 24 E) are long, stout, and covered with short hair. The femur is longer than the tibia, the tarsus about one-half the length of the tibia, the claw is slightly curved with a tooth on the inner margin. The spines of the anal lobes (Figure 25 E) are shorter than the six circumanal spines. The body is covered with hair. On the lateral margins of all the segments are dark callouses bearing from 2 to 8 denticles.

Although a large number of specimens were taken no eggs were to be found. They are probably viviparous.

Figure 29. Phenacoccus ramonae

The adult male is yet unknown, but the pupa-cases (Figure 29) were taken in considerable numbers.

Figure 30. Phenacoccus ramonae

The insect lives in great numbers (Figure 30) in the ground on the roots of the Black Sage, *Ramona stachyoides*.

It has also been taken from the foliage of *Diplacus glutinosus*, in the canyons above Claremont.

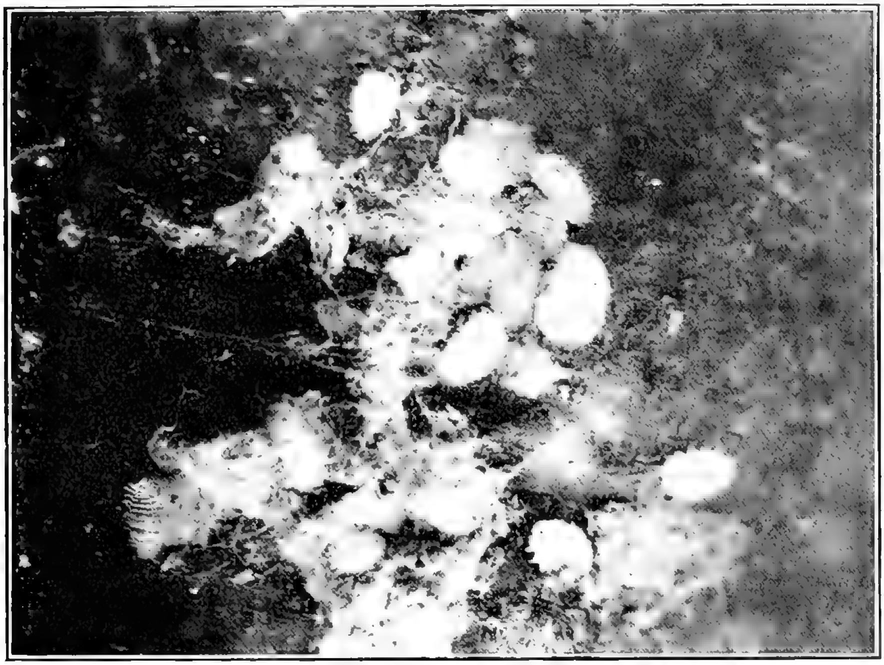


Figure 31. Pseudococcus citri

Pseudococcus citri (Risso)

It is to be noted that this species (Figures 31 and 32) as it occurs in California, has been treated very fully in Bulletin No. 1 of the Claremont Pomological Club, Claremont, California, February, 1909.

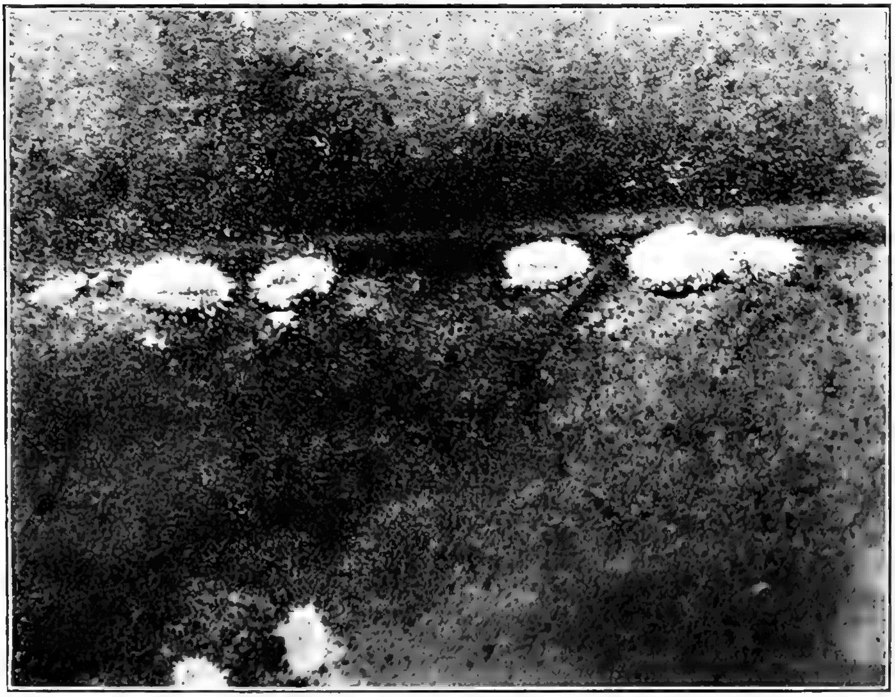


Figure 32. Pseudococcus citri

APHIDIDAE OF SOUTHERN CALIFORNIA II

E. O. ESSIG.

Rhopalosiphum violae Pergande

In the last number of the Journal this aphid should have been credited to Pergande, who described it in Canad. Ent. vol. 32, page 29, 1900.

Aphis citri Ashmead

Winged Viviparous Female (Figure 33)—Length 1.2 mm., width 0.7 mm., wing expansion 2.65 mm. Prevailing color of thorax dark, abdomen dull green.

Head narrower than thorax, nearly twice as wide as long. *Compound eyes*

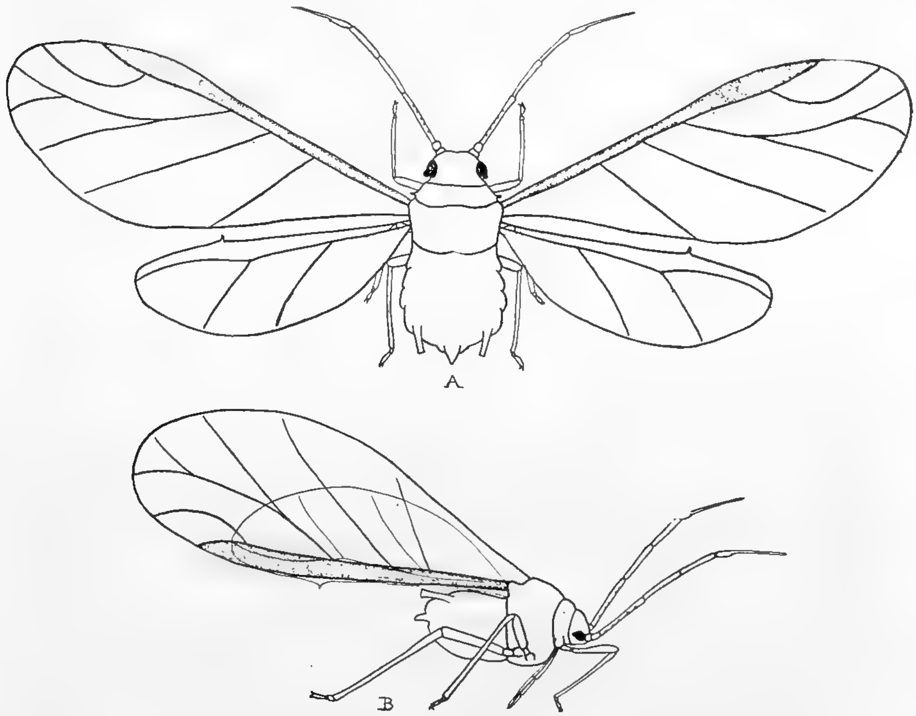


Figure 33. A. and B. Aphis citri

large, black, with long terete tubercles just behind the outer margin. *Antennae* (Fig. 34 I) arise from inconspicuous tubercles, nearly black, longer than the body, 1.42 mm., six-articled with a nail-like process near the apex of the sixth article. The lengths of the respective articles are as follows: I 0.5 mm., II 0.07 mm., III 0.4 mm., IV 0.35 mm., V 0.3 mm., VI 0.45 mm. Distribution of the

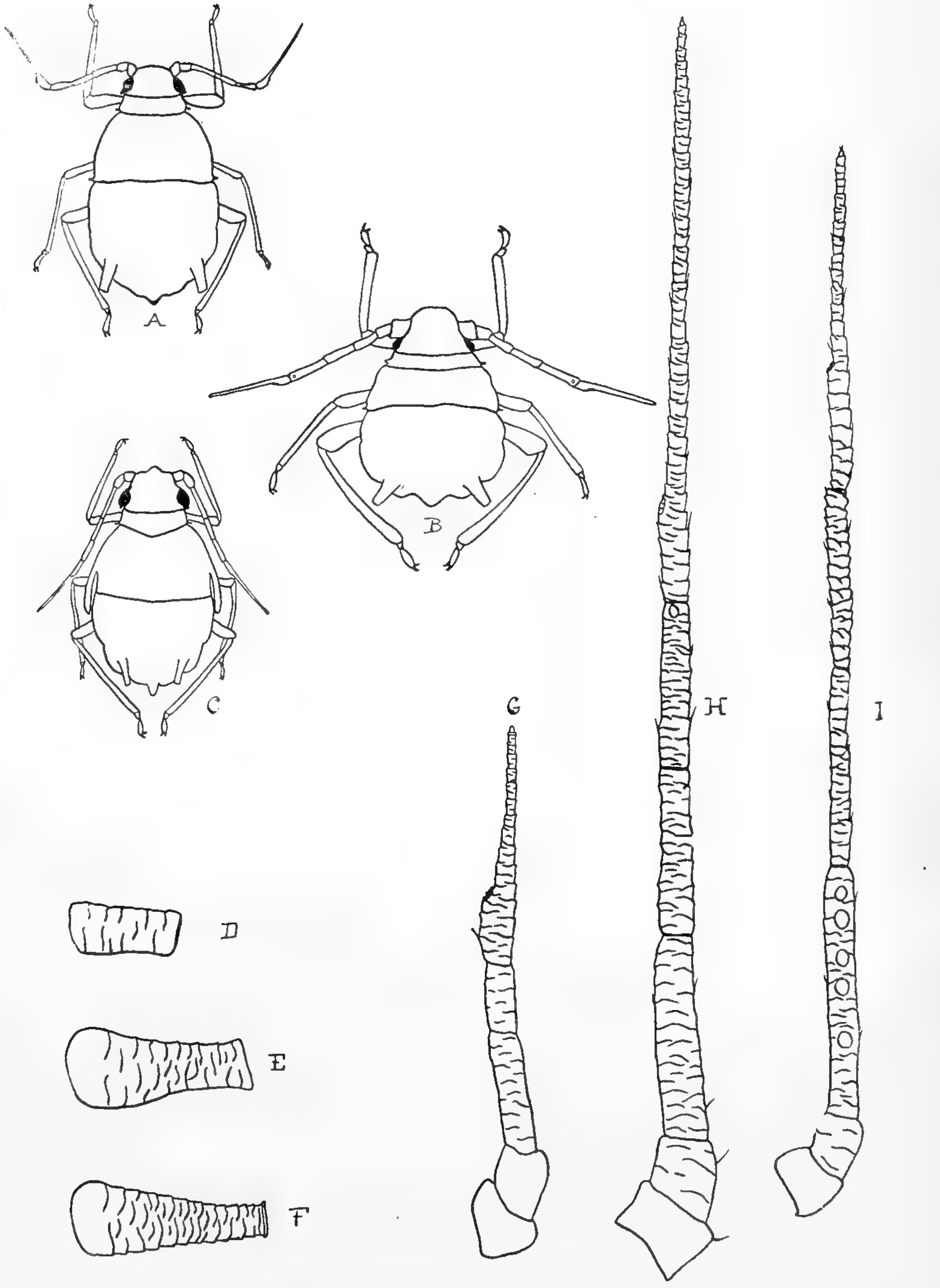


Figure 34. Aphis citri. A and B, apterous female; C, pupa; D, cornicle of nymph; E, cornicle of apterous female; F, cornicle of winged female; G, antenna of young; H, antenna of apterous female; I, antenna of winged female

sensoria; I and II none, III five large circular in a row, IV none, V one large circular at distal end, VI several small ones in the nail-like process. All but the last articles are scabrous, and there are few hair on any. *Pro-thorax* with lateral tubercles. *Rostrum* reaching just beyond the metathoracic coxae. *Abdomen* more or less distinctly segmented. *Cornicles* (Figure 34 F) cylindrical and scabrous, length 0.18 mm. *Legs* moderately long with few hair and no sensoria. *Wings* hyaline; *primary* length 2.3 mm., width 0.95 mm. *Cubitus* very distinct, as are all the veins. *Stigma* long and linear. *Radius* sharply curved. *First and second obliques* straight, third twice forked. *Secondary* wing, length 1.55 mm., width 0.6 mm. *Sub-costal* extends to wing tip, slightly bent at base of second discoidal. *First Discoidal* arises from the sub-costal one-third its distance from the base. *Second Discoidal* arises from the sub-costal two-thirds its distance from the base. *Style* cylindrical, about one-half the length of the cornicles.

The pupa is shown in Figure 34 C.

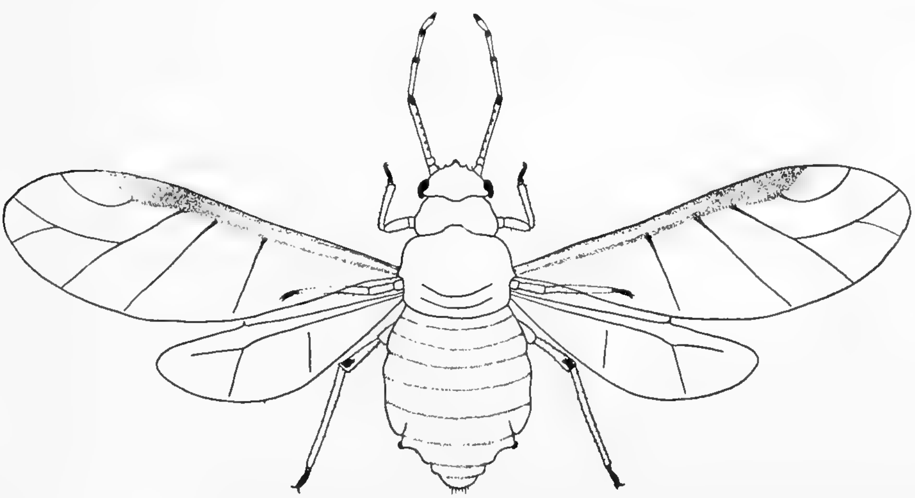


Figure 35. Callipterus juglandicola, winged female

Apterous Viviparous Female.—(Figs. 34 A and B.) Length 1 mm., width 0.8 mm. Differs from the winged form in the following respects: Body nearly globular, scarcely segmented at all, dark brown to black. Antennae (Fig. 34 H) considerable longer than the body, 1.22 mm., and without sensoria. The cornicles of this form are shown in Figure 34 E.

Nymph of Apterous Viviparous Female.—Resembles the adult only is much smaller and lighter in color. The *antennae* (Fig 34 G) are five-jointed, the respective lengths are as follows: I 0.93 mm., II 0.95 mm., III 0.12 mm., IV 0.06 mm., V 0.22 mm. The body segmentation is more distinct than in the adult. *Rostrum* reaches just beyond the meta-thoracic coxae. The cornicles of the nymph are shown in Figure 34 D.

This, the Orange Aphid, attacks with vigor the tender shoots of the citrus trees. Although in time checked by parasites, it succeeds in doing a great deal

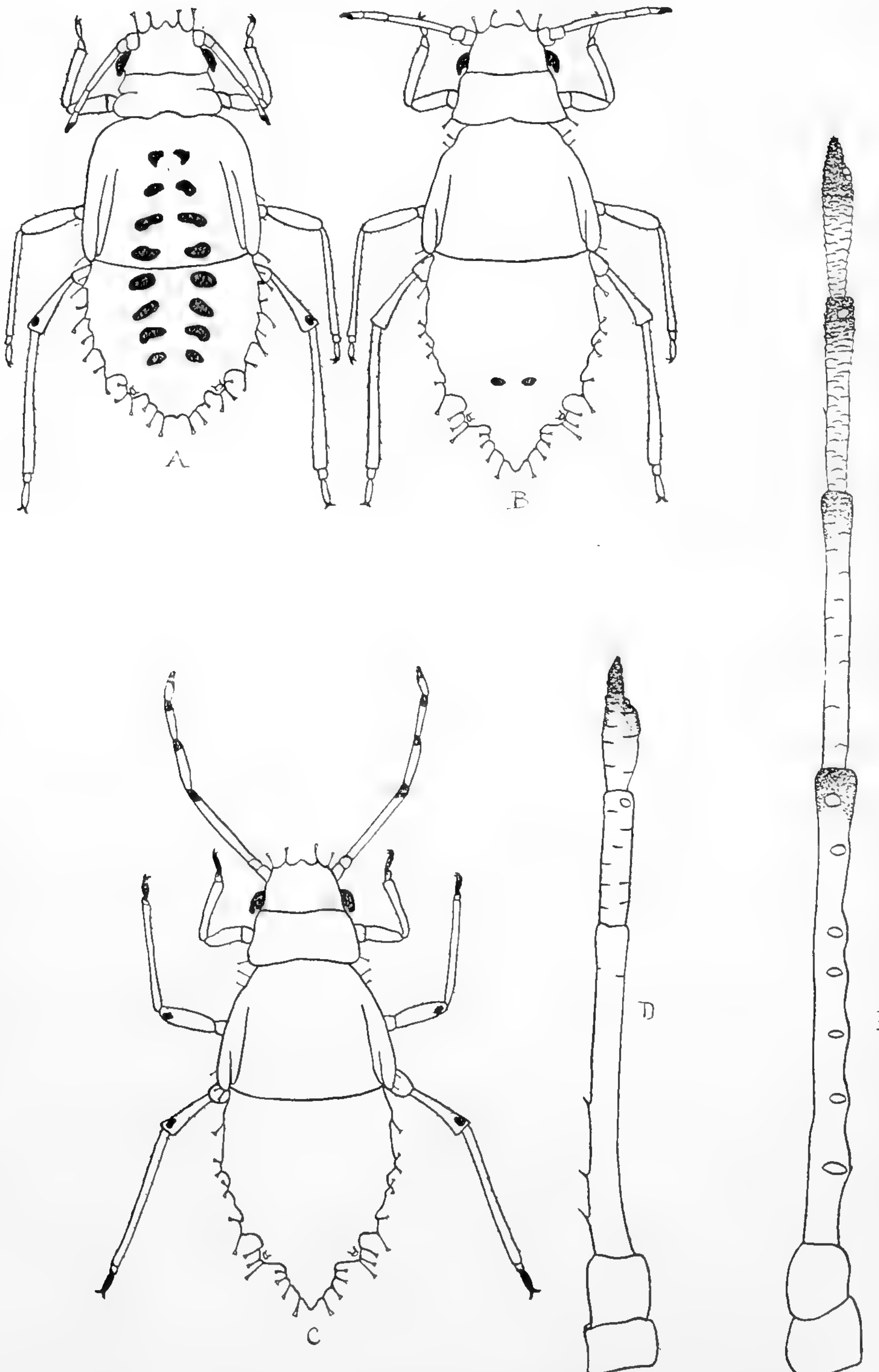


Figure 36. Callipterus juglandicola, A, A, and C, forms of pupae; D, antenna of pupa; E, antenna of winged female

of damage, first because of its rapid increase in numbers, and secondly because it is able to do a life's work before the parasite finally gets the upper hand. In this way much of the new growth is completely destroyed and the tree thereby injured. By summer only isolated specimens of the aphid can usually be found.

I have referred this common Californian form to the *Aphis citri* of Ashmead, but it is only a provisional reference, since there appears to be no way in which to tell what *Aphis citri* really is, except by a re-examination and description of authentic material.

Callipterus juglandicola Koch

Pterocallis juglandicola—Kalt.
Lachnus juglandicola—Kalt.
Aphis juglandicola—Walk.

Winged Viviparous Female.—(Figure 35). Length 2 mm., width 0.5 mm., wing-expansion 3.25 mm. Prevailing color light yellow, many individuals having two rows of black blotches on the back extending from the pro-thorax to the cauda. Eyes are red.

Head short and as wide as the pro-thorax, with few short hairs on the frontal margin between the antennae. *Compound eyes* large, bright red, with long terete tubercles just behind near the posterior border. *Antennae* (Figure 36 E) arise from head without tubercles, are shorter than the body, being 1.975 mm. long. The tips of articles III, IV, V and VI are very deeply clouded. There are very few hairs. Article VI has an apical nail-like process. The lengths of the respective articles are as follows: I 0.1 mm., II 0.1 mm., III 0.375 mm., IV 0.225 mm., V 0.125 mm., VI 0.15 mm. The distribution of the sensoria is: I and II none, III one row of seven large circular, IV none, V one large circular near distal end, VI several small ones in the nail-like process. *Pro-thorax* without lateral tubercles. *Rostrum* short, not reaching the coxal cavities. *Abdomen* distinctly segmented, in many cases having two rows of black blotches on the back. With few hairs and no digitules. *Cornicles* short, with trumpet-shaped openings. *Legs* moderate in length, more or less hairy, without sensoria. Hind tibia with a large black blotch on the distal end. *Wings* hyaline, veins slightly pigmented at the base. *Primary* wings, length 2.45 mm., width 0.75 mm. *Cubitus* well defined *Stigma* long and narrow. *Radius* well curved. First and second *obliques* straight, third well curved and twice-forked. *Secondary* wings, length 1.45 mm., width 0.5 mm. Two discoidals. *Sub-costal* bends down at the base of the secondary discoidal and extends to the wing-tip.

First discoidal is straight and arises from the sub-costal nearly one-half its length and extends nearly to the margin. *Second discoidal* curves slightly in and arises from the sub-costa at about two-thirds its length and extends nearly to the margin. *Cauda* rounded and hairy. *Style* obscure.

Apterous Viviparous Female.—This form has not been obtained, although close watch has been kept since the first of January.

Pupa of Viviparous Female.—(Figure 36 A, B. C.) In shape and color the pupa resembles the adult form. On the frontal margin the hairs are replaced by digitules, these digitules also cover the entire body in great numbers, as is shown in the cut, but disappear with age, as there are none on the adults. *Antennae* (Figure 36 D) five-jointed and short, being 0.58 mm. long. The comparative lengths of the various articles are: I .05 mm., II .05 mm., III 1.18 mm., IV 0.2 mm., V 0.1 mm. The margins of the abdomen are deeply serrulated between the many digitules. *Rostrum* very short, scarcely reaching beyond the pro-thorax. *Legs* as in the adult, only the hind tibia are marked, but in many cases the middle tibia, and in some cases, all the tibia are marked at the distal end with a conspicuous black blotch.

Of all the Southern California Aphids this form, commonly known as the Walnut Aphid, is of the greatest economic importance because of the damage it does to the Walnut trees. Introduced from Europe on nursery stock, it is attacking the walnut, *Juglans regiae,* so vigorously as to threaten the out-put greatly. Its appearance is so sudden and it often occurs in such countless numbers that the damage is done before the orchardist is aware of its presence. Last year it threatened to ruin the entire crop on the Limoneira Ranch. It appears to infest walnut trees throughout Southern California, settling on the under side of the leaves, in numbers which at times entirely hide the whole surface.

HOST INDEX TO CALIFORNIAN COCCIDAE

E. O. ESSIG AND C. F. BAKER.

The following index was first roughly compiled from all the publications which we happened to have at hand, and it was then submitted for correction and emendation to Mr. Edw. M. Ehrhorn (Deputy Horticultural Commissioner at San Francisco), Mr. R. S. Woglum (of the U. S. Department of Agriculture), Mr. E. K. Carnes (Superintendent of State Insectary), Prof. T. D. A. Cockerell (of Colorado State University), and Mr. E. R. Sasscer (of the U. S. Department of Agriculture). The index has been completely remodelled in accordance with their notes. But even now it is evidently only a good beginning. Many of our common cultivated plants, some of which at least must often be scale infested, are not yet on the list, while there are beyond doubt many more native species awaiting discovery. We shall be glad to publish all further corrections or additions, since the great value of a complete index of this sort is very evident. We heartily invite all Californian entomologists, horticultural commissioners, and inspectors, to assist us in the development of this index. It is especially important that we indicate the species which are found only in the greenhouses. Of course, quarantine records are not in reality Californian records at all, though very important as indicating the species which are actually knocking at our doors for admission. It is a splendid justification of our quarantine service, that so many of such records have remained, so far as we know, only quarantine occurrences. Several specialists have indicated to us that the name *Aspidiotus camelliae* should be used in place of *Aspidiotus rapax, Dactylopius coccus* in place of *Coccus cacti,* and *Pulvinaria vitis* in place of *Pulvinaria innumerabilis,* all of these apparently being changes compelled by priority rules.

Abies sp.? (Fir).
Chionaspis pinifoliae.

Abies concolor (White Fir).
Aspidiotus ehrhorni.
Leucaspis kelloggi.
Physokermes concolor.

Abies grandis.
Leucaspis kelloggi.

Abies magnifica (Red Fir).
Leucaspis kelloggi.

Abies shastensis.
Leucaspis kelloggi.

Acacia sp.?
Aspidiotus camelliae—Woglum.
Aspidiotus hederae.
Chrysomphalus aurantii—Woglum.
Diaspis boisduvalii. Only in quarantine—Carnes.
Icerya purchasi.
Saissetia oleae.

Acacia melanoxylon (Australian Blackwood).
Aspidiotus hederae.
Aspidiotus camelliae.

Acer sp.? (Maple).
Aspidiotus hederae.
Chrysomphalus tenebricosus.
Leucaspis japonica.
Pulvinaria vitis.

Acer macrophyllum (Large-leaved Maple).
Eulecanium crawii.

Adenostoma fasciculatum (Chamiso).
Eriococcus adenostomae.
Eulecanium adenostomae.
Lecaniodiaspis rufescens.
Tachardia sp.—Woglum.
Xerophilaspis prosopidis—Woglum.

Adiantum pedatum (Maiden-hair Fern).
Aspidiotus hederae—Woglum.
Saissetia hemisphaerica. Only in greenhouses—Ehrhorn.

Aesculus californica (Buckeye—Horsechestnut).
Aspidiotus aesculi.

Agathis—see Dammaria.

Agave sp.? (Century Plant).
Chrysomphalus aurantii.

Alder—see Alnus.

Almond—see Prunus amygdalus.

Alnus sp.? (Alder).
Pulvinaria ehrhorni.

Alnus japonica.
Chionaspis wistariae . Only at quarantine—Ehrhorn.

Ananassa sativa (Pineapple).
Diaspis bromeliae . Only at quarantine—Ehrhorn.

Andropogon furcatus.
Aclerda californica.

Anemone sp.?
Pseudococcus affinis—U. S. Dept. Agrcl.

Apple—see Pyrus malus.
Apricot—see Prunus armeniaca.

Aralia sieboldi.
Coccus hesperidum—Ehrhorn.
Saissetia hemisphaerica—Ehrhorn.
Saissetia oleae.

Araucaria bidwelli.
Chrysomphalus rossi—Woglum.
Chrysomphalus aonidum. Only in greenhouses—Ehrhorn.
Eriococcus araucariae—U. S. Dept. Agrcl.
Pseudococcus aurilanatus.

Araucaria excelsa.
Eriococcus araucariae—Woglum.

Araucaria imbricata.
Chrysomphalus rossii—U. S. Dept. Agrcl.
Eriococcus araucariae—U. S. Dept. Agrcl.

Arbor-vitae—see Thuya.

Arctostaphylos viscida.
Aspidiotus abietis—U. S. Dept. Agrcl.

Areca catechu (Betel Nut).
Saissetia hemisphaerica. Only in greenhouses—Ehrhorn.

Artemisia californica (Sagebrush).
Eriococcus artemisiae.
Erium lichtensioides—Essig.
Phenacoccus artemisiae.
Pseudococcus artemisiae—Essig.
Pseudococcus crawii.
Pseudococcus hymenocleae—U. S. Dept. Agrcl.

Asparagus plumosus (Climbing Asparagus).
Aspidiotus hederae.

Asparagus sprengerii.
Aspidiotus hederae—Ehrhorn.

Aspidistra lurida.
Chrysomphalus aonidum—U. S. Dept. Agrcl.
Hemichionaspis aspidistrae. Only at quarantine and in greenhouses—Ehrhorn.

Atriplex sp.?
Phenacoccus simplex.

Atriplex canescens.
Ceroplastes irregularis—Ehrhorn.

Atriplex confertifolia.
Ceroplastes irregularis—Ehrhorn.

Aucuba sp.?
Phenacaspis chinensis. Only at quarantine—Ehrhorn.

Australian Blackwood—see Acacia melanoxylon.

Azalea sp.?
Pseudococcus azaleae. Only at quarantine—Ehrhorn. In greenhouses—Carnes.

Baccharis pilularis.
Aspidiotus camelliae—U. S. Dept. Agrcl.

Bahia sp.?
Ceroputo bahiae.
Targionia dearnessi—U. S. Dept. Agrcl.

Bambusa sp.? (Bamboo).
Antonina crawii. Only at quarantine—Ehrhorn.
Aclerda tokionis. Only at quarantine—Ehrhorn.
Odonaspis bambusarum. Only at quarantine—Ehrhorn.

Begonia sp.?
Pseudococcus citri. Only in greenhouses—Ehrhorn.
Betelnut—see Areca catchu.

Bigelovia sp.?
Pulvinaria bigeloviae.

Bigelovia brachylepis.
Targionia bigeloviae.

Bignonia sp.?
Ceroplastes cistudiformis.
Pseudococcus citri.

Blackberry—see Rubus nigrobaccus.
Blackwood—see Acacia melanoxylon.
Boston Fern—see Nephrolepis exaltata.
Bottle brush—see Callistemon.
Boxwood—see Buxus.

Brunfelsia sp.?
Eucalymnatus perforatus. Only in greenhouses—Ehrhorn.

Bryophyllum calycinum (Ghost Plant).
Saissetia hemisphaerica.

Buckeye—see Aesculus.

Buxus sp.? (Boxwood).
Aspidiotus hederae—Woglum.
Saissetia hemisphaerica—Woglum.
Saissetia oleae—Woglum.

Cacti (genera? species?)—see also Opuntia, Cereus, etc.
Dactylopius coccus—U. S. Dept. Agrcl.
Diaspis cacti—Ehrhorn.
Diaspis echinocacti—Ehrhorn.

Cajaput tree—Melaleuca leucadendron.
Calla Lily—see Richardia africana.

Callistemon lanceolatus (Bottle brush).
Pseudococcus citri.

Camellia japonica.
Aspidiotus camelliae.
Aspidiotus hederae.
Ceroplastes ceriferus. Only at quarantine—Ehrhorn.
Chrysomphalus aonidum. Only in greenhouses—Ehrhorn.
Coccus hesperidum.
Fiorina fiorinae. Only in greenhouses—Ehrhorn.
Parlatoria pergandii—U. S. Dept. Agrcl.
Pseudaonidia duplex. Only at quarantine—Ehrhorn.
In greenhouses—Carnes.
Pseudaonidia paeoniae. Only at quarantine—Ehrhorn.
Pulvinaria camelicola—Woglum.
Saissetia hemisphaerica.

Camphora officinalis (Camphor tree).
Aspidiotus camelliae.
Chrysomphalus aurantii—Woglum.
Pseudaonidia duplex. Only at quarantine—Ehrhorn.

Carex breweri (Sedge).
Exaeretopus caricis—U. S. Dept. Agrcl.

Castor Bean—see Ricinus communis.

Cattleya sp.?
Diaspis boisduvalii.
Diaspis cattleyae. These two scales only at quarantine and in greenhouses—Ehrhorn.

Ceanothus sp.?
Chionaspis salicis-nigrae.

Ceanothus cuneatus.
Ceroputo yuccae.
Aspidiotus camelliae—Essig.

Ceanothus rigidus.
Mytilaspis concolor—U. S. Dept. Agrcl.

Century Plant—see Agave.

Cercis sp.? (Judas Tree, Red Bud).
Aspidiotus camelliae.

Chamiso—see Adenostoma fasciculatum.

Chenopodium sp.?
Eriococcus neglectus—U. S. Dept. Agrcl.

Cherry—see Prunus cerasus.

Cissus sp.?
Aspidiotus camelliae—U. S. Dept. Agrcl.

Citrus aurantium (Orange).
Aspidiotus camelliae.
Aspidiotus hederae.
Ceroplastes ceriferus. Only at quarantine—Ehrhorn.
Ceroplastes cirripediformis. Only at quarantine—Ehrhorn.
Ceroplastes rubens. Only at quarantine—Ehrhorn.
Chrysomphalus aonidum. Only at quarantine—Ehrhorn.
Chrysomphalus aurantii.
Chrysomphalus citrinus.
Coccus hesperidum.
Eulecanium pruinosum—U. S. Dept. Agrcl.
Hemichionaspis aspidistrae. Only at quarantine—Ehrhorn
Howardia biclavis. Only at quarantine—Ehrhorn.
Icerya purchasi.
Lepidosaphes beckii.
Lepidosaphes gloverii.
Parlatoria pergandii.
Pseudococcus citri.
Pseudococcus longispinis.
Saissetia hemisphaerica.
Saissetia oleae.

Citrus deoumanus (Forbidden Fruit, Fruit of Paradise, Pomelo, Grape Fruit).
Same list as for Citrus aurantium.

Citrus medica (Citron).
Same list as for Citrus aurantium.

Citrus limonum (Lemon).
Same list as for Citrus aurantium.

Citrus trifoliata.
Aspidiotus perniciosus var. andromelas.

Clianthus sp.?
Coccus hesperidum—U. S. Dept. Agrcl.

Coachwhip—see Fouquieria splendens.
Cochineal cactus—see Nopalea cochinellifera.
Coconut palm—see Cocos nucifera.

Cocos nucifera (Coconut Palm).
Pseudococcus pseudonipae—Woglum.
Saissetia hemisphaerica. Only at quarantine—Ehrhorn.

Cocos plumosa.
Hemichionaspis aspidistrae. Rare in greenhouses—Ehrhorn.

Coelogyne cristate.
Aspidiotus dictyospermi—U. S. Dept. Agrcl.

Coleus sp.?
Pseudococcus citri. Only in greenhouses—Ehrhorn.
Pseudococcus longispinis—Carnes.

Cornus sp.?
Chionaspis salicis-nigrae—U. S. Dept. Agrcl.
Lepidosaphes ulmi—U. S. Dept. Agrcl.

Crane's-bill—see Geranium.

Crataegus sp.? ...(Thornapple, Hawthorn).
Aspidiotus perniciosus.

Cucurbita pepo (Pumpkin).
Pseudococcus citri.

Cupressus goveniana.
Leucaspis cupressi.
Pseudococcus andersoni.

Cupressus macnabiana.
Aspidiotus coniferarum shastae.
Pseudococcus dudleyi.

Cupressus macrocarpa (Monterey Cypress).
Chionaspis striata—U. S. Dept. Agrcl.
Pseudococcus cupressi.
Pseudococcus ryani.
Xylococcus macrocarpae.

Currant—see Ribes.

Cycas revoluta (Sago Palm).
Coccus hesperidum. Only in greenhouses—Ehrhorn.
Fiorina fiorinae. Only in greenhouses—Ehrhorn.
Pseudococcus longispinis. Only in greenhouses—Ehrhorn.

Cydonia vulgaris (Quince).
Aspidiotus camelliae.
Aspidiotus perniciosus.

Cydonia japonica (Japanese Quince).
Aspidiotus camelliae.
Aspidiotus perniciosus.

Cyperus alternifolius.
Aspidiotus hederae. Only in greenhouses—Ehrhorn.
Pseudococcus citri. Only in greenhouses—Ehrhorn.
Pseudococcus longispinis. Only in greenhouses—Ehrhorn.

Cypress—see Cupressus.

Dammaria ovata.
Pseudococcus aurilanatus. Only at quarantine—Ehrhorn.

Dammaria vitiensis.
Pseudococcus aurilanatus. Only in greenhouses—Ehrhorn.

Dioscorea sp.?
Aspidiotus camelliae—Woglum.

Diospyros kaki (Japanese Persimmon).
Diaspis pentagona. Only at quarantine—Ehrhorn.

Diplacus glutinosus (Monkey flower).
Ceroputo yuccae.
Phenacoccus ramonae—Essig.

Distichlis maritima (Marsh spike grass).
Sphaerococcus distichlium.

Dracaena sp.?
Aulacaspis crawii. Only at quarantine—Ehrhorn.
Pseudococcus longispinis.
Saissetia oleae.

Elaeagnus sp.?
Chionaspis difficilis. Only at quarantine—Ehrhorn.
Lepidosaphes beckii. Only at quarantine—Ehrhorn.

Elaeagnus umbellata.
Aulacaspis crawii. Only at quarantine—Ehrhorn.

Elder—see Sambucus.
Elm—see Ulmus.

Ephedra californica.
Pseudococcus ephedrae.

Erica sp.?
Aspidiotus camelliae.

Eriogonum sp.?
Erium eriogoni.

Eriogonum fasciculatum.
Eriococcus palmeri. Recorded also from Lower California on Boureria sonorae—Ehrhorn.

Eriogonum latifolium.
Pseudococcus maritimus.

Eucalyptus sp.?
Aspidiotus camelliae.
Aspidiotus hederae—U. S. Dept. Agrcl.
Phenacaspis latissima. Only at quarantine—Ehrhorn.
Saissetia oleae.

Euonymus japonicus.
Aspidiotus camelliae.
Chionaspis euonymi. In nursery houses—Ehrhorn.
Chrysomphalus aurantii.
Saissetia oleae.

Euonymus latifolius.
Chionaspis euonymi. Only at quarantine—Ehrhorn.

Euphorbia pulcherrima (Poinsettia).
Chrysomphalus aurantii.
Pseudococcus citri.
Saissetia oleae.

Ferns—see Filicales.
Fescue—see Festuca scabrella.

Festuca scabrella.
Ripersia festucae.

Ficus carica (Fig).
Aspidiotus camelliae.
Chrysomphalus aurantii.
Chrysomphalus citrinus—Carnes.
Coccus hesperidum.

Fig—see Ficus carica.

Filicales (Ferns).
Ceroplastes rubens. Only at quarantine—Ehrhorn.
Hemichionaspis aspidistrae. Only at quarantine—Ehrhorn.
Pinnaspis buxi. Only at quarantine—Ehrhorn.
Pseudococcus citri. In greenhouses—Ehrhorn.
Pseudococcus longispinis. In greenhouses—Ehrhorn.
Pulvinaria psidii. Only at quarantine—Ehrhorn.
Saissetia hemisphaerica. In greenhouses—Ehrhorn.
Saissetia oleae. In greenhouses—Ehrhorn.

Fir—see Abies.
Forbidden Fruit—see Citrus decumana.

Fouquieria splendens (Octillo, Coach-whip, Vine Cactus, Jacob's Staff).
Lecaniodiaspis rufescens.

Fragaria chilensis (Wild Strawberry).
Aulacaspis rosae.

Fuchsia sp.?
Aspidiotus camelliae.
Pseudococcus citri.

Gardenia sp.? (Jasmine).
Ceroplastes ceriferus. Only at quarantine—Ehrhorn.
Coccus hesperidum.

Genista alba.
Aspidiotus camelliae—U. S. Dept. Agrcl.

Geranium sp.? (Crane's-bill).
Icerya purchasi—Carnes.
Pseudococcus citri. In greenhouses—Ehrhorn.
Coccus hesperidum.
Saissetia hemisphaerica.
Saissetia oleae.

Ghost Plant—see Bryophyllum calycinum.

Gleditschia sp.?
Aspidiotus camelliae—U. S. Dept. Agrcl.

Golden Rod—see Solidago.

Gramineae, genera? species? ...(Grass).
Odonaspis graminis—Ehrhorn.
Pseudococcus salinus.
Ripersiella kelloggi.

Grape—see Vitis.

Grape-fruit—see Citrus decumana.

Grass—see Gramineae, Festuca, Distichlis and Spartina.

Gum-tree—see Eucalyptus.

Hawthorn—see Crataegus.

Hedera helix (English Ivy).
Aspidiotus camelliae—U. S. Dept. Agrcl.
Aspidiotus hederae.
Coccus hesperidum—Carnes.
Fiorina fiorinae. Only at quarantine—Ehrhorn.
Saissetia oleae.

Heteromeles arbutifolia.
Coccus hesperidum—U. S. Dept. Agrcl.

Hibiscus sp.? (MarshMallow, Rose Mallow, Chinese Rose).
Diaspis pentagona. Only at quarantine—Ehrhorn.
Ceroplastes ceriferus. Only at quarantine—Ehrhorn.
Saissetia oleae.

Incense Cedar—see Libocedrus decurrens.

Ivy—see Hedora helix.

Jacob's Staff—see Fouquiera splendens.

Jasmine—see Gardenia.

Judas Tree—see Cercis.

Juglans regia (Walnut).
Aspidiotus camelliae—U. S. Dept. Agrcl.
Aspidiotus juglans-regiae.
Aspidiotus perniciosus.
Eulecanium cerasorum—Woglum.
Eulecanium pruinosum.

Juniperus sp.? (Juniper).
Diaspis carueli.

Kentia sp.?
Aspidiotus dictyospermi—U. S. Dept. Agrcl.

Lantana sp.?
Orthezia insignis—Woglum.

Larrea sp.?
Tachardia larreae—U. S. Dept. Agrcl.

Latania borbonica (Fan Palm).
Aspidiotus hederae.

Laurus nobilis (Sweet Bay Tree).
Coccus hesperidum—Ehrhorn.
Eucalymnatus perforatus.
Saissetia oleae—U. S. Dept. Agrcl.

Lavatera assurgentifolia.
Aspidiotus camelliae—U. S. Dept. Agrcl.

Lemon—see Citrus limonum.

Leucadendron argenteum (Silver Tree).
Saissetia oleae.

Libocedrus decurrens (Incense Cedar).
Aspidiotus ehrhorni.
Pseudococcus andersoni.

Ligustrum ovalifolium (Privet)
Saissetia oleae.

Ligustrum vulgare (Privet).
Aspidiotus perniciosus.

Magnolia sp.?
Aspidiotus hederae.
Eulecanium magnoliarum.
Lepidosaphes gloverii.
Leucaspis japonica.

Maiden-hair Fern—see Adiantum pedatum.
Maple—see Acer.
Marsh Mallow—see Hibiscus.
Mazzard—see Prunus avium.

Melaleuca leucadendron (Cajaput Tree, Paper-bark Tree).
Saissetia oleae.

Melia azedarach (Umbrella Tree).
Aspidiotus cameliae—Ehrhorn.
Aspidiotus hederae.
Coccus hesperidum.

Mistletoe—see Phoradendron flavescens.
Monkey Flower—see Diplacus glutinosus.
Monterey Cypress—see Cupressus macrocarpa.

Morus sp.? (Mulberry).
Aspidiotus hederae.
Chrysomphalus aurantii—Woglum.

Mulberry—see Morus.

Myrtus sp.? (Myrtle).
Aspidiotus cameliliae—Ehrhorn.
Coccus hesperidum.
Saissetia oleae.

Nerium oleander (Oleander).
Aspidiotus hederae.
Chrysomphalus aurantii.
Coccus hesperidum.
Pseudococcus citri—Essig.
Pseudococcus longispinis—Carnes.
Saissetia hemisphaerica.
Saissetia oleae.

Nephrolepis exaltata (Boston Fern).
Pinnaspis buxi. Only at quarantine—Ehrhorn.
Saissetia hemisphaerica. In greenhouses—Ehrhorn.

Nightshade—see Solanum douglasii.

Nopalea cochinellifera (Cochineal Cactus).
Dactylopius coccus.

Norfolk Pine—see Araucaria.
Oak—see Quercus.
Octillo—see Fouquieria splendens.

Odontoglossum sp.?
Aulacaspis boisduvalli—U. S. Dept. Agrcl.
Aulacaspis miranda—U. S. Dept. Agrcl.

Olea fragrans (Olive).
Aspidiotus camelliae.
Aspidiotus hederae.
Chrysomphalus aurantii.
Pollinia pollini. Appeared in Los Angeles county, but was eradicated—Carnes.
Pseudaonidia duplex. Only at quarantine—Ehrhorn.
Saissetia oleae.

Oleander—see Nerium oleander.

Olive—see Olea.

Opuntia sp.?
Pseudococcus obscurus—Essig.

Opuntia littoralis.
Aspidiotus hederae—U. S. Dept. Agrcl.

Orange—see Citrus aurantium.
Orchids—see Coelogyne, Cattleya, Odontoglossum.
Osage Orange—see Toxylon pomiferum.

Paeonia sp.? (Poeony).
Leucaspis japonica. Only at quarantine—Ehrhorn.
Pseudaonidia paeoniae. Only at quarantine—Ehrhorn.
Pseudococcus citri. In greenhouses—Ehrhorn.

Palma Cristi—see Ricinus communis.

Palmae genera? species? (Palms).
Aspidiotus hederae.
Phenacaspis cockerelli. Only at quarantine—Ehrhorn.
Phenacaspis latissima. Only at quarantine—Ehrhorn.

Pandanus sp.? (Screw Pine).

Palms—see Cocos, Kentia, Latania, Phoenix.
Paper Bark Tree—see Melaleuca leucadendron.
Peach—see Prunus persica.
Pear—see Pyrus.
Persimmon—see Diospyros kaki.

Phlox sp.?
Saissetia oleae.

Phoenix dactylifera.
Aspidiotus hederae.
Chrysomphalus aurantii.
Parlatoria victrix—U. S. Dept. Agrcl.
Phenicococcus marlatti—U. S. Dept. Agrcl.

Phoradendron flavescens (Mistletoe).
Aspidiotus camelliae—U. S. Dept. Agrcl.
Aspidiotus hederae.
Saissetia oleae—U. S. Dept. Agrcl.

Phormium tenax.
Pseudococcus calceolariae.

Picea sp.? (Spruce).
Chionaspis pinifoliae.

Picea breweriana.
Phenacoccus kuwanae.

Pine—see Pinus.
Pineapple—see Ananassa sativa.

Pinus sp.? (Pine).
Chionaspis pinifoliae.

Pinus attenuata.
Aspidiotus californicus.

Pinus attenuata tuberculata.
Aspidiotus abietis—U. S. Dept. Agrcl.

Pinus coulteri.
Aspidiotus abietis—U. S. Dept. Agrcl.

Pinus insignis.
Aspidiotus hederae—U. S. Dept. Agrcl.
Chionaspis pinifoliae—U. S. Dept. Agrcl.
Coccus hesperidum—U. S. Dept. Agrcl.
Physokermes insignicola.

Pinus lambertiana (Sugar Pine).
Aspidiotus abietis—U. S. Dept. Agrcl.
Aspidiotus californicus.

Pinus ponderosa (Bull Pine).
Aspidiotus abietis—U. S. Dept. Agrcl.
Aspidiotus californicus.
Aspidiotus coniferarum.
Aspidiotus florenciae.

Pinus radiata.
Chionaspis pinifoliae—U. S. Dept. Agrcl.

Pinus sabiniana.
Aspidiotus californicus.
Chionaspis pinifoliae—U. S. Dept. Agrcl.

Pittosporum undulatum.
Icerya purchasi.
Saissetia oleae.

Platycerium sp.? (Staghorn Fern).
Coccus hesperidum. In greenhouses—Ehrhorn.
Hemichionaspis aspidistrae. In greenhouses—Ehrhorn.
Pseudococcus longispinis. In greenhouses—Ehrhorn.

Pluchea sp.?
Pulvinaria plucheae—U. S. Dept. Agrcl.

Plum—see Prunus domestica.

Plumbago sp.?
Pseudococcus citri—U. S. Dept. Agrcl.

Poinsettia—see Euphorbia pulcherrima.

Populus sp.? (Poplar, Aspen).
Aspidiotus perniciosus.
Chionaspis ortholobis.
Chionaspis salicis-nigrae.

Populus deltoides (Cottonwood).
Aspidiotus camelliae.
Chionaspis ortholobis.

Populus tremuloides.
Aspidiotus ancylus—U. S. Dept. Agrcl.

Privet—see Ligustrum.
Prune—see Prunus domestica var. galatensis.

Prunus amygdalus (Almond).
Aspidiotus camelliae.
Aspidiotus juglans-regiae.
Aspidiotus perniciosus.

Prunus armeniaca (Apricot).
Eulecanium armeniacum.
Eulecanium pruinosum.
Saissetia oleae.

Prunus cerasus (Cherry).
Aspidiotus camelliae—Ehrhorn.
Aspidiotus juglans-regiae.
Aspidiotus perniciosus—Ehrhorn.
Eulecanium armeniacum.
Eulecanium pruinosum.

Prunus domestica (Plum).
Aspidiotus hederae.
Aspidiotus juglans-regiae.
Aspidiotus perniciosus.
Chrysomphalus aurantii.
Epidiaspis pyricola.
Eulecanium armeniacum.
Eulecanium pruinosum.

Lepidosaphes ulmi.
Pseudococcus longispinis.
Pulvinaria amygdali—U. S. Dept. Agrcl.
Saissetia oleae.

Prunus domestica var. galatensis (Prune).
Aspidiotus juglans-regiae—U. S. Dept. Agrcl.
Aspidiotus perniciosus.
Diaspis pentagona—U. S. Dept. Agrcl.
Eulecanium armeniacum.
Eulecanium persicae—U. S. Dept. Agrcl.
Eulecanium pruinosum.
Saissetia oleae—Ehrhorn.

Prunus persica (Peach).
Aspidiotus juglans-regiae—U. S. Dept. Agrcl.
Aspidiotus perniciosus.
Diaspis pentagona—U. S. Dept. Agrcl.
Eulecanium armeniacum.
Eulecanium persicae—U. S. Dept. Agrcl.
Eulecanium pruinosum.
Epidiaspis piricola.
Saissetia hemisphaerica.
Saissetia oleae.

Prunus triflora (Japanese Plum).
Aspidiotus perniciosus.

Pseudotsuga taxifolia (False Tsuga).
Aspidiotus abietis—U. S. Dept. Agrcl.
Leucaspis kelloggi.
Physokermes taxifolia.

Pomegranate—see Punica Granatum.
Pomelo—see Citrus decumanus.
Pumpkin—see Cucurbita pepo.

Punica granatum (Pomegranate).
Aspidiotus camelliae—Ehrhorn.
Aspidiotus hederae—Ehrhorn.
Saissetia oleae.

Pyrethrum roseum.
Saissetia oleae.

Pyrus communis (Pear).
Aspidiotus camelliae.
Aspidiotus juglans-regiae.
Aspidiotus perniciosus.
Aulacaspis rosae.
Epidiaspis piricola.
Eulecanium armeniacum.
Eulecanium cerasorum—Carnes.
Eulecanium pruinosum.
Lepidosaphes ulmi.
Pulvinaria vitis.
Saissetia oleae.

Pyrus malus (Apple).
Aspidiotus camelliae.
Aspidiotus juglans-regiae.
Aspidiotus perniciosus.
Chionaspis furfurus—U. S. Dept. Agrcl.
Chrysomphalus aurantii.
Chrysomphalus tenebricosus.
Epidiaspis piricola.
Eulecanium pruinosum—Woglum.
Lepidosaphes ulmi—U. S. Dept. Agrcl.
Saissetia oleae.

Pyrus sinensis (Sand Pear, Chinese Pear).
Aspidiotus perniciosus.

Quercus sp.? (Oak).
Aspidiotus densiflorae.
Aspidiotus hederae.
Aspidiotus yulupae.
Cerococcus quercus.
Chionaspis quercus.
Eulecanium pubescens.
Eulecanium quercitronis var. kermoides.
Kermes nigropunctatus.
Kermes shastensis.
Pseudococcus quercus.

Quercus agrifolia.
Cerococcus ehrhorni.
Cerococcus quercus.
Chionaspis quercus—U. S. Dept. Agrcl.
Pseudococcus agrifoliae.
Ripersia villosa.

Quercus chyrsolepis.
Kermes rattani—U. S. Dept. Agrcl.
Pseudococcus quercus.
Xylococcus quercus.

Quercus lobata.
Aspidiotus yulupae—U. S. Dept. Agrcl.
Chionaspis quercus—U. S. Dept. Agrcl.

Quince—see Cydonia.

Ramona polystachya.
Phenacoccus ramonae—Essig.

Raspberry—see Rubus.

Redwood—see Sequoia sempervirens.

Rhamnus californica.
Aspidiotus hederae—U. S. Dept. Agrcl.
Chionaspis ortholobis—U. S. Dept. Agrcl.

Rhododendron sp.?
Coccus hesperidum—U. S. Dept. Agrcl.
Pseudaonidia duplex. Only at quarantine—Ehrhorn.
Pseudaonidia paeoniae—Ehrhorn.

Rhus sp.?
Aspidiotus hederae—Woglum.
Chrysomphalus aurantii—Woglum.
Saissetia oleae.

Rhus diversiloba (Poison Sumac).
Pulvinaria rhois.

Rhus integrifolia.
Aspidiotus hederae—U. S. Dept. Agrcl.

Ribes sp.?
Aspidiotus ancylus—U. S. Dept. Agrcl.
Aspidiotus juglans-regiae—U. S. Dept. Agrcl.
Chionaspis furfurus—U. S. Dept. Agrcl.

Ribes rubrum (Red Currant).
Aspidiotus hederae.
Aspidiotus perniciosus.
Epidiaspis piricola.
Lepidosaphes ulmi.

Richardia africana (Calla Lily).
Saissetia oleae. In greenhouse—Essig.

Ricinus communis (Castor Bean, Palma Crista).
Chrysomphalus aurantii—Maskew.
Saissetia oleae.

Rosa sp.? (Rose.)
Aspidiotus camelliae.
Aspidiotus perniciosus.
Aulacaspis rosae.
Chrysomphalus aurantii.
Eulecanium pruinosum.
Lepidosaphes ulmi.
Icerya purchasi.
Saissetia oleae.

Rubus nigrobaccus (Blackberry).
Aulacaspis rosae.
Coccus hesperidum—Ehrhorn.

Rubus strigosus (Red Raspberry).
Aspidiotus perniciosus.
Aulacaspis rosae.

Sage—see Artemisia.
Sago Palm—see Cycas revoluta.

Salix sp.? (Willow).
Aspidiotus camelliae.
Aspidiotus perniciosus.
Chionaspis ortholobis.
Chionaspis salicis-nigrae.

Salix babylonica.
Chionaspis wistariae. Only at quarantine—Ehrhorn.

Salvia sp.?
Aspidiotus camelliae—U. S. Dept. of Agrcl.

Sambucus glauca.
Pseudococcus obscurus—Essig.

Schinus molle (Pepper Tree).
Aspidiotus camelliae—Carnes.
Coccus hesperidum—Woglum.

Saissetia hemisphaerica—Ehrhorn.
Saissetia oleae—Ehrhorn.

Screw Pine—see Pandanus.
Sedge—see Carex.

Selaginella sp.?
Pseudococcus citri. In greenhouses—Essig.

Sequoia sempervirens (Redwood).
Aspidiotus hederae—U. S. Dept. Agrcl.
Pseudococcus sequoiae.

Silver Tree—see Leucadendron.
Slough Grass—see Spartina stricta.
Snow Ball—see Viburnum.

Solanum douglasii (Nightshade).
Chrysomphalus aurantii—Woglum.
Pseudococcus citri.
Pseudococcus solani—P. E. Smith.
Saissetia hemisphaerica.
Saissetia oleae.

Solanum umbelliferarum.
Aspidiotus hederae—U. S. Dept. Agrcl.

Solidago sp.?
Saissetia oleae—Essig.

Spartina stricta (Slough Grass).
Chionaspis spartinae.

Spike grass—see Distichlis maritima.
Spruce—see Picea.

Stachys pullata (Incorrectly "Stachyos").
Phenacoccus stachyos.

Staghorn Fern—see Platycerium.
Strawberry—See Fragaria.
Sumac—see Rhus.
Tea—see Thea.

Thea japonica (Japan Tea).
Lepidosaphes newsteadi. Only at quarantine—Ehrhorn.
Pseudaonidia paeoniae. Only at quarantine—Ehrhorn.

Thuya sp.?
Diaspis carueli.

Thuya orientalis.
Pseudococcus ryani.

Toxylon pomiferum (Osage Orange).
Aspidiotus perniciosus.

Trisetum subspicatum.
Exaertopus caricis.

Ulmus americana (Elm).
Aspidiotus perniciosus.
Gossyparia spuria.
Lepidosaphes ulmi.

Umbellularia californica.
Aspidiotus camelliae—U. S. Dept. Agrcl.
Aspidiotus hederae—U. S. Dept. Agrcl.

Umbrella Plant—see Cyperus.
Umbrella Tree—see Melia.

Viburnum sp.?
Phenacaspis latissima. Only at quarantine—Ehrhorn.

Vitis vinifera (Grape).
Aspidiotus camelliae.
Chrysomphalus aurantii.
Diaspis pentagona—U. S. Dept. Agrcl.
Eulecanium magnoliarum—Carnes.
Eulecanium pruinosum.
Pulvinaris vitis.

Walnut—see Juglans regia.

Wistaria sp.?
Chionaspis wistariae. Only at quarantine—Ehrhorn.

Willow—see Salix.

Yucca aloifolia.
Saissetia oleae—Essig.

Yucca whipplei.
Aspidiotus hederae.
Ceroputo yuccae.

WEST COAST NEWS NOTES

FORDYCE GRINNELL, JR.

(In this department we hope to give in each number of the Journal, some idea of the doings and movements of western entomologists, notices of publications of interest to western students, notices of entomological meetings, etc. To this end, we hope that students or collectors will send in all items of entomological interest about themselves or others. Address, Fordyce Grinnell, Jr., 572 N. Marengo Avenue, Pasadena, Cal.)

Mr. Erval J. Newcomer, of Palo Alto, will probably spend the summer collecting around Lake Tahoe, where he has already spent two summers.

Mr. Virgil W. Owen, of Los Angeles, has been engaged in natural history collecting on the Tres Marias Islands, off the west coast of Mexico. He is expected home the last of May.

Mr. and Mrs. V. L. Clemence left Pasadena the first part of May, for a four months' trip to Europe. Mr. Clemence will visit the British and Tring Museums, and will probably go over to Rennes, France, and see Oberthur's collection, which is supposed to contain Boisduval's California Lepidoptera.

Mr. J. G. Grundel has presented his collection of 100 boxes of Lepidoptera to the California Academy of Sciences. This collection is especially rich in species of the Santa Cruz mountains, where Mr. Grundel lived for several years.

Mr. Don. Ross, of Pasadena, made a short trip to San Clemente Island in April. The only butterfly which he saw and captured is probably the same as the mainland form—*Cyaniris pseudargiolus piasus.*

The Monograph of the Eleodiini by Dr. F. E. Blaisdell of San Francisco, will soon be issued by the U. S. National Museum as Bulletin No. 63, 519 pages, 13 plates, and 8 figures. This work has been in preparation for eight years.

At the Entomological Conference held during the last of April at Berkeley, an organization of the Society of Economic Entomologists was effected. Prof. C. W. Woodworth was elected president; Prof. W. B. Herms secretary-treasurer, and thirteen vice-presidents, representing the various Western States. There are now five entomological clubs or societies in California, most of which, however, are in need of a tonic.

Mr. Wilhelm Schrader, of Los Angeles, is doing some very interesting and significant experimental work with *Dione vanillae, Junonia coenia,* and *Lemonias chalcedon.*

In Wickson's California Fruits and How to Grow Them, 4th edition, 1909, there is a section on injurious insects, edited by Prof. W. T. Clarke, of the University of California. On page 394 there is a figure of an insect labeled "Thrips—greatly enlarged." The insect figured belongs to the Mallophaga or Biting Bird-lice. One would hardly look for it on a fruit tree.

Prof. W. B. Herms of the University of California, is writing a book on Medical Entomology.

The annual Field Day of the Pacific Coast Entomological Society was recently held near San Mateo.

In the Annals of the Entomological Society of America, I, 4, 1908, is an interesting account of the trap-door spiders and tarantulas of California, by Mr. C. P. Smith. There are four rather important papers referring directly to the habits of California forms, which are not to be found in the appended bibliography. I will give these titles here to render the bibliography more complete, and to bring them to the notice of students. Three of them are in publications which are seldom consulted by entomologists, which may account for their omission by Mr. Smith:

Davidson, Dr. A.—An Enemy of the Trap-door Spider. Entomological News, XVI, 7, pp. 233-234, 1905.

Monks, Sarah P.—Trap-door Spiders. Publication of Historical Society of Southern California, I, pp. 28-36, 1886.

Monks, Sarah P.—Aestivation of Californian Mason Spiders. loc. cit. pp. 18-22, 1887.

Rivers, J. J.—Description of the nest of the Californian Turret-Building Spider, with some reference to allied species. Zoe, II, 4, pp. 318-320, 1892.

Pomona Journal of Entomology

Volume I OCTOBER 1909 Number 3

CONCERNING TWO NEW GENERA AND THREE NEW SPECIES OF APHIDS OF CALIFORNIA

G. DEL GUERCIO.

(The following very important paper has recently appeared in the Rivista di Patalogia Vegetale, Pavia, Anno III, n. 20-21, 1909. As this publication is inaccessible to most of our students, I have made a free translation from the Italian of the most important portions, and give it herewith.—Editor.)

Of the three species of new aphides which are figured and described by E. O. Essig in Pomona Journal of Entomology, I, 1-10, under the names of *Lachnus californicus, Rhopalosiphum violae,* and *Pemphigus radicicola,* two are here referred to new genera under the names *Essigella* and *Trifidaphis* Del Guercio.

I. Lachnus californicus Essig

The pine louse resembles in a general way *Lachnus agilis* Kalt. From that species and all others of this small tribe, *californicus* differs first of all in the antennae, which are five-articled and not six. By the character of the cubital vein this species resembles more the genus *Schizolachnus* Mord., than the old genus *Lachnus* Burm., though this character, drawn from the winged female only, is far less important than one drawn from the tarsi, since the latter is a more comprehensive and constant one. So that the characters as a whole do not correspond either with those of *Eulachnus* or *Lachnella,* which latter, however, have the first tarsal article also distinctly elongate and subequal to half of the second article. We are obliged to exclude *californicus* from either of these genera on account of the nature of the antennae, and I call it *Essigella,* the name taken from that of the student who has collected and described the species. The new genus is distinguished from others of the Tribe Lacnidi in the following manner:

Tribe **Lacnidi** *(Lachnides)*

I. Tarsi with the first article much elongate, always subequal to half of the second article.

A. Apterous and winged females with antennae formed always of five articles.

Genus *Essigella* Del Guercio.
(Sp. top. *Lachnus californicus* Essig.)

AA. Apterous and winged females with antennae of six articles.

Genus *Eulachnus* Del Guercio.

II. Tarsi with the first article very short, always shorter than half of the second article.

Genus *Lachnus* Burm.

Among other characters of interest in the systematic study of the species, it is enough to mention that the apterous and winged females have shorter antennae, with the third article equal to the two following together, the two last subequal—including in the fifth article its very short appendix. It lives on a cultivated pine at Claremont, California, where it is common, according to Essig.

III. Pemphigus radicicola Essig

The apterous and winged females in this species have the abdomen distinctly margined. Their antennae are formed of five articles. In the apterous female the second article is rounded at tip where it is broader than at base and is as long as the third article, longer than the fourth, and a little shorter than the fifth. In the winged female the second article is also somewhat swollen at the tip, but is subequal to only half of the third, the third becoming attenuated in the apical half, while the fourth is clavate like the fifth, but shorter than it. The third article is provided with numerous sensoria of various sizes. Now, even from these characters alone it seems evident to me that this species is not a *Pemphigus,* and also that because of the wing venation it forms a part of the Pentafidi. In the fore wings it has the four oblique veins of *Pentaphis,* but in that genus the two oblique veins of the posterior wings are distant or remote, while in this they spring from practically the same point. *Pemphigus radicicola* resembles *Pentaphis,* as the genus *Pachypappa* resembles the genus *Schizoneura,* or as the genus *Pemphigus* resembles *Tetraneura.* It, therefore, can well serve for the type of a new genus, which, because of the peculiar position of the two oblique veins of the posterior wings taken in connection with the distal portion of the subcostal, may well be named *Trifidaphis.* The genera in question may be separated thus:

Tribe **Pentafidi** *(Pentaphides)*

A. Posterior wings with the two oblique veins distinct and remote.

Genus *Pentaphis.*
(Sp. tip. *Tychea trivialis Pass.*)

AA. Posterior wings with the two oblique veins united at the base, causing the subcostal to appear trifid at the point of division.

Genus *Trifidaphis* Del Guercio.
(Sp. tip. *Pemphigus radicicola* Essig.)

Trifidaphis radicicola (Essig) was collected for the first time at Santa Paula in California in November, 1908, on the roots of *Amarantus retroflexus,* on which we have also found *Tetraneura phaseoli* (Pass.). *T. radicicola* was collected on the roots of *Solanum douglasii* near Claremont, California.

AN ENTOMOLOGICAL EXPEDITION TO GUADALAJARA

D. L. CRAWFORD.

(The following account adds one more to successful entomological ventures into the Mexican field. Though with but limited time and at an unfavorable season, yet Messrs. Crawford and McConnell brought together extensive collections in the groups to which they gave especial attention—namely, the Hemiptera and Hymenoptera. Their gatherings in some other groups were also of great interest and value. Most of this material has already been permanenty deposited in the collections of various institutions, but there still remain for sale considerable numbers of Coleoptera, Arachnida, Neuroptera, and some other groups.—Editor.)

Mr. R. A. McConnell and the writer left Claremont for Mexico on the last day of June, 1909, arriving in Mexico City about five days later. Several delays along the route enabled us to make collections at various points on the way. Less than a week was spent in Mexico City. We arrived in Guadalajara, our headquarters, on July 12. About this latter city, collecting was done over most of the desirable territory within a radius of perhaps twenty miles and a trip was made high up on the slopes of San Pedro Mountain, about forty miles from the city. A visit was also made to Lake Chapala, about fifty miles from headquarters. The altitude covered ranged from 3000 feet above sea level upward, most of the work being done at or near 5000 feet.

The chief difficulty lay in the frequent rains. It might be supposed that any part of Mexico so far south as Guadalajara would be very tropical in character, but this is not at all the case. Instead of a more or less continuous rainy season such as may be found in truly tropical regions, there is a period of about three months of thunder storms and cloud-bursts, lasting from about June to September, while during the remaining nine months it is very dry and sometimes quite cold. In consequence of this condition, the great burst of insect life comes during the winter months of January, February and somewhat later. During our few weeks of work, we noticed hordes of larvae, hemipterous and orthopterous nymphs and pupae, as well as coleopterous grubs, dipterous larvae, and odonate nymphs. Towards the close of our trip we were able to find a few early butterfly chrysalids here and there, but apparently the great majority of larvae had not yet pupated. There were some butterflies, but nearly all had frayed or torn wings—relics of the past season.

The same might be said of Orthoptera. In some grassy places we encountered hopping masses of immature grasshoppers and locusts, a great many of them beautifully colored. Any amount of some four or five common varieties were in season, but of the very numerous later forms we encountered only a few extra early adults. Mature Blattidae were, of course, abundant, as they are at all seasons. Mantidae were still in the nymphal stages. Also adults of one phasmid and several gryllids were taken. However, throughout the rainy season, there were thousands of good Coleoptera, Hemiptera, Hymenoptera, Diptera, and Arachnida, everywhere, and somewhat less of Odonata and Neuroptera. It might be remarked that the general cast of the whole insect fauna at this season is, as to families and genera, remarkably similar to that of the Southwestern United States.

The topography of the region about Guadalajara is very interesting. The city is situated on a high inland plateau ranging from 4000 to 7000 feet altitude. Enclosing the city, but some fifty miles away, are numerous mountain peaks of varying height, San Pedro overtopping them all. Between two of these small ranges of mountains and at about 6000 feet altitude, lies Lake Chapala, which is some seventy miles long and half as wide. Santiago River, the outlet of the lake, flows through these mountains and out into the level valley, on its way carving out a long deep cañon or barranca. In some places this barranca may be as much as 2000 feet below the surrounding country, and is filled with a very rich vegetation. Bananas, mangoes, cocoanuts and other tropical fruits flourish in the barranca, while they do not thrive in the level country about Guadalajara. The walls of the barranca are practically cloaked with creeping vines which make progress very difficult. The insect fauna of the barranca includes many forms not found in the country above, though very many are common to the two regions. Some very distinct and interesting forms were also taken during a hasty visit to the slopes of San Pedro mountain.

One would naturally assume that the waters of the region would yield a great number of aquatic forms, but this certainly was not so during our visit. Careful dredging was done everywhere, but very few Hemiptera and Coleoptera were taken. Collecting about electric lights also proved very poor. We were told that at Vera Cruz there were millions of "bugs" flying about the lights, but there were very few at Guadalajara. In spite of the unfavorable season we managed to secure some 30,000 specimens. All of the Hemiptera and Hymenoptera went to Pomona College. All of the Diptera and some of the Coleoptera, Lepidoptera, and Odonata went to the Carnegie Museum in Pittsburg. The Academy of Natural Sciences in Philadelphia took the Orthoptera, as well as the entire collection of landshells. Mr. E. O. Essig is now studying the Coccidae, and the writer is working up a report on the Thysanoptera.

Mexico certainly needs active practical work in economic entomology and botany. The parks, plazas, and private plantings are usually very badly infested with all sorts of serious pests. In one of the chief parks of Mexico City we made a considerable collection of Coccidae. In the central plaza of Guadalajara, *Chrysomphalus aurantii* was abundant on citrus trees, and *Diaspis echinocacti* thrived on cactus, and there were many other species besides these. In this same park also occurred myriads of Aleyrodidae. During most of the summer, a species of rose beetle—*Macrodactylus*—was enormously abundant on rose bushes, though this disappeared about the first of September and was replaced by swarms of another beetle.

ON SOME DIPLOPTERYGA FROM THE SOUTHWEST OF NORTH AMERICA

P. CAMERON.

Nortonia acanthopus Cam.

A female of what is doubtless this species from Lee county, Texas, (Birkman), has an oblique longish mark or line on the top of the basal slope of the first abdominal segment on the sides, and the mark on the sides of the metanotum is larger and wider, covering the apical half of the sides.

Ancistrocerus pilias Cam.

A specimen of this species from the mountains near Claremont, California, has the two large marks of the second abdominal segment of the type, united into one broad yellow band; the other markings are larger.

Ancistrocerus howardi sp. nov.

Black, the head and thorax covered densely with fuscous pubescence, the clypeus except for a wide mark down the center of the upper half, a small triangular mark on the base of the mandibles, a mark not much wider than long over the antennae, a short line on upper part of outer orbits, a line on the basal third of pronotum narrowed in the center, a broad line on the scutellum roundly narrowed at the base and nearer the apex than the base of the scutellum, postscutellum, a line on the apex of the first abdominal segment broadly dilated backwards to the suture on the sides, a line all around on the second and fourth, and one on the top of the fifth segment, the apices of the femora broadly, and the tibiae, bright orange yellow; the tarsi rufofulvous; the tegulae of a paler yellow, with a fuscous spot in the center. Wings hyaline, the radial cellule smoky, the costa and nervures black, the stigma dark fuscous. Female, length to end of second segment 8 mm. Lee county, Texas, (Birkman).

Metanotum bordered all around with a stout keel, there being also a keel down the center; the keels at the top curve down obliquely to unite with the central keel, at the sides below is a leaf-like expansion. Clypeus broad, pyriform, strongly punctured, the apex transverse. Antennal scape yellow except above and there is a small yellow spot at its outer side; the flagellum is brownish below. Base of thorax almost transverse, the sides rounded, not projecting. Apex of postscutellum almost transverse. First abdominal segment longish cup-shaped, the base triangular, flat, smooth and shining, the second segment narrowed at the base, distinctly longer than it is wide at the apex, which is flat.

Belongs to Saussure's Section I. It comes near *A. trichionotus* Cam., but is more slenderly built, is not so densely pilose, and the mark on the clypeus of *trichionotus* is much larger, triangular, and united by a narrow line to the apex; the thorax in the latter, too, is wider compared with the length.

Odynerus approximatus Cam.

This species comes close to *O. mediatus* Cam. from California. The females may be separated thus:

A. Clypeus longer than wide, a broad black mark down the center, commencing behind the middle and continued to the apex, the yellow mark on postscutellum rounded at apex, the oblique line on first abdominal segment longish, of equal width, the second abdominal segment fully as long as wide. *approximatus.*

AA. Clypeus as wide as long, the center only marked with black, the yellow mark on postscutellum completely transverse at apex, the oblique line on first abdominal segment broad, narrowed on inner side, the second abdominal segment longer than wide. *mediatus.*

Odynerus macfarlandi sp. nov.

Black, a curved band slightly wider than the antennal scape on the top of the clypeus, small irregular spot on the front, one on the base of the mandibles, a small spot on the top of the outer orbits, a line on the basal fourth of the pronotum, a conical mark below the tegulae a little longer than wide, the entire postscutellum, a line on the sides of the metanotum, its spines, lines on the basal five abdominal segments at the apices, a semi-circular large mark on the sixth, and the apices of the second to fourth ventral segments, yellow. The apices of the femora narrowly and the tibiae yellow; the base and apex of the hind tibiae and the tarsi rufo-fulvous. Wings hyaline, iridescent, darker colored in front, the radial cellule violaceous, the stigma dark fuscous, the nervures black. Tegulae pale yellow, with the usual fuscous spot. Female, length 8 mm. Sapello Cañon, New Mexico, (Oslar).

Closely strongly punctured, sparsely pilose, the metapleurae closely weakly obliquely striated. Clypeus pyriform, longer than wide, its apex with a distinct but not deep rounded incision. Temples broad, rounded, nearly as long as the top of the eyes. Thorax more than twice longer than wide, the base transverse, not projecting laterally; the apex with the sides bluntly rounded, the center very little depressed, the lateral keels large, curved, more prominent than usual. Postscutellum gradually obliquely narrowed to a bluntly rounded point. First abdominal segment, longish, cup-shaped, longer than it is wide at the apex, the base narrowed to a point. Second segment clearly longer than wide, narrowed at the base, the apex more strongly punctured than the rest, with a narrow smooth border.

A narrow slender species, showing an approach to *Nortonia*. It is not unlike *O. acanthopus* Cam., and has, like that species, a blunt tooth on the top of the hind coxae, but in other respects it is very different. The species with the coxae spined appear to have the first abdominal segment longer than usual, e. g. *O. acanthopus* Cam., and *O. austrinus* Cr. *O. austrinus* Cr. has a distinct curved spine on the hind coxae, narrowed towards the apex.

Odynerus blakeanus sp. nov.

Black, the clypeus except narrowly around the apex and two small spots in the middle, a small semi-circular mark on the front, a short line behind the top of the eyes, underside of antennal scape, a large irregular triangular mark on the base of the sides of pronotum, an irregular mark as large as the tegulae at the base of mesopleurae above, a small irregular mark on the sides of the scutellum in the center, postscutellum, a small irregular mark on the sides of the metanotum at the base, the first abdominal segment from the top of the apical slope, an irregular mark on the sides of the second segment near the base, the apices of the second to fifth segments somewhat broadly, the apices of the second to fourth ventrals more narrowly, and the sides of the fifth, lemon-yellow. The first abdominal segment is yellow from the top of the apical slope, except for an irregular mark which at the base is slightly more than one-third the width of the segment, beyond this dilated into a longish line from the inner part of which it becomes gradually narrowed to a fine point, which does not extend near to the apex. Apices of the femora broadly, and the tibiae, yellow, the tarsi rufous. Wings smoky violaceous, more deeply so in front than elsewhere, the nervures and stigma black. Female, length 12 mm. Lee county, Texas, April.

Head and thorax densely covered with longish fuscous pubescence, closely strongly punctured, the clypeus less closely than the rest of the head, and the latter more closely than the thorax, the metapleurae opaque, bare, and alutaceous. Clypeus as long as wide, rounded above, the apex depressed, transverse. Temples broad, rounded, not much narrowed. Base of thorax almost transverse, the sides of the apex rough, almost margined, the center hardly depressed, somewhat coarsely obliquely striated. Apex of postscutellum broadly roundly narrowed and smooth. First abdominal segment large, cup-shaped, the basal slope weakly and sparsely punctured compared with the apex in the center of which is a narrow longitudinal furrow. The second segment is slightly longer than wide, weakly punctured, the apex more strongly and closely punctured, not reflexed, the third to fifth more coarsely punctured.

Allied to *O. arvensis* Sauss. Apart from the differences in coloration—the presence of a yellow mark on the sides of the second abdominal segment, there being only two small marks on the clypeus, etc.—*arvensis* may be known by the shorter second abdominal segment and by its being strongly depressed and punctured in the center behind the apical line. The mandibles in *blakeanus* are black save for a small yellow mark near the base; in *arvensis* they are for the greater part rufous.

Odynerus (?) bradleyi sp. nov.

Black, the clypeus, a narrow line on the lower half of the upper inner orbits reaching to the lower edge of the incision, a similar line on the upper half of the outer, the base of the prothorax broadly, this mark extending close to the apex of the propleurae where it is narrowed, a narrow line on the lower edge of the propleurae, a large oblique spot widest above on the base of mesopleurae above, a broad band on apex of postscutellum, a large irregular mark on the sides of apical slope of the metanotum, an irregularly oval mark on the sides of the base of first abdominal segment, the band dilated laterally, and broad bands on the following five segments, bright yellow. The lower edge of the segment on the lower basal half between the yellow and a large mark on the sides of the basal half of the second segment, rufous. Coxae black, the trochanters and femora reddish fulvous, the tibiae red, the tarsi yellow einged with fulvous. Antennal scape yellow below, the flagellum reddish brown below, the apical joints marked with black at the apex, the last rounded above, flat below, roundly narrowed at the apex. Wings fulvous hyaline, the apex smoky, the costa and nervures fulvous. Female, length 13 mm. Collected at Durango, Colorado, by Oslar.

Clypeus not much longer than wide, the top dilated broadly in the middle, the apex with a shallow incision. Antennae longish, stout, dilated towards the apex. Front and vertex closely not very strongly punctured, densely covered with long fuscous pubescence. Temples obliquely narrowed. Pronotum roundly narrowed from the apex to the base, which is keeled, transverse and slightly projecting at the angles. Mesothorax closely strongly punctured, a smooth line down the center of the base, and the two short furrows on the apex. Apex of postscutellum steeply sloped, transverse, smooth and shining. Metanotum short, its sides broadly rounded. Base of metapleurae smooth, irregularly striated below, the apex aciculated and sparsely punctured. First abdominal segment cup-shaped, large, a short but distinct neck at the base, the second is as wide as long and narrowed at the base, both are sparsely weakly punctured, more strongly at the apex. Mandibles reddish at the apex, a yellow spot at their base. Head as wide as the thorax. The thorax is distinctly longer than wide, and is narrowed posteriorly. The whole body is longer than usual with the *Odynerina*. The species may be an *Epiponus* to which it has a greater resemblance than to *Odynerus* proper or to *Pachodynerus*.

Odynerus bruesi sp. nov.

Black, the basal segment of the abdomen red, the clypeus except around apex, underside of antennal scape, the outer edge of tegulae, two irregular spots on the apex of scutellum, a triangular spot below the tegulae, its sides rounded, and narrow bands on the apices of the basal three abdominal segments (that on the first with a shorter black line in front), pale yellow. The apex of the femora and the outer side of the tibiae pale yellow. Wings hyaline, the stigma and nervures black. Male, length * mm. Claremont, California (Baker).

Base of the thorax stoutly obliquely distinctly projecting laterally, the projection longer than it is thick at the base, narrowed and rounded at the apex. Clypeus clearly broader than long, rounded broadly above and below, widest in the middle, the top not so broad as the bottom. Head and thorax closely punctured, except the metapleurae which are aciculated, sparsely punctured, and obscurely striated. Postscutellum strongly punctured at the base, the rest smooth and shining; it has an oblique slope and its apex is broadly rounded. First abdominal segment cup-shaped, strongly punctured, especially before the apex, which is smooth and raised. The second segment is less strongly, but more closely punctured, except at the apex, which is slightly raised. The other segments are more closely punctured. Antennal hook black, not quite reaching to the apex of the last joint. Trophi long, reaching beyond the middle coxae.

Odynerus tosquineti sp. nov.

Black, the abdomen rufous, the clypeus, mandibles except at apex, underside of antennal scape, a broad line narrowed in the middle on the apex of pronotum, tegulae except for a fuscous spot in the middle, scutellum broadly, a large spot below the tegulae longer than wide, transverse above and rounded and narrowed below, a broad line on the top of the first abdominal segment, a broader one on the second, all around, considerably dilated above, the apex of the femora narrowly and the greater part of the tibiae, whitish yellow. Flagellum of antennae brownish red, darker at the apex above. Wings hyaline, the stigma fuscous, the nervures blackish. Male, length 5 mm. Claremont, California (Baker).

Front and eye incision densely covered with silvery pubescence, the rest of the head and body with shorter and sparser silvery pubescence. Head and thorax strongly punctured, the puncturation on the pronotum and clypeus sparser and weaker on the metathorax than on the mesothorax, the lower part of the metapleurae almost smooth. The apical slope of the median segment is red, as is also the apex of the metapleurae. Clypeus longer than wide, rounded above, the apex with a V-shaped incision. Base of thorax not quite transverse, being slightly dilated in the middle, the sides are almost rounded. Postscutellum large, transverse at the apex. The sides of metanotum rounded and with two pale teeth. The apices of the two basal segments of the abdomen are slightly raised, closely and strongly punctured, the first is sup-shaped, the second about one-fourth longer than it is wide, its apex more strongly punctured than the rest. The antennae are thicker than usual, the hook black and reaching to the apex of the last joint. The second abdominal segment is not much narrowed at the base. The four anterior tibiae are broadly lined with black behind; so also are the posterior, which have besides a line on the innerside. The apical segments of the abdomen are darker colored than the basal two.

Odynerus acuticarinatus sp. nov.

Black, two curved lines or spots on the top of the clypeus at the sides, a narrow indistinct line across the base of the pronotum, a narrow but distincter one along the sides, and the postscutellum at the base, pale yellow. The upper angles of the metanotum and broad bands on the apices of the second and following abdominal segments, pale orange yellow. The wings hyaline, the costa, stigma, and nervures fulvous, the latter darker at the apex of the wings. Abdomen smooth silky pruinose, the head sparsely covered with short black pubescence, the thorax with short pale pubescence. Head, prothorax, and mesothorax strongly closely punctured, the head less strongly than the thorax. Clypeus slightly longer than its greatest width, the apex slightly roundly incised, the sides broadly rounded and lined with yellow. Base of thorax transverse, the sides not angled. Postscutellum smooth, the apex transverse. Upper half of the sides of metanotum with a distinct keel, the upper part of the metanotum obscurely reticulated, the rest for the most part finely transversely striated, the upper part of the metapleurae reticulated, the rest finely closely longitudinally striated. Propleurae finely aciculated with scattered punctures, shortly above the middle of the basal half is a wide furrow. The apex of the second and following segments are closely strongly punctured. The last ventral segment is entirely orange yellow, and the second and following segments are broadly banded with that color. Female, length 12 mm. Nogales, Arizona, (Oslar).

Belongs to the group of *O. nasidens,* but the head and thorax are not densely pilose. The wings too are hyaline.

Odynerus pallidipictus sp. nov.

Black, densely covered with a white pruinosity which gives it a greyish appearance. The top of the clypeus to shortly below the middle, two small lines on the apex, a spot on the base of the mandibles, a longish line above the antennae which is slightly gradually narrowed below and transverse at the top and bottom, the inner side of the eye incision, a line on the top of the outer side of the eye orbits a mark near the apex of mesonotum, postscutellum, a broad line on the upper lateral half of metanotum, a large wide conical mark below the tegulae, a band on the first abdominal segment, a large transversely oval mark on the sides of the base of the second segment, a broad irregular band on its apex and a narrow one on the third and fourth segments all around, pale yellow. Tegulae reddish, pale at the base and apex. Under side of antennal scape yellow, the flagellum rufous below. Legs bright red, the coxae black, the tibiae broadly yellow at the base. The apex of the second abdominal segment is more strongly punctured than the rest. Wings hyaline. Female, length 8 mm. Hot Springs, Arizona, (Oslar).

There is a specimen from Albuquerque, New Mexico, which agrees in structure and form with the above, but has no mark on the mesonotum, the frontal mark is smaller, and the others larger. In coloration the species is almost identical with *O. vegasensis* Cam., but that species is easily separated by the incised apex of the clypeus. In *pallidipictus* the head and thorax are closely strongly punctured, the punctures sparser on the base of the metapleurae, the apex of the clypeus is depressed in the center, the base of the postscutellum is broadly raised, and its apex not transverse, the sides of the metanotum are rounded but not broadly, and the base of the first abdominal segment is roughened.

Pterochilus luteicollis sp. nov.

Luteous, the front except for a small transverse spot over the antennae, vertex, the hinder part of the head except for a broad line behind the eyes narrowed above and below, mesonotum, the base and apex of scutellum and a line down its middle, a line on the base of the metanotum gradually widened to the middle and one down the middle dilated at the apex, a broad line on the lower basal half of the propleurae, the lower part of mesopleurae, a broad line on the upper two-thirds of the apex, mesosternum, the base of metapleurae broadly above and gradually narrowed below, the extreme base of first abdominal segment (from this a narrow line runs, uniting the basal line to an irregular large mark which becomes gradually widened to the middle, then slightly narrowed to the apex which is transverse), an irregular ragged line on the base of the second segment united by a narrow line to a broad transverse one, distinct laterally narrowed lines on the base of third and fourth segments, and irregular tripartite lines on the basal three or four ventral segments, black. Legs colored like the body, their bases irregularly marked with black, the tarsi tinged with rufous. Wings hyaline, the anterior distinctly tinged with fulvous, the nervures and stigma fulvous. The antennal scape below, mandibles except at the apex and a line on the lower side of the eye orbits, yellow. Female, length 14-20 mm. Ormsby county, Nevada, (Baker), small form; Claremont, California, (Baker), large form.

Densely covered with short pale fuscous pubescence, longest and densest on the head, shorter and sparser on the abdomen. Clypeus clearly broader than long, strongly but not closely punctured, gradually narrowed from the eyes to the apex, which is rufous and transverse. Front, vertex and thorax closely punctured, the mesopleurae with the punctures more widely separated, the metanotum almost smooth, its sides broadly rounded, the metapleurae smooth. Abdomen almost impunctate except on the penultimate segment, which is weakly, and the last which is strongly, but not closely punctured. Tibial and tarsal spines numerous, short thick and rufous. Base of the thorax transverse, the edges slightly projecting.

The smaller example from Nevada has the black color more extended all over, the scutellum is black except for a lateral spot on the basal half, the pleurae are for the greater part black (not for the greater part yellow as in the larger specimen), the black marks on the basal two abdominal segments are larger and irregular as in the type.

Pterochilus flavobalteatus sp. nov.

Black, the clypeus, mandibles except at the apex, a broad line on the lower side of the eye incision, a small spot between the antennae, a broad line on the upper half of the outer orbits, a line on the pronotum broadly dilated on to the upper half of the pleurae, tegulae, two irregular spots on the scutellum, postscutellum, the sides of the median segments largely, a large broad conical mark on the base of the mesopleurae, a smaller irregular one below it, broad bands on the five basal abdominal segments, and all of the apical segment, bright yellow. Antennal scape yellow, black above, the flagellum orange-red, the apical half black above. Legs black, the fore femora except broadly on top at the base, the middle femora except at the apex, the posterior femora more narrowly, and the tibiae and tarsi, yellow. Wings fulvous hyaline, the apex fuscous-violaceous, the stigma and nervures fulvous. Female length 8 mm. Durango, Colorado, (Oslar).

Front and vertex strongly coarsely punctured, the clypeus much more sparsely and weakly punctured and surrounded by a black line, except on the transverse apex, which is fulvous. Occiput distinctly roundly excised. Base of thorax transverse, the sides hardly projecting. Apex of postscutellum broadly rounded. Propleurae irregularly obliquely striated, the mesopleurae strongly punctured with a large closely striated triangular space at the apex, the metapleurae smooth with the apex irregularly punctured. Abdomen closely somewhat strongly punctured. Apex of tibiae and the apices of the tarsal joints with rufous spines.

WEST COAST NEWS NOTES

(In this department we hope to give in each number of the Journal, some idea of the doings and movements of western entomologists, notices of publications of interest to western students, notices of entomological meetings, etc. To this end, we hope that students or collectors will send in all items of entomological interest about themselves or others. Address,—Fordyce Grinnell, Jr., 572 N. Marengo Ave., Pasadena, Calif.)

—Mr. Francis X. Williams and Mr. Erval J. Newcomer collected a lot of interesting Lepidoptera in the Lake Tahoe region this summer, including the life-history of *Papilo indra.*

—From numerous cards and letters received, Mr. and Mrs. Victor L. Clemence are having a delightful time on their European trip, notwithstanding the disagreeable weather prevailing in that part of the world.

—Mr. Karl R. Coolidge of Palo Alto is recovering from an attack of typhoid fever, contracted at Visalia. We wish him speedy and complete recovery and return to his entomological studies.

—Mr. Leo Goeppinger has been collecting a few interesting *Lepidoptera* in Kern and Inyo counties, including both color forms of *Rusticus emigdionis* and *Pieris beckerii.*

—Mr. E. K. Carnes of the State Insectary at Sacramento has been appointed a member of the State Board of Horticultural Examiners.

—Mr. Dudley Moulton has an interesting article on "Controlling the Pear Thrips," in the California Fruit Grower for July 24.

—The first annual meeting of the Pacific Slope Association of Economic Entomologists assembled at Portland, Oregon, on August 20 and 21. A program of papers and discussions on certain subjects of interest to economic entomologists was prepared; the Secretary of the Association is W. B. Herms, Berkeley, Calif.

—The "White Fly at Marysville" has become quite famous, but "the closest and most extensive inspection fails to find any trace" of it now. It looks as though politics or something else was badly mixed in this episode.

—According to "Nature," London, Lord Walsingham's large collection of Micro-Lepidoptera is to be transferred to the British Museum, in the course of next year. This collection contains types of a good number of Californian species, collected in the early days.

—It is announced in the Pacific Rural Press of recent date, that Mr. E. M. Ehrhorn, deputy commissioner of horticulture and state horticultural quarantine officer, has resigned, to accept the position of superintendent of entomology and inspection at the port of Honolulu. This position was held by Alexander Craw, whom Ehrhorn succeeded at San Francisco.

—The thirty-third regular meeting of the Pacific Coast Entomological Society will be held at Thompson's Café, O'Farrell street, between Fillmore and Steiner streets, San Francisco, on Saturday evening, August 28, 1909, at 8 o'clock. Luncheon will be served. These meetings are always full of enthusiasm and inspiration, and are remembered long after the time of dispersal.

—Prof. C. F. Baker made two trips East during the summer, visiting Washington, New York, and other points, and also Seattle.

—Mr. C. O. Metz collected large series of Hemiptera, Hymenoptera, and Lepidoptera in Northern Wyoming during the summer, and has brought these collections to Pomona College, where they are being mounted.

—Mr. E. O. Essig has been appointed horticultural commissioner of Ventura County and will make his headquarters at Santa Paula, where he has an office and laboratory.

—Professors Cook and Baker have announced the presentation to the Biological Department of Pomona College, of their entire professional private libraries, consisting of many valuable sets of technical journals, rare scientific works, and special technical papers in great numbers, amounting in all to about 4000 books and pamphlets, valued nominally at about $5000. These two libraries combined with what the College already possesses will give the Department of Biology most unusual facilities in this direction. These libraries have been well developed on both the technical and the economic sides, and along several special lines are practically complete, representing the assiduous gatherings of twenty to thirty years, at a total expense far exceeding that mentioned above. This is one more step in a logical program of upbuilding which Professors Cook and Baker have in mind for the Biological Department.

Pomona Journal of Entomology

Volume I | DECEMBER 1909 | Number 4

COMBATING THE CITRUS MEALY BUG

E. O. ESSIG.

(Horticultural Commissioner of Ventura County, California.)

Without doubt, this is by far the worst scale pest which could be introduced into an orchard in the vicinity of Santa Paula, for here it thrives as in no other locality in California. This is probably due to the following reasons:

A. A moist ocean climate, but not too cold.

B. Fifteen years of adaptation.

C. No effort to hold it in check until it had become firmly intrenched.

It is now an established fact that scale pests which may be harmless when first introduced into a new place become in time acclimated and very harmful. This is evidently the case with the Mealy Bug in this locality. During the long years in which it was apparently harmless it was becoming perfectly adapted, until now we are facing the most serious problem which has ever come before our citrus growers, worse I believe by far than the White Fly or any other scale. In no case has fumigation failed so completely as with the Mealy Bug. We are aware of the good work done on the White Fly at Marysville, where in less than one year it has been practically exterminated. Not so with the Mealy Bug. For two years every possible means has been tried without regard to expense, for the fruit growers have done all in their power to help in the fight. The following work which has been done will show this:

Last Fall Mr. P. E. Smith, a Pomona graduate and a man excellently equipped for carrying on this work, was called to the Commissionership of this county in order to exterminate this scale. The aim was to rely wholly on fumigation, and a new county outfit for the purpose was furnished him. He used at first the Purple Scale dosage, R. S. Woglum's Dosage No. 1, which did not kill all of the Mealy Bugs. The dosage was increased, with no better results. He then came to the conclusion that a tighter tent was necessary, so the entire number were dipped in a preparation of cactus and tannin recommended by prominent fumigators for this business. A slight difference was noted in results, which seemed better than before. This led to the belief that an absolutely air-tight tent would solve the problem, and one was accordingly dipped in linseed oil, which rendered it so. In use it did not take more than half the dosage to get the results obtained with the other tents, but in no case could more than 90% be killed. The oil rotted the cloth, and the weight alone made the tent impractical.

This year we started with what knowledge had been accumulated the year before, but without better results.

The dosage was increased from Schedule No. 1 to *three and four times its strength!* The trees were very badly burned in many cases with a heavy loss of fruit, and a serious back-set to the tree.

In general the work was done with double Dosage No. 1, or to 3 oz. of Cyanide, 3 fluid oz. Sulphuric Acid, and three times as much water to 100 cu. ft. of tent space, the Morrill system being used exclusively.

It was found that two tents over the tree gave excellent results and promised to do the work, and this was used in most of the fumigations for the Mealy Bug. Later inspections however have revealed the fact that little better results were really obtained, for live individuals and eggs are plentiful on all fumigated trees. Where the dosage was increased 1½, 2, 2½, 3, 3½ times the results were *no better than the normal dose!* The following table of inspection will show this:

Row	Tree	Tents	Dosage	Date of Fumigation	Date of Inspections and Results 1st	2nd	3rd
23	15	2	1	10-5	10-5 70% killed.	10-12—Poor.	11-15—Very poor.
23	16	2	1	10-5	10-5 70% killed.	10-19—Poor.	11-15—Very poor.
26	17	2	2	10-5	10-5 75% killed.	10-19—Poor.	11-15—Very poor.
26	21	1	3	10-5	10-5 85% killed.	10-19—Fair.	11-15—Fair.
27	5	1	2½	10-8	10-8 85% killed.	10-19—Fair.	11-15—Very poor.
27	6	1	3	10-8	10-8 85% killed.	10-19—Poor.	11-15—Many young.
27	8	1	3	10-9	10-9 90% killed.	10-19—Good.	11-15—Many young.
27	9	1	2	10-9	10-9 70% killed.	10-19—Poor.	11-15—Poor.
29	13	2	2	10-9	10-9 95% killed.	10-19—Good.	11-15—Fair
29	14	2	2	10-9	10-9 95% killed.	10-19—Good.	11-15 Many young and live adults on all of the last trees.
30	14	2	2	10-6	10-6 None found alive.	10-19—Good.	11-15
30	15	2	2	10-6	10-6 None found alive.	10-19—Good.	11-15
31	13	2	2	10-6	10-6 None found alive.	10-10—Good.	11-15
31	14	2	2	10-6	10-6 None found alive.	10-19—Good.	11-15—Not at all good.

Dosage 1 equals Woglum's Schedule Dosage No. 1.

At the present time the results show very discouragingly for fumigation but our work gave the scale a decided set-back, the advantage of which we hope to take by now introducing all the enemies of the mealy bug. Of course we must concede that the pest has been intrenched for so long that it cannot be cleaned out in so short a time, but we contend that two years should give at least some results which might be hopeful. Fumigation has not given this.

However, the general outlook is not so discouraging as would appear from the foregoing account. The enemies are doing excellent work. *Cryptolaemus montrouzieri* was introduced last year by P. E. Smith. Now it is simply beyond belief how it has increased. In every part of the orchards where it was placed last year it may be found abundantly. Hundreds have been found pupating on one tree trunk.

At this time of the year the Mealy Bug is massed on the trunks of the tree and limbs. In these masses are millions of eggs intermixed with a cottony excretion to protect them from cold and rain. The larva of the *Cryptolaemus* works on these egg masses and upon the adult female. All stages of it may still be found (November), showing that it will yet work on through most of the winter. In not a few cases these masses have been cleaned from the tree, the mark being left to show its position. On the fruit the same thing is found and there are prospects that in another year it will clean the trees almost completely. Nothing is more encouraging to the grower than to see the millions of these insect friends doing such good work.

Rhizobius ventralis is doing just as good work, from all that I can ascertain through successive observations. This Lady-bird Beetle pupates right in the egg masses, and the larva is more abundant than the larva of the *Cryptolaemus.* This is because it has been here for years.

The Brown Lace-wing, a Hemerobid, works very rapidly and is very effective. The one draw-back is the fact that it is preyed upon by an internal parasite which reduces its numbers so that it cannot hope to compete with the Mealy Bug, which breeds so uninterruptedly.

The work done is thorough enough to warrant some success along this line. I am not willing to give up fumigation, for there is no better way possible to reduce the numbers of the pests in so short a time. The aim is to fumigate and introduce the parasites and predaceous insects into the orchards immediately, checks being reserved to propagate them. I have found it harder to kill the larva of the *Cryptolaemus* with the cyanide gas than the Mealy Bug, so it is hardly probable that fumigating would kill all of them. However, until they get a fine start we shall take no chances.

The hope of ridding the community of the Mealy Bug lies, I believe, in the work of beneficial insects, for it is simply on everything. It is the aim of this commission to procure an internal parasite this Fall to aid in this work. We hope to introduce several other varieties of the Lady-bird Beetles also. They way to handle such a pest is simply to employ every possible agency that will help reduce the numbers. To this end we are now working.

NOTES ON CALIFORNIA COCCIDAE

E. O. ESSIG.

Parlatoria pergandii Comst.

Figure 37. Parlatoria pergandii

Figure 18 of the second number of the Journal was intended to be from a photograph of this species as it occurs on the twigs of the orange. By mistake the cut was replaced by one of the citrus mealy bug on lemon. We now present herewith (Figure 37), the proper cut illustrating this interesting species.

Ceroplastes ceriferus Anderson.

Adult Female.—The general exterior appearance (Fig. 38, and 39, A) of this scale reminds one of lumps of dough stuck to the limbs of a plant. The uneven lobes of the large waxy secretion have the yellowish-white color of well-kneaded dough. In diameter the secretion varies from 1 mm. to 1½ mm., in height from ½ mm. to 1 mm.

Figure 38. Ceroplastes ceriferus

The body proper (Figs. 39, B, C) is jet black and the size of a small garden pea. Its chief characteristic is a long anal projection nearly half as long as the body. This projection or tail corresponds to the anal plate in most coccids, and is two lobed (Fig. 39 D).

The male has never been obtained.

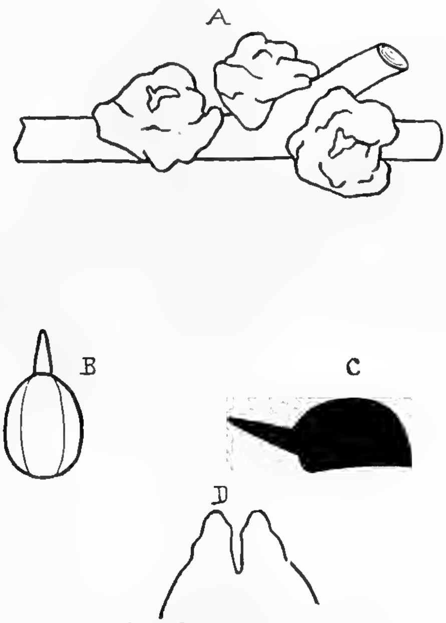


Figure 39. Ceroplastes ceriferus

This most interesting form was taken at Mexico City and Guadalajara, Mexico, by David Crawford. It occurs in great numbers, infesting *Hibiscus* in the public gardens of the cities. Nothing is being done to stay its ravages, which are very severe.

Chionaspis quercus Comst.

Female. *Scale*—(Fig. 40 and 41 B).—The scale is long and tapers from the anterior to the posterior end. Length, 1 mm. to 2 mm.; width, ½ mm. to 1 mm. The color is gray and very hard to distinguish from the oak bark.

Body—(Fig. 41 A)—Greatly resembles *Lepidosaphes beckii in* shape and manner of segmentation, being much broader at the posterior end and the sides deeply segmented. *Pygidium* (Fig. 41 E) consists in one large median lobe, instead of the usual two with two smaller lobes and a rudimentary lobe on both sides. The *spine arrangement* is as follows: median lobe—1 large and 2 small, second pair lobes—1 large and 1 small, third pair—1 on tip and 1 on middle. *Spinnerets*—consist in 4—6 marginal, 18—22 lower laterals, and 18—20 upper laterals.

Male. *Scale*—(Fig. 42 B)—Is white with three ridges extending from the anterior to the posterior end. Length, ½ mm. to 1 mm.; width, ⅛ mm. to

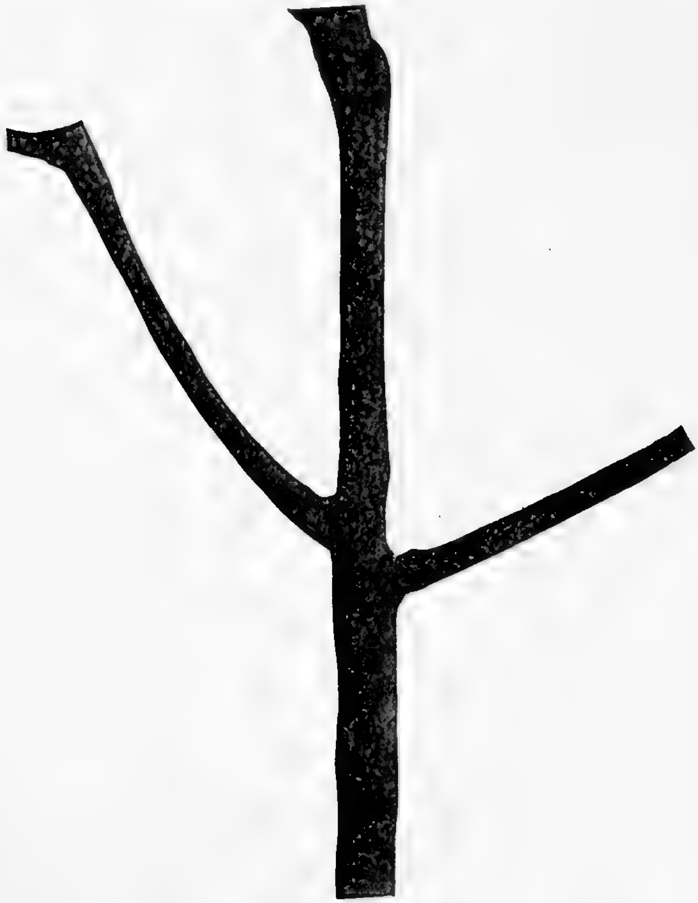


Figure 40. Chionaspis quercus

¼ mm. The scales are so numerous on the limbs as to make them appear white. *Body*—(Fig. 42 A)—Very minute, near ¼ mm. *Color,* carmine with appendages yellow. *Eyes,* black and prominent. *Antennae,* ten articled and hairy. *Thorax,* with dark band. *Wings,* hyaline, and hardly distinguishable under the microscope. The two veins join one-fourth the distance from the base to the wing tips. *Legs,* slender, yellow, hairy. *Tibia,* as long or longer than femur. *Tarsus,* less than half the length of tibia. *Abdomen,* very distinctly segmented. *Style,* as long as abdomen.

Young—(Fig. 41 D)—Nearly oval in shape and very small. The *antennae* (Fig. 41 C) are 6-articled with long hairs on distal article.

Taken in large numbers from *Quercus agrifolia,* at Santa Paula. (Essig.)

Ceroputo yuccae Coq.

In the second number of the Pomona Journal of Entomology this insect was described as *Phenacoccus ramonae* n. sp. The female as therein stated, was found in great numbers on the roots of the wild Black Sage (*Ramona* *stachyiodes*) in the Spring. On examining over fifty slides of mounted specimens, I failed to find a single individual with more than seven articles to the antennae. Not having found the male, and the fact that *Ceroputo yuccae* had never been reported on Black Sage, led me to believe that the insect was a new species, and so I described it as such. This Summer I have given it a great deal of time and have obtained all the forms.

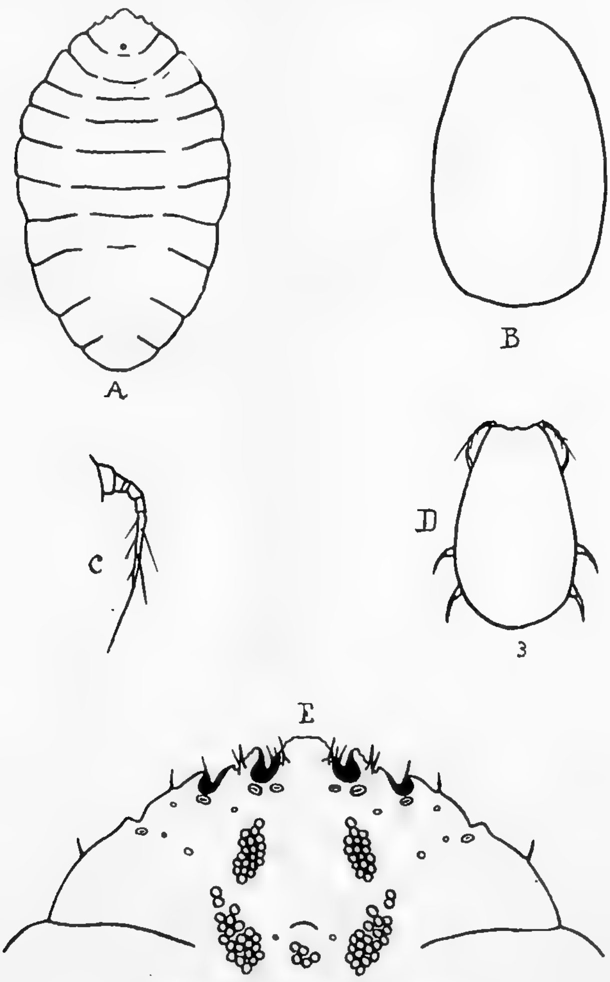


Figure 41. Chionaspis quercus

Both the male and female were taken in large numbers from the leaves and stems of *Diplacus glutinosus* near Claremont, on roots of *Ramona stachyoides*, at Santa Paula, and from *Yucca* at Guadalajara, Mexico, by David Crawford.

The female is described as *Phenacoccus ramonae* in the Journal, Vol. II, page 44. A drawing of the antennae of the adult female is shown in Fig. 43 E of this number.

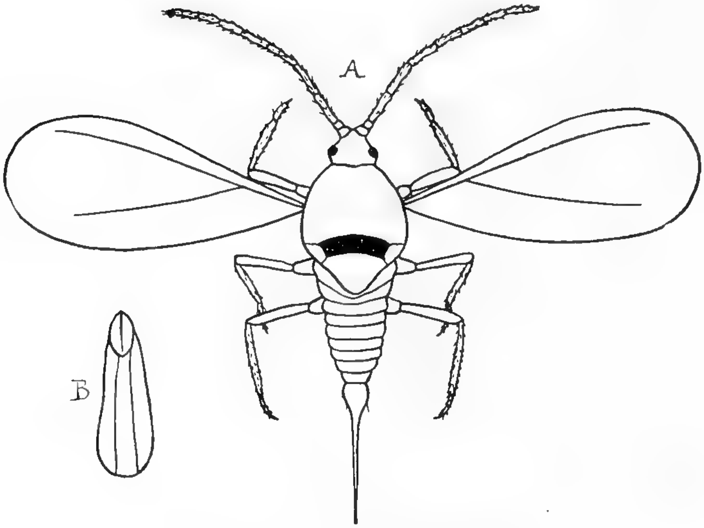


Figure 42. Chionaspis quercus

MALE.—(Fig. 43 A)—Length of body, 1.5 mm.; width, 0.34 mm.; wing expansion, 2.74 mm. Prevailing color, almost black with yellow membrane. The entire body is covered with a white waxy secretion. Antennae (Fig. 43 F) are 10-articled, very dark, and covered with long hair. The lengths of the respective articles are as follows: I 0.4 mm., II 0.4 mm., III 0.2 mm., IV 0.17 mm., V 0.2 mm., VI 0.17 mm., VII 0.13 mm., VIII 0.13 mm., IX 0.1 mm., X 0.08 mm. The abdomen is distinctly segmented with a long style on either side of which is a white wax appendage as long as the body. The legs are long, slender, and hairy. The claw (Fig. 43 D) has the characteristic tooth common to the genera *Phenacoccus* and *Ceroputo*. Wings, hyaline; elngth 1.2 mm., width 0.47 mm. A detailed drawing (Fig. 43 B) shows the poiser, hooks, and pockets of the wings.

The male pupates in a white cottony sac which is very numerous among the females. The adult is quite active.

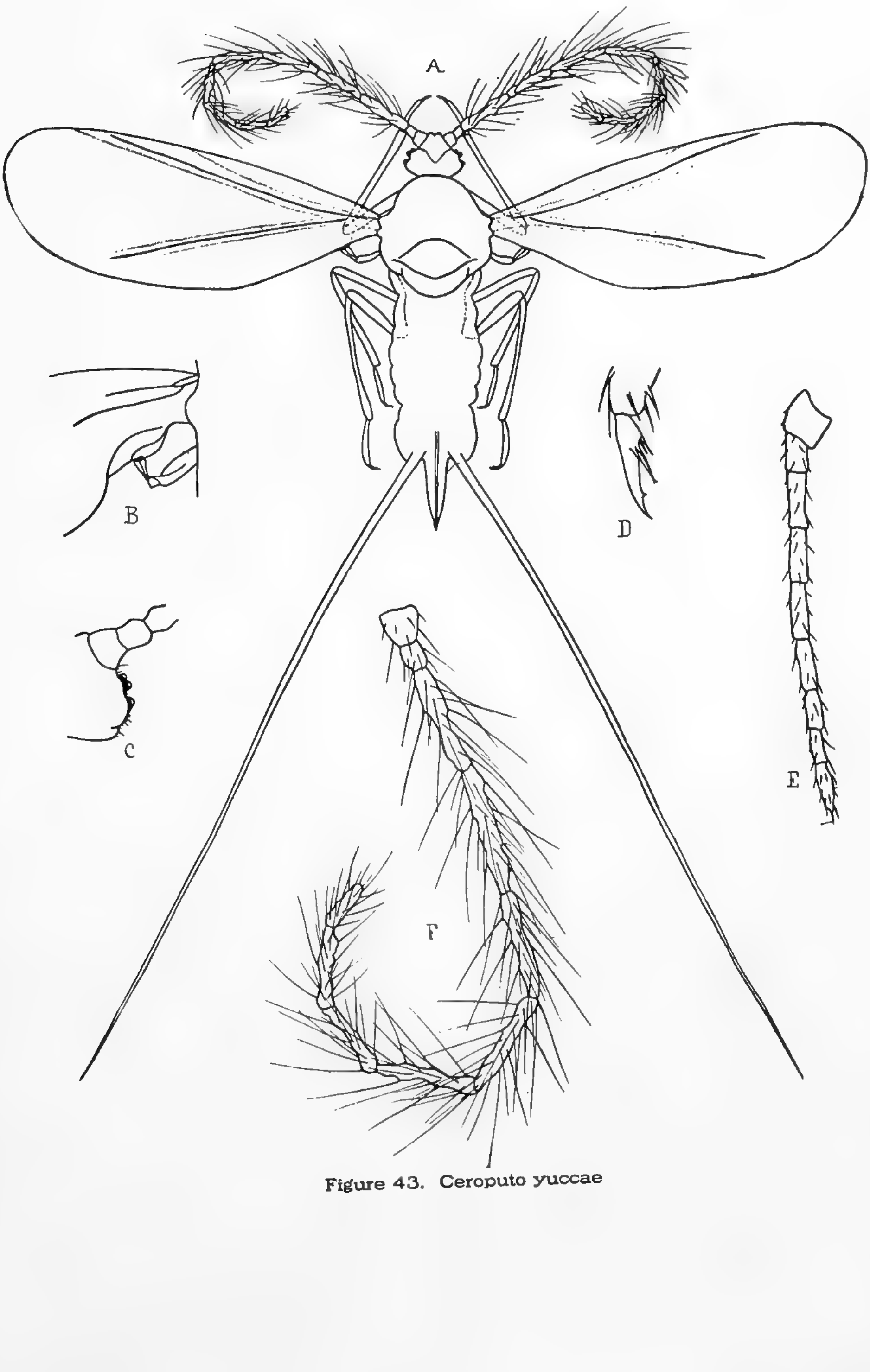


Figure 43. Ceroputo yuccae

APHIDIDAE OF SOUTHERN CALIFORNIA III

E. O. ESSIG.

Chaitophorus populicola Thos. (?)

Winged Viviparous Female: (Fig. 44 A)—Length 1.38 mm., width 0.5 mm., wing expansion 2.7 mm. *Prevailing color,* nearly black with yellow membrane. *Head,* slightly narrower than thorax, much wider than long, and hairy. *Compound eyes,* coarsely granulated, red, with terete tubercles just behind the outer margin. *Antennae,* (Fig. 44 G) do not arise from frontal tubercles, two-thirds as long as body, 6-articled. The color and length of the respective articles are as follows: I 0.06 mm. dark, II 0.06 mm. dark, III 0.26 mm. yellow, IV 0.15 mm. yellow with dark distal end, V 0.12 mm. dark, VI 0.2 mm. dark. Distribution of sensoria: I and II none, III many large circular, IV several large circular in row, V one large circular at distal end, VI several marginal in the nail-like process. All the articles are hairy. *Pro-thorax,* without lateral tubercle, hairy. *Rostrum,* reaches to metathoracic coxae. *Abdomen,* distinctly segmented, hairy or spiny. *Cornicles* (Fig. 44 C) cylindrical and pale yellow. *Legs,* moderately long and hairy. *Color,* dark near body and at tips, light near the middle. *Wings,* clouded along the veins. *Primary,* length 1.1 mm., width 0.33 mm. *Cubitus,* hairy near the stigma. *Stigma,* long and rounded at apex, very dark. *Radius,* well curved. *Obliques,* first straight, second curving slightly out, third curving and twice-forked. *Secondary,* slightly clouded, length 0.7 mm., width 0.2 mm. *Sub-costal,* extends to wing tip. *First discoidal,* rudimentary, does not connect with the sub-costal, short and straight. *Second discoidal,* does not connect with the sub-costal, nearly twice as long as first discoidal, curves slightly outward. *Style,* rounded, hairy, *Cauda,* obscure.

Apterous Viviparous Female: (Fig. 44 E)—Length 1.4 mm., width 0.8 mm. Differs from the winged form in the following: Body is more robust and is extremely hairy or spiny. *Prevailing color,* reddish brown with light yellow marking on the back. *Antennae,* sensoria are distributed as follows: I, II, III, IV, none; V, one circular near the distal end; VI, several small marginal in the nail-like process. Antennae (Fig. 44 F). Cornicles (Fig. 44 C).

Nymph of Apterous Viviparous Female: (Fig. 44 B)—The first-born are extremely small—almost microscopic. *Color,* pinkish. *Antennae* (Fig. 44 D) usually four-articled, half as long as the body, with sensoria as follows: I, II, none; III, few circular; IV, small marginal in the nail-like process. All articles are slightly hairy. *Abdomen,* distinctly segmented with hair or spines in definite rows on the back, usually six. *Rostrum,* nearly as long as the body.

This aphid is found in considerable numbers on the young stems of *Populus trichocarpa* in the Santa Clara River Valley near Santa Paula.

While in general it conforms to the general description of *Chaitophorus populicola* by Thomas, yet the yellow marking on the back of the apterous female is more triangular than y-shaped. In no case has it been found on the leaves of the tree.

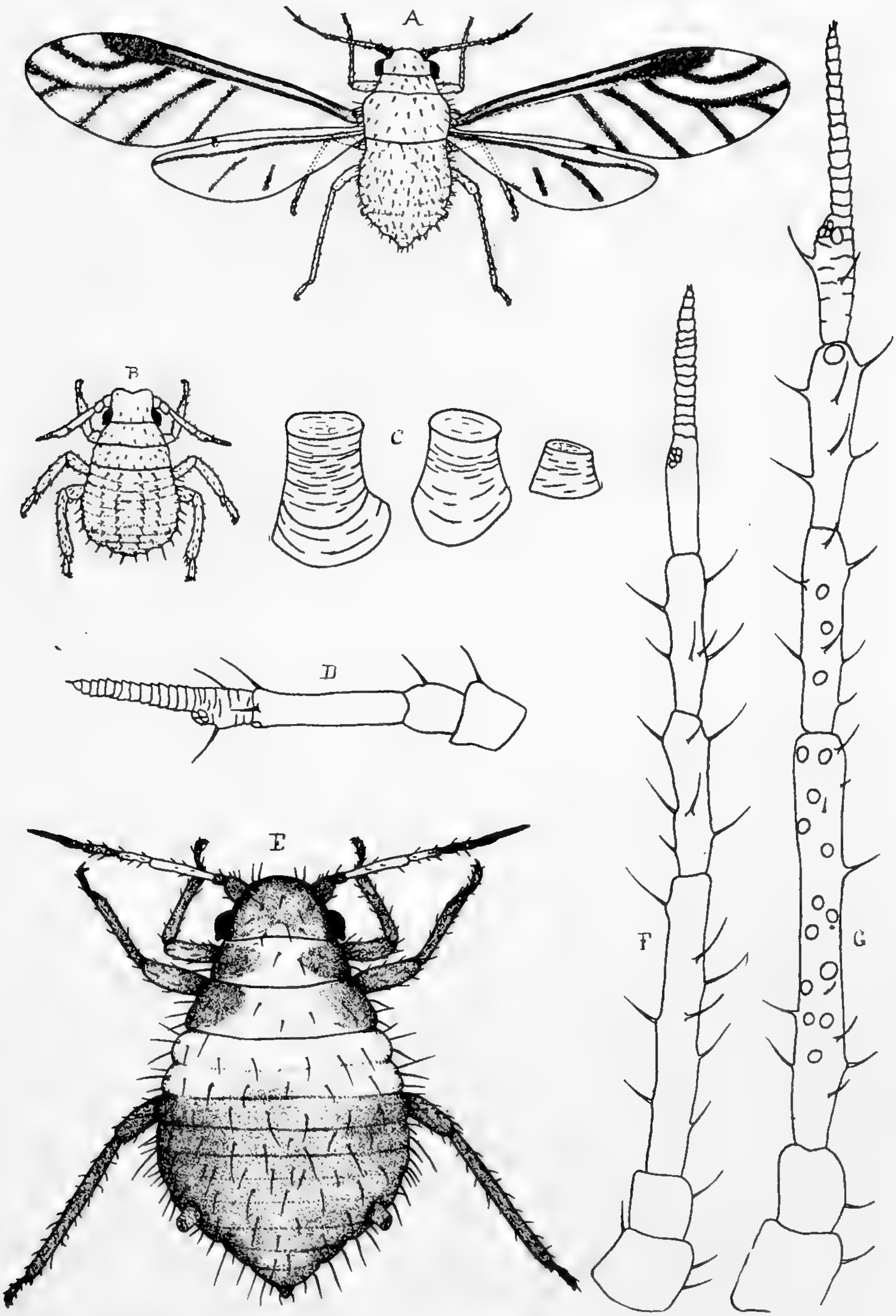


Figure 44. Chaitophorus populicola (?)

SOME NEW THYSANOPTERA FROM SOUTHERN CALIFORNIA, I

D. L. CRAWFORD.

In collections made by the writer in the vicinity of Claremont, ten different species are represented, three of which are new, besides a new variety of a species previously described, and one new genus..

Ankothrips, new genus.

Antennae strongly geniculate, with the tip of second segment strongly produced inwardly beyond insertion of third (Fig. 45 I).

Head broader than long, reticulated posteriorly; ocelli present in both sexes. Antennae nine-segmented, all segments free; without long spines. Maxillary palpi three-segmented; labial palpi two-segmented. Prothorax shorter than head, with bristles on both anterior and posterior angles. Fore-femora thickened in both sexes. Wings present in both sexes; the forewing with two longitudinal veins and five cross veins; anterior margin with a row of unusually strong spines. Anterior wings colored a uniform pale brown; posterior wings clear white. Abdomen with several stout spines on posterior angles of each segment; last two segments with extremely long strong bristles.

Ankothrips robustus, n. sp.

Average length, 1.46 mm. General color, dark brown to black.

Head (Fig. 45 C) somewhat wider than long, rounded and slightly narrowed anteriorly; with subrectangualr projection over insertion of antennae bearing two spines; cheeks arched; back of head reticulate; with several very long spines around the eyes. Eyes prominent, black, coarsely facetted, slightly pilose. Ocelli present, placed well forward; posterior ocelli nearly contiguous with inner margin of eyes. Mouth cone reaching five-sixths the length of prothorax; bluntly pointed; maxillary palpi with terminal segment very small. Antennae (Fig. 45 H) less than twice as long as head, brown, unicolorous with body; each segment with from six to ten small spines on distal end; small sense areas on segments four to seven.

Prothorax (Fig. 45 C) about twice as wide as long and shorter than head; with two large spines on each anterior and posterior angle, and two midlaterals on each side; with a row of twelve conspicuous spines on posterior dorsal margin and several scattered on dorsal surface. Thorax broadest across mesothorax. Metathorax tapering roundly from mesothorax to abdomen. Legs (Fig. 45, G, F, and E) dark brown, a trifle lighter than the body; clothed rather sparsely with bristles; fore-legs very large, with femora and tibiae strongly thickened; fore-coxae with several large conspicuous spines; fore and second tibiae with two long spines at tip, and hind tibiae with several; tarsi with only a few spines. Forewings (Fig. 45 A) broadly rounded at tip, and somewhat narrowed after the mid-cross vein; with two prominent longitudinal veins extending from base to tip; anterior longitudinal connected with ring vein by two distinct cross veins, and with the posterior longitudinal by one large cross vein in center of wing; posterior longitudinal connected with ring vein by two slightly less distinct cross veins; both longitudinal veins with a row of conspicuous spines; twenty-five on the anterior and eighteen on the posterior; anterior markin a row of stout spines, and a short fringe appearing about the middle of margin and increasing in length toward the tip; posterior margin with long double fringe; entire surface covered with microscopic hairs. Forewings light brown; hind wings clear white, and margined on both sides with a long fringe.

Abdomen ovate, about half as broad as long; uniform brown; segments four to seven with a row of short spines on the dorsal surface, and all segments with several longer spines on edges and posterior angles; last three segments (Fig. 45 B) with numerous very long, stout bristles; three last segments form sheath for large upturned ovipositor.

Measurements: Head, length, .18 mm. (.15 - .21 mm.), width .21 mm.; prothorax, length .15 mm., width .27 mm.; mesothorax, width .26 mm.; abdomen, width .32 mm.; total length 1.46 mm. (1.28 - 1.65 mm.) Antennae: I .025 mm., II .067 mm., III .054 mm., IV .040 mm., V .041 mm., VI .040 mm., VII .027 mm., VIII .018 mm., IX .023 mm.; total, .32 mm.

Males.—Males somewhat smaller than females; legs slightly lighter than body; abdomen very dark brown to black, darker than thorax, with a broad, white intersegmental membrane between first and second segments, appearing as a white band across the abdomen. Ninth abdominal segment with four very long bristles (Fig. 45 D), and twenty shorter but extremely stout spines (almost teeth) on dorsal surface; anal segment with a partially covered depression on dorsal surface, and two claspers on ventral side; four very long bristles at tip of abdomen.

Described from five females and three males.

Food plant: California laurel (*Umbellularia*) and Cal. lilac (*Ceanothus*).

Locality: Cañon near Claremont, Cal.; altitude, 5000 ft. (Crawford.)

Aeolothrips longiceps n. sp.

Head (Fig. 46 F) as long as wide, rounded in front and slightly elevated between basal segments of antennae; distance from eye to occiput unusually long; cheeks arched; with many inconspicuous spines on the dorsal surface and several on the ventral. Eyes prominent, pilose, with dark encircling ring; facets large, well separated. Ocelli present, placed well forward on anterior part of head, posterior ocelli almost contiguous with inner margin of eyes. Mouth cone long, reaching three-fourths the length of the prothorax, subacute; maxillary palpi three segmented, basal segment large, terminal very small; labial palpi four segmented. Antennae (Fig. 46 B) nine segmented, a little more than twice as long as head; light brown, lighter than body, except segments four and five, which are unicolorous with body; third light lemon yellow with darker area at distal end; all segments, except two basal ones, thickly and uniformly clothed with stout spines; basal segments with fewer spines;

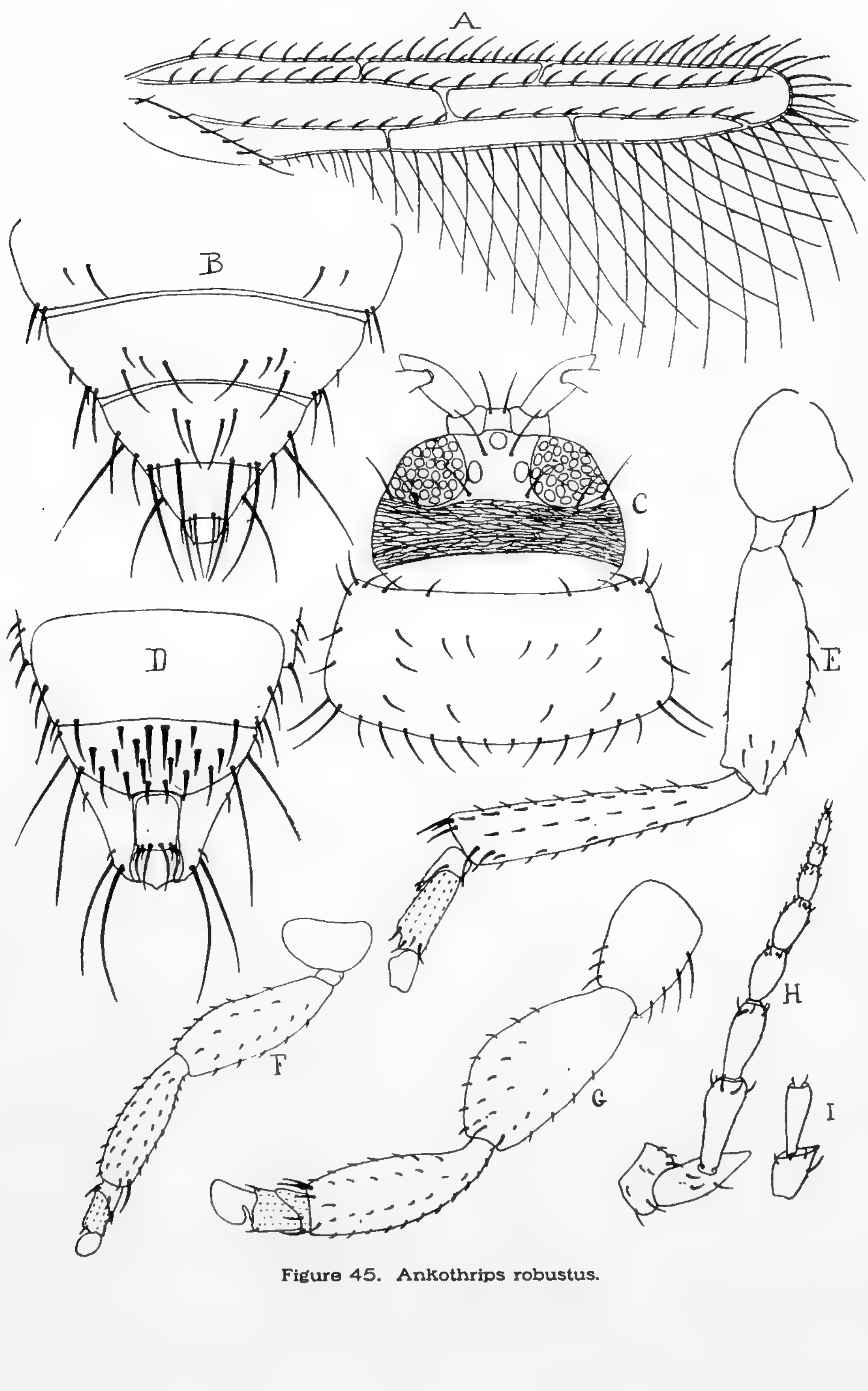


Figure 45. Ankothrips robustus.

spines on third very light colored; sense area on distal portion of third and fourth, and conspicuous sense cone on lower side of fifth near tip; two conspicuous long spines on tip of ninth.

Prothorax one and one-half times as wide as long, and wider than head, with an emargination and thickening of wall on each side; with several small inconspicuous spines on dorsal surface. Thorax broadest across mesothorax. Metathorax with sides tapering uniformly, and quite noticeably posteriorly. Legs (Fig. 46 A, C, D) dark brown, except fore-tibiae, which are lighter; fore-femora thickened; fore-tibiae with conspicuous long spine on inner side near the middle (Fig. 46 A); fore- and second tibiae with two stout spines at tip, and posterior tibiae with several stouter spines at tip; fore-tarsi armed with a stout hook and tooth and overreaching spine; legs thickly clothed with conspicuous spines, and the second and posterior tibiae and tarsi with numerous microscopic hairs. Fore-wings (Fig. 46 E) broadly rounded at tip and slightly broadened in distal half; with no longitudinal veins whatever, but two rows of spines extending the entire length of the wing; the anterior row is white and inconspicuous, but the posterior row brown and distinct; anterior margin without fringe, but having a row of short spines; posterior margin with long fringe of cilia; wings clear white with dark brown longitudinal band covering posterior half of wing, extending from near base to near tip; microscopic hairs on clear portion white, on brown portion brown. Posterior wings clear white, except small brown longitudinal band near base; without longitudinal veins; with simple fringe on posterior margin.

Abdomen widest at seventh segment, about one-third as wide as long; first segment lightest in color, the rest shading uniformly to dark brown at ninth segment; segments three to seven with dark transverse line near anterior margin. One small spine on posterior angles of eighth segment, and several on ninth, which bears two large articulated claspers (Fig. 46 G); six very long and stout and several smaller spines on tip of ninth segment; posterior ventral margin of ninth segment with deep indentation, reaching one-third the length of segment.

Measurements: Head, length .17 mm., width .17 mm.; prothorax, length .13 mm., width .20 mm.; mesothorax, width .25 mm.; abdomen, width (at seventh segment) .26 mm.; total length of body 1.33 mm. Antennae: I .034 mm., II .051 mm., III .098 mm., IV .083 mm., V .080 mm., VI .010 mm., VII .010 mm., VIII .08 mm., IX .09 mm.; total .38 mm.

General color, brown; head, pro- and mesothorax brown; metathorax and first five abdominal segments lighter; remaining abdominal segments shading to dark brown.

Described from one male.

Food plant: *Artemisia.*

Locality: Claremont, Calif. (Crawford.)

This species in general appearance is close to *Acolothrips kuwanaii,* Moulton, but in having no longitudinal veins in anterior wings it not only differs sharply from that species, but presents a slight departure from current descriptions of the family.

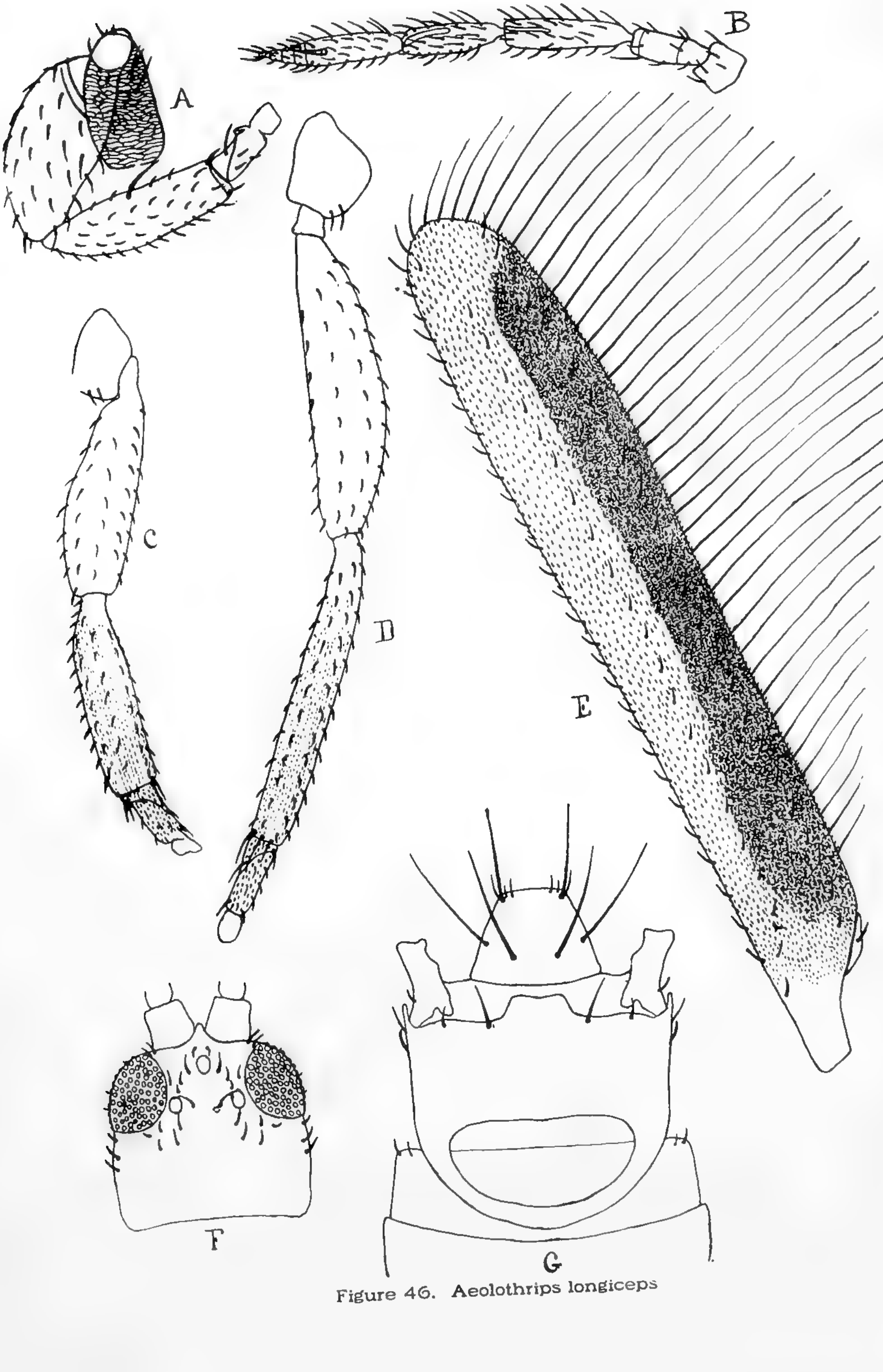


Figure 46. Aeolothrips longiceps

Euthrips minutus var. setosus n. var.

The specimens of this variety resemble very closely *Euthrips minutus*, Moulton, but possess several distinctive characters, which, however, are hardly of specific value. In the description, only the diagnostic characters will be mentioned.

Anterior margin of head (Fig. 47 A) with distinct notched prolongation of vertex between insertion of antennae. Antennae (Fig. 47 F) nearly three times as long as head.

Prothorax (Fig. 47 A) with anterior margin reticulate; two spines on each anterior angle; four long spines on posterior margin; without a spine on lateral side of posterior angle. Anterior margin of wing (Fig. 47 G) with twenty-two spines; fore vein with nineteen spines; hind vein with fourteen.

Abdomen (Fig. 47 B) with two conspicuous spines on each side of every segment, and two on the dorsal surface of each segment.

Measurements: Head, length .076 mm., width .14 mm.; prothorax, length .125 mm., width .18 mm.; mesothorax, width .24 mm.; abdomen, width .29 mm.; total length 1.28 mm. (.91 - 1.65 mm.). Antennae: I .015 mm., II .032 mm., III .035 mm., IV .039 mm., V .030 mm., VI .041 mm., VII .08 mm., VIII .013 mm.; total .28 mm. Color, uniform light to dark brown; wings, gray-brown.

Described from numerous females.

Food plants: Certain Compositae, *Rhamnus crocea, Monardella lanceolata, Sambucus glauca,* and other flowers.

Locality: Claremont, Calif. (Crawford.)

Phyllothrips fasciculata n. sp.

Average length 1.55 mm.; general color very dark brown to black.

Head (Fig. 48 A) a little more than one and one-half times as long as wide, widest posteriorly, narrowed anteriorly; frons projecting over insertion of basal segments of antennae, with anterior ocellus on vertex; back of head slightly reticulate and conspicuously serrated, and set with small spines raised on inconspicuous tubercles; post-ocular spines long, and blunt at tip. Eyes medium, finely facetted, slightly pilose, light brown. Ocelli present, anterior ocellus on apex of produced part of vertex above insertion of antennae, and directed forward; posterior ocelli nearly contiguous with inner concave margin of eyes. Mouth cone short and broadly rounded, reaching scarcely half the length of prothorax; maxillary palpi long and slenger. Antennae (Fig. 48 D) eight-segmented, only a little longer than head; two basal segments almost black, three light yellow, the remaining segments brown; sense area on two and seven; two sense cones on distal end of three to six, inclusive; antennae sparsely clothed with small spines.

Prothorax (Fig. 48 A) more than twice as wide as long, very much wider posteriorly than anteriorly; with one spine on anterior angles, one on posterior, and one midlateral about equal in length to the one on anterior angle; a few spines on posterior margin. Pterothorax with sides almost parallel, converging slightly posteriorly; coxae somewhat protruding. Legs (Fig. 48 E, F, G) sparsely clothed with inconspicuous hairs or spines; fore-femora somewhat enlarged; with a membranous appendage near distal end within; tibiae with a few short spines; fore-tarsi with conspicuous tooth on inner side of basal joint. Wings fully developed, both pairs alike; with no venation or spines;

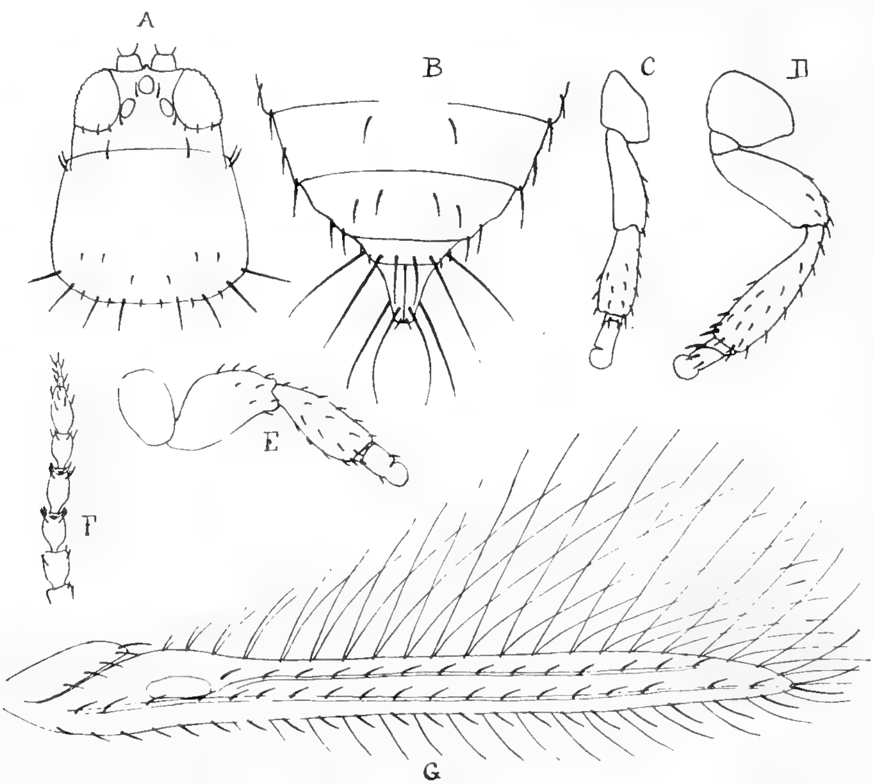


Figure 47. Euthrips minutus var. setosus.

both anterior and posterior margins with long simple fringe.

Abdomen about as wide as pterothorax; intersegmental membrane as dark as segments. Segments one to six, inclusive, with a row of two spines on each segment about 0.1 mm. from each margin, and two spines on each posterior angle; segments seven and eight (Fig. 48 C), with several spines on each posterior angle; tube about half as long as head, and converging toward tip; with four long, and sevearl short spines at tip.

Males are similar to females in most respects and averaging fully as large; with distinct scale at base of tube (Fig. 48 B); tube shorter than in female, with six long spines and several short ones at tip; with a long setigerous tubercle on ventral surface near base.

Measurements (female): Head, length .28 mm., width .17 mm.; prothorax, length .14 mm., width .31 mm.; pterothorax, width .32 mm.; abdomen, length .81 mm.; tube, length .14 mm.; total length of body 1.55 mm. (1.28 -

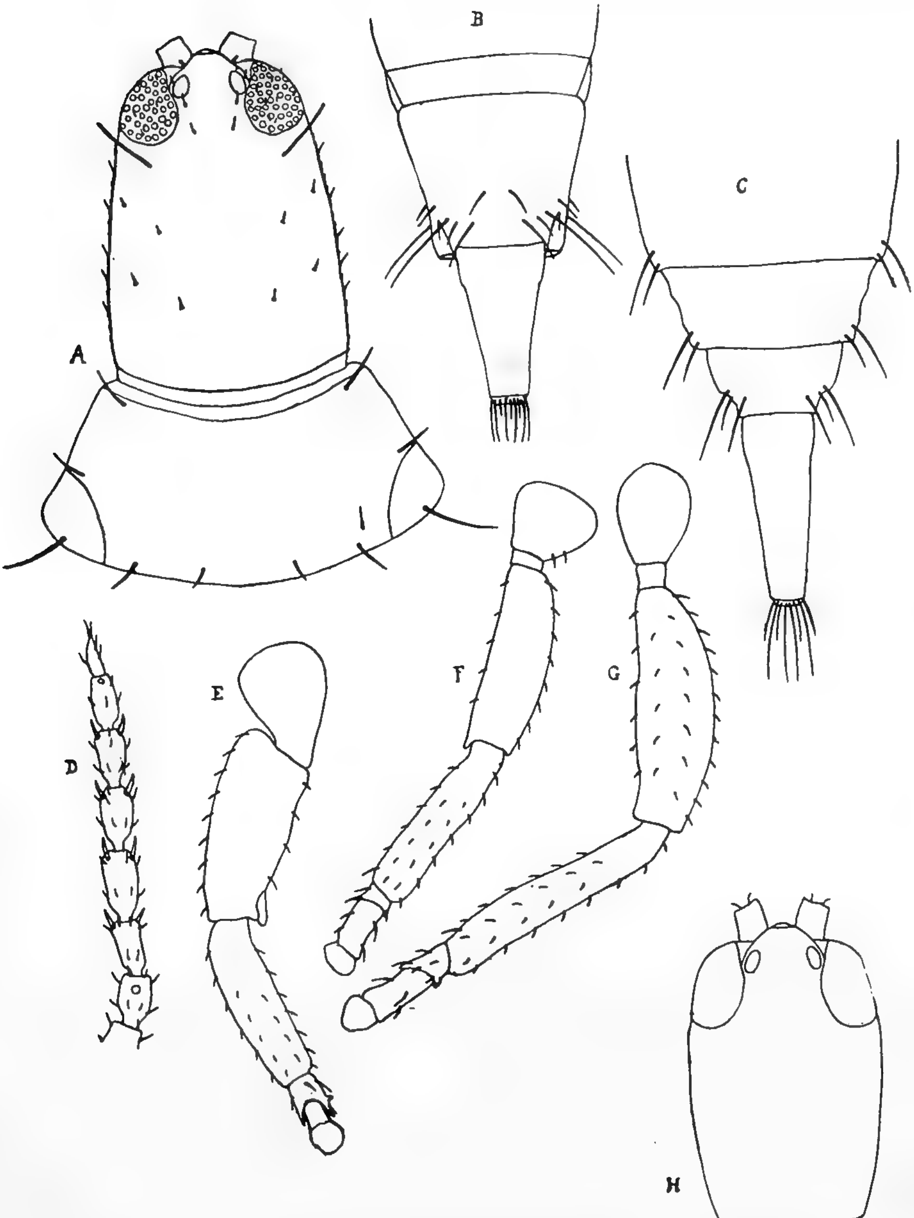


Figure 48. Phyllothrips fasciculata

1.81 mm.). Antennae: I .027 mm., II .040 mm., III .044 mm., IV .055 mm., V .053 mm., VI .051 mm., VII .045 mm., VIII .025 mm.; total .34 mm.

Described from many specimens of both sexes.

Food plant: *Eriogonum fasciculatum* (Wild Buckwheat).

Locality: Claremont, Calif. (Crawford.)

This species undoubtedly belongs in the genus *Phyllothrips,* being closely related to *P. aspersus* Hinds, and to *P. citricornis* Hood, but differs from the generic description as given by Mr. Hood, in the following points: Head narrowed anteriorly instead of posteriorly. Mouth cone very blunt, reaching to middle of prothorax. Fore-tarsi in both sexes with small tooth. It, however, shows abundant evidence of the closest relationship to the other species of *Phyllothrips,* even in minor details.

Phyllothrips fasciculata var. stenoceps, n. var.

The specimens of this variety (Fig. 48 H) resemble the species *fasciculata* in almost every respect, but differ in the following: the insect is somewhat smaller, and the head converges distinctly posteriorly instead of anteriorly. The specimens were taken among specimens of *P. fasciculata.* The existence of this variety shows that the form of the head does not furnish in this genus a character of even certain specific value.

SOME THYSANOPTERA OF MEXICO AND THE SOUTH I

D. L. CRAWFORD.

Aeolothrips vespiformis n. sp.

Length of body 1.6 mm.; general color dark brown, with first two and part of third abdominal segments light.

Head (Fig. 49 A) broader, posteriorly, than long, rounded uniformly from prothorax to insertion of antennae; distinctly retracted into prothorax; a notched projection between insertion of antennae; two spines on each side near posterior margin, and one near basal antennal segment; head giving a general hemispherical appearance. Eyes large, extending far under onto ventral side of head, coarsely facetted, not pilose. Ocelli present, large, conspicuous, marking an equilateral triangle between eyes. Mouth cone long, bluntly rounded; maxillary palpi three-segmented. Antennae lost, one basal segment, only, present; inserted very close to each other.

Prothorax (Fig. 49 A) longer and broader than head, broader anteriorly than posteriorly, and broader than long; sides roundly tapering posteriorly, with two mid-lateral spines and no others; head and prothorax at first sight, appear as a large elongate head, so closely are they united. Mesothorax narrowest at attachment to prothorax, diverging so that midlaterally it is a little wider than prothorax; sides converging to posterior margin of meta thorax. Legs (Fig. 49 D) long, clothed with conspicuous spines; posterior tibiæ with a stout spine at tip; posterior tarsi long, second joint with numerous microscopic hairs. Wings (Fig. 49 C) moderately long, reaching a little beyond posterior margin of seventh abdominal segment; broadly rounded at tip; no cross veins present, but about one-third the wing's length from the tip the anterior longitudinal and ring vein bulge out and apparently unite; with a small clear area near base and another almost at the tip, and a larger clear area near center, occupying nearly one-fourth the wing's length and almost the entire width; eight spines on anterior longitudinal vein between base and central clear area, none on clear area, and seven beyond clear area; on posterior longitudinal vein, one spine between base and central clear area, four on clear area—two on proximal and two on distal portion,—and nine beyond clear area; a row of twenty-two spines on anterior margin, beginning at base of central clear area; posterior margin with long simple fringe; wings light brown, except above mentioned clear areas. Posterior wings almost clear, margins light brown; with long fringe on both margins.

Abdomen (Fig. 49 B) very narrow at attachment to thorax, subpetiolate, diverging to fully one and one-half the width of mesothorax; widest at sixth segment, converging abruptly to tip; third to fifth with one short spine on outer margin and segments six to eight with two; ninth with one long spine on each side on dorsal surface near outer margin, and anal segment with four spines on dorsal surface near anterior margin, and two small spines at tip. Segments one and two and posterior half of three white, the rest very dark brown, darker than thorax and head.

Measurements: Head, length 0.15 mm., width 0.24 mm.; prothorax, length 0.22 mm., width 0.27 mm.; mesothorax, width midlaterally 0.29 mm.; metathorax, width posteriorly 0.21 mm.; abdomen, width at base 0.10, at sixth segment 0.46 mm.; total length 1.59 mm.

Described from one female, taken by Prof. C. F. Baker in Managua, Nicaragua.

Food plant unknown.

This specimen was taken several years ago and, unfortunately, mounted on a pinned slip; consequently, the antennæ and all but one hing leg had been broken off before being mounted in balsam by the writer. Although some of the most important characters were thus destroyed, nevertheless it is plain that it belongs to the fam. *Aeolothripidae,* and to the genus *Aeolothrips,* in which I have placed it. It resembles closely *Ae. bicolor* Hinds, and *Ae. albocincta* Uzel, in having the basal portion of the abdomen white, abdomen more or less narrow at attachment to thorax, and, also, in the general aspect of the head and prothorax, though the shape of these differ in the different species. In *Ae. bicolor* and *albocincta,* however, the white band is on the second and third abdominal segments, while in *Ae. vespiformis* the first, second, and posterior half of third are white. The absence of cross veins presents not only a specific difference, but also a slight departure from the generic description as given by Hinds. It is hoped that other specimens of this same species, or some closely related to it, will at some future time be taken, and thus the true relationships of this imperfect specimen be made plain.

Heterothrips decacornis n. sp.

Average length 1.18 mm.; color dark brown, occasionally light brown; body surface reticulated.

Head (Fig. 50 A), one and one-half times as wide as long, slightly retracted into prothorax, broadest across cheeks, narrowed anteriorly, with concave depressions at insertion of antennae; cheeks arched, with two setigerous tubercles behind eyes on margin; no prominent spines on head; back of head reticulated. Eyes large, bulging; facets large, sometimes conspicuously protruding; pigment orange-yellow; eyes pilose. Ocelli remote from front, somewhat elevated, the anterior ocellus on anterior incline of elevated area, and directed forward; posterior ocelli contiguous with inner margin of eyes. Mouth cone medium, subacute; maxillary palpi three-segmented; labial palpi one-segmented. Antennae (Fig. 50 D) ten-segmented, without style at tip; III and IV lemon yellow, the rest dark brown; IV with pseudo-joint near base and a round sense area in the space cut off by the pseudo-joint; IV and V largest,

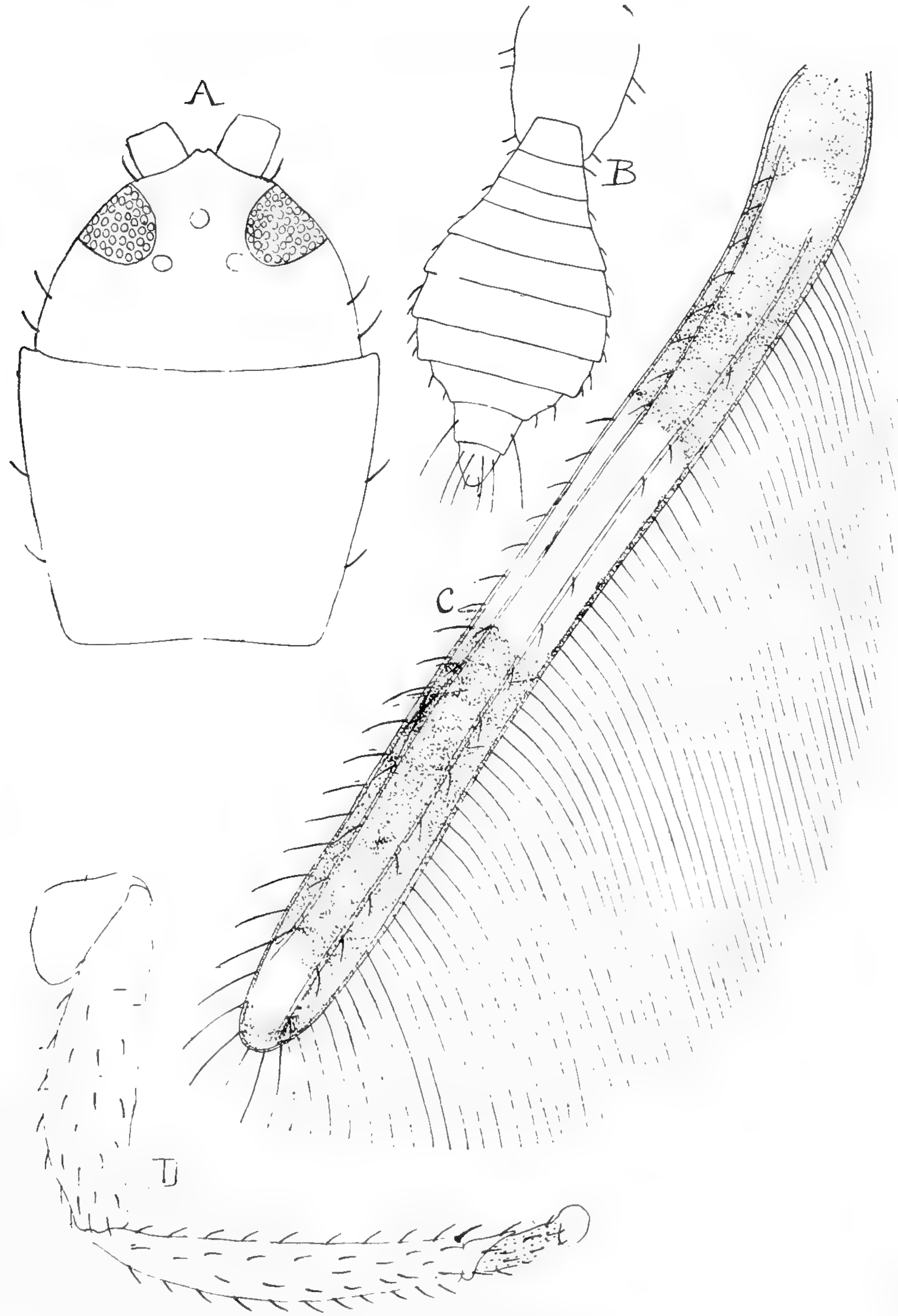


Figure 49. Aeolothrips vespiformis

with broad tip—IV with convex surface to receive base of V; V notched at tip to receive base of VI; VI to X all free, with small sense areas; antennal spines not very large.

Prothorax (Fig. 50 A) a little longer and wider than head; angles rounded; one spine on anterior angles, and one very inconspicuous spine on posterior angles; a few small spines on dorsal surface; reticulated. Mesothorax largest, with a triangular area on dorsal surface near the front more conspicuously reticulated than the rest. Legs (Fig. 50 E, F, G) medium; tibiae with moderately stout spines at tip; anterior tibiae light on distal half, the rest dark; fore-tarsi with small tooth at tip; middle and posterior tibiae dark; femora reticulated. Wings (Fig. 50 H) fully developed, broad at base, the rest narrow; with two longitudinal veins extending the entire length, set with short spines, twenty on anterior vein and sixteen on posterior; simple fringe on both margins, and a row of short spines on anterior margin posterior fringe longer; wings light brown, except basal one-sixth clear; scale small.

Abdomen (Fig. 50 B) uniform dark brown, usually very stout, occasionally slender; with two spines on dorsal surface in center of each segment, and a few small spines on margin; spines at tip of abdomen short; comb-like arrangement of spines on posterior margin of segments one to nine; surface reticulated.

MALE: Much smaller than female, but similar in every respect except tip of abdomen; with two claspers on posterior margin of anal segment (Fig. 50 C).

Measurements of female: Head, length .13 mm., width .19 mm.; prothorax, length .145 mm., width .26 mm.; pterothorax, width .25 mm.; abdomen, length .61 mm., width .28 mm.; total length 1.18 mm. Antennae: I .020, II .032, III .021, IV .058, V .044, VI .025, VII .028, VIII .017, IX .016, X .020; total length .28 mm.

Described from twenty-six females and ten males.

Food plant: A low native tree, with small yellow flowers, common in the barrancas near Guadalajara; also a shrub belonging to the family *Malpighiaceae*.

Locality: Guadalajara, Mexico. (Crawford.)

There is no doubt as to the antennae being 10-segmented, for in some of the mounted specimens used in this study, the segments are completely separated at every true joint. The last five segments are smaller and free, as described in some *Aeolothripidae*. There is no differentiation of the style, which is present in most *Thripidae*. In one deformed specimen the left antenna is eight-segmented (Fig. 50 I), the right possessing the ten normal segments. This is evidently a reversion to the normal type of *Thripidae*, the three basal segments being similar to the normal, but the fourth is shortened and has apparently two pseudo-joints instead of one in the normal, the fifth being somewhat similar to the normal except that it is not notched at the distal end, but is convex like the normal fourth; the last five segments of the normal antenna are represented in this case by three relatively longer segments; the arrangement of the antennal spines is similar in the two cases.

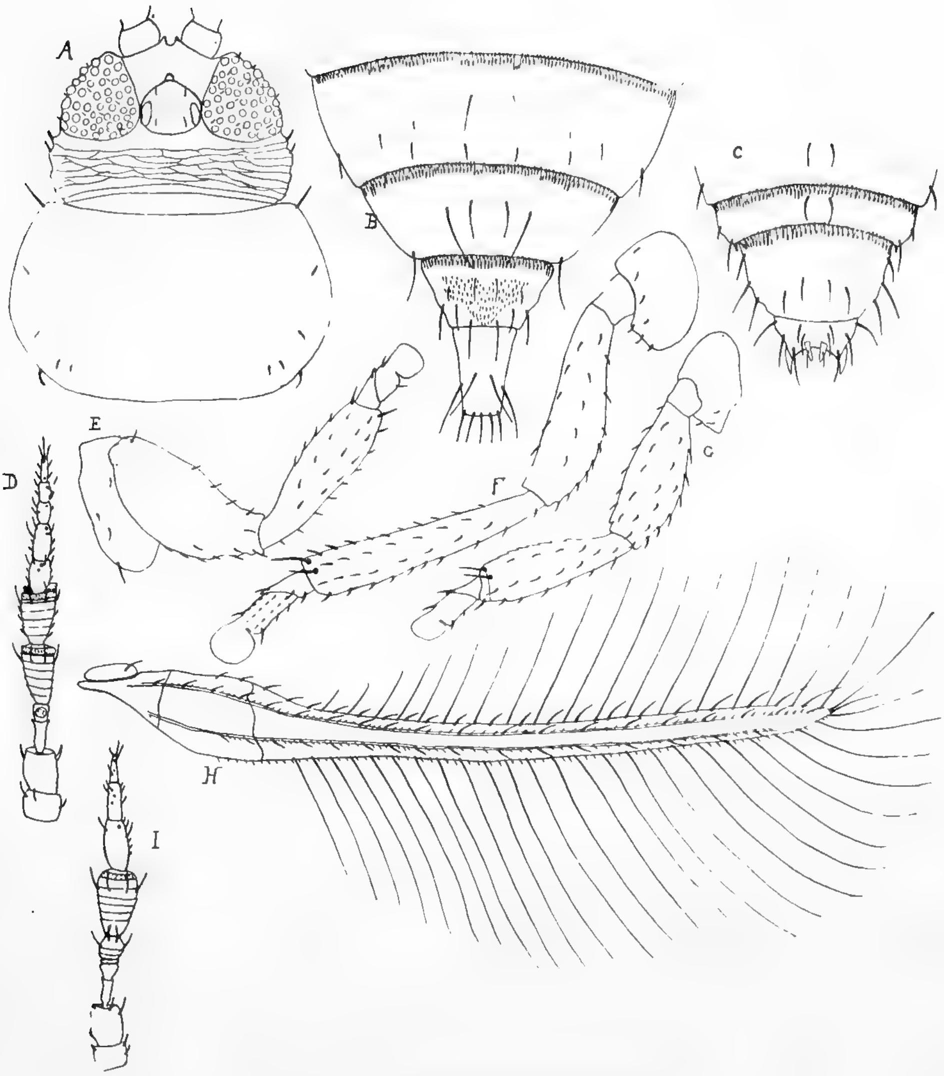


Figure 50. Heterothrips decacornia

In the main, this species conforms to the characterization of the genus *Heterothrips* Hood, but in one or two peculiarities it does not: (1) antennae clearly 10-segmented; (2) prothorax much less than twice as long as head; (3) rows of minute teeth extending across entire posterior dorsal margins of abdominal segments two to eight. These characters, however, are not necessarily of generic value. The general type of the antennae in this genus is unmistakable.

Chirothrips mexicana n. sp.

Length, .86 mm.; general color, medium brown.

Head (Fig. 51 A) somewhat wider than long, small, spatulate and narrowed anteriorly; cheeks arched, about two-fifths as long as eye; portion between posterior margin of eyes and occiput *very* much elevated, arched and reticulated, bearing the ocelli on the abrupt incline from the occiput to the vertex; front prolonged triangularly between insertion of antennae; with eight small spines in front of the ocelli, and two very small postocular spines on each side. Eyes moderately large, finely facetted, slightly pilose; distance between eyes less than half the greatest width of head; ocelli small, pale, situated far back on elevated portion of head, between posterior angles. Mouth cone moderately long, broadly rounded at tip; maxillary palpi consisting of three very short segments; labial palpi one-segmented. Antennae (Fig. 51 B) twice as long as head, stout, with only a few small spines; general color lighter than body—basal segment concolorous with body, and second lemon yellow; basal segment large, transversely egg-shaped, the point outward, with dark transverse line; segment II prolonged outwardly into a long acute apophysis with a small sense cone at tip; III pedunculate, asymmetrically pyriform, with a prominent sense cone on outer anterior angle, as has, also IV; IV and V roughly rounded, V smaller than IV; VI elongate, with two small sense cones on distal half; VII and VIII small, moderately slender.

Prothorax (Fig. 51 A) about two and one-half times as long as head, one and one-ninth times as wide as long, more than twice as wide posteriorly as anteriorly; sides with a deep indentation above coxae and a short, black chitinised line curving in from it; with one prominent spine on posterior angles and a few small inconspicuous ones on dorsal surface; dorsal surface deeply reticulated. Metathorax wider than prothorax, and pleurae bulging beneath insertion of wings. Pterothorax reticulated. Wings (Fig 51 H) long and narrow, reaching beyond tip of abdomen; forewings light brown, surface covered with microscopic hairs; hind wings lighter colored; fore-wing with one median longitudinal vein, which disappears before the middle of the wing; with five spines on median vein, and five on apical half of wing, arranged as though the two longitudinal veins were present; anterior margin with row of twenty-six long slender fringe-like spines; posterior fringe long. Legs (Fig. 51 E, F, G) short, with only a few small spines; fore-femora (Fig. 51 E) enormously thickened, trapezoidal, nearly as broad at base as long; fore-tibiae short and thick; fore-tibiae and all tarsi lemon yellow.

Abdomen elongate-ovate, bluntly pointed at tip, about one and four-fifths times as long as broad; spines on last two segments (Fig. 51 C) moderately long and stout; segments one to five distinctly beaded (Fig. 51 D) on posterior dorsal margin, five less so than the others; surface deeply deticulated.

Measurements: Head, length .084 mm., width .096 mm.; prothorax, length .19 mm., width .21 mm.; pterothorax, width .24 mm.; abdomen, width .23 mm.; total length .86 mm. Antennae: I .027 mm., II .025 mm., III .023 mm., IV .022 mm., V .024 mm., VI .028 mm., VII .011 mm., VIII .011 mm.; total ,.17 mm.

Described from one female.

Food plant: Tobacco flowers (*Nicotiana tabacum*).

Locality: Guadalajara, Mexico. (Crawford.)

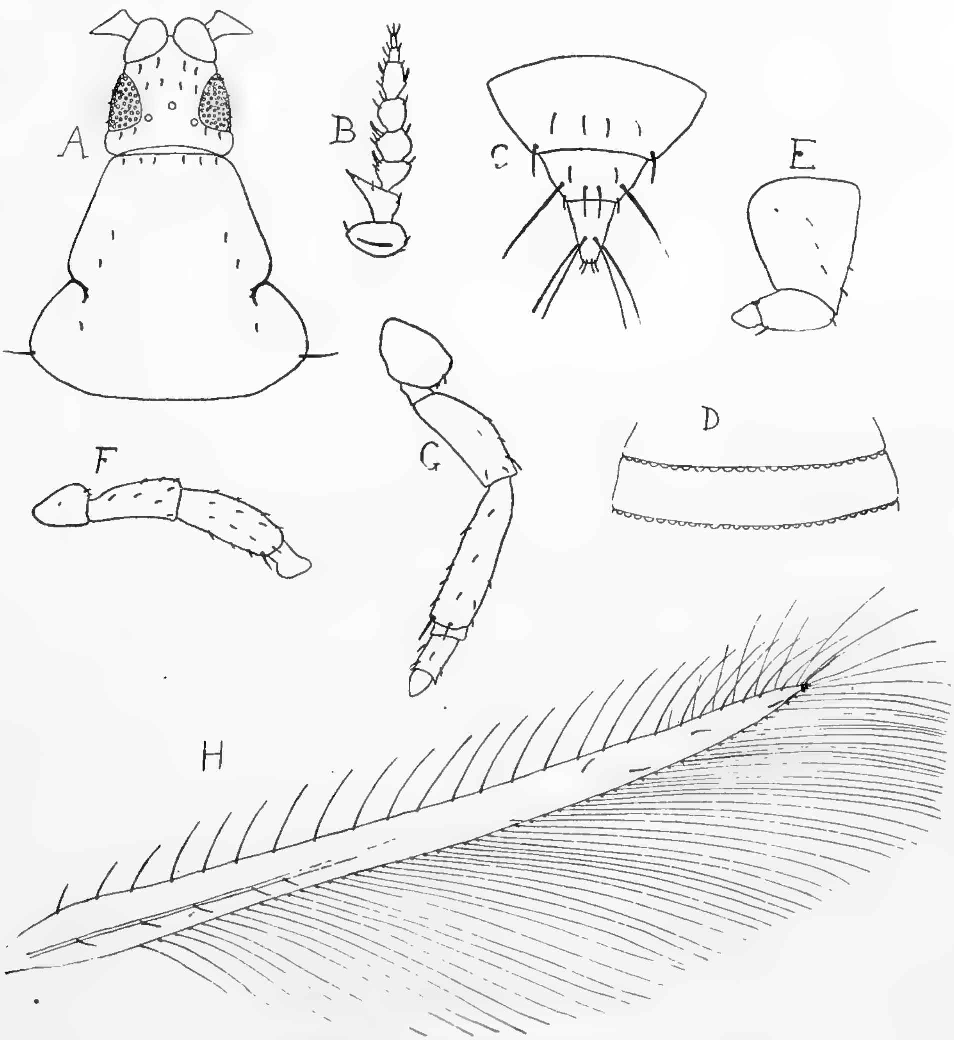


Figure 51. Chirothrips mexicana

Euthrips insularis Franklin var. reticulata n var.

Mr. Franklin speaks of the species as being very common throughout the Barbadoes and West Indies; it is perhaps the most common species, also, in the region of Guadalajara, Mexico. Hundreds of specimens were taken by the writer on various flowering plants—several species of *Lupinus, Convolvulus,* Compositae, and a *Rhamnus,* the localities ranging in altitude from 2500 feet above sea level to 10,000 feet. There is quite a marked variation in the species. All the specimens have a reticulated body surface, some more markedly than others—this character is not mentioned in the description of *Eu. insularis;* the general color varies from dark brown, almost black, to very light yellowish brown. The antennae vary in the shape, color, and relative lengths of the segments; some, as in Mr. Franklin's descriptions, have the third and fourth segments yellow, the fourth darker on distal half; others have the third and fourth segments uniformly yellow; the shape of the segments varies from slender, as in the description, to comparatively stout; nor are the relative lengths of the segments constant. The wings, also, vary in length considerably.

It seems that the most constant characters of this species are (1) the arrangement of the cephalic and thoracic bristles, (2) the comb-like arrangement of spines on the posterior dorsal margin of the eighth abdominal segments, (3) a large clear area at base of fore-wings, (4) antennae eight-segmented, with the third segment yellow, and (5) in the Mexican variety, reticulation of head, thorax, abdomen and femora.

Rhaptothrips, new genus

Head small, rectangular; eyes extremely small, with a few facets on outer side; ocelli wanting. Antennae seven-segmented, long and slender, third segment very elongate. Mouth cone of medium size, very blunt at tip; maxillary and labial palpi one-segmented. Prothorax about as long as head, wider posteriorly than anteriorly; pterothorax much broader than prothorax, with a facetted spiracular(?) plate on anterior angles of mesothorax. Entire dorsal surface from mesothorax to eighth abdominal segment inclusive covered with irregular chitinous, setigerous plates, this irregular arrangement giving the insect a curious patched appearance. Posterior coxae almost as widely separated as second coxae. Legs of medium size, with several very long slender spines on femora and tibiae, and one large spear-shaped horizontal spine on apical end of tibiae. Wings wanting so far as known. Abdomen long and slender, with facetted spiracular plates (sense organs?) on second and eighth segments; all spines occur on the chitinous plates; ninth segment heavily chitinized, tube nearly as long as ninth segment, converging to tip, with two short apical spines.

Rhaptothrips peculiaris n. sp.

Total length of body 4.12 mm.; general color black.

Head (Fig. 52 A) small, about one and one-fourth times as long as broad, and about as long as prothorax; cheeks parallel; anterior angles concave to receive antennae; a concavity between insertion of antennae; four inconspicuous spines on anterior half of dorsal surface, one pair in front and the other pair behind the eyes, and one small spine on each cheek. Eyes extremely small, dark, with two or three widely separated facets, which are light, the rest of the eye apparently blind; no ocelli present. Mouth cone long, broad, and broadly rounded at tip, reaching almost to posterior margin of prothorax; maxillary and labial palpi one-segmented, the latter short. Antennae (Fig. 52 D) seven-segmented, long and slender, more than two and one-half times as long as head; two basal segments rectangular in shape, I shorter than II; III very elongate, enlarged at both ends, sides rough; IV to VI elongate, but shorter than III, with a sense cone on distal end of each; VII bluntly pointed at tip, with an obscure suture just beyong the middle and another more obscure midway between the first suture and the tip; segments II, III, and VII with three or four long slender spines at apical end; IV to VI with one spine on side opposite to the sense cone; III light brown, except distal one-sixth, the rest of the segments concolorous with body.

Prothorax (Fig. 52 A) about one and two-thirds times as wide as long, narrowed anteriorly and bulging midlaterally, partly due to fore-coxae; two rectangular chitinous plates between fore-coxae, each bearing two spines; no other spines on prothorax. Mesothorax (Fig. 52 A) about as long as prothorax, and one and one-half times as wide posteriorly; sides diverging to midpoint, and from there to posterior margin of metathorax, sides about parallel, slightly diverging; with a pair of large facetted spiracular plates (Fig. 52 H) near anterior angles, with closely crowded facets; dorsal surface of both meso- and metathorax and all but two anal abdominal segments, with irregular chitinous plates (Fig 52 A), most of which bear one spine, a few with two spines, and some with none; these are scattered promiscuously over the dorsal surface, and are distinctly convex; spines moderately long and stout; the rest of the body surface, both dorsal and ventral, apparently very weakly chitinized. Metathorax shorter and slightly wider than mesothorax, diverging somewhat to midpoint of pleurae, and then converging, but slightly wider posteriorly than anteriorly; hind coxae almost as widely separated as middle pair. All thoracic spines set on chitinous plates. Legs (Fig. 52, E, F, C) moderately long, with roughened surface; with several extremely long and slender spines on all femora and tibiae, and several other shorter ones on each; distal end of tibiae, without, with a very long, remarkable, spear-shaped spine (Fig. 52 G); tarsi almost abortive; middle tarsi with a heavy setigerous projection on each side of the bladder. Wings not present.

Abdomen (Fig. 52 B) long, uniformly tapering from posterior margin of metathorax to tip; segments one to six, with numerous irregular chitinous plates; as described above, and segments seven and eight with two or three larger and more symmetrical plates, with several spines; two anal segments long and tube-like, and heavily chitinized over entire surface, deep black; ninth segment with eight long slender bristles on distal end; anal segment

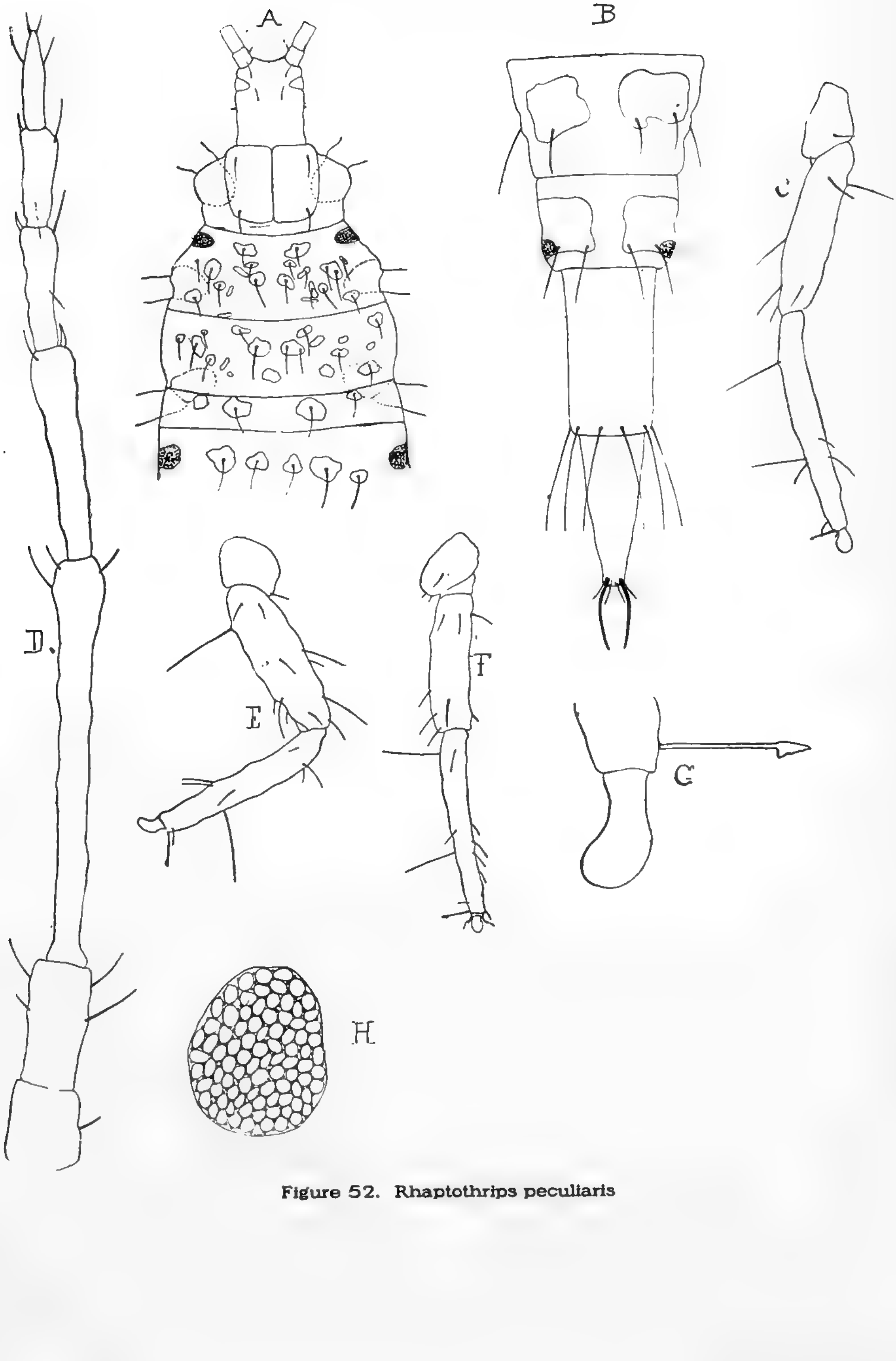


Figure 52. Rhaptothrips peculiaris

with two extremely stout and moderately long bristles at tip, and four short inconspicuous ones, also; second and eighth segments with spiracular plates on each side, as described on mesothorax; nearly all abdominal spines set on chitinous plates.

Before treatment in caustic potash and clearing in clove oil, the general color of the insect is a deep black; but after clearing, the chitinous plates appear dark brown and the rest of the surface a clear transparent shade, showing that the whole surface, in the natural state, is darkly pigmented, but this pigment is more easily removed from the weakly chitinized portions. Owing to the deep pigmentation of the two anal segments, it is difficult to determine the sex of the insect.

Measurements: Head, length .35 mm., width .27 mm.; prothorax, length .34 mm., width .54 mm.; mesothorax, width .82 mm.; metathorax, width .85 mm.; distance between mesocoxae .50 mm.; between posterior coxae .47 mm.; abdomen, width .86 mm.; tube, length .34 mm.; total length 4.12 mm. Antennae: I .065 mm., II .097 mm., III .31 mm., IV .17 mm., V .096 mm., VI .076 mm., VII .075 mm.; total .88 mm.; color, natural, black.

Described from one specimen. The writer, while on a trip up the slopes of San Pedro mountain, near Guadalajara, reached into a thorny solanaceous shrub to capture a beetle, and a moment later discovered this thysanopterous insect on his hand; repeatedly beating the same shrub failed to bring forth any more of the insects.

Food plant: A certain spiny solanaceous plant.

Locality: San Pedro mountain, near Guadalajara, Mexico.; altitude 8000 feet. (Crawford.)

It might be noted here that there is somewhat of a similarity between this species and members of the Fam. *Urothripidae* Bagnall; in that family the palpi are one-segmented, the antennae seven-segmented, and the posterior coxae widely separated, though the middle pair are more so. But inasmuch as *Kladothrips* Froggatt, *Allothrips* Hood, and *Neothrips* Hood, all have the antennae seven-segmented, and, furthermore, since this species does not possess the eleven pairs of stigmata, the posterior coxae are not most widely separated, and the bristles and spines are not by any means absent or obsolete, therefore it is most reasonable to suppose that this new genus—for it probably is such—belongs in the family *Phloeothripidae,* necessitating, however, some slight modification of the diagnosis of that family. A difference in palpi and antennae is hardly enough to erect a new family on, when such differences are frequently of questionable generic value.

NOTES ON CALIFORNIA THYSANOPTERA I

Euthrips tritici (Fitch)

(*Euthrips occidentalis* Pergande.)

This is the most common species in Southern California, being present in nearly all the wild flowers and many of the cultivated ones. The differences indicated for *occidentalis* are not very marked; about the most constant difference is in the relative lengths of the fourth and fifth antennal segments, and even these relative lengths are not always constant. There is a wide specific variation in color, from extremely light lemon yellow to light brown; the cephalic and thoracic spines, also, present a specific variation in length. These variations make it very difficult to assign any definite characters to either form, which could distinguish it from the other; owing to these variations, and to the inconstancy of the relative lengths of the fourth and fifth antennal segments, it hardly seems justifiable to maintain these as two distinct species, although they have been so thus far. *Occidentalis* certainly does not have more than varietal value.

Thrips tabaci, Lindeman

Specimens belonging to this species were taken by the writer on flowers of onion and also of chilicote (*Micrampelis macrocarpa*). This species is not very abundant, however, in this locality, because of the fact that not many onions are raised here. Larval and pupal forms were taken together with the adult forms.

Thrips madronii Moulton

Specimens evidently of this species were taken by the writer on *Umbellularia, Ceanothus,* and on *Sambucus glauca.* Their general color ranges from light lemon yellow to brown, a few very dark brown. The description of the species by Moulton is: color uniform brown, usually dark brown. The specimens in this collection show, also, a considerable variation in the size of the individuals.

Heliothrips fasciatus Pergande

Numerous specimens of this have been sent to me from Santa Paula, Cal., by E. O. Essig, taken from pine foliage; others have been taken by the writer on pine foliage in this locality; also, from *Lotus glaber,* and from the flower end of ripe apples brought from Chino, Cal. The wings are very long, reaching much beyond tip of abdomen; posterior longitudinal vein branches from anterior just beyond distal margin of basal white area. Femora are black, except distal portion yellow; tibiae black in the middle, and yellow at both ends. Abdomen is very stout. Color almost black.

Leptothrips aspersus Hinds

Several specimens of *L. aspersus* have been taken by the writer on the foliage of orange trees; one specimen was taken from a breeding cage in which orange foliage, infested with yellow scale (*Chrysomphalus aurantii*) had been placed about three weeks before. This species was formerly placed in *Cryptothrips* Uzel, by Hinds, but was later referred to the genus *Phyllothrips* Hood, and finally to *Leptothrips* Hood.

SOME ODYNERINAE OF THE SOUTHWEST UNITED STATES

P. CAMERON.

Leptochilus cratocerus n. sp.

Black, the clypeus, labrum, mandibles (except the apex which is rufous), a small spot on the front, the lower edge of the eye incision, a short line behind the eyes above, a line on the base of the thorax, dilated irregularly on to the propleurae, a small spot on the sides of the scutellum at the base, post-scutellum, an irregular spot narrowed behind on the sides of the metanotum in the middle, a large conical spot below the tegulae, and broad bands on the bases of the basal six abdominal segments, bright lemon yellow; the ventral segments are also edged with the same color, the mark on the second being wider and trilobate. Legs bright lemon yellow, the base of coxae in front, entirely behind, the trochanters, and the base of the femora broadly, the posterior to near the apex above and below, and the middle femora beyond the middle above, black. Antennal scape lemon yellow, black above, the flagellum brownish red, black on top. Wings hyaline, the costa and stigma dark fulvous, the nervures black. Male—Length 7 mm.

Ormsby county, Nevada, July (Baker).

Antennae long, stouter than usual, especially toward the apex, the last joint straight above, roundly narrowed to a blunt point below. Clypeus sparsely punctured, covered with silvery pile; the apex transverse, broad, as wide as the sides which are straight and oblique. Front and vertex closely rugosely punctured, thickly covered with long pale fuscous hair. Temples roundly obliquely narrowed; the occiput transverse. Thorax clearly longer than wide, the base transverse, with bluntly projecting lateral angles, the apex narrowed, the sides broadly rounded. Pro- and mesothorax strongly closely punctured; the postscutellum large, with a rounded oblique slope, the apex transverse. Metanotum deeply depressed in the middle where it is finely closely striated, the rest distinctly punctured above, sparsely punctured and obscurely striated below. Metapleurae shining, aciculated. First abdominal segment cup-shaped, longer than it is wide at the apex, gradually narrowed from the apex to the base, somewhat strongly but not closely punctured; the second segment is about one-fourth longer than wide, but not much narrowed at the base, sparsely weakly punctured. The trophi are very long, the maxillae reaching slightly beyond the apex of thorax. The basal two joints of the maxillary palpi are clearly thicker than the others, which are long and slender; the penultimate joint of the labial palpi is very long and slightly nodose at the apex, the last is about six times longer than wide. Mandibles long, with two teeth behind the apical, the posterior being less distinct than the second. Labrum large, projecting, longer than wide, its apex rounded.

Saussure (Syn. Am. Wasps, 367) describes two species of *Leptochilus: fallax* Sauss., of doubtful origin, and *ornatus* Sauss. from Carolina. The former is omitted by Mr. Cresson in his Catalogue (Trans. Am. Ent. Supp. 1887, 288), while *ornatus* he refers to *Odynerus*. As the species are very easily recognized, *Leptochilus* might as well be adopted as a generic group.

Pterochilus bakeri n. sp.

Black, the clypeus except a small irregular spot in the center; mandibles except apex, a narrow line on the lower edge of the eye incision, a broader one obliquely narrowed below on the outer orbits, the upper part of the thorax to near the apex, where it is broad and incised, tegulae, two large marks on the scutellum, postscutellum, the sides of metanotum broadly, the marks not reaching to the lower edge, a squarish mark on the base of the mesopleurae rounded below and reaching beyond the middle, a similar but longer mark immediately below it, and the abdomen for the greater part, lemon yellow; the basal slope of the first abdominal segment the mark continued beyond as a narrower rounded projection, a larger similar mark on the second, narrow rounded bands on the base of the second to fifth, and the basal half of the sixth all around, black. Legs of a paler yellow, the coxae behind, the hind femora to near the apex, the four anterior femora at the base all around, more broadly behind, and the intermediate to beyond the middle, black. Antennal scape yellow, black above, the flagellum black, reddish brown below. Wings hyaline, suffused with fulvous, the apex slightly violaceous, the costa and stigma fulvous. Female—Length 9 mm. Claremont, California. (Baker.)

Clypeus as broad as long, sparsely punctured, the apex somewhat broad, transverse, margined. Head and thorax closely but not strongly punctured. Base of thorax transverse, the sides slightly but distinctly bluntly projecting, the sides at the apex broadly rounded, apical half of mesonotum with a longitudinal furrow bordering the middle. Abdomen closely coarsely punctured, the second segment square, the base of the second ventral segment has a band, which bifurcates at the outer edges the outer fork the larger.

The apex of the clypeus is broader than it is in *luteicollis* Cam.; in that species the lower mark on the mesopleurae is narrower, more irregular and obliquely sloped, there is a yellow mark on the metapleurae, and the marks on the basal two abdominal segments are differently shaped, *e. g.*, they are incised in the middle.

Symmorphus hornii n. sp.

Black, a small, semi-circular mark on the top of the clypeus, a small one over the antennae, a triangular spot on the sides of the pronotum slightly longer than that on the clypeus, two spots wider than long, and narrowed on the inner side on the scutellum, an irregular spot narrowed below under the tegulae, a line of uniform width on the apices of the first and second abdominal segments, a narrow interrupted one on the middle of the third, a broader one (not much narrower than those on the basal segments) on the fourth, and an irregular line curved and laterally dilated, on the underside of the third, pale whitish yellow. Tibiae, except at the apex, testaceous. Wings, hyaline, suffused with violaceous, the base tinged with dark testaceous, the stigma and nervures black. Female—Length 10 mm. Gunnison, Colorado. (Baker.)

A longish insect, narrow compared with the width, the thorax more than twice longer than wide, the base narrowed transverse, the sides distinctly projecting. Parapsidal furrows complete, but shallow. Scutellum with a distinct furrow down the apical three-fourths. Apex of postscutellum rounded, almost transverse. Metanotum furrowed down the center, the furrow widened below, keeled stoutly in the middle, the sides with a distinct edge. Propleurae punctured above, the rest strongly closely striated; mesopleurae with scattered punctures, the apex above closely rugosely punctured; metapleurae obscurely finely striated at the apex. First abdominal segment distinctly longer than it is wide at the apex, without a distinct neck at the base, it is narrower than the second which is clearly longer than wide, and is narrowed at the base, smooth and shining. Clypeus pyriform, shining, weakly sparsely punctured, its apex with a wide shallow incision. The transverse keel on the base of the abdomen is weak, the apical longitudinal furrow deep and clearly defined. Pubescence short, sparse and pale.

Belongs to Saussure's division a. It is not unlike *S. trisculatus* Cam., but that species has the markings luteous, not white, the stigma testaceous, the wings hyaline, the first abdominal segment with a distinct narrowed neck, and the propleurae are punctured, not regularly striated as in the present species.

Odynerus annulatus Say.

This species appears to be fairly common and widely distributed, judging by the number of specimens in Prof. Baker's collection, also it is a very variable one. The varieties seem to run into local races. The variety from Fedor, Texas, (Birkmann) is black, with the following parts rufous: Clypeus except above, a broad line on the upper half of the outer orbits, pronotum except at the base, tegulae, scutellum, sides of metanotum and the parts round the black central spot on first abdominal segment; yellow are the under side of the antennal scape, clypeus, base of mandibles, the frontal spot, base of pronotum, the postscutellum, sides and apex of first abdominal segment broadly, and the apices of the second and third. Some of the red markings may be yellow and vice versa, *e. g.*, the clypeus, and the sides of metanotum may be yellow or red; the scutellum may rarely be black; there may be a rufous spot on the sides of the second abdominal segment at the base; in most the postscutellum is yellow; in all the wings are fuscous violaceous. This variety may be known as var. *birkmanni.*

The form from Prescott, Congress, and Phoenix, Arizona (Oslar), and from Berkeley, Colorado (Oslar), is smaller and has the yellow and red colors much more extended. The female has the head and thorax red, with the ocelli, the sides and base of mesonotum, and more or less of the pleurae and breasts black; the top of the clypeus, a line on the eye incision, a line on the center of the apex of pronotum, a large spot under the tegulae, sides of scutellum, postscutellum, and the sides of the metathorax broadly, bright lemon yellow; the abdomen is bright lemon yellow, with the bases of the first and second segments broadly red; the wings are almost hyaline, smoky violaceous along the anterior margin. The male of this variety has the front, vertex, occiput, lower part of prothorax, mesothorax, middle of metanotum, and a more or less large spot on the center of the basal abdominal segments; the clypeus, a large semi-circular spot on the front, the eye incision, a spot under the tegulae, a spot on the sides of the scutellum, and the postscutellum, are yellow more or less tinged with rufous. The red mark on the base of the second abdominal segment is of irregular form and may be incised laterally at the middle and at the apex; there may be a square or triangular black mark in its middle; the basal half may be black with an enclosed transverse oval spot on the sides; the yellow apical band on the first segment may be dilated backwards at the sides. An example from Ormsby county, Nevada, has the upper part of the head, the thorax, except the apex of pronotum, a mark below the tegulae, one on the sides of the scutellum, the postscutellum, and the first and second segments of the abdomen (except at the sides), black. This variety may be known under the name *oslari.*

This is a very variable species and very confusing, owing to some of the varieties simulating other but distinct species. *O. orasus* Cam., for example, agrees with the last form that I have described, but may at once be known by the incised apex of its clypeus. *O. bradleyi* Cam., could be matched in color by one of the aberrations, but may be known by the apex of the clypeus not being transverse, and by the very different form of the antennae. *O. belti* Cam., from Nicaragua is very similar in coloration, but has the clypeus longer compared with the width, and otherwise differs in the middle of the metapleurae at the sides projecting into a distinct tooth.

Some of the forms are not unlike *Rhygchium dorsale* F., in coloration. Two characteristic features of the species are: the broad clypeus truncated at the apex in both sexes, and the form of the second abdominal segment, which is broader than long, its apex depressed, the depression widest in the middle and strongly punctured.

Odynerus sapelloensis n. sp.

Black, the clypeus except for a small black spot (broad and round above, narrowed beneath shortly below the middle), a mark over the antennae, a line on the base of the mandibles, a line on the base of the thorax, narrowed in the middle, an irregular oval mark (straight behind, rounded in front and narrowed), tegulae, base of postscutellum, two small irregular spots on the sides of the postscutellum, two small irregular spots on the sides of the metanotum, the apex of first abdominal segment (the sides of the apical half more broadly, the yellow projecting towards the center so that the black central part is narrower than the apical), the sides of the second segment from near the base (the yellow projecting into the central part at the base, the apex more narrowly), the greater part of the following segments, the apex of the second ventral and the greater part of the following except the last, sulphur yellow; the apex of the femora above, their lower part more broadly (especially the anterior), and the tibiae and tarsi, of a more rufous yellow, the rufous tint most distinct on the tarsi. Wings almost hyaline, clouded slightly with fulvous in front, the radial cellule violaceous. Antennal scape yellow, black above. Female. Length 11-12 mm. Sapello Cañon and Las Vegas, New Mexico (Oslar).

Clypeus as wide as long, its apex transverse. Base of thorax transverse, the sides of the apex bluntly margined, the upper half more distinctly than the lower, the middle projecting into a slight blunt tooth. The puncturation on the head, pro, and mesothorax, is strong and close; the apex of the metanotum is closely finely obliquely striated, the metapleurae except at the base is closely somewhat strongly obliquely striated, the striae intermixed with punctures. Abdomen closely punctured, the apex of the second segment and the following much more coarsely than the rest; the first segment cup-shaped, the second slightly wider than long, its apex reflexed. The pubescence is dense and fuscous.

The male is smaller, its clypeus is entirely yellow and with a transverse apex, the whole being longer than wide; the markings on the abdomen are more irregular, e. g. the yellow oblique line on the second abdominal segment is almost enclosed, the black mark on the second ventral is divided on the sides by an oblique yellow line; the antennal hook is broad, thick, rounded, and slightly narrowed at the apex, reaching to the apex, of the penultimate; the legs have less black on the base, the coxae being yellow below, and the black on the femora shorter.

This species is allied to *O. arvensis* Sauss., that being larger with clypeus not entirely yellow below, the legs not broadly black at the base, the sides of the metanotum yellow above, and the sides of the second abdominal segment only yellow at the apex. It is not unlike some of the varieties of *O. annulatus* Say: that species may be separated by the broader more bluntly pointed clypeus, it having also the sides of the metanotum yellow at the base.

Odynerus deficiens n. sp.

Black, the head and thorax densely covered with long fuscous pubescence, the clypeus, mandibles except at apex, a mark over the antennae, a short one behind the eyes, a line on the base of thorax laterally not reaching to the middle of pronotum, tegulae except for a central spot, a spot below them, postscutellum, a mark on the sides of the metanotum above, a broad line on the apex of the first abdominal segment broadly dilated laterally to the top of apical slope, a wider one on the second widely dilated laterally to near the base where there is an oblique projection narrowed towards the innerside, broad lines on the other segments, the second ventral (except for a large wide black mark irregularly narrowed laterally in the middle on the basal three-fourths), the greater part of the third to fifth ventrals, and a mark in the center of the last, yellow. Legs yellow, the femora largely marked with black. Male. Length 10 mm. Prescott, Arizona (Oslar).

Clypeus pyriform, a little longer than wide, the apex depressed, not quite transverse, the sides slightly projecting. Base of thorax transverse, the sides not projecting, the apex transverse, the sides more strongly keeled above than below. Apex of postscutellum transverse. First abdominal segment cup-shaped with a short neck, the second is, if anything, wider than long, narrowed at the base, the apex reflexed. Wings hyaline, tinged with violaceous; the basal nervures, costa and stigma, testaceous, the apical nervures blackish.

Allied to *O. sapelloensis* Cam., but that species may be known by the second abdominal segment being clearly longer than wide, by the yellow basal line being enclosed, not open, by the apical part of the black mark on the first abdominal segment being narrower and broader on the projecting sides, by the black mark on the second ventral segment being larger, having a larger more rounded incision on the sides, and the apex having a broad rounded incision.

Odynerus viereckii n. sp.

Black, the clypeus, base of mandibles, a triangular frontal mark (the narrow end below and with a short pedicel), the eye incision, the greater part of the outer orbits, the basal half of pronotum, sides of scutellum, postscutellum, a broad conical spot below the tegulae, the sides of the first abdominal segment from the top of the basal slope, its apex more narrowly, the second segment except a large broad mark on the center of the basal two-thirds (this mark has the basal half obliquely narrowed, the narrowed apical part of equal width), and all the rest of the abdomen pale orange yellow. Legs fulvous, the underside of the coxae pale yellow, the upper black, the apex of the femora and of the tibiae in front, yellow. Antennal scape rufous. The center of the clypeus tinged with rufous; the apical half of pronotum, the center of the scutellum broadly, the upper edges of the sides of metanotum broadly, and a broad band bordering the sides of the black spots on the center of the first and second abdominal segments, rufous. Wings fulvo-hyaline, the apex slightly infuscated, the nervures blackish, the costa and stigma fulvous. Female. Length 12 mm. Claremont, California (Baker).

Clypeus as wide as long, the upper half strongly but not closely punctured, the lower flat with scattered punctures; the apex broad, transverse, furrowed behind. At the end of the vertex in the center, there is a smooth transverse curved space roundly dilated behind, and with a curved transverse depression on the hinder half. Base of thorax transverse, the apex laterally becomes gradually widened from the top and bottom to the middle; the center of the apex is roundly depressed and closely transversely striated. The puncturation is strong and close, and on the pleurae running into reticulations. First abdominal segment smooth, cup-shaped, the second slightly longer than wide, sparsely weakly punctured, the apex strongly punctured with a smooth reflexed border, the other segments are much more coarsely punctured, the apex of the third is strongly reflexed.

This species might be taken for a form of *annulatus* but may readily be known by the reflexed borders of the second and third segments, by the fulvous tinted wings and by the longer second abdominal segment.

Odynerus trichiosomus n. sp.

Black, the clypeus, mandibles except the teeth, labrum, a mark over the antennae (broad and transverse above, the lower part of it obliquely roundly narrowed, the lower half of equal width, half the breadth of the upper), a line on the lower part of the eye incision, a narrow interrupted line on the outer orbits, the pronotum, two small spots on the scutellums, a curved spot narrowed below on the sides of the metanotum above, and the greater part of the abdomen, orange yellow; the yellow on the pronotum and two basal segments of abdomen largely suffused with rufous; the abdomen has the following black markings: the basal slope of first abdominal segment, the black continued down the middle of the segment to shortly beyond its middle, this part being narrowed at the base, widely dilated at the apex, it becoming gradually widened from the base to the apex, a large broad mark on the basal half of the second segment, its basal part extends to the outer edge of the segment, from where it becomes gradually obliquely narrowed to the middle, then obliquely dilated to the apex which is transverse, this apical part not being so wide as the basal; an irregular band on the base of the fifth segment, a broader regular one on the base of the sixth, a narrower more irregular line around its sides and apex, the first ventral segment, a narrow band on the base of the second with a square projection in its middle, and the basal half of the apical segment. Basal three joints of the antennae rufous above, the scape yellow below. Legs reddish yellow, the coxae, trochanters, and base of femora black, the black on the hinder femora longer than on the others. Wings fuscous hyaline, the anterior fulvous in front to the stigma, the costa and stigma fulvous. Male—Length 11 mm. Gallinas Cañon, New Mexico, July. (Oslar.)

Entire body covered with long dark fuscous pubescence. The yellow on the pronotum and on the basal two segments of abdomen is suffused with rufous. Clypeus pyriform, slightly but distinctly longer than wide, the apex with a shallow rounded incision. Upper part of head and thorax coarsely punctured, the punctures on the mesopleurae coarser, running into reticulations; the base of the metapleurae finely closely striated, the rest much more coarsely irregularly striated. First abdominal segment cup-shaped, smooth, the second as wide as long, the basal two-thirds smooth, the apical deeply irregularly, but not very closely punctured; the third to sixth are similarly punctured, the punctures becoming gradually smaller, the apices of the segments smooth, not reflexed. Antennal hook black, curved, reaching to the case of the penultimate joint. Base of thorax transverse, the sides not projecting. Postscutellum with a steep slope, its base punctured, the rest smooth, the apex transverse. Sides of metanotum rugose, not margined, the center closely transversely striated, not hollowed; it is almost transverse behind.

This species can only be placed in *Odynerus* sens. str.

Odynerus approximatus n. sp.

Black, the clypeus, mandibles except the teeth, a line fully three times longer than wide and roundly dilated above over the antennae, a broad line bordering the lower part of the eye incision, a short narrow line behind the eyes near the top, a broad spot of equal width behind on the base of the pronotum reaching close to the middle, tegulae, postscutellum, a narrow line on the top half of the sides of metanotum, an oblique conical mark below the tegulae, lines on the apices of the abdominal segments, an oblique mark touching the apical line on the sides of the first about three times longer than wide, a large irregular oval spot on the sides of the second, and two small spots in the center of the second ventral, pale yellow. Legs pale yellow, the coxae, trochanters and base of femora black above, the black on the fore-femora on the basal third, on the intermediate reaching shortly beyond the middle, on the hinder close to the apex; the tarsi tinged with fulvous. Wings hyaline, tinged with violaceous, the nervures and stigma black. Male—Length 6-7 mm. Fedor, Texas. (Birkmann.)

Antennae stout, becoming thicker towards the apex, the hook brown, reaching to the middle of the penultimate joint. Clypeus slightly longer than wide, the lower half straight, obliquely narrowed, the apex with a shallow rounded incision. Base of thorax almost transverse, the sides not projecting. Apex of postscutellum broadly rounded. Sides of metanotum rounded, not margined. Basal slope of first abdominal segment smooth, the second segment a little wider at the apex than it is long; the apex is more strongly punctured than the rest; it is slightly reflexed. The apical half of the middle femora is dilated laterally and compressed, of irregular form. Puncturation of the head and thorax close and strong; they are covered with white pubescence.

This species is based on three males which agree in form, sculpture, size, and coloration, and in having the middle femora more or less dilated and compressed. The structure of the middle femora is not quite alike in any two of them, though this may not be a point of specific distinction. The two ventral yellow marks may be absent.

Odynerus mediatus n. sp.

Male—Length 6 mm. Three Rivers, California (Culbertson.)

This species agrees in coloration of the body with *O. approximatus,* having also the same form of clypeus and thorax; they may be separated as follows:

A. Hind femora black except at the extreme apex, the middle femora as as seen from the front dilated from near the middle, the apex of the expanded part dilated, with an oblique slope; the middle tibiae becoming gradually widened from the base to the apex; the second abdominal segment distinctly longer than wide, its apex flat, its basal half smooth; the apical weakly punctured except at the apex, where the puncturation is stronger. *approximatus.*

AA. Hind femora yellow on the outer side, black below and within, middle femora compressed at the apex, clearly thinner than the basal, the middle tibiae not much thickened at the apex compared with the base, the second segment distinctly punctured throughout, its apex reflexed. *mediatus.*

The yellow on the legs (especially on the anterior) is largely suffused with rufo-fulvous; the pubescence is dense, white, and silky; the sides of the first abdominal segment are yellow, as is also the apex; the oblique mark is large and broad, the mark on the sides of the second segment is large, broad, and widest on the outer side; there are two spots on its ventral surface, which are large and oval; the incision on the clypeus is triangular and is deeper and more distinct than in *approximatus*. First abdominal segment cup-shaped, wider than long, almost smooth except at the apex, which is weakly punctured.

The female (from mountains near Claremont, California) has the yellow markings larger, the apex of the second abdominal segment is more deeply punctured, and is distinctly reflexed, the clypeus is slightly broader than long, has the apex depressed and transverse, and has in its center a large transverse oval black spot, the yellow oblique mark on the first abdominal segment is almost enclosed on the outer hinder part, the narrowed black part of the apex being almost continued to the outer edge; as in the male there are two large irregular oval yellow marks.

Odynerus crassispinus n. sp.

Black, the clypeus, mandibles except the teeth, a line about two and a half times longer than wide and of equal width over the antennae, a broad line dilated above on the lower edge of the eye incision, a short line near the top of the outer orbits, an interrupted line of equal width on the base of the thorax, a large conical mark (the wide end above) below the tegulae, tegulae except a large brownish spot on the inner basal part, base of postscutellum, a small oblique longish oval mark on the middle of the first basal obdominal segment, a line on the apex of the first abdominal segment of almost equal width, broad lines extending backwards on the sides to near the base, broad lines on the apices of the second to sixth ventrals and two large oval marks on the second ventral near the outer edges, bright orange yellow. Legs of a paler yellow, the coxae, trochanters, and basal two-thirds of the femora behind, black. Underside of the antennal scape bright yellow, of the flagellum fulvous brown. Wings clear hyaline, the radial cellule clouded, the stigma dark fuscous. Male—Length 7 mm. Claremont, California. (Baker.)

Hind coxae armed at the base with a stout tooth, narrowed towards the apex gradually, and longer than it is wide at the base. Clypeus longer than wide, broad and transverse at the apex. Apex of postscutellum broadly rounded, narrowed. Metanotum with bluntly rounded sides, rough, the middle finely closely obliquely striated. First abdominal segment cup-shaped, smooth, the second as long as it is wide at the apex, its base smooth finely, the apex more strongly punctured and flat; the other segments are finely but distinctly punctured. Pro- and mesopleurae distinctly but not closely punctured, the metapleurae closely roughly obliquely striated. Characteristic of this species are the transverse broad apex of the clypeus, and the stout spine on the hind coxae.

Odynerus sulciventris n. sp.

Red; flagellum narrowly at the base, a large mark square in front obliquely narrowed behind covering the ocelli, the lower part of occiput, a mark dilated at the base on basal half of mesonotum, a narrower longer one down the sides extending to the apex, a line around the postscutellum, lower edge of propleurae, lower half of mesopleurae, mesosternum, base of metapleurae, the base of the third abdominal segment narrowly, of the fourth more broadly, and the base of the second ventral, black. Wings hyaline, narrowly suffused with fuscous in front, the costa and stigma dark testaceous, the nervures black. Female—Length .12 mm. Nogales, Arizona. (Oslar.)

A broad stout species, sparsely haired and except the basal abdominal segment, closely strongly punctured. Clypeus as broad as long, its apex bluntly rounded. Thorax about twice longer than wide, as wide as the head, the base with the sides rounded, the sides of the apex rounded and rough. Postscutellum projecting over the metanotum, coarsely punctured except on lower apical slope which is perpendicular. Metanotum roundly hollowed, the sides transversely striated. Abdomen long-ovate, as long and as wide as the thorax; the first segment cup-shaped, with a distinct pedicel at the base, as wide as the second which is slightly wider than long, its apex depressed and more strongly punctured than the rest. Mandibles of a paler rufous color than the head, the teeth black. Tegulae rufous, with a large lead-colored spot in the center. There is a distinct oblique depression over each antenna, the lower part of the front being thus gradually narrowed. The base of the second ventral segment is thicker than usual, projecting more downwards, and therefore appearing more clearly separated from the first; there is a distinct furrow down the basal half. The punctured apical depressed part of the second abdominal segment is wide, and broadly roundly dilated backward in the middle.

Odynerus jeromensis n. sp.

Black, the head, thorax and base of abdomen densely covered with a longish pale pile; the clypeus, the greater part of the antennal scape a small mark wider than long and roundly narrowed below over the antennae, postscutellum, a line on the apex of the first abdominal segment dilated laterally, the dilation longer up and down than longitudinally and with the edge of the base ragged, the basal two-thirds of the second segment, the apex not reaching to the outer edge, before it an irregular indentation longest laterally, narrowed inwardly, the base with an irregular edge, the apical boundary narrow and narrowed towards the outer edge, the third and fourth segments except narrowly at the base, the 1fth more widely, the line roundly widened at the base, the apical half of the sixth, and the greater part of the ventral surface, lemon yellow. The following parts are black on the ventral segments: the first segment, the base of the second broadly, the line in the middle narrowed gradually and continued to the middle, where it ends in a narrow square projection, the base of the following segments and the basal two-thirds of the last, a short line behind the top of the eyes, a line narrowed in the middle on the base of the thorax rufo-fulvous. Tegulae dark yellowish testaceous, largely fuscous in the middle. Legs rufo-testaceous, the trochanters, the four anterior coxae behind, base of four anterior femora, the hind coxae, and the hind femora broadly, black. Wings hyaline, slightly infuscated, the costa and stigma rufo-testaceous. Male—Total length 9 mm. Jerome, Arizona. (Oslar.)

Base of thorax almost transverse, the edges bluntly rounded, the sides of the apex rough, not very blunt, the center closely obliquely striated. Apex of postscutellum broad, transverse, first abdominal segment large, cup-shaped, the second clearly longer than it is wide at the apex, where it is strongly punctured and reflexed, the base is slightly narrowed, the third, fourth and fifth segments are closely punctured, the punctures deep and distinctly separated, the apex of the sixth is less strongly punctured. Clypeus slightly longer than wide, the apex depressed, almost transverse. Antennal hook black, reaching to the middle of the tenth joint.

Allied to *O. sapelloensis, aequalis,* and *santaefeae* from all of which it may be known by the black mark on the first abdominal segment not being incised laterally in the middle and by there being no yellow mark on the base of the metanotum at the sides.

Odynerus congressensis n. sp.

Ferruginous, the following parts black: a broad oblique line above each antenna, the vertex between the eyes, the fourth and following joints of the antennae, the base and sides of the mesonotum broadly, the parts surrounding the postscutellum, more or less of the center and apex of the metanotum, the edges of mesopleurae, the mesosternum. The following parts are yellow: the clypeus except for a curved rufous line around the center, a line on the apex of the pronotum, a longish oval mark below the tegulae, postscutellum, the apices of the first and second abdominal segments broadly, their sides to near the base still more broadly, the others entirely, and the sides of the metanotum broadly in the female, more narrowly in the male. Legs ferruginous, the tibiae tinged with ferruginous in front. Wings hyaline, largely tinged with violaceous in front; the costa and stigma fulvous, the other nervures black. The pubescence is dense and pale. Female and male—Length 13 mm. Congress and Prescott, Arizona. (Oslar.)

Clypeus as long as wide, its apex broad, transverse; it is strongly but not closely punctured. Mandibles rufous, the teeth black. Apex of postscutellum broadly rounded, rugosely punctured. Base of thorax transverse, the sides not projecting; the thorax is more than twice longer than wide. First abdominal segment cup-shaped, smooth, the second if anything longer than wide, smooth except at the apex which is strongly but not very closely punctured, and not reflexed; the third, fourth, and fifth similarly punctured, the last smooth, the same parts of the ventral surface are more weakly punctured.

The male is similarly colored except that the sides of the metanotum are not broadly yellow, the front is yellow, not rufous, the clypeus is broad as in the female, but the apex is not quite transverse. The antennal scape below, the mandibles, the tibiae, and to a less extent, the tarsi, are yellow. Probably the amount of yellow varies in both sexes. The puncturation is strong, and is sparser on the center of the mesonotum.

Allied apparently to *O. ductus* Cr. It is more slenderly built than *arvensis* or *annulatus,* to both of which it is related.

Odynerus (?) tanynotus n. sp.

Reddish; the greater part of the first and the sides of the other abdominal segments broadly, the apical two-thirds of the scutellum, and its lateral keels, yellow. The fifth and following joints of the antennae, a large irregular mark in the center of the vertex from which two broad lines run down to the antennae, the mesonotum except for a broad V-shaped mark in the middle, the base and apex of the scutellum, of the postscutellum more narrowly, breasts, base of metapleurae broadly, a large semicircular mark on the apex of the metanotum, and a broad band on the apex of the second abdominal segment, black. Legs rufous, of a brighter tint than the body. Wings fuscous-violaceous, the costa and stigma dark fulvous, the nervures black. Female—Length 11 mm. Congress, Arizona. (Oslar.)

Thorax somewhat more than twice longer than wide, rounded laterally behind, transverse at the base, the base of metanotum with a wide shallow furrow on the middle, the apex hollowed. Apex of postscutellum broadly rounded. Head cubical, fully wider than the thorax, the temples broad, slightly rounded, not narrowed, the apex transverse. Clypeus pyriform, broadly rounded above, gradually narrowed towards the apex which is transverse. The head is longer than usual viewed from the sides or front; it is closely strongly punctured, the rufous mark on the front is obliquely narrowed above and below, the lower part being longer and narrower than the upper. Thorax closely strongly punctured, more closely rugosely above than on the pleurae where the punctures are much more clearly separated. The sides of the metanotum project into pale colored horny plates, narrowed broadly in the middle. The first abdominal segment is elongated bell-shaped, roundly narrowed at the base which is more rugosely punctured than the rest; it is about one-half longer than it is wide at the apex, and is of equal width from the top of the narrowed part, and it is longer than the second, which is slightly but distinctly longer than broad, not narrowed at the apex; its apex and that of the third are slightly reflexed. All the segments are closely strongly punctured, but not so strongly as the thorax. The abdomen is not much longer than the thorax.

A distinct species from its coloration, large cubical head, long thorax compared with its width, and long bell-shaped first abdominal segment. The wings are placed shortly beyond the middle, the fore part of the thorax being thus longer than the posterior. There is no transverse keel on the base of the first abdominal segment, which is, however, roughened as in many of the Section *Ancistrocerus,* but not in *Odynerus* sens. str.

Odynerus leucospilus u. sp.

Black, shining, covered with a white down, dense and silvery on the clypeus; the clypeus except for a line down the center and a broad one across the apex, a narrow line on the lower part of the eye incision, a line on the base of the thorax, the lateral widened part incised at the apex, tegulae except for a black spot, a mark of almost equal width below them, two spots on the apex of scutellum, the postscutellum, a mark on the lower edge of apex of metanotum, lines on the apices of the basal five abdominal segments, that on the first trilobate, the middle lobe smaller than the lateral, and an oblique spot gradually narrowed on the outerside, white. Underside of antennae rufous brown, the hook small, not extending beyond the base of the joint. Legs bright red, the coxae, trochanters, and base of anterior femora broadly, of posteriorly more narrowly, black. The anterior femora behind, and the tibiae behind, white. Wings hyaline, the radial cellule smoky, the costa testaceous, the nervures black. Male—Length 10 mm. Prescott, Arizona. (Oslar.)

Clypeus longer than wide, its apex rather broad, bluntly rounded, narrowly rufous. Thorax about twice longer than wide, the base transverse, the apex broadly rounded laterally, the center hollowed, the whole strongly but not closely punctured. The first abdominal segment is nearly as long as the second, the basal half becoming gradually widened from the base, almost impunctate, shining, the apical part rather strongly punctured, the following four segments more strongly and closely punctured, the second as wide as long, distinctly roundly narrowed at the base, its apex not reflexed, the last smooth and bluntly rounded.

WEST COAST NEWS NOTES

[In this department we hope to give in most numbers of the Journal, some idea of the doings and movements of western entomologists, notices of publications of interest to western students, notices of entomological meetings, etc. To this end, we hope that students or collectors will send in all items of entomological interest about themselves or others. Address, Fordyce Grinnell, Jr., 572 N. Marengo Ave., Pasadena, Cal.]

Mr. C. W. Herr, a lepidopterist, formerly of Pasadena, Cal., and Telluride, Colo., has settled in northern Idaho, where he will doubtless collect some interesting insects.

Recent additions to the collectors and students of insects in Southern California, are Mr. Karl R. Coolidge, formerly of Palo Alto, and Mr. G. R. Pilate, formerly of Dayton, Ohio.

Mr. Karl R. Coolidge has finished a report on the *Arachnida* of the Galapagos Islands, which is about to be published in the Proceedings of the California Academy of Sciences.

The Regular Quarterly Meeting of the Pacific Coast Entomological Society was held at Thompson's Café, San Francisco on November 20, 1909.

Mr. William T. Bather, Librarian of the Brooklyn Entomological Society, who visited Pasadena and the northern part of the State in September, addressed the November meeting of the Society on "A Collector Twice Across the Continent."

The last informal gathering of entomologists in Pasadena took place at the residence of Mr. V. L. Clemence on November 11. Mr. Schrader of Los Angeles, told more of his interesting experimental work with the Lepidoptera. These meetings are held on the second Thursday evenings of each month, and all students and collectors are cordially invited to attend.

Prof. J. J. Rivers of Santa Monica, our veteran student of entomology, although near 80 years, is still active, and is writing up some notes on the genus *Melitaea* (*Lemonias*) which he knows so well.

All students of zoo-geography in California should read and study Dr. James Perrin Smith's article in "Science" for September 10, on the "Geological History of California."

Dr. F. E. Blaisdell's valuable paper on the *Eleodiini* has elicited a number of reviews and criticisms, mostly of a very commendatory character. In "The Entomologists' Record and Journal of Variation," for October, an interesting criticism is found. Although Dr. Blaisdell divides his genus *Eleodes* into subdivisions and groups, with full diagnoses, he drops these subdivisions and uses Eleodes for all subdivisions; "the binomial used not offering the slightest suggestion as to the position of the species in any one of the eleven subdivisions into which the group falls, and of which *Eleodes* is common to both series." It might be said the same of the *formae,* under the species, which are evidently incipient species or subspecies, possibly a few mutations, and are consequently very interesting, more so than the well differentiated and isolated species; they should be as much recognized by name, although possibly in a trinomial form to express their relationships.

The intensive and systematic study of the variation of species, subspecies, etc., with strict regard to their environment and geographical distribution is of great value and interest in the study of the origin of species, faunae and florae. Of course, this has to be done with immense series of specimens from all over the range of distribution and in different years; for species which are in process of formation vary in all directions in pattern or structure, *i. e.,* fluctuating variation, some variations being more numerous than the others and eventually one pattern or structure is evolved through selection; whether this selection is germinal, environmental or determinate remains to be learned. In a beginning study of the variations of a little blue butterfly, *Cupido fulla,* from various mountains of Southern California, some very interesting points are being discovered. The species which evidently had a continuous range, rather recently, geologically, has become more or less isolated into colonies; the various colonies(although showing their relationship among themselves, are, it seems, beginning to vary in different directions, one form of pattern predominating over the others. Is this an example of determinate variation? The mutations of certain plant breeders and experimenters are simply these individual or fluctuating variations, isolated by human means and perpetuated for a time. There are many mutations in every variable species, one of which, in course of time, by means of *natural* selection may become the prevailing form —the species. We can only get a correct idea of species from the study of species in their true habitat and environment. Of course, plant and animal breeding and improvement is of use *economically;* but it is not *natural* history. De Vries' idea is that "the slow and gradual changes surmised by Wallace and his followers, . . . are entirely beyond our future and present experience"! And further; "One of the greatest objections to the Darwinian theory of descent arose from the length of time it would require, if all evolution was to be explained on the theory of slow and nearly invisible changes. This difficulty is at once met and fully surmounted by the hypothesis of periodical but sudden and quite noticeable steps."!! That reminds us of the teachings of Werner and his followers in geology, in a different line, a century ago. "Time is as long as space is wide." Our finite minds can not grasp all the infinite.

Code des Couleurs, à l'usage des Naturalistes, Artistes, Commerçants, et Industriels. 720 Echantillons de Couleurs Classés d'apres la méthode Chevreul simplifiée. par Paul Klincksieck et Th. Valette. Paris: Paul Klincksieck, Editeur, 3 rue Corneille, 1908.

This is a book of 32 pages of text, and 50 plates, on heavy paper, containing 720 blocked colors; a table of 10 principal colors in 18 languages, and a table of contents. The whole making a neat and portable volume.

The publication of this book is a great boon to systematic naturalists everywhere, as Ridgway's *Nomenclature of Colors* has long been out of print, and it has been practically impossible to obtain a copy of it.

This book was planned in 1906, through a real need felt in the study and description of the "Champignons"; thus it was planned, in part, by a naturalist for naturalists. The hope is expressed that this color code may recommend itself to the whole world, and there is vertainly great need of a uniform nomenclature of colors accepted and used by naturalists everywhere. As the recognition of geographic isolation as one of the chief factors in evolution, comes to be better known and studied, it is imperative that tones of color, where color is of use, should be very accurately stated, instead of in general comparative ways as is usually done.

The fundamental colors are six, those of the solar spectrum, and the tones are indicated by a number, the method invented by Chevreul; which is decidedly better than "Se fatiguer pour trouver dans les trois Regnes on ailleurs le nom d'un équivalent qui lui ressemble plus on moins vaguemont," and "qui ne signifient rien de précis." There are over 14,000 tones in Chevreul's system, but some of these, Chevreul himself, could hardly distinguish. 720 tones were thought to be enough for the use of naturalists. Part II. of the text, is by Th. Valette and considers the following subjects:

1. Des couleurs au point de vue physique.
2. Sources de lumiére colorées.
3. Des couleurs matérielles on pigments colorés.
4. Classification des couleurs.
5. Code des couleurs à l'usage des naturalistes.
6. Confection du Code des Couleurs.
7. Examen des couleurs complémentaires contrastes.

The book ought to be in use by every systematic naturalist, dealing with groups which exhibit color differences, thus helping to make a uniform nomenclature, instead of indicating colors by some vague term, which leaves an idea of uncertainty. Stability in terminology ought to be as important as the other rules of nomenclature,—priority, etc., and should be taken up by committees on nomenclature. The book can be had from the firm of G. E. Stechert & Co., 129-133 West 20th St., N. Y.

Pomona College Journal of Entomology

Volume II | MARCH 1910 | Number 1

FUMIGATION STUDIES—I

THE USE OF WATER IN FUMIGATION DOSAGES

WRIGHT M. PIERCE.

[The people of this immediate region spend hundreds of thousands of dollars each year for citrus fumigation. They are acutely interested to know just what they are getting, and want to understand clearly the factors which control successful work. Mr. Pierce has taken up this work here in our own region and has gathered a large amount of first hand facts by actually following up many contracting fumigators in the field and studying carefully their methods and results. His work this year may be gathered under four heads, (1) Use of Water in Fumigation Dosages, (2) Estimating Fumigation Dosages for Trees, (3) Does Contract Fumigation Pay, and (4) Handling Chemicals in Fumigation Work. Some of his first results are presented herewith. He has gathered a remarkable series of photographs in evidence of the points he wishes to make—many more than we are able to present here.—Ed.]

An enormous amount of Fumigation is being done in Southern California now, and to keep the more destructive scales out of his grove is the most important problem facing the citrus grower of today. With our poor knowledge of parasites and the best ways to use them in our service, it seems that fumigation is now the most efficient process by which the citrus grower can combat the insect pests found here. Within many miles of Claremont practically all of the fumigating done is for the black scale alone, and the cost to this district on account of this pest alone, amounts to tens of thousands of dollars. With this outlay and the prime importance of the work to the whole citrus industry, it becomes a matter of the highest import to study carefully the methods actually employed in the district, determining if the methods used are the most efficient ones, if the greatest possible service is obtained from the chemicals used, and if the whole operation is accomplished with the least possible cost to the grower. In work so extensively carried on as this is, it is easy to see that a very small saving of materials in some one operation, or perhaps a little adding of expense in another, would in the long run, amount to a difference of thousands of dollars to those who are now compelled for their own safety to have the fumigating done. Out of the many problems and urgent questions with which this subject is replete, the present article will consider briefly the use of water in fumigation.

In the production of hydrocyanic acid gas by the action of acid upon cyanide, it is absolutely necessary to add a certain definite proportion of water in order that the action shall be complete and the maximum amount of gas obtained for the chemicals used. Mr. R. S. Woglum, the Department of Agriculture expert who has been carrying out fumigation investigations at Whittier for several years, has long since called attention to the fact that to vary the amount of water from a certain optimum standard, is to change very materially the ultimate results obtained. His original conclusions were based

Figure 53. "Frosted" Generators

upon laboratory work with the chemicals. As a result of his investigations he recommends as giving the best all around results the following formula: Water three parts, sulphuric acid one part, and potassium cyanide one part. This having been determined, it was an interesting matter to follow up our local fumigators and examine the actual practice in this regard. Three out of four of the outfits studied were found to be using this standard formula. Those using it were getting very satisfactory results from it. All the cyanide "burned" and no "baking" or "frosting" took place in the generating dishes. When the refuse was turned out of the dishes there was no hard residue left, showing conclusively that the action had been complete.

In the case of one outfit using a different formula a very different result was encountered. Here the generating dishes were in a very dirty condition, (Figure 53), much of the dose having "frosted," so that each time it was dumped out, a very liberal supply of the light colored flaky substance remained, sticking to the generator. When the material dumped upon the ground in piles was examined again, even after several days, the strong odor of hydrocyanic acid gas was easily distinguishable. Old specimens of this material when analyzed, do not show the presence of any unused cyanide, as a report from the Government Chemist kindly made by Dr. L. O. Howard on some of this very material, would seem to indicate. Yet many days had elapsed between the use of the material in the generators and its analysis by the Chemist. It seems unquestionable that there is a considerable loss of gas in real practice where severe "frosting" occurs, and when minimum dosages are used as for black scale, it means not only a waste of materials, but a loss in efficiency. Last year one outfit was followed up closely by men from this department and was found not to be killing *even the black scale* on certain trees with the dosages and times of exposure it was using. The outfit mentioned above, the work of which was seriously impeded by "frosting" of the generators, was using a formula: water one part, cyanide two parts, acid one and a half parts. In this formula there is evidently not enough water to dissolve and free the potassium sulphate which is formed by the action of the acid on the cyanide, and thus it cakes (Figure 54), retarding the action and preventing the most rapid escape of the gas.

Figure 54. Showing amount of material often dumped out of a single generator

In spite of the importance to be attached to the matter of a proper amount of water in the formula, we know of one outfit which sent a boy through the orchard with a pail and dipper to ladle water into the generators. Such an occurrence is, however, a rarity. All of the outfits whose work I have followed, have measured out the water with glass graduates (Figure 55), and have shown a disposition to mix the dosages with care, even when the formula used was an unwise one, and the method of estimating the dosage a most uncertain one—as is usually the case in this region. The day of guesswork is, however, rapidly passing. The growers have had enough of it, and are rapidly coming to the point where something better will be demanded. So in the matter of the water used, in the case of contract fumigating the formula should

Figure 55. Showing a common method of handling water

be one of the important items of the contract, and it is up to the grower to see that the 3-1-1 formula is the one stipulated and carried out.

Figure 56. The water wagon of a fumigating outfit

THE NATURAL ENEMIES OF THE CITRUS MEALY BUG. I

E. O. ESSIG.

Beginning with this article, we expect to present, as thoroughly as possible, the life-histories of all our natural enemies of the Citrus Mealy Bug (Pseudococcus citri). Due to the great variety of its food plants, and its natural ability to ward off sprays and gases, it is believed by good authorities that the only remedy possible for the Mealy Bug lies with its insect enemies. Whether this be entirely true or not, we are sure that they will play a very important part and should be known by all who are interested in the raising of citrus fruits. Two divisions of friendly insects are recognized: First, those insects which prey directly upon and devour the host, or *Predacious enemies;* and second, those which undergo their transformations from the egg to the adult within the body of the host, or *Internal parasites.* The first to come under consideration is one of the *predacious enemies:*

Sympherobius angustus Banks

(Brown Lace-wing).

Adult Female.—(Fig. 57)—In general the color is brown, and rightly deserves the name Brown Lace-Wing. In shape and carriage it greatly resembles the green Aphis-Lion, or Chrysopa, which is familiar to all. Length of body, 6mm.; including wings, 7 mm. Width of body, 2 mm. Wing spread, 14 mm. Head, small with large compound eyes. Mouth-parts as shown in Figure 58A. Antennae nearly as long as body, many articled (59 to 60); the articles are nearly rectangular, and very hairy, as is the entire body. Legs, rather long and slender. Wings, primary and secondary, are nearly alike in structure. The former are much larger and highly pigmented, while the latter are nearly hyaline. In repose the wings are folded with the costal margin down, as are the wings of most Neuropteroids. The general and detailed structure may be seen in the drawing (Figure 57).

The adult forms are very short-lived and scarcely survive a day or two. In confinement they usually live about 24 hours. Although they have little need of food, I have seen them greedily devour adult Mealy Bugs. The process of eating is simple. With their effective mouth-parts (Fig 58 A) they rapidly eat a hole in the back of the mealy bug and extract the contents, without lifting the prey from off its feet. At all times the female is very active and continually keeps its antennae moving while it runs about or flits hither and thither. As yet the eggs have not been found. I believe this is because they are laid in the cottony egg masses of the Mealy Bug and are very difficult

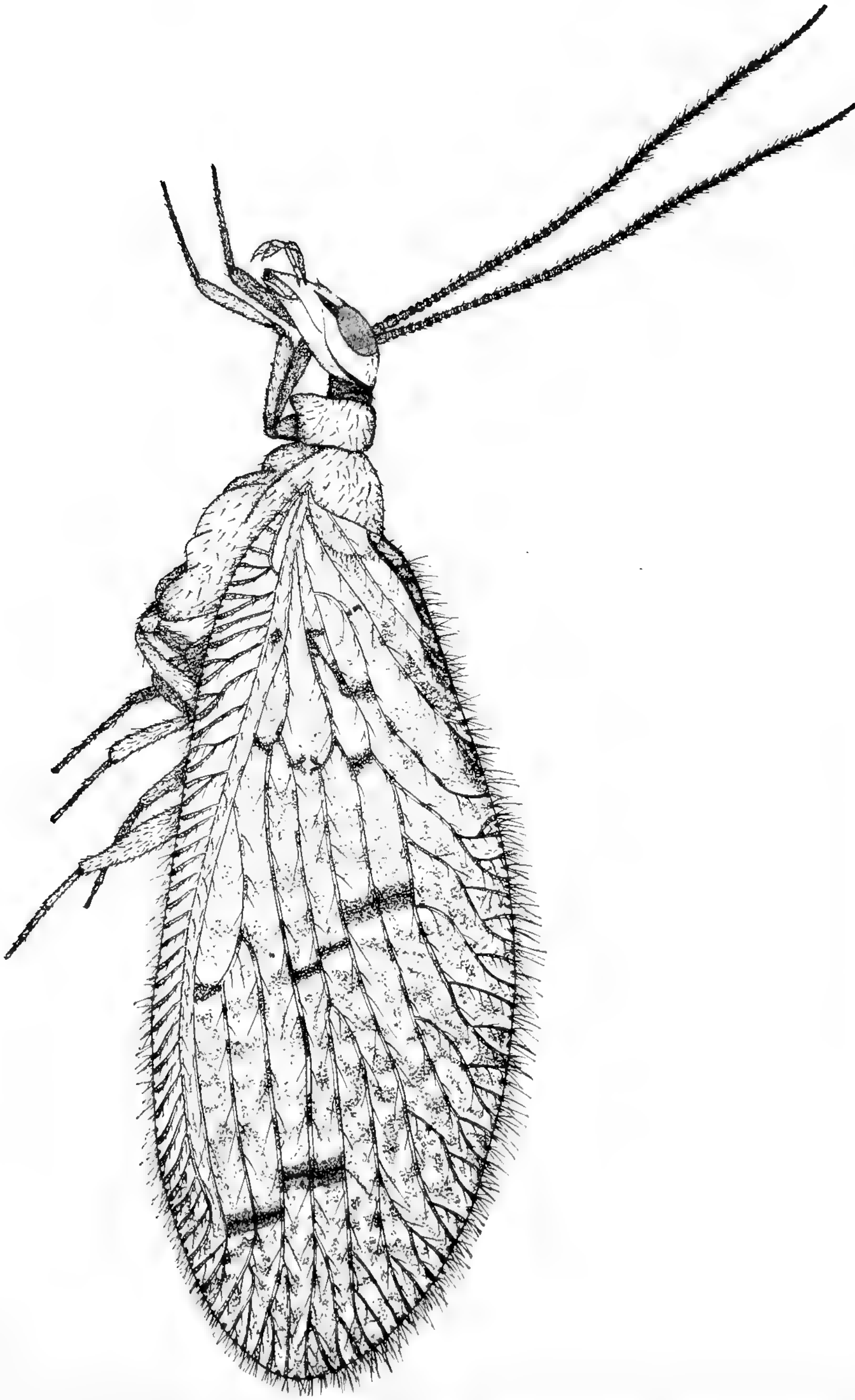


Figure 57. Sympherobius angustus. Adult, enlarged about twenty-one times

to find. The young larvae are always found in these egg masses, and in these the pupa cases are also formed, so the whole life-cycle is practically right among the eggs and bodies of the prey.

Larva (Fig. 59)—Length, 6 to 8 mm.; width, 1 to 2 mm. The prevailing color is slate gray to red at the ends of the body.

The larva resembles slightly the larva of the Chrysopa, but might be taken for a maggot because the legs are very short and the movements are slow. The movements of the head, however, are very rapid, and almost continual. The mouth-parts (Fig. 58, B, D) are specially fitted for sucking out the juices of insects. The mandibles or jaws are deeply grooved, allowing the liquids to flow down on the inside. The prey is lifted bodily from its feet by seizing it

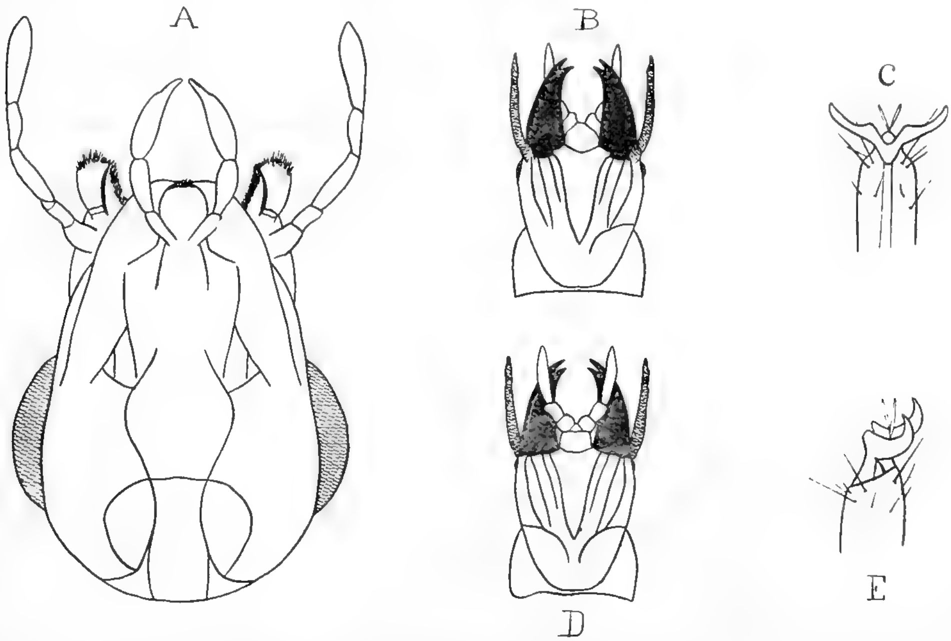


Figure 58. Sympherobius angustus; A, head of adult, ventral; B, head of larva, dorsal; D, head of larva, ventral; C and E, claws of larva

with the long jaws. It is held suspended in the air until the entire contents have been extracted and nothing but the empty shell remains. The claws of the feet (Fig. 58, C, E) are excellent for grasping the leaf or footing on which the larva stands. To hold a wriggling insect almost of its own weight must needs require such an adaptation. As before stated, these larvæ are found always in the egg masses, and feed a great deal on the eggs, and young Mealy Bugs.

When the time for transformation comes the larva spins a cocoon, which resembles a miniature moth cocoon. The head is folded on the breast as shown in the cuts (Fig. 59, A). The cast-off larva skins may be seen in the empty cases. When the pupa has emerged into the adult it eats out a hole in one end and makes its exit.

The development or life-cycle begins about September and the broods are still (in January) hatching. Adults are coming out every day in the laboratory breeding cages, and there are still plenty of the larval stages which go to show that some adults may emerge late in the spring.

In general the life-cycle is much longer than that of the Citrus Mealy Bug and the rate of multiplication much lower. Although a native of this section and here prior to the Mealy Bug it has never been able to cope with it. This is certainly due to a secondary internal parasite which attacks the pupa and

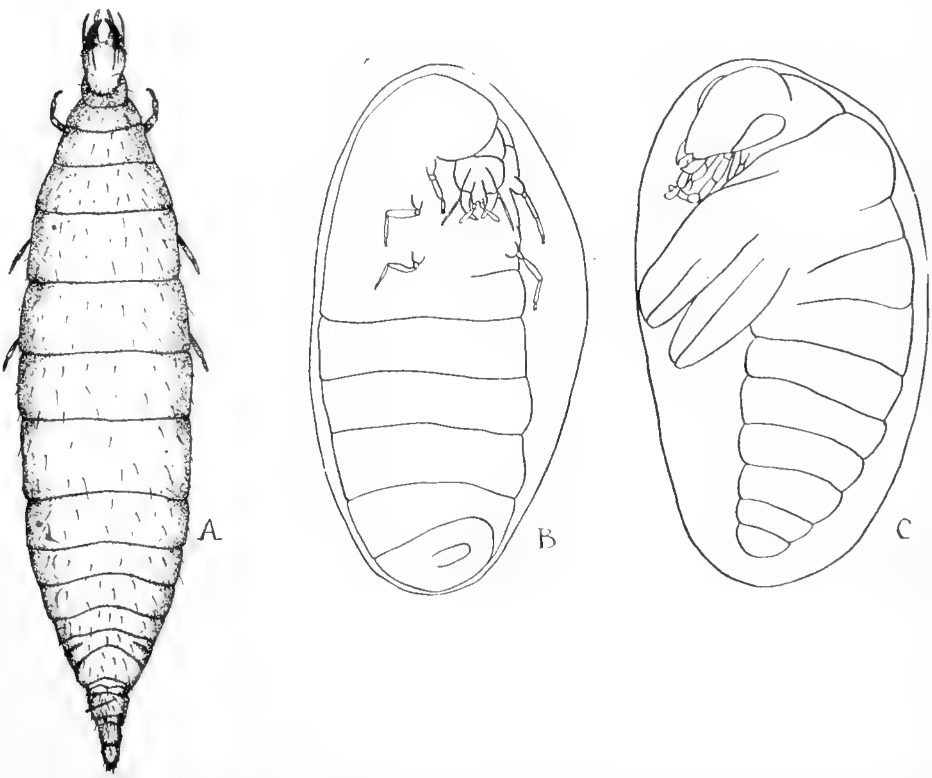


Figure 59. Sympherobius angustus; A, larva; B, early, and C, late, stages of pupa

destroys it. Large numbers of parasites have been hatched from it, and will be described later.

While we can never hope for it to destroy the Mealy Bug by itself, we can always look for quick and effective work wherever it has a chance. A combination of several as effective enemies as this one could do the work. Many different enemies for the Mealy Bug must be obtained, and only when they are all finally established and working together will we begin to really experience relief through their efforts.

THE GENUS PSEUDOCOCCUS IN CALIFORNIA

E. O. ESSIG.

Pseudococcus agrifoliae Essig

The description of this form on page 42, Vol. II, of the Journal applies to the winter form. After close study I find that there are two forms; a summer and a winter. The winter form as described is viviparous, has antennae with 7 short articles, legs with femur and tibia nearly co-equal. I am including the drawings of the leg and antennae of the summer form and a rough outline sketch of a winter form showing the chief characters (Fig. 60).

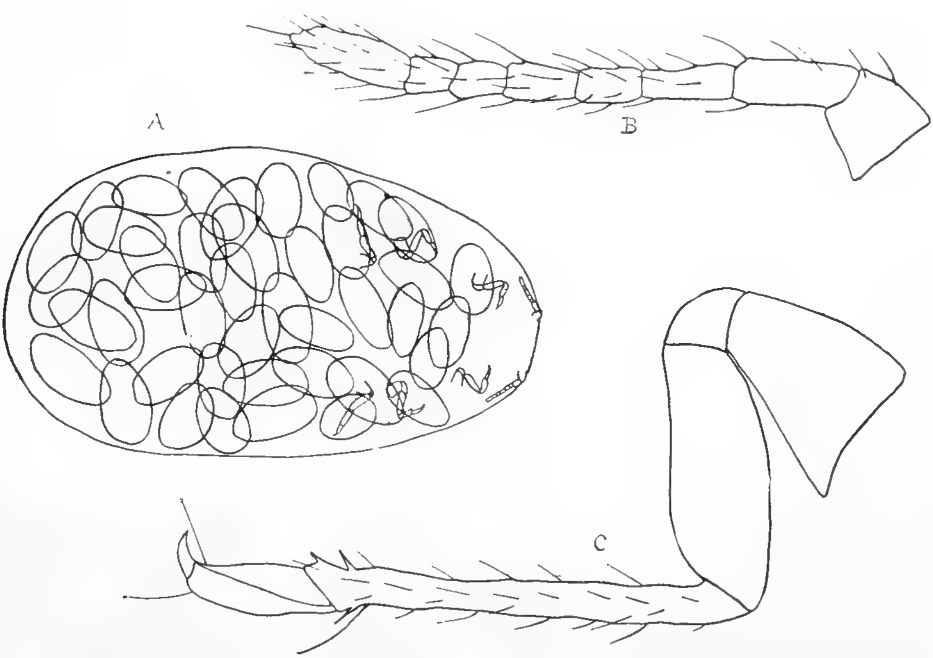


Figure 60. Pseudococcus agrifoliae. A, summer form with young; B, antenna of same; C, leg of same

SUMMER FORM—Antennae (Fig. 60 B)—8-articled and normally hairy. The respective lengths of the articles beginning with the longest are: (2 and 8), 3, (1 and 5), 4, 6, 7. These characters would throw the form in F or FF in the provisional key, on pages 36-37, Vol. II, of the Journal.

Legs (Fig. 60 C), are normal with few hair. Tibia nearly twice as long as femur, and three times as long as the tarsus. In the anal lobes or pygidium, there were no material differences noted. It is very probable that the same dimorphic forms exist in *Pseudococcus artemisiae.*

In the Twenty-fifth Report of the State Entomologist of Illinois, Mr. Stephen A. Forbes has drawings illustrating a similar case with *Pseudococcus trifolii,* and it perhaps exists in a great many cases. This is a very interesting fact, and seems to add to the complexity of a very difficult genus.

Pseudococcus ryani Coq.

This species was obtained from Mr. Edw. Ehrhorn, who collected it from Monterey Cypress (*Cupressus macrocarpa*) at Berkeley, Cal. In Volume I,

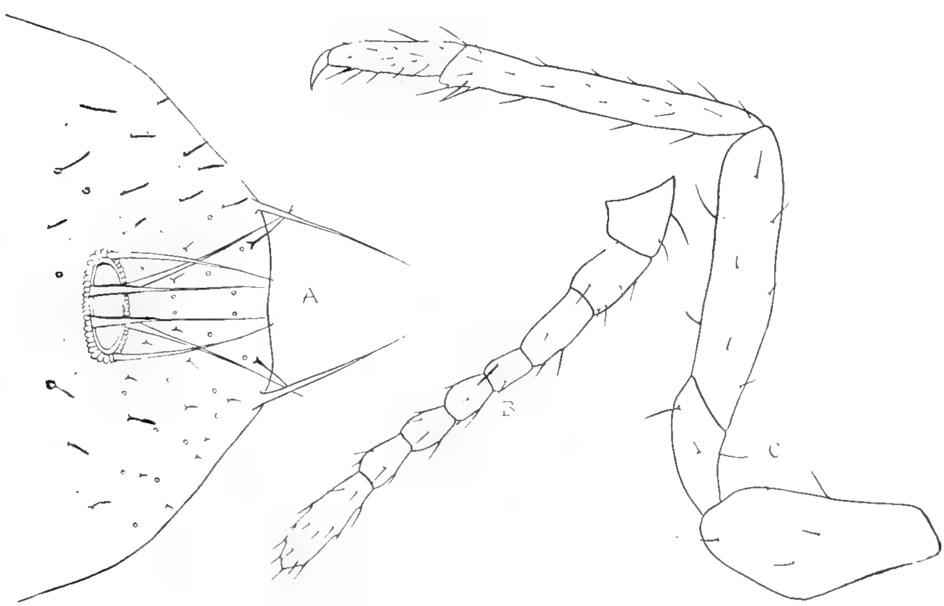


Figure 61. Pseudococcus ryani. A, pygidium; B, antenna; C, leg

Number 2 of the Journal this form was included with the other California species and I herewith add the drawings showing the chief characteristics.

Antennae (Fig. 61 B) 8-articled, the respective lengths beginning with the longest as follows: 8, 3, 2, 1, 7 (5 and 6), 4.

Legs (Fig. 61 C) normally long and hairy. Tibia and femur nearly equal. Tibia nearly twice as long as tarsus.

Pygidium (Fig. 61 A) spines of the anal lobes as long as the circum-anal spines. Lobes smooth and well rounded.

Body, slightly hairy, and covered with small round pores.

THYSANOPTERA OF SOUTHERN CALIFORNIA. II

D. L. CRAWFORD.

Euthrips minutus Moulton

This species has a wide distribution throughout California and quite naturally, therefore, it is by no means constant in certain respects. Since describing the variety *setosus* of this species in the previous number of Pom. Journ. Ent., I have received author's specimens of *E. minutus* from Mr. Moulton. After a careful comparison of these with the var. *setosus,* and, also, with closely related specimens taken at Elsinore, Cal., by C. F. Baker, I have come to the conclusion that neither of these latter are true varieties, but all merely forms of the same variable species. The original description was drawn from one specimen, and that, no doubt, is accountable for the fact that some important details were omitted from the description and accompanying illustrations; in the specimens sent me by Mr. Moulton I find the following variations from his figures: on the posterior margin of the prothorax there are three small spines, one larger than the other two between the second and third spines on each side (Contribution to our Knowledge of California Thysanoptera, Moulton, 1907, p. 56, Fig. 32); also the number of spines on anterior margin of fore-wing and on both veins is not constant, and sometimes not the same even on the two wings of one specimen. A comparison of the figure referred to above with Fig. 47A on p. 106, Pom. Journ. Ent. Vol. I., will show beyond a doubt that the extra prothoracic spine of var. *setosus* is nothing more than the longer of the three spines, not shown in Moulton's illustrations, merely more developed and longer, while the two spines beside it have remained minute in all specimens. Inasmuch as the species itself is variable in regard to the spines on the forewing, it is simply impossible to found a new variety on that basis.

Furthermore, the antennæ of the species are sometimes nearly three times as long as head, instead of twice; and the prolongation of the vertex, shown in var. *setosus,* is present also in the species. One point of variation, however, between the northern and southern forms is in the apparent absence of the orange crescents, bordering the ocelli, in the southern forms.

After such a comparison, the only reasonable thing to do is to let *E. minutus setosus* m. fall into synonymy as a good variety, and amend the description of the species as follows: Anterior margin of head almost straight, *with a small notched prolongation between insertion of antennae;* ocelli *sometimes* margined inwardly with large orange crescents; *antennae varying in length from two to three times as long as head.*

Posterior margin of prothorax with *four* spines on each side, *the third spine relatively shorter in some forms.* Wings reaching to tip of abdomen, *or more;* anterior margin of forewing with *from twenty-two to thirty-two* spines, anterior vein with *eighteen to twenty-six* spines, and posterior vein with *twelve to seventeen.*

Average length from .83 mm. to 1.26 mm., occasionally more.

Food plant: Grass, several Compositæ, and others mentioned for var. *setosus.*

Locality: Berkeley, Cal., (Moulton), Elsinore, Cal., (C. F. Baker), and Claremont, Cal. (Crawford).

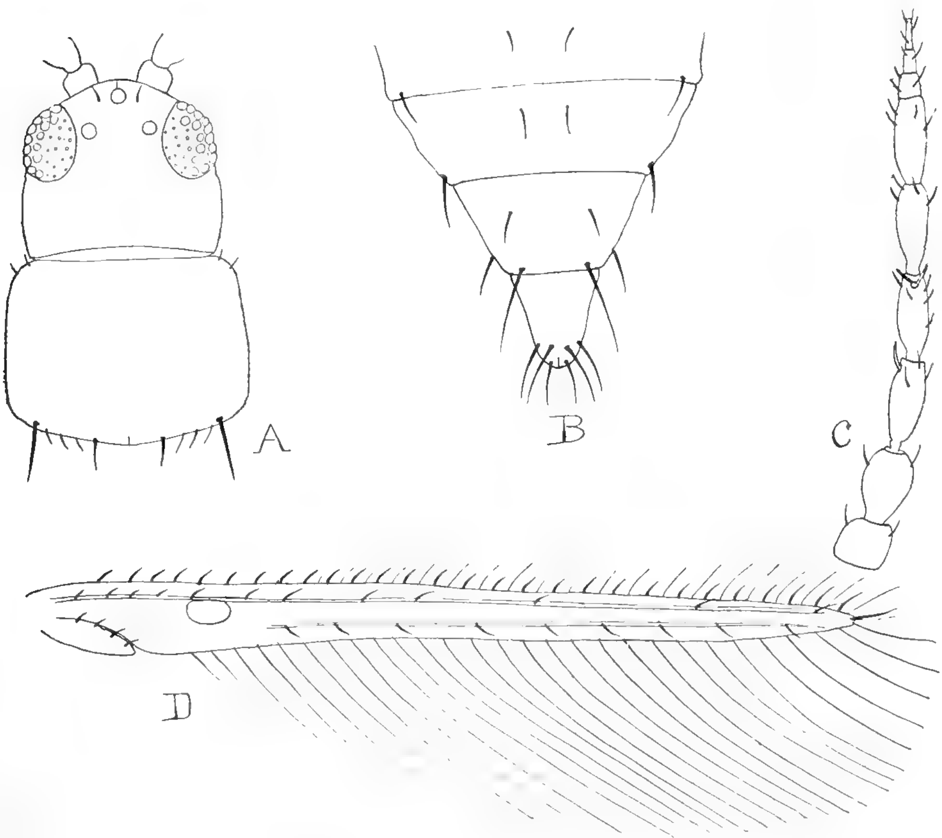


Figure 62. Anaphothrips longipennis

Anaphothrips longipennis n. sp.

Average length about .96 mm.; general color, brownish yellow to yellowish white; all spines very light colored and indistinct.

Head (Fig. 62A) somewhat wider than long, subglobose, broadly rounded in front, with two small spines beside the anterior ocellus, and no more; cheeks full; occiput faintly reticulated. Eyes prominent, bulging, somewhat darker than head, lateral facets medium, dorsal facets very small; ocelli anterior, rather small, very pale and indistinct. Mouthcone moderately short, reaching about three-fifths the length of prothorax, blunt at tip and distinctly tipped with black; maxillary palpi three-segmented. Antennæ (Fig. 62 C) apparently nine-segmented, about twice as long as head, slender, sparsely, briefly and indistinctly spinose; with a sense cone on segment III, and a bifurcate one on IV; II subglobose, III pedicellate, VI with a very distinct suture apically, which appears to be as true a joint as either of the joints of the style; style rather long and slender; basal segments very light, apical segments darker.

Prothorax (Fig. 62 A) subrectangular, about as long as head and three-fourths as long as broad; with one comparatively long transparent and indistinct spine at each posterior angle, several shorter ones on posterior margin, and two very small ones on each anterior angle. Legs medium in length, very sparsely spinose; tarsi unarmed. Wings (Fig. 62 D) long, slender, extending one-fourth the abdomen's length beyond tip of abdomen, very light brown, almost transparent, with a small clear area near base; veins rather prominent, posterior vein appearing close after basal clear spot; anterior vein with twelve spines, three on apical half; posterior vein with nine equidistant spines; anterior margin with a row of twenty-nine short spines; posterior marginal fringe moderately short, all spines and cilia very inconspicuous. Posterior wings shorter, entirely transparent, with a fringe on both sides.

Abdomen usually rather stout, fully half as broad as long, pointed at tip; occasionally the abdomen is longer and more slender, and only one-third as broad as long, and in such forms the wings only *slightly* over-reach the abdomen; broadest across segments five and six, tapering uniformly from six to ten; anal segment (Fig. 62 B) rounded at tip; abdominal spines few, and short; anal spines very short and almost transparent. This species apparently is not saltatory.

Measurements: Head, length .11 mm., width .13 mm.; prothorax, length .12 mm., width .16 mm.; pterothorax, width across mesocoxae .21 mm.; abdomen, length .42 mm., occasionally about .66 mm., width .24 mm.; total length about .96 mm. (.84—1.11). Antennæ: I, .022 mm.; II, .032 mm.; III, .040 mm.; IV, .041 mm.; V, .038 mm.; VI, .041 — .010 mm.; VII, .011 mm.; VIII, .014 mm; total .25 mm.

Described from several females (two of which have the longer abdomen), taken from olive foliage infested with black scale (*Saissetia oleae*). It has not been determined yet whether or not this species has any definite relation to the scale insect; a few specimens have been found also on the foliage of common pine.

Locality: Claremont, Cal. (Crawford).

Although the current description of *Anaphothrips* precludes spines on posterior angles of prothorax, and the genus *Scirtothrips* Shull was erected for a certain species having such spines, nevertheless, I believe that without a doubt this species belongs in the genus *Anaphothrips*. The obvious and unmistakable similarity to *A. striatus* Osborn places it beyond doubt in the closest generic relationship with that species, at least, but whether a genus characterized by the apparent division of the sixth antennal segment should be erected might be a question of fair discussion; be that as it may, it is evident that the presence or absence of spines on the prothorax is not in this case a true generic character, and if this is true, *Scirtothrips* becomes a very doubtful genus. *Scirtothrips* was erected with the following diagnostic characters separating it from **Anaphothrips*: "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." If these three characters were constantly associated, a new genus erected on them would be unquestionable; but *A. longipennis* shows beyond a doubt that these characters are *not* constant; this species possesses the spines on the posterior angles or prothorax, but is nonsaltatory, while the head is broader than long and somewhat shorter than prothorax; consequently, the only diagnostic character left to *Scirtothrips* is the presence of the saltatory habit, and it is always more or less dangerous to erect a new genus on *one* character, especially a mere habital character. Whether the power of springing, taken alone, can serve as a generic character, or not, we shall not discuss here.

*Ent. News XX, No. 5, p. 222.

Phyllothrips fasciculata Crawford

(Pom. Journ. Ent. I, p. 105.)

Since the genus *Phyllothrips* is now in synonymy, this species should be known as *Liothrips fasciculata;* although *Leptothrips* was erected to replace *Phyllothrips,* still this species undoubtedly should be included in *Liothrips.*

THYSANOPTERA OF MEXICO AND THE SOUTH. II

D. L. CRAWFORD.

In this paper the remaining new species from the South, including Mexico, Central and South America, Cuba, etc., are described and figured; the fact that only one previously described species was found, and that all the rest were new, shows how little is really known of this group in the South.

Euthrips cephalicus n. sp.

Average length 1.1 mm.; general color, yellow.

Head (Fig. 63A) wider than long, rectangular, somewhat concave at insertion of antennæ; distinctly retracted into prothorax; cheeks parallel with one pair of large postocular spines and several small ones; anterior portion of head between the eyes and in front of the ocelli abruptly depressed, with the anterior ocellus on the vertical plane, and a pair of very large spines on the margin of the depression. Eyes pale yellow, comparatively large and prominent; ocelli very indistinct, larger than facets of eyes; anterior ocellus directed forward, with a small seta on each side. Mouthcone long and pointed, reaching almost to posterior margin of prothorax; maxillary palpi three-segmented. Antennæ (Fig. 63B) about two and one-half times as long as head, moderately slender; segments VI - VIII and apical half of IV, light brown, the rest almost white; basal segment short; II, with a large double tubercle on dorsal surface extending beyond insertion of III, and bearing two very stout, black spines; a bifurcate sensecone on III, and a single one on IV.

Prothorax (Fig. 63A) wider than long, and slightly longer and wider than head, broadly rounded posteriorly; with two large spines on posterior angles, one equally large on anterior angles, an equal pair on anterior margin, and a smaller pair midway on posterior margin; dorsal surface with numerous small spines. Thorax broadest at mesothorax, with two large spines midway on anterior dorsal margin of mesothorax; metathorax with sides slightly converging. Legs (Fig. 63 E, F, G) of medium size, with numerous inconspicuous spines; posterior tibiæ, within, with a row of several stout spines, and two longer ones on apical end; legs concolorous with body throughout. Wings (Fig. 63 H) long and comparatively stout, reaching to eighth abdominal segment, uniform light yellow; with two longitudinal veins, the posterior one appearing about one-fourth the wing's length from the base and disappearing before reaching the tip; anterior margin with a row of twenty-three stout spines, anterior vein with twenty-one, and posterior vein with seventeen; posterior margin with a long double row of cilia.

Abdomen moderately slender, spines not prominent on basal segments; ninth segment (Fig. 63 D) with six very long stout spines, and anal segment with four equally long ones; ovipositor large and conspicuous.

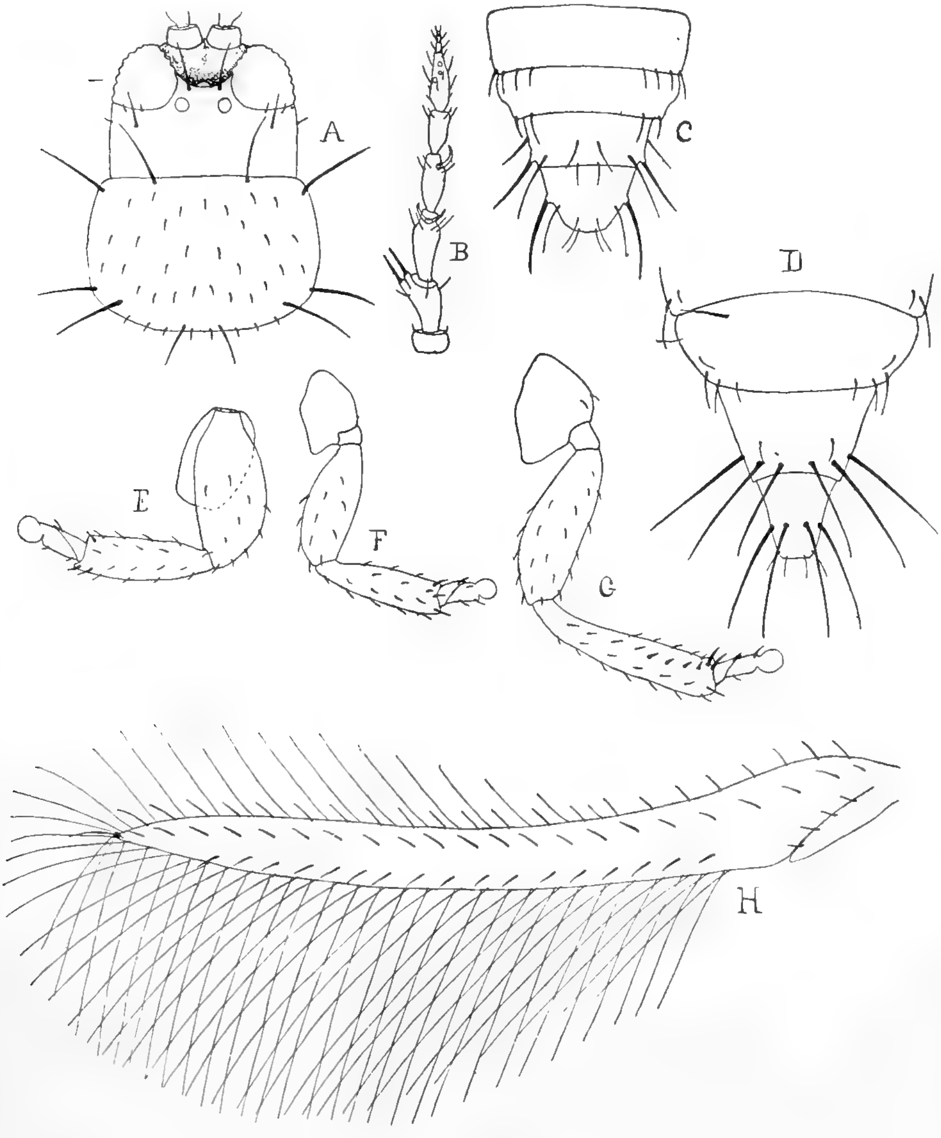


Figure 63. Euthrips cephalicus

Measurements: Head, length .10 mm., width .14 mm.; prothorax, length .12 mm., width .18 mm.; mesothorax, width .26 mm.; abdomen, width .28 mm.; total length 1.12 mm. (.98 mm — 1.24 mm.). Antennæ: I, .015 mm.; II, .040 mm.; III .054 mm.; IV, .045 mm.; V, .034 mm.; VI, .046 mm.; VII, .008 mm.; VIII, .006 mm.; total length, .25 mm. Color almost uniform yellow.

Males much smaller than female, average length .74 mm.; with smaller depression in front of eyes; legs smaller and weaker. Abdomen (Fig. 63 C) rounded at tip; with a pair of very long stout spines on ninth segment, set on a distinct tubercle, and a similar pair on anal segment; four small spines at tip of anal segment.

Described from numerous females and several males.

Food-plants: Several Compositæ, a small native acacia-like tree, a *Solanum,* and several other plants.

Locality: Guadalajara, Mexico (altitude 2000-6000 feet), (Crawford).

This species resembles most closely *E. tritici* Fitch, but in the characters of the head and antennæ and several other details it is markedly different. It is a very common species, found on many flowering plants and trees, and, consequently the characters are not constant within the species; the double spine-bearing tubercle on the second antennal segment is, in some of the mounted specimens, less pronounced than in the illustration (Fig. 63 B); the depression on the vertex and frons is sometimes smaller in extent, but *always* the anterior ocellus is directed forward, and the large pair of spines is on the margin of the depression. The color and the arrangement of the spines is quite constant; in some of the mounted specimens there is an abrupt variation in color to dark brown; as there are several distinct minor characters in these brown specimens, they are described below as a variety of the species.

Euthrips cephalicus reticulata n. var.

General color uniform brown. Average length .97 mm. Entire body surface reticulated deeply; production of second antennal segment present. but not so marked as in the species; depression of vertex less pronounced, but with anterior ocellus directed forward. Spines arranged as in species; wings light brown; legs concolorous with body except fore tibiæ and all tarsi light brown; basal antennal segment and basal two-thirds of II brown; apical third of II, III, IV, and basal half of V yellow; the rest light brown.

Described from two females and three males taken with the species on certain Rosaceae and Labiatae.

Locality: Guadalajara, Mexico. (Crawford.)

Dictyothrips reticulata n. sp.

Length 1.55 mm.; general color light brown; entire body surface, including legs and basal antennal segments, deeply and finely reticulated.

Head (Fig. 64 A) slightly broader than long, converging somewhat posteriorly, and broadly rounded anteriorly; occiput elevated; cheeks finely serrated, full, not spinose; vertex lower than occiput, elevated and produced between eyes and bearing the anterior ocellus at its apex; front broadly bisulcate, sloping down to insertion of antennæ, slightly produced between basal segments; with six short but conspicuous postocular spines, one behind each posterior ocellus, two behind and one outside of anterior ocellus, and two on the ridge between the sulca. Eyes very large, prominent, slightly bulging, very coarsely faceted and very pilose; ocelli very large, prominent, oval, between posterior angles of eyes; anterior ocellus on apex of produced vertex and directed forward; posterior ocelli slightly more elevated than the eyes. Mouth-cone very small and weak, scarcely reaching one-third the length of prothorax; maxillary palpi long, three-segmented. Antennæ (Fig. 64 B) very slender, more than twice as long as head, moderately spinose; segment III pedicelate, with a pseudojoint near base; III, IV and VI elongate, III and IV a symmetrically fusiform; V very small; style short, with several long spines; III and IV with

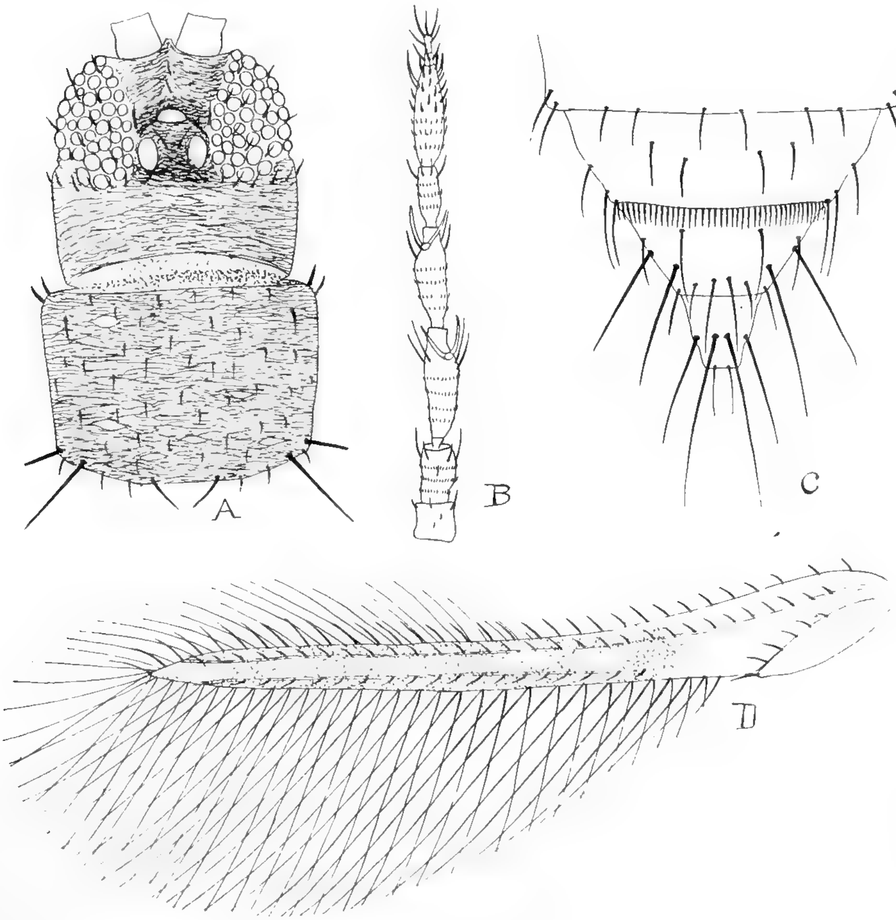


Figure 64. Dictyothrips reticulata

a bifurcate sense cone, VI with a single one; antennae uniform light brown, except base and tip of III and base of IV white.

Prothorax (Fig. 64 A) a little shorter than head, and about seven-tenths as long as broad anteriorly, converging somewhat posteriorly; anterior margin straight, posterior broadly rounded; with one short spine at each posterior angle, and two pair on posterior margin; anterior angles with two short spines only a trifle longer than the numerous spines on dorsal surface. Pterothorax large, broadest across mesocoxae, broadly rounded anteriorly, metathorax tapering slightly to abdomen. Legs medium, very spinose; forefemora not enlarged; femora concolorous with body; tibiæ lighter, tarsi yellowish brown. Wings (Fig. 64 D) not very long, reaching about to seventh abdominal segment; basal one-fourth clear, the rest light brown; posterior vein extending from apical margin of clear area to near tip, with twenty spines; anterior vein with twenty-nine spines, anterior margin with thirty-two spines increasing in length toward the tip, and a short fringe of cilia on apical half; posterior margin with a long double fringe of cilia. Posterior wings clear white with a narrow longitudinal median stripe from base to near tip.

Abdomen large, moderately broad, broadest across fourth and fifth segments; with several long spines on each posterior angle and margin; last three segments (Fig. 64 C) abruptly converging to tip; posterior dorsal margin of eighth with a row of long sharp comb-like spines; nine and ten with several very long stout bristles on dorsal surface.

Measurements: Head, length .16 mm., width .18 mm.; prothorax, length .145 mm., width anteriorly .205 mm., posteriorly .19 mm.; pterothorax, width .27 mm.; abdomen, width .29 mm.; total length 1.55 mm. Antennæ: I, .026 mm.; II, .040 mm.; III, .087 mm.; IV, .071 mm.; V, .043 mm.; VI, .072 mm.; VII, .009 mm.; VIII, .014 mm.; total .37 mm.

Described from one female taken on blossoms of a native Acacia-like tree.

Locality: Guadalajara, Mexico. (Crawford.)

Thrips abdominalis n. sp.

Average length 1.0 mm.; general color light brown; body surface reticulated; *all* spines very inconspicuous.

Head (Fig. 65 A) about one and one-half times as broad as long, angular, markedly retractile, reticulated posteriorly; frons vertical; cheeks parallel; with no prominent spines, but several very small and inconspicuous ones near the eyes and ocelli. Eyes large, prominent, bulging, finely faceted, and slightly pilose; anterior ocellus on frons and directed forward; posterior ocelli on the sides of an elevated portion between the eyes and directed outwardly, slightly higher up than the eyes. Mouthcone short and blunt, reaching one-third the length of prothorax; maxillary palpi three-segmented. Antennæ (Fig. 65 B) more than twice as long as head, quite stout, with spines short and inconspicuous; with a sense cone on segments III and IV, and several small sensory areas on VI; II distinctly stouter than the rest, III pedicellate; V very broad at apical end; VII comparatively long; I, II, IV, VI and VII concolorous with body, III and V somewhat lighter.

Prothorax (Fig. 65 A) one and one-half times as long as head, and one and one-fourth times as long as broad, posteriorly; sides strongly divergent, with angles rounded; with no prominent spines, but a row of ten very small spines on anterior dorsal margin, and eighteen on posterior margin, two on each posterior angle larger than the rest; with a distinct dark emargination and chitinous thickening on each side above the fore-coxae. Legs small, short, with no conspicuous spines, except two at tip of posterior tibiæ; fore-femora

(Fig. 65 C) somewhat enlarged. Wings (Fig. 65 E) narrow, moderately long, reaching to seventh abdominal segment, somewhat broadened at base; posterior longitudinal vein extending from near base to near tip, with seven short spines, the first one about opposite the sixth spine on anterior vein; anterior vein with either eight or nine short spines, six on basal half and either two or three on distal half, the number varying on the same insect sometimes; when there are three the first one occurs near the center of the vein, the third one near the tip, and the second about midway between; when only two are present the one near the center is wanting, and the two are arranged

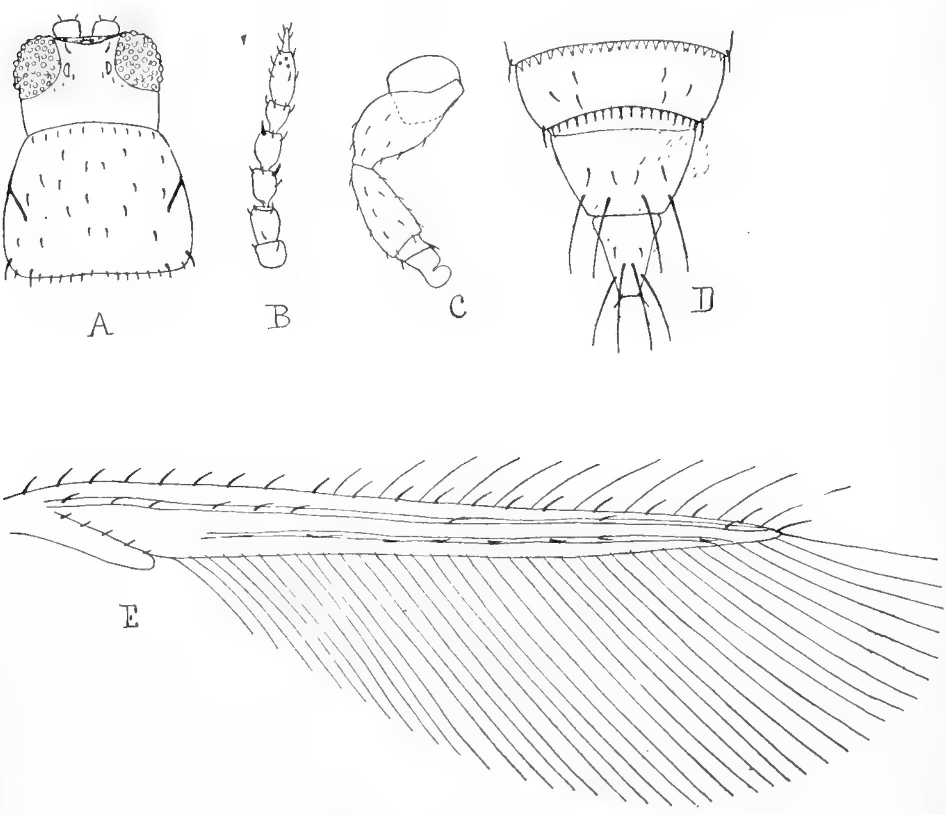


Figure 65. Thrips abdominalis

as the distal two when three are present; anterior margin with a row of twenty short spines, and a row of short cilia, on distal three-fifths of margin; posterior margin with a row of long cilia; color of fore-wings light brown, with a small more or less clear area near base between third and fourth spines on anterior vein; posterior wings almost clear, with a light brown stripe in center, extending through basal half of wing.

Abdomen usually slender, sometimes comparatively stout; with a row of distinct sharp serrations on posterior margin of segments one to seven inclusive; eighth with longer and sharper teeth; almost no spines on abdomen except on two anal segments; four comparatively stout spines on ninth (Fig. 65 D), and four on anal segment near tip; ovipositor weak and inconspicuous.

Measurements: Head, length .064 mm.; width .11 mm.; prothorax, length .12 mm., width anteriorly .10 mm., posteriorly .15 mm.; mesothorax, width .22 mm.; abdomen, width (average) .24 mm.; total length 1.02 mm. (.84 — 1.20 mm.) Antennæ: I, .019 mm.; II, .024 mm.; III, .026 mm.; IV, .027 mm.; V, .020 mm.; VI, .037 mm.; VII, .018 mm.; total .17 mm.

Described from numerous females.

Food-plants: Various Compositæ, Solanum, Daucus sp. (?), and others.

Locality: Guadalajara, Mexico. (Crawford.)

This species resembles somewhat *Thrips albopilosa* Uzel, (1) in having very inconspicuous spines, though they are not white as in that species; (2) in the general arrangement of spines on the fore-wing; (3) in the shape of the fifth antennal segment. Although these resemblances are unmistakable, still this can not be the same species by any means.

Phloeothrips raptor n. sp.

Average length about 2 mm.; general color brown.

Head (Fig. 66 A) rather large, about one and one-half times as long as broad, distinctly narrowed both posteriorly and postocularly; broadly rounded in front; cheeks arched, with several conspicuous setigerous tubercles; vertex elevated and produced, but not attaining the insertion of the antennæ; with one pair of long knobbed postocular spines, basal half of spine dark, distal half almost transparent; all other cephalic spines small. Eyes large, prominent, slightly bulging, finely and closely faceted, pigment transparent white; ocelli rather large, but indistinct; anterior ocellus directed forward on apex of produced vertex; posterior ocelli not contiguous with inner margin of eyes. Mouth-cone short, reaching about three-fourths the length of prothorax; labrum produced, very pointed at tip. Antennæ (Fig. 66 C) about one and one-half times as long as head, and slightly more than twice the width of head, rather stout and very spinose, but the spines not conspicuous; several long thick sense cones on segments III-IV; III-VII pedicellate, III and IV pyriform, V and VI fusiform, VII and VIII connate; I and basal half of II concolorous with body, the rest uniform light brown, III and IV transparent at extreme base.

Prothorax (Fig. 66 A) slightly more than twice as wide (including coxae) as long, and a little over half as long as head; with long light colored, knobbed spines on posterior and anterior angles and one pair midlaterally; a smaller blunt pair on both anterior and posterior margins.Mesothorax a little wider than prothorax, widest across mesocoxae; pterothorax reticulated. Wings of medium length, slender, transparent; with three long spines on basal posterior margin; posterior wings with a brown stripe in the center, extending from base to near tip. Legs rather long and stout, sparsely spinose; forelegs (Fig. 66 E) apparently rapatorial; forefemora enlarged, with a conspicuous depression on inner side extending from base to tip (evidently a sheath for the tibiæ), with the margins of the depression finely toothed; foretarsi with a large sharp tooth, within, much smaller, however, than in the male; no conspicuous spines on forelegs; femora, meso- and posterior tibiæ concolorous with body, foretibiæ and all tarsi light brown.

Abdomen long and slender, equally broad from base to fifth segment, and from there tapering evenly to ninth, which is broadly rounded at the tip; abdominal spines on segments one to seven knobbed; tube slightly more than half as long as head, with several small spines on dorsal surface; four long spines on posterior dorsal margin of ninth segment, and four extremely long spines at tip of tube, and several shorter ones.

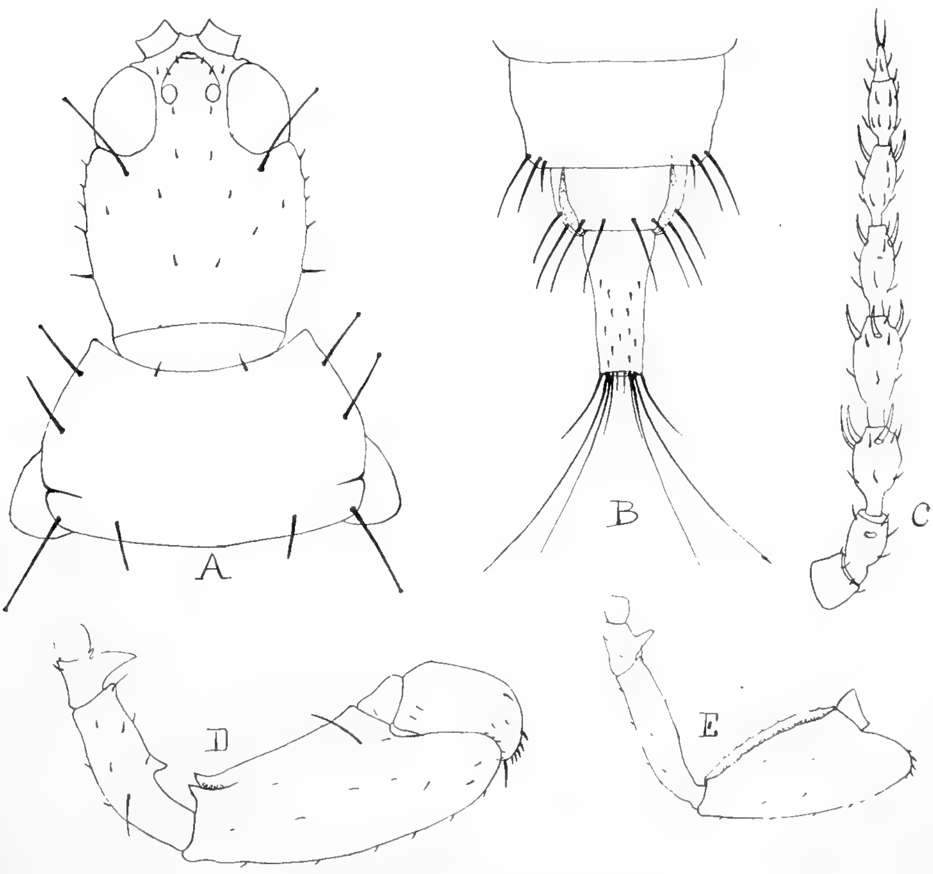


Figure 66. Phloeothrips raptor

Measurements: Head, length .27 mm., width .18 mm.; prothorax, length .16 mm., width .35 mm.; pterothorax, width .36 mm.; abdomen, width .32 mm.; tube, length .15 mm., width, at base .06 mm., at tip .04 mm.; total length 2.09 mm. Antennæ: I, .030 mm.; II, .044 mm.; III, .065 mm.; IV, .081 mm.; V, .069 mm.; VI, .052 mm.; VII, .049 mm.; VIII, .026 mm.; total length .41 mm.

Males fully as large as female, and more powerful; similar in every respect except the following: Spines on cheek much larger and more numerous; forelegs (Fig. 66 D) immense in proportion to female; forefemora with two sharp tooth-like projections at the tip, within, and a depression between them; foretibiæ with a prominent anteriorly directed tooth near the base, within; foretarsi with an immense sharp tooth on inner side; forefemora and foretibiæ each with one long spine, all other spines very small. Abdomen about as broad as in female, but tapering more from seventh segment to tube; tube (Fig. 66 B) with a distinct and large scale at base, bearing two large spines at each upper margin. Measurements about the same as in female.

Described from one female and one male, taken in sweeping shrubbery.

Locality: Guadalajara, Mexico. (Crawford.)

This species is very close to *Ph. uzeli* Hinds, especially in respect to the forelegs of the male; but the two species differ sharply in the form of the head, in the shape and form of the antennæ, in the distinct depression in the forefemora of the female, and in having a scale at the base of the tube in the male. But *Ph. raptor* is congeneric with *Ph. uzeli* Hinds, although differing so sharply from it, and the generic description should be altered accordingly.

Liothrips umbripennis mexicana n. var.

This variety is very similar to the species in many respects; only the diagnostic characters are given here.

Anterior ocellus with a small spine on each side. Antennæ about one and three-fourths times as long as head; only segment III and basal half of IV yellow, the rest dark brown to black. Facets of eyes moderately large. Prothorax (including coxae) about twice as wide as long. Forewings clouded very light brown instead of black, with a conspicuous vein at base bearing three long spines, and extending about one-fourth the wings' length. Forefemora distinctly enlarged; meso- and posterior tibiæ with a very long, stout, blunt spine near tip; all tarsi with a conspicuous fringe of spines on apical margin of both segments; males with a stout terminal hook; female tarsi unarmed.

Measurements: Head, length .26 mm., width .19 mm.; prothorax, length .14 mm., width .30 mm.; pterothorax, width .38 mm.; abdomen, width .42 mm.; total length 1.8 mm. Antennæ: I, .027 mm.; II, .052 mm.; III, .082 mm.; IV, .077 mm.; V, .075 mm.; VI, .067 mm.; VII, .059 mm.; VIII, .028 mm.; total .46 mm.

Described from five females and four males, taken *on* galls of oak, elevation 10,000 feet; it is not at all certain that this species has anything to do with the formation of the galls.

Locality: San Pedro Mountains, near Guadalajara, Mexico. (Crawford.)

Liothrips bakeri n. sp.

Average length 2.7 mm.; general color dark brown to black, thorax lighter; entire body surface, including femora and tibiæ, conspicuously reticulated.

Head (Fig. 67 A) fully one and one-half times as long as broad, subrectangular, finely reticulated, sparsely spinose; vertex elevated and produced beyond insertion of antennæ, and bearing the anterior ocellus at its apex;

cheeks usually parallel, sometimes converging slightly posteriorly, serrated, and somewhat spinose; postocular spines long, broadened and flattened at tip. Eyes large, prominent, bulging, coarsely and closely faceted, pigment whitish; ocelli large, distinct, oval, placed well forward; anterior ocellus at apex of produced vertex and directed forward; posterior ocelli not contiguous with inner margin of eyes. Mouthcone very large and powerful, almost rectangular. square at tip, and reaching almost to posterior margin of prothorax; maxillary palpi extremely short. Antennæ (Fig. 67 B) less than twice as long as head (about one and two-thirds), moderately slender and scarcely visibly spinose;

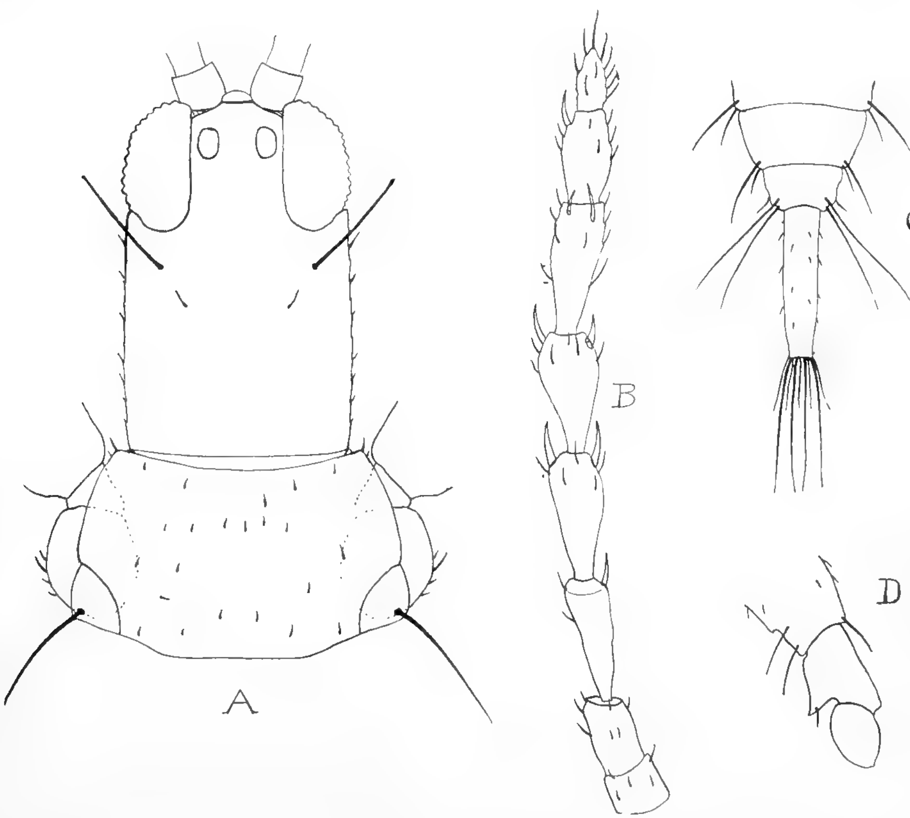


Figure 67. Liothrips bakeri

segments I and II concolorous with body, the rest lemon yellow, VII and VIII usually slightly darker; III-V almost transparent at base; antennal spines yellow and very inconspicuous; III-VII with transparent sense cones; I and II subrectangular, III-V clavate, VI and VII fusiform, VIII depressed, broad at base and pointed at tip.

Prothorax (Fig. 67 A) slightly more than half as long as head, and (including coxae) about twice as wide as long, (excluding coxae) not very much broader than head; with one pair of long spines at posterior angles and no others; dorsal surface with several short spines. Mesothorax very broad, sides parallel; metathorax converging to abdomen; thorax, especially laterally, deeply reticulated. Legs moderately long and slender, sparsely spinose; all tibiæ scarcely spinose; foretarsi (Fig. 67 D) with a large setigerous tooth; foretibiæ and all tarsi light yellow, the rest concolorous with body. Wings large, heavy, powerful, uniformly broad throughout, extending to posterior margin of seventh abdominal segment; clear white, except, occasionally, a light brown stripe through center of wing in basal half; fringe long; posterior fringe of forewing, subapically, double for about twenty-one cilia.

Abdomen long, slender, broadest at base and converging uniformly to tube (often parallel from base to segment six, then converging to tube); with two spines at each posterior angle of segments one to eight, and two very long ones on nine; tube (Fig. 67 C) longer than head, very slender and almost parallel except at tip; with four spines at tip almost as long as tube.

Measurements: Head, length .31 mm., width .205 mm.; prothorax, length .17 mm., width (including coxae) .37 mm.; mesothorax, width .48 mm.; abdomen, width .36 mm.; tube, length .37 mm., width at base .08 mm., at tip .06 mm.; total length 2.73 mm. (2.64 — 2.82). Antennæ: I, .029 mm.; II, .051 mm.; III, .080 mm.; IV, .082 mm.; V, .078 mm.; VI, .086 mm.; VII, .060 mm.; VIII, .041 mm.; total .52 mm.

Males smaller and more slender than females; tarsal tooth only a little larger than that of female; abdomen exceedingly slender; tube shorter than that of female; with a scale at base of tube.

Described from numerous females and males.

Food plant: galls on leaves of *Ficus nitida* and flowers of *Ficus religiosa.*

Localities: Pinar del Rio, Cuba (C. F. Baker), and Havana, Cuba (Dr. Santos Fernandez).

I name this species for Prof. C. F. Baker, who has contributed many specimens for this study, and in many ways has given me much assistance.

Liothrips mcconnelli n. sp.

Average length 2.28 mm.; general color dark brown to light brown.

Head (Fig. 68 B) about one and seven-tenths times as long as broad, sparsely and inconspicuously spinose; with a pair of rather short postocular spines; cheeks subparallel, converging slightly posteriorly; vertex produced over insertion of antennæ, with the anterior ocellus at the apex, overhanging. Eyes moderately large, finely and closely faceted, prominent, but not bulging; ocelli large, round, pale white, situated well forward; anterior ocellus directed forward; posterior ocelli at the base of the produced vertex and nearly contiguous with inner anterior margin of eyes. Mouthcone rather short, reaching three-fourths the length of prothorax, midway between forecoxae; labrum sharp. Antennæ (Fig. 68 C) about one and one-fourth times as long as head, slender, moderately spinose; segments III and VI with one sense cone and IV and V with two; VII and VIII connate; I and base of II concolorous with body, apical half of II and of V, and VI-VIII light brown; III, IV and basal half of V yellow, IV clouded at tip. In one specimen used in this study, the left antenna is six-segmented, while the other is normally eight-segmented (Fig. 68 D); this is apparently caused by the union of segments IV-VI to form one long irregular segment.

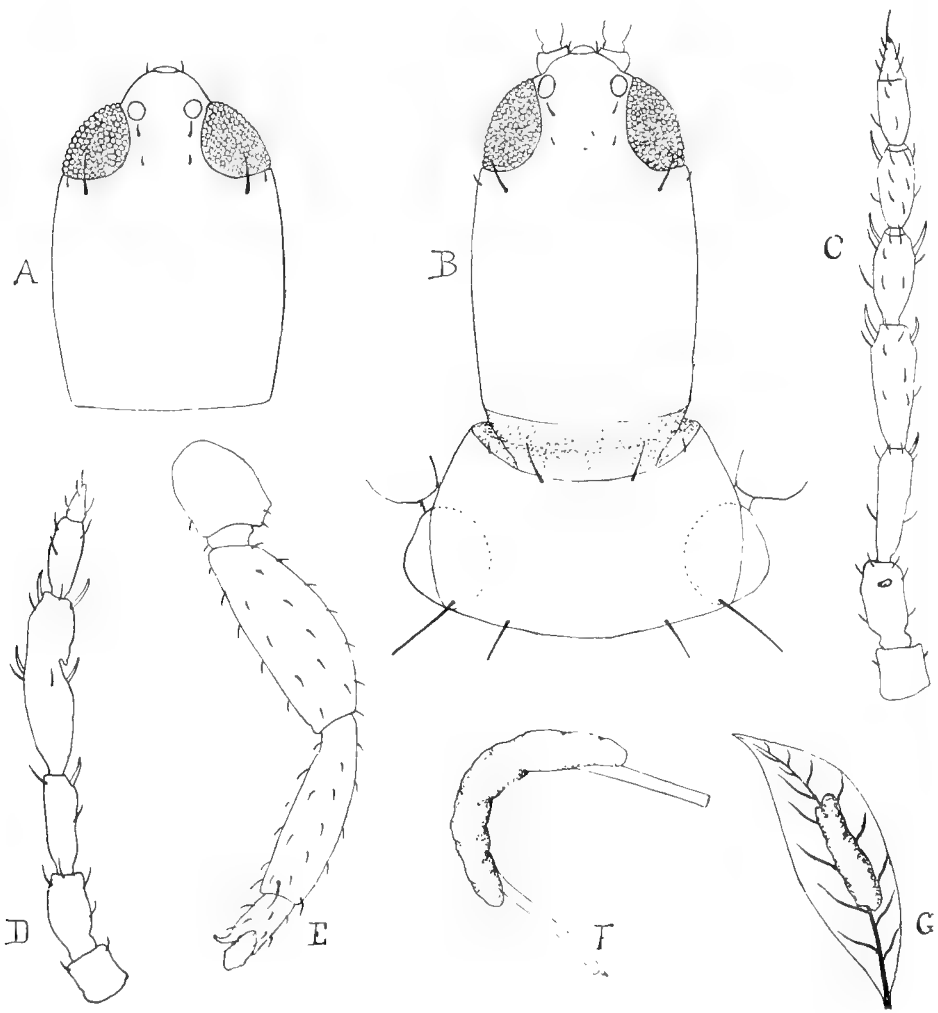


Figure 68. Liothrips mcconnelli

Prothorax (Fig. 68 B) about twice as wide as long, and two-fifths as long as head; with one pair of long blunt spines on posterior angles, one pair on posterior margin, and two pairs, one very small, on anterior margin; midlaterals wanting. Pterothorax large, broadest across mesocoxae, converging posteriorly and anteriorly; thorax somewhat reticulated. Legs long and slender, concolorous with body throughout; forefemora (Fig. 68 E) only slightly enlarged, briefly spinose; with a terminal tarsal hook in both sexes; middle and posterior tarsi with a fringe of spines on apical margin of both segments. Wings medium, reaching to seventh abdominal segment, clear from base to tip, very slightly narrowed at the middle; posterior fringe, subapically, double for about seven cilia.

Abdomen long and slender, tapering evenly from base to tip; spines not conspicuous; tube short, less than half as long as head, converging toward tip; with a few comparatively short spines at tip of ninth segment, and six short stout spines at tip of tube, and a few shorter and more slender ones also.

Measurements: Head, length .31 mm., width .18 mm.; prothorax, length .12 mm., width (including coxae) .23 mm.; pterothorax, width .32 mm.; abdomen, width .36 mm.; tube, length .13 mm., width, at base, .065 mm., at tip .035 mm.; total length 2.28 mm. Antennæ: I, .030 mm.; II, .055 mm.; III, .071 mm.; IV, .077 mm.; V, .061 mm.; VI, .050 mm.; VII, .041 mm.; VIII, .028 mm.; total .39 mm.

Males smaller, but relatively stouter than female; head (Fig. 68 A) distinctly shorter, about one and four-tenths times as long as broad; terminal tarsal hook larger in male; prothorax relatively broader, abdomen more slender; tube almost alike in both sexes; with a closely lying scale at base of tube.

Measurements: Head, length .24 mm., width .17 mm.; prothorax, length .12 mm., width .26 mm.; pterothorax, width .32 mm.; abdomen, width .34 mm.; total length 2.11 mm.

Described from four females and four males, taken from galls (Fig. 68 F, G) on the stems and leaves of a certain bignoniaceous shrub, and also from sweepings on other shrubs.

Locality: Guadalajara, Mex. (Crawford).

I name this species for Mr. R. A. McConnell, who accompanied me on an expedition to Mexico in July-September, 1909.

This species could have been included in *Leptothrips* Hood about as truly as in *Liothrips*, which shows how much of a line of true demarcation there is between these two genera. The diagnostic characters of *Leptothrips*, distinguishing it from *Liothrips*, are given by Hood as being "the much slenderer form, the longer head, the more bulging eyes, the shorter mouthcone, the weaker, slenderer wings which are distinctly narrowed at the middle." This group of characters, taken together, might be enough to erect a new genus on, but one can see at a glance that such characters could hardly be constantly associated. In *Liothrips mcconnelli* there are the combined characters of both genera: of *Leptothrips*—the slender form and relatively long head of the females, and a short mouthcone; of *Liothrips*—the relatively stouter form and shorter head of the males, eyes not at all bulging, while the wings are only slightly constricted at the middle. Again, in *Liothrips bakeri* there are still further complications; this species has the slender form, rather long head, and bulging eyes characteristic of *Leptothrips*, and broad wings not constricted, and the large mouthcone characteristic of *Liothrips*. The constriction of the wings, therefore, is the only character presented, which is of generic value, and this is very apt to be a poor one, for the simple reason that it is often obscured by the doubling or folding of the wings, and in case there were but a few specimens available, one would be at a loss where to place the new species. All the other characters presented are purely relative, and until diagnostic generic characters can be found which are not mere relative proportions, the mean average of which may easily be possessed by a species, no group of species ought to be separated as a genus. If they are separated by such characters, the inevitable result is *confusion;* it is scarcely scientific to have to "toss up" to determine in which of two genera a certain species belongs. As an illustration of such confusion, *Leptothrips aspersus* has been placed in three different genera, and may yet end up in *Liothrips* where it rightfully belongs.

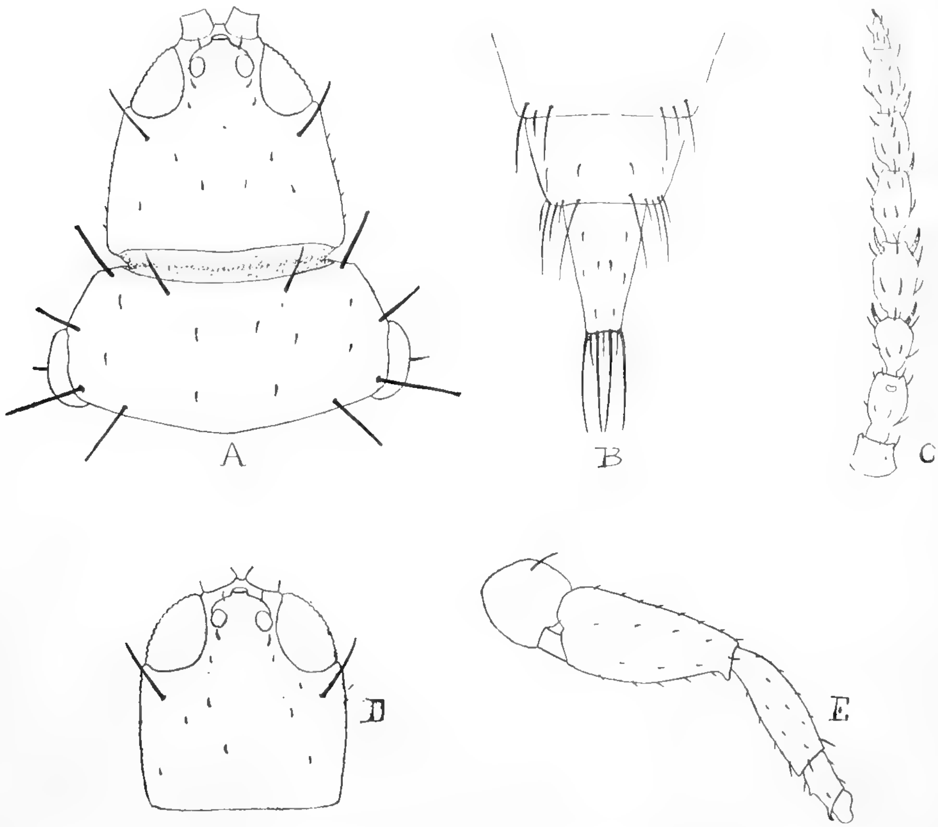


Figure 69. Anthothrips variabilis

Anthothrips variabilis n. sp.

Average length 1.6 mm.; general color light brown to dark brown, occasionally black.

Head variable in form; usually very slightly longer than broad (Fig. 69 D), subrectangular, rounded somewhat anteriorly; occasionally the head is slightly broader than long, and more rectangular, and sometimes it is *distinctly* longer than broad; very seldom the head is more or less narrowed anteriorly (Fig. 69 A)—partially caused by the collapsing of the eyes; cheeks full, sparsely spinose; vertex slightly elevated, and distinctly produced, but not attaining the insertion of the antennæ; postocular spines moderately long, and blunt at the tip. Eyes medium, finely faceted and slightly pilose, pigment almost white; ocelli large and distinct; anterior ocellus on apex of produced vertex and directed forward; posterior ocelli not quite contiguous with inner anterior margin of eyes. Mouthcone short and blunt, scarcely reaching half the length of prothorax. Antennæ (Fig. 69 C) about twice as long as head, very stout and thickly, but briefly, spinose; segments II-VII distinctly pedicellate and subglobose; II-V with spotted sense cones, or sometimes transparent; I, base of II, and VII and VIII concolorous with body, intermediate segments yellowish brown or lemon yellow.

Prothorax (Fig. 69 A) including coxae, twice as wide as long, and about seven-ninths as long as head; with all the usual prothoracic spines present, long and blunt at tip; dorsal surface slightly spinose. Pterothorax widest across mesocoxae, converging both anteriorly and posteriorly, partially reticulated. Wings moderately long, broadest at base, and distinctly narrowed beyond the middle like a drawn-out shoesole; scale and extreme base light brown; with a short median vein at base, bearing three long spines and one short one; posterior fringe double subapically for eight cilia. Legs medium, moderately stout, sparsely spinose; foretarsi (Fig. 69 E) with a small tooth near the middle, within, and a terminal tarsal hook; foretibiæ and foretarsi light yellow, the rest concolorous with body.

Abdomen long, slender, very weak, tapering evenly from base to tip; with two prominent spines on each posterior dorsal angle; tube (Fig. 69 B) about as long as prothorax, seven-ninths as long as head, converging toward tip; with six long spines at tip, and several shorter ones.

Measurements: Head, length .17 mm., width .165 mm.; prothorax, length .13 mm., width .26 mm.; pterothorax, width .31 mm.; abdomen, width at base .32 mm.; tube, length .13 mm, width at base .05 mm., at tip .03 mm.; total length 1.64 mm. Antennæ: I, .024 mm.; II, .047 mm.; III, .038 mm.; IV, .050 mm.; width .031 mm.; V, .049 mm.; VI, .040 mm.; VII, .042 mm.; VIII, .024 mm.; total .33 mm.

Males smaller than females, but similar in nearly all respects; abdomen more slender, tube shorter; average length of male 1.46 mm.

Described from numerous females and several males.

Food plants: Celosia, Dodder, and a native tropical creeping vine.

Localities: Santiago de las Vegas, Cuba (C. F. Baker); Managua, Nicaragua (C. F. Baker), and Guadalajara, Mexico (Crawford).

The abdomen was described as being weak, because of the fact that in many, perhaps the majority, of the specimens used in this study the abdomen is constricted in several of its basal segments, probably by the action of the reagents used in the preparation of the mounts.

Idolothrips angusticeps n. sp.

Average length 5.28 mm.; general color deep black; entire body surface, including femora and tibiæ, finely reticulated.

Head (Fig. 70 A) more than two and one-half times the width across eyes; with numerous tuberculous serrations on dorsal and lateral surfaces; with numerous short, stout spines, and two pairs of very long ones, one pair in front of the posterior ocelli, and the other postocular, smaller; head about as wide posteriorly as across eyes, constricted somewhat behind the eyes; vertex produced triangularly over insertion of antennæ, with the anterior ocellus on the apex. Eyes moderately large, bulging, finely faceted and not pilose, pigment yellow; ocelli small, indistinct; posterior ocelli not contiguous with inner margin of eyes; anterior ocellus directed forward, beyond insertion of antennæ. Mouthcone short, broadly rounded at tip, scarcely reaching to posterior margin of prosternum; maxillary palpi two-segmented, the basal joint very short. Antennæ (Fig. 70 F) almost one and one-third times as long as head, very slender; two basal segments comparatively short and thick, II with a sense area near tip; III-V elongate, clavate, III longest, with several long spines on apical half and one long sense cone near tip; IV and V with several long spines and several transparent, but prominent, sense cones near tip; VI-VIII fusiform; VI and VII with several long spines and one sense cone on each; VIII with a longitudinal row of six spines, and one long spine at tip; I and basal half of II concolorous with body; apical half of II and all but the tip of III, basal three-fourths of IV and basal half of V yellow; tip of III and IV light brown, apical half of V and VI-VIII dark brown.

Prothorax (Fig. 70 A) about half as long as wide, including coxae, and two-fifths as long as head; coxae conspicuously protruding, with one stout, black spine on each coxa, without, and one on posterior angles of prothorax; a few small spines on dorsal surface, and three small ones in front of the coxae; membraneous portions of prothorax conspicuous. Mesothorax distinctly wider than prothorax, with a few conspicuous spines; with a faceted spiracular (?) plate on each anterior angle. Legs long and very spiny; forefemora (Fig. 70 G, male) enlarged, prolonged posteriorly over trochanter; foretibiæ with numerous conspicuous spines, and one extremely long one near base; foretarsi (Fig. 70 D) within, with a sharp tooth, bearing two spines; middle and hind legs very slender, long and spinose; posterior tibiæ (Fig. 70 E) in both sexes with a long and *exceptionally* stout, black spine near tip; meso- and posterior tarsi (Fig. 70 E) with a fringe of cilia-like spines on the entire distal margin of both segments; all bladder-like appendages easily retractile; femora black, tibiæ brown, yellow at tip, tarsi yellow. Wings clear white, comparatively short, with a long fringe on both margins; forewings with a brown longitudinal stripe in the center extending from base to middle of wing, and a few spines at base of wing.

Abdomen long and slender, widest at segments two to four; with two long spines at each posterior angle, and a few small ones on dorsal surface; ninth segment (Fig. 70 B) with several long, slender spines on posterior margin;

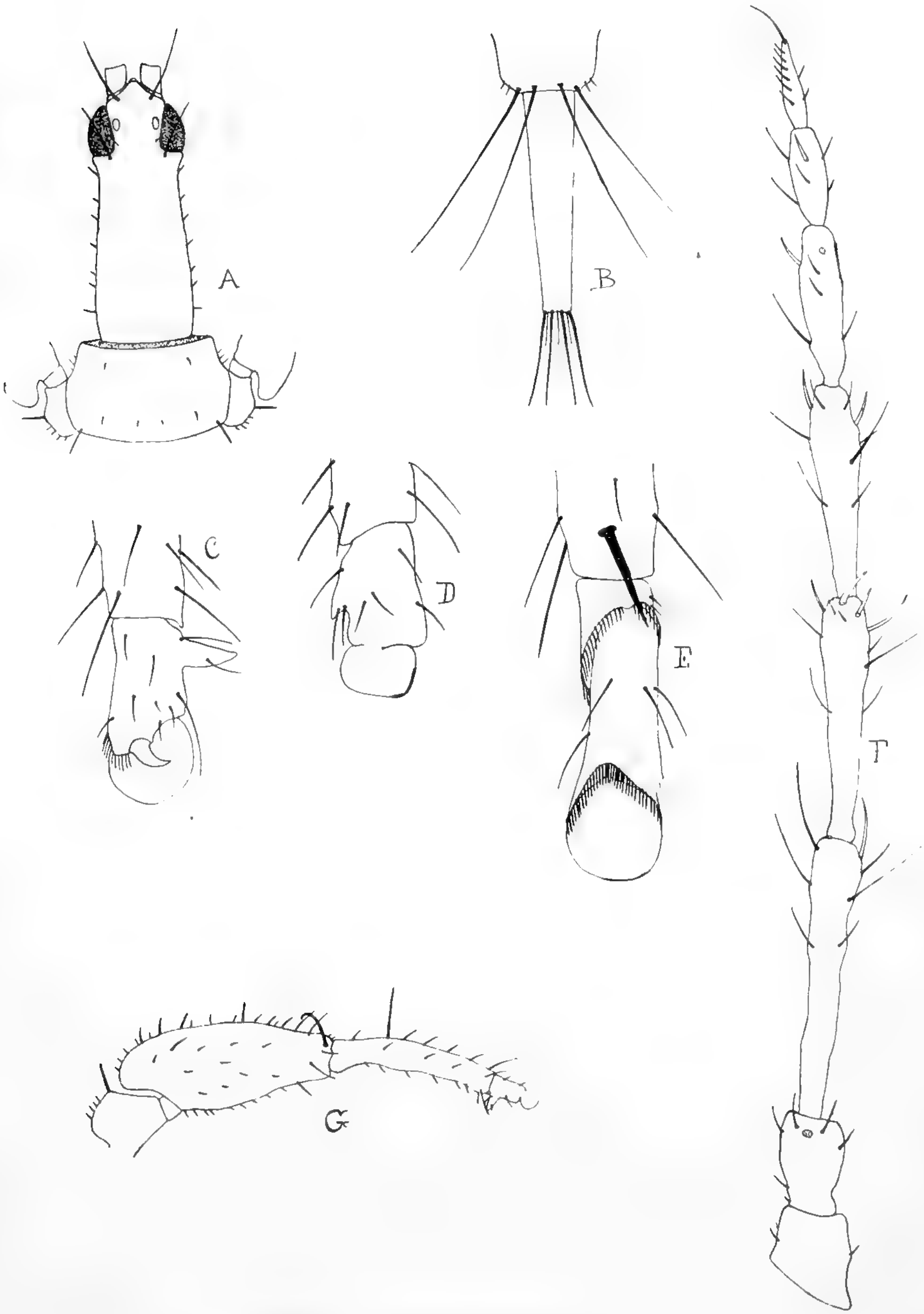


Figure 70. Idolothrips angusticeps

tube fully three-fourths as long as head, slender, slightly converging toward tip; with several long, stout bristles at tip.

Measurements: Head, length .68 mm., width .26 mm.; prothorax, length .29 mm., width, including coxae, .56 mm.; mesothorax, width .67 mm.; abdomen, width .82 mm.; tube, length .53 mm., width at base .11 mm.; total length 5.28 mm. (4.32 — 6.24 mm.) Antennæ: I, .074 mm.; II, .072 mm.; III, .22 mm.; IV, .17 mm.; V, .15 mm.; VI, .12 mm.; VII, .075 mm.; VIII, .065 mm.; total .94 mm.

Males fully as large as females, sometimes larger; antennæ somewhat longer; forefemora (Fig. 70 G) with a long curved, prehensile spine at tip, within; foretarsi (Fig. 70 C) with an exceptionally long, stout tooth near base, within, and another smaller, curved one at tip; with a partial fringe of spines at tip of second tarsal segment; bladder of foreleg easily retractile, probably to facilitate the use of apical tooth. Abdomen very slender, much more so than in female; tube and anal spines distinctly shorter than in female.

Described from fifteen females and seventeen males, taken, mostly, in sweepings of various tropical shrubbery; some were found by the writer on the under surface of leaves of a common tropical vine.

Localities: Belize (James D. Johnson); Havana, Cuba (C. F. Baker); San Marcos and Chinandega, Nicaragua (C. F. Baker), and Guadalajara, Mex. (Crawford).

This giant species is well distributed throughout the American tropics; the specimens in the writer's collection, from these various localities, are almost identical in every respect. There are minor variations, however, such as a difference in the relative length of the third antennal segment; the illustration (Fig. 70 C) represents the average. The spines on the legs and abdomen, also show a variation in length and color, some being black, others light, and still others of intermediate shades.

This species resembles *Megalothrips* (?) *spinosus* Hood (really an *Idolothrips*), but differs in the arrangement of the cephalic and prothoracic spines, the shape of the head anteriorly, and, in general, in the relative proportions; because of this resemblance and its resemblance to still other members of the genus *Idolothrips,* it would seem reasonable to refer this to *Idolothrips spinosus.* In all probability, the males of *I. spinosus* will be found to have a large tarsal tooth, just as the males of *I. angusticeps* have a larger tooth than the female.

WEST COAST NEWS NOTES

[In this department we hope to give in most numbers of the Journal, some idea of the doings and movements of western entomologists, notices of publications of interest to western students, notices of entomological meetings, etc. To this end, we hope that students or collectors will send in all items of entomological interest about themselves or others. Address, Fordyce Grinnell, Jr., 572 N. Marengo Ave., Pasadena, Cal.]

Mr. Victor L. Clémence and Mr. Karl R. Coolidge are planning to leave in April for a three months' entomological trip to Cordoba, Mexico. This region is the richest in Mexico or Central America, according to the *Biologia.*

Lord Walsingham's collection of Micro-Lepidoptera, about to be transferred to the British Museum, consists of 260,000 specimens, adding about 45,000 species to the collection.

The Lepidopterological Library of the late Dr. Staudinger has been bought by the firm of R. Friedländer & Sohn, Berlin, and a catalogue is being prepared. This is one of the richest collections in the world.

Max Weg, Buchhandlung und Antiquariat, Leipzig, Germany, has just issued a very interesting and valuable catalogue of books, "Zoogeographie," it has 3006 titles listed, arranged under XII divisions, including the zoogeographical regions of the world. It contains 94 pages, and on the cover a photograph of Dr. R. Bergh, student of the Opisthobranch Mollusks.

Prof. J. D. Tinsley, formerly of Las Cruces, N. M., and a student of the Coccidæ, has been appointed soil specialist for the Santa Fé railway system. "His duties will be to instruct the farmers along the railway what crops can give the best yield," thus increasing the crop out-put. A new departure for the railroad interests.

The new edition of Ridgway's Nomenclature of Colors, will appear this spring; it will be much better than the former edition and will be indispensable to systematic naturalists everywhere. It will contain about 1350 colors, named and numbered. The price will be very moderate, about $5.00

In the California Fruit Grower, for January 8, 1910, p. 4-5, 8 columns, is an article by W. H. Volck, on Insect Pests and Diseases of the Apple, delivered at the California State Fruit Growers' Convention, at Watsonville in December.

The last meeting of the Entomological Club was held at the residence of Mr. V. L. Clémence, Pasadena, on January 13, Thursday evening. The following persons were present: Messrs. Fall, Fenyes, Bollerman, Schrader, Haskins, Coolidge, Ross, Smith, Clémence, and Grinnell. Mr. K. R. Coolidge was elected secretary. A very enthusiastic discussion was indulged in till after 11 P. M.

The annual meeting of the San Diego Society of Natural History was held at the local office of the Weather Bureau on January 13, at 4 P. M. Frank Stephens is the secretary.

The Southern California Academy of Sciences held its regular monthly meeting on the evening of January 3, in Symphony Hall, Los Angeles. Prof. W. L. Watts gave an Outline of the Geological History of California, and Prof. J. Z. Gilbert spoke on Quaternary Life in California. Both talks being of interest to the biologist.

At the biological section of the Academy of Sciences, held on January 10, in Los Angeles, Prof. L. H. Miller spoke on Variation in Plants and Animals. It was a very suggestive talk to the biologist, as many of the unsolved problems of organic evolution, will probably be opened up in the study of variation.

According to a newspaper report, Dr. Alexander Petrunkevitch of the American Museum of Natural History, on his recent return from Mexico, "brought back 2000 spiders, 500 bottles of insects, and numerous assortments of scorpions, snakes and amphibians." It also states that he found a "very rare trap-door spider" in the State of Tabasco.

The Sleeping Sickness. By Louis L. Seaman. The Outlook, January 15, 1910, p. 119-124. An interesting account of the Tsetse-flies, Glossina Spp. and Trypanosoma gambiense. Trypanosomiasis or Sleeping-sickness is said also to occur in South America, where Glossina is not found, but the disease is transmitted by a bug—"the conorrhinus"; a small monkey is supposed to be the permanent host of the parasite.

From the California State Journal of Medicine, December, 1909, the following is extracted from the editorials as being of considerable interest: Dr. Creighton Wellman is to have charge of a department of Tropical Medicine in the State Journal in which he is "to prepare from time to time a critical summary of advances in knowledge in this direction as well as other matter relating to the incidence, etc., of tropical disease in this part of the country." A further editorial in the State Journal is as follows: "With the object of gaining an idea of the amount of tropical disease in the city of Oakland, the writer has examined a number of patients in its hospitals, clinics and dispensaries, with the result that tertian, quartan and aestivo-autumnal malaria, leprosy, amoebic dysentery and liver abscess, bubonic plague, filariasis, flagellate diarrhœa and various intestinal parasites—including flukes (*Opisthorchis*), tapeworms (*Dibothriocephalus*), (*Taenia*), (*Hymenolepis*) and round worms, (*Ascaris, Oxyuris, Necator, Trichocephalus Strongyloides*)—have all been seen. It is proposed to publish a fuller communication on this subject when the list is complete, but the existence of these and probably other tropical diseases is here recorded as being of interest and illustrative of the dangers of infection to which the inhabitants of the bay cities are constantly exposed." The State Journal thus becomes of immense interest to all those interested in the study of tropical disease in which the Arthropods and Protozoans play such an important part. In the January number of the State Journal is an interesting and suggestive article by Dr. Creighton Wellman, of Oakland, on "Comments on Tropical Medicine." And among the book reviews in the same number are notices of Nuttall and Warburton's "Ticks: A Monograph of the Ixodoidea," and Calkins' Textbook of Protozoology. And a notice that the New York Post-Graduate Medical School "has established a regular and completely equipped department of Tropical Medicine."

The Trees of California. By Willis Linn Jepson, Ph. D., Assistant Professor of Dendrology in the University of California, etc. Illustrated with one hundred and twenty-five original figures. Issued December 16, 1909, Cunningham, Curtis & Welch, San Francisco and Los Angeles. $2.50 net.

This book is absolutely indispensable to the entomologist who is also a naturalist (sens. st.) who is interested in the relations of living things (Biota). We will never comprehend the "unknown factors" of evolution, till we study and understand the relations and interrelations of *all* the participants.

The spirit in which the book was written is to be highly commended, as shown in the dedication, quotations, preface and the body of the book. It is the spirit of the naturalist (including in the term, the systematic student). "The author, therefore cherishes the hope that these pages may be an inspiration to some who have opportunity to take up special studies of our trees for the sake of the intellectual pleasure and cultivation to be derived from such an avocation." If the person who should read this book thoughtfully and "is not stirred by the lure of the unknown," he is *not* "really and truly alive."

On pages 13-49 are taken up twenty-four subjects connected with the study of trees, which are very suggestive and stimulating. The Forest Provinces, each treated very fully, should be studied by students of zoogeography, and those preparing lists of species found in certain regions. Other suggestive and interesting sections are: Arboreal Islands, The "Klamath Mountains,' A Historical Sketch of Sequoia, Local Tree Distribution and the Indian Tribes, and Exploration; Far Afield and Locally. From page 50, with a key to the families, the various trees are described, with full distribution and bionomic notes on each. It is a book which the naturalist should study in the laboratory and take with him on his field excursions.

Pomona College Journal of Entomology

Volume II | MAY 1910 | Number 2

FUMIGATION STUDIES—II
DOES ORDINARY CONTRACT FUMIGATION PAY?

WRIGHT M. PIERCE

Very little information has ever been published on the cost of fumigation. The contractor naturally wishes to make the maximum profit, while the grower must labor to reduce the cost to a minimum. For any well founded deductions we need complete detailed figures from many sources, and we are hoping that this paper may arouse enough interest among the growers to induce them to obtain and send to us their fumigation accounts in detail. Our own observations were confined to a few outfits working in the neighborhood of Claremont. Even these limited and variable data make some facts in the whole matter very evident, the principal being that throughout the county there appear to be no standards governing either the work or the cost of it. Three cases are presented herewith, the trees in all cases being understood as averaging an ordinary medium size, and the fumigation for black scale.

OUTFIT A.

This outfit contracted to fumigate 10 acres, using 22 hours of work. The cost to the fumigator was as follows:

183 pounds of cyanide at .26	$47.58
183 pounds acid at .2	3.66
22 hours of work at $1.95	42.90

giving a total of $94.14. The grower was charged $158 for the job, leaving a profit of $63.86 to the fumigator. The tents, in this case, were left over the trees for forty-five minutes. The formula used was 1-1-3.

Outfit B.

This contract covered 15 acres, and the grower paid for the materials separately, the contractor merely doing the work of fumigating. The entire bill to the grower was:

529 pounds cyanide at .255	$134.90
870 pounds acid at .02	17.40
35 hours service of estimator at .40	14.00
1436 trees, tenting, at .08	114.88

or a total of $281.18.

The actual cost to the fumigator in this case was,

35 hours with five men at .30	$52.50
35 hours with 1 man at .40	14.00

or a total cost of $66.50. Subtracting this from the entire amount paid for the application ($114.88), we have $48.38, the profit to the fumigator. The tents in this case were left on one hour.

Outfit C.

In the case under observation this outfit was working on a contract covering 21 acres. The entire cost was as follows:

837 pounds cyanide at .255	$213.44
1800 pounds acid at .02	36.00
100 trees, tented, at .065	6.50
1980 trees, tented, at .08	158.40
50.5 hours estimator, at .40	20.20

or a total of $434.54. The cost to the fumigator was as follows:

5 men for 50½ hours at .30	
1 man for 50½ hours at .45, together	$98.50

Subtracting this from $164.90 gives the actual profit to the fumigator as $66.60 for his 50½ hours' work. The tents in this case were left over the trees forty-five minutes. Formula same as in B.

One of the above outfits which used an exposure of but forty-five minutes, required 30 to 35 minutes to throw the tents over a row of 35 to 40 trees, giving a rest of 10 to 15 minutes on each row during which time all were idle, excepting the one man who fills the water tank. In another outfit, however, where the trees were larger and the rows longer, even though the tents were left on for one hour, the gang had comparatively no time to waste. In this latter outfit there were only four men, and they were doing the work of six or seven in other orchards. These men worked for 30 cents per hour for ordinary help and 40 cents for foreman, so there was practically a saving of 60 cents per hour over other outfits, the work being practically all done by hand, one team serving several outfits for moving, etc.

Since the earliest days of fumigating the ordinary contract in this region has covered both materials and labor, so that there are many opportunities for shortcomings on the part of the fumigator, he thereby realizing a greater profit for his effort. Without the control of fumigating by either the County or by the Exchanges, the partial contract covering only the labor is by far the most economical for the grower. Under this arrangement the chances of cutting either the dosages or time of treatment may be practically eliminated. The grower buys his own chemicals, and gives the fumigator so much per tree for doing the work. In this case the contract should always provide that the tents be left over the trees *at least one hour.* Thus the grower, by keeping account of the materials used, and by comparisons with the number of his trees, the number of tents and men in the outfit, and the time of treatment, may judge exactly as to the efficiency of the service he is getting

Outfit A, working as indicated above, after allowing for the cost of supplies and labor, earned approximately $2.90 for every working hour. This outfit used unmarked tents.

In both outfits B and C, marked tents were used, and this necessitated greater care and time, B netting but $1.38 per hour, and C $1.32. Figuring out the total cost to the grower on ten acres in each case, we have:

Orchard No. 1, where A worked, cost the grower	$158.00
Orchard No. 2, where B worked, cost the grower	187.86
Orchard No. 3, where C worked, cost the grower	206.92

In each instance the amount spent for labor was practically the same for ten acres, so that the extra cost of B and C went for materials rather than to swell the profits of the fumigator. Another striking fact to note from these figures is that where the profit was greater to the fumigator in outfit A, the cost to the grower was less than in the other cases where the chemicals were carefully measured. It seems almost certain that Outfit A was cutting not only the time but the dosage, both acts very prejudicial to the interests of the grower.

The system of marking tents and accurately measuring the dosage certainly does not lessen the cost to the grower, *but it insures honest fumigation,* and *a guaging of the dosage that will kill the scale!*

It is an exceedingly interesting and important matter now, to compare these figures, picked up at random in actual practice here in Los Angeles county, with the figures covering the work of fumigating on one of the largest and most successful ranches in Southern California, where it is to be supposed that the work would be done as near actual cost as would be possible. At the same time, on this ranch, they fumigate for a purpose, and would not fumigate at all were it not for their confident belief in being able to do effective work. Three grades of dosage were used, gauged to kill red and yellow scale, as well as black, and the cost in each case figures out as follows:

For ten acres containing 960 trees, 14 years old

It costs at 7½ ozs. to the tree	$259.20
at 8 ozs. to the tree	273.98
at 10 ozs. to the tree	306.80

This is more than is usually paid in Los Angeles county for fumigation, and here we must at the same time pay the necessary margin of profit to the contractor.

In this whole matter several salient truths appear:

1. That we have no standards set by the Horticultural Commission or otherwise, governing such work.

2. That the work we are now getting over the county is very variable in price and in results.

3. That growers, as a rule, do not know enough about fumigation to make a contract that efficiently protects their own interests.

4. That we must come finally to fumigation by the Exchanges, or by solid groups of growers, on the block system, if we cannot have it done by the county as in San Bernardino. Others never will take the interest in one's welfare that he himself would take, and it behooves growers everywhere to take a real and a live interest in this whole matter.

*THE NOCTUIDAE OF CALIFORNIA. I

BY JOHN B. SMITH, SC. D.
ENTOMOLOGIST OF NEW JERSEY EXPERIMENT STATION

The Noctuid fauna of California is very rich, but quite as imperfectly known as it is wealthy. Few localities have been at all well-collected, none have been thoroughly collected, and vast ranges of the State are utterly unknown from this point of view. While there is quite a respectable list of species described from the State, there are almost no good series in eastern collections. A few examples are here and there, and some species have never turned up again since the original types were taken and described.

My own collection is quite as poor in Californian material as any other, and this series of papers, prepared at the request of Prof. Baker, will be necessarily more or less incomplete, unless the California collectors help out. I will be very glad indeed to look over and determine specimens that may be sent me for that purpose, for the privilege of retaining such examples as may be needed for my collection and for completing study series.

The family *Noctuidac* is distinguished from moths of similar appearance by the venation of the primaries (Fig. 71) or anterior wings. The submedian, or vein 1, is furcate or divided at base, veins 3, 4 and 5 are grouped together out of the end of the median, vein 6 is out of the upper end of the cell, 7 to 10 are out of the accessory cell which is usually present, and of these 8 and 9 are usually on a shorter or longer stalk. Vein 11 is out of the sub-costal and runs to the costal margin before the tip, while vein 12 extends from the base just below the costa and reaches the margin a little beyond the middle. It is desirable that the student should become familiar with this type of venation and Cut 5 of Fig. 71 shows just what it looks like. Use any common Agrotid, Hadenid or similar species to verify the figure, and the easiest way to prepare the wing for examination is to rub off most of the scales with a camels-hair brush, lay on a glass slide, put on a drop of alcohol to wet thoroughly, then a drop of carbolic acid, full strength, and cover with another slide or thin cover-glass. That will make

*The present is the first of a large series of most important articles for publication of which in the Journal we have recently made arrangements. Mr. Busck will give us a synopsis of the known Microlepidoptera of California, Mr. Chamberlain of the Myriapoda, Mr. Folsom of the Thysanura, Mr. Grinnell of the Rhopalocera, Sphingidæ, and Pterophoridæ; Mr. Burr of the Euplexoptera, Mr. Banks of the Neuropteroid insects, Araneida, Phalangida, and Pseudoscorpionida, and so on. We shall assist these gentlemen to the utmost with material, and we hope that other Californian students and collectors will do the same.

the wing membrane transparent and will bring the veins into sufficient contrast to make them easily seen. The veins of the figure are numbered to correspond with the system in common use by describers of this family, and they are also given the names used where numbers are not available.

The secondaries, or hind wings (Fig. 71) have two free or internal veins, vein 8 is out of the sub-costal a little beyond base, and the median vein is either 3 or 4 branched, depending upon whether 5 is from a short spur close to 4, or whether it is obsolescent and out of the obscure cross-vein closing the cell. At the base of the costal margin there is, in the male, a single spine or spur, the frenulum, which fits into a loop or retinaculum attached to the costa of primaries, and holds the wings together; in the female there are three or four weaker bristles, and these are held by crossed scales on the under-side of the median cell. This gives us a convenient way of determining sex in this family, the loop of the males or crossed scales of the females being very readily determinable, as a rule. There are, however, a few exceptions to this rule; the half a dozen species of *Euteliini* and *Stictopterini* having the frenulum single in the female as well as the male, but no loop in the female.

On the basis of the difference in vein 5 of the secondaries, the Noctuidæ are divided into two series—the*Trifidae* in which the vein is nearly or quite lost and, when traceable, is from the cross-vein, well beyond the end of the median—and the *Quadrifidae* in which vein 5 is nearly or quite as strong as the others and is connected at base by a strong spur with the end of the median. In another way of putting it, the median vein is 3-branched in the one case, 4-branched in the other. The difference can be readily seen by comparing any large species of *Hadena* or *Mamestra* with a *Catocala*.

The body of the Noctuids is usually stout and well-developed, very few species having large or frail wings, and the body vestiture may be hairy or scaly, the differences furnishing bases for generic distinctions.

The abdomen is quite frequently tufted on the dorsum, and sometimes along the lateral edges of the segments. It is rarely much longer than the anal angle of the secondaries, and in the *Quadrifidae* tends to become cylindri-conic and smoother.

The thorax usually has a well-developed collar, which may be produced at the sides or middle, or even projected forward into a distinct hood. The patagia are usually well-marked and quite usually sufficiently up-lifted to give the thorax a distinctly squared appearance. On the dorsum the vestiture may be flat and smooth, formed into a keel-like ridge, produced into anterior or posterior tufts or both, or there may be a divided crest through the center; all these furnishing bases for generic divisions.

The head is usually well developed, rarely retracted, and the eyes are usually round and more or less globose. In this matter there are differences, however, and in some series reniform or kidney-shaped eyes occur. The front of the head is usually smooth, slightly convex; but it sometimes becomes protuberant, bulging, roughened or furnished with processes of various kinds; all these modifications being used in systematic work. The antennæ are always well developed, usually simple or sparsely ciliated in the female and ranging from simple through serrate into bi-pectinate in the male. In the Deltoid series the males frequently have curious twists, distortions or tuftings before the middle, which are quite characteristic and useful for specific as well as generic separation. The labial palpi in the typical series vary little, extending upward along the front to the vertex. In the quadrifids the terminal joint tends to elongate and becomes smooth and more slender. In the Deltoids the palpi become very much elongated, more slender, or clothed with upright scales on the upper edge, giving a blade-like appearance or forming a snout. This snout-like appearance (Fig. 71) is sometimes seen in the other series as well, but in those cases the scaly clothing is usually directed downward, and a pointed frontal tuft adds to the effect. Only in *Hyblaea*, in our fauna, is there any trace of maxillary palpi, and it is a question whether this should really remain as a Noctuid. The tongue is usually well developed; but in a few cases it is wholly aborted and in such instances the head is usually small, retracted, and the palpi are reduced in size.

In the trifids three series are distinguished on eye characteristics: those which have the eyes hairy, clothed with short, even pile; those which have them naked with overhanging ciliæ or lashes, and those which have them naked, without overhanging ciliæ or lashes. The first of these series is well defined and there is rarely a question as to whether a species belongs to it or not. These will be treated here as *Mamestrini*. The difference between the lashed and unlashed eyes is less obvious and no tribal or serial division can be satisfactorily based on this feature.

In a long series of species the middle and hind tibiæ (Fig. 71), and often the anterior pair as well, are furnished with stiff, longer or shorter spines, sometimes abundantly, sometimes sparsely; but always distinctly when they are present at all. These spines are different from the normal spurs, a pair of which occurs at the end of the middle tibiæ, while there are two pair at and near the tip of the hind tibiæ. On the fore tibiæ there are no spurs comparing to those of the middle and hind pairs, but there may be claws or other corneous processes, and on the inner side there is always an appendage or epiphysis which covers a depression or excavation.

The term *Agrotini* has been applied to the series with spinose tibiæ and this is made to include the Heliothid series in which the colors are brighter and more contrasting, while the armature is much heavier on the fore tibiæ.

The term *Hadeninae* has been applied to those forms in which the eyes are naked and the middle and hind tibiæ are not spinose; but this is a mixed mess and divisible in a number of smaller series based on minor characters of vestiture, tufting and the like.

Claws or spines at the end or tip of the fore tibiæ may occur in any series, and sometimes there are long, more or less curved claws on the tarsal joints as well.

On any or all the legs there may be sexual tuftings or other modifications in the males. These are rare in the trifid series, but common in the quadrifids, and reach their maximum development in the Deltoid series where secondary sexual modifications furnish excellent bases for generic and specific divisions.

The quadrifids are broken up into a larger number of smaller series, and some of these contain very few species in our fauna; in California some are not represented at all.

For convenience, the table given by Sir George F. Hampson, in the 4th Volume of the Catalogue of the Lepidoptera Phalænæ in the British Museum is here repeated with a very few changes in the sub-family terms. It should be understood that I do not consider all these as really sub-families, nor are the divisions always sharply marked; but for convenience the table is better than any other that I know and it will work in the vast majority of cases.

1—Maxillary palpi absent; labial palpi developed........ 2
Maxillary as well as labial palpi developed........16

2—Secondaries with vein 5 obsolete or from the cross-vein, well removed from 4........ 3
Secondaries with vein 5 well developed........ 6

3—Tibiæ, one or more pairs spinose........AGROTINÆ
Tibiæ not spinose........ 4

4—Eyes hairy........MAMESTRINÆ
Eyes not hairy........ 5

5—Eyes with long overhanging ciliæ or lashes........CUCULLIINÆ
Eyes without overhanging ciliæ or lashes........ACRONYCTINÆ

6—Hind wing with vein 5 more or less approximated to 4 at base........ 7
Hind wing with vein 5 parallel to 4........15

7—Frenulum of female simple........ 8
Frenulum of female multiple........ 9

8—Abdomen with lateral anal pencils of hair........EUTELINNÆ
Abdomen without anal hair pencils; fore-wings with tufts of raised scales in cell........STICTOPTERINÆ

9—Retinaculum of male bar-shaped........10
Retinaculum of male not bar-shaped........11

10—Fore-wing with tufts of raised scales in cell........SARROTHRIPINÆ
Fore-wing without tufts of raised scales in cell........ACONTIINÆ

11—Middle tibiæ spinose........CATOCALINÆ
Middle tibiæ not spinose........12

12—Eyes hairy........MOMINÆ
Eyes not hairy........13

13—Eyes with long, overhanging ciliæ or lashes........PLUSIINÆ
Eyes without such ciliæ or lashes........14

14—Vein 5 of secondaries close to lower angle of cell and strong...EREBIINÆ
Vein 5 of secondaries well above angle of cell and rather weak........ERASTRIINÆ

15—Palpi elongated, sickle-shaped, or laterally compressed with upright vestiture........HYPENINÆ

16—Palpi forming a short snout, head small, primaries narrow........HYBLÆINÆ

EXPLANATION OF FIGURE 71.

1. A Noctuid showing the typical maculation and other descriptive characters: on body, *c,* collar; *pa,* patagium; on primary wing, *b,* basal line or half line; *bd,* basal dash or streak; *t. a.,* transverse anterior line; *m,* median shade; *t. p.,* transverse posterior line; *s. t.,* sub-terminal line; *c. m.,* costal margin; *t.,* terminal line; *ap.,* apex; *o. m.,* outer margin; *h. a.,* hind angle; *i. m.,* inner margin; *cl,* claviform; *or,* orbicular; *rn, reniform;* on secondary wing, *apex, o, m.,* outer margin; *a. n.,* anal angle; *i. m.,* inner margin; *d. s.,* discal spot; *e. l.,* exterior line.
2. Head from front, showing a hairy eye at right; a naked, lashed eye at left; front smooth, not protuberant.
3. Head of *Nonagria* from above, showing location of ocelli; front with a keel-like process, the lateral edges serrate.
4. Same structure seen from side.
5. Venation of a Noctuid; the veins named and numbered as usually referred in descriptive work; the secondary shows a trifid, in which vein 5 is weak and from the cross-vein, remote from 4.
6. Hind wing of a quadrifid, showing vein 5 as strong as the others, and from the same point with 3 and 4 at end of median.
7. An anterior leg showing tibial epipysis at inner side and a short stout claw at end of tibia.
8. Anterior tibia of a *Schinia* with two inner terminal and 4 outer lateral claws.
9. Middle leg with tibia moderately spinose.
10. Hind leg with normal development; no spines, tufts or brushes of any kind.

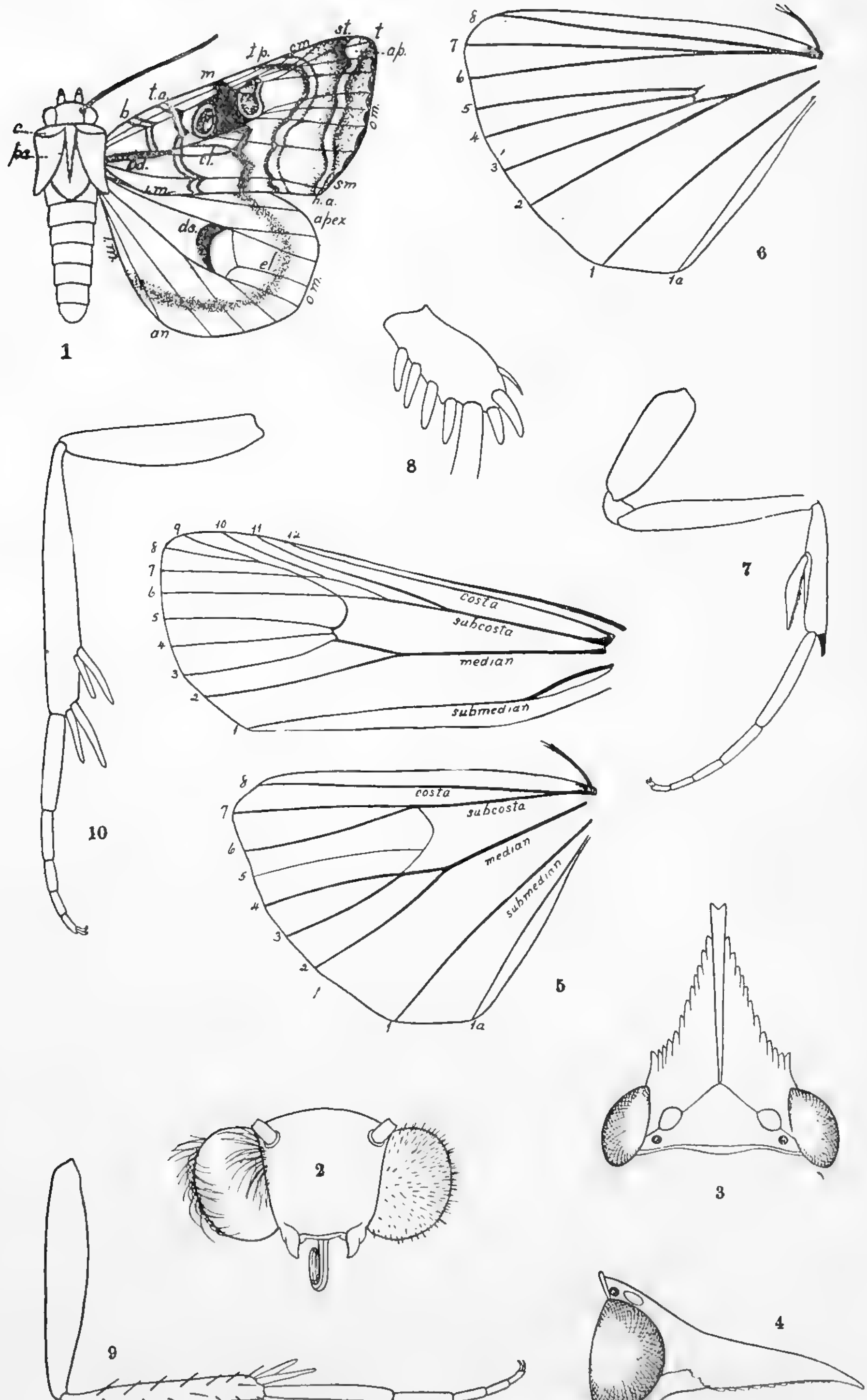


Figure 71. Anatomical Details of Noctuidae.

THE SCORPIONS OF CALIFORNIA

NATHAN BANKS
OF THE U. S. DEPARTMENT OF AGRICULTURE

The scorpions are readily known from all other arachnids by the presence of two peculiar characters; the body terminates in a poison sting, and on the venter, near the base of the abdomen is a pair of appendages (Fig. 80, d), each bearing a number of lamellae; these are the pectines, or combs. The palpi are enlarged at tip and chelate, the claw being of three parts; the hand, or basal portion, and two fingers, one movable, the other fixed. There are three groups of eyes on the anterior part of the cephalothorax, one median of two, and a lateral group at each anterior corner, of two or three eyes. The last five segments of the body are much narrower than the others, and form the cauda, or tail; the last segment is the "vesicle," and bears the sting. These caudal segments bear ridges, which are called "keels." The legs have no patella between femur and tibia. The mandibles in front consist of a basal part, or paturon, (Fig. 80, f), and two curved fingers, one fixed and one movable; these fingers are usually provided with teeth. Beneath on the venter is a small triangular or pentagonal area between the posterior coxæ; this area is the sternum.

The poisonous nature of scorpions has been exaggerated by most people; the commoner forms are no more dangerous than a wasp; one species, *Centrurus exilicauda,* which occurs in western Mexico and up into the southern part of California, is considered by some to be more poisonous than other species; however, there is little evidence, as yet, on this matter.

The species so far known to occur in California are distinguished in the following table:

1. Between tarsus and metatarsus is a single spur (on anterior side); sternum pentagonal; cephalothorax deeply emarginate in front; cauda very small; fingers shorter than hand; pectines rarely more than 12 in number 2
   Between tarsus and metatarsus are a pair of spurs, one in front, one behind 3
2. No tooth below sting; hand longer than broad; pectines not more than seven .... *Opisthacanthus lepturus.*
   A tooth below sting; hand as broad as long; pectines about 10; surface of cephalothorax finely granulate .... *Diplocentrus keyserlingi.*
3. Sternum long, triangular, with converging sides; immovable finger of mandibles with lower tooth 11
   Sternum short, pentagonal; immovable finger of mandibles without lower tooth; no tooth below the sting 4
4. With but two lateral eyes; stigmata oval; with about 7 pectines; hand very broad; small, short species .... *Broteochactas allenii.*
   With three lateral eyes; stigmata more elongate, usually slit-like 5

5. A large tooth on lower edge of movable finger of mandibles; long hairs on legs and pedipalpi; about 30 pectines, or more; last dorsal segment without distinct keels; all caudal segments with keels below; fingers of hand longer than hand (Fig. 81, F D)........*Hadrurus hirsutus.*
   No such tooth on movable finger of mandibles; less hairy forms; last dorsal segment more or less distinctly keeled........ 6

6. Middle lamellæ of pectines broken up into many small subequal sclerites; usually at least 15 pectines; colors rather pale........ 8
   Middle lamellæ of pectines not broken up; pectines rarely more than 10 or 12; colors very dark........ 7

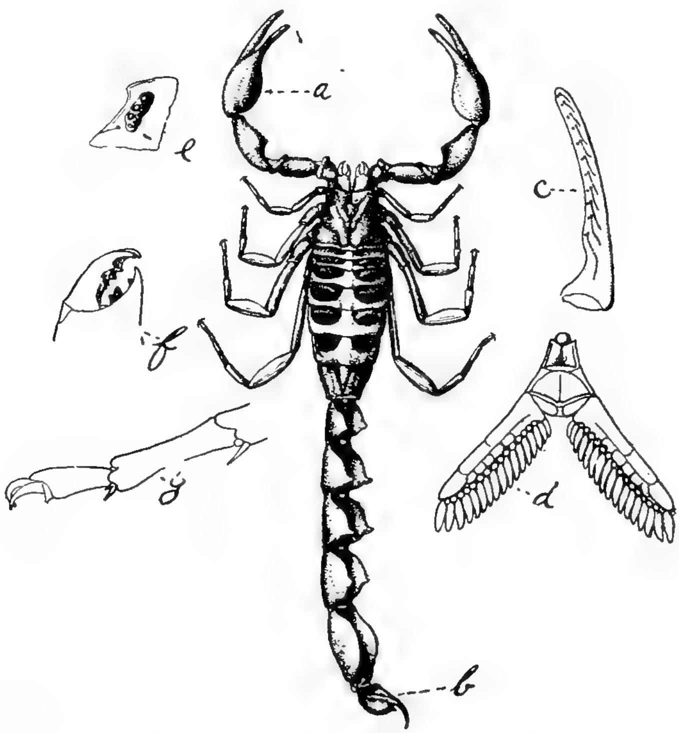


Figure 80. Anatomical details of a Scorpion.

7. Movable finger of mandible with at least 5 small teeth; stigmata rather short; fourth segment of cauda keeled below; about 10 or 12 pectines; sting of male normal. (Fig. 81, E)........*Uroctonus mordax.*
   Movable finger of mandibles with not more than three small teeth; stigmata very slender; fourth segment of cauda without keels below; about 7 pectines; sting of male swollen near base. (Fig. 81, H)........
   ....*Anuroctonus phaiodactylus.*

8. Hand with distinct ridges or keels, more or less granulate; on under side of second caudal segment the median keels are more or less distinct 9
Hand without keels, smooth and rounded; under side of second caudal segment without keels, but indicated by black lines........*Vejovis spinigerus.*

9. The median keels on cauda are strong and granulate, also on last segment of abdomen below; fingers but little longer than hand; cephalothorax in front of eyes granulate; the vesicle of male is densely long-haired. (Fig. 81, J)........*Vejovis hirsuticauda.*
The median keels on cauda are weak and not granulate; vesicle of male not densely long-haired 10

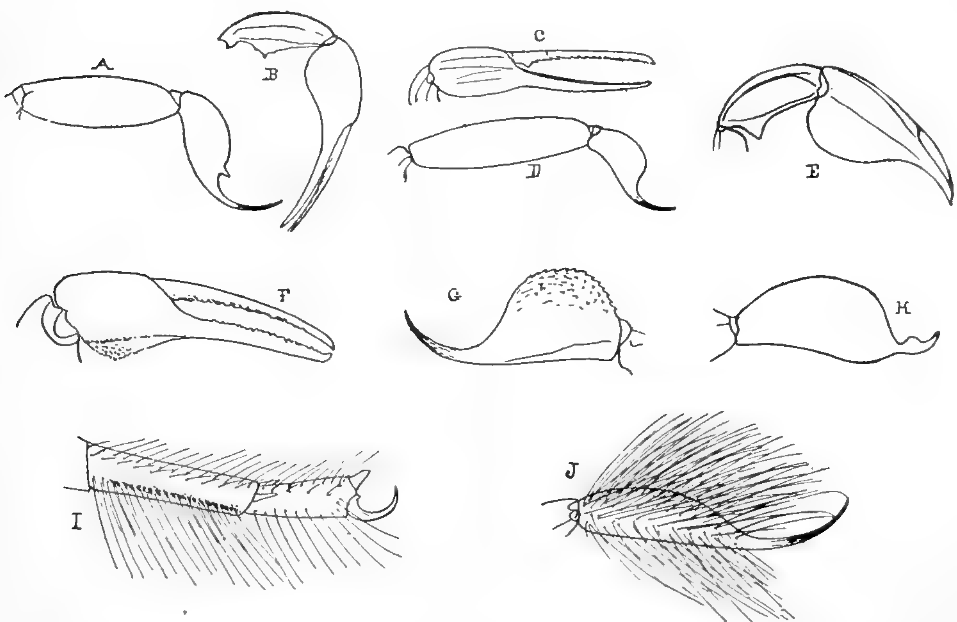


Figure 81. A, sting of Centrurus californicus; B, claw of same; C, claw of C, exilicauda; D, sting of same; E, claw of Uroctonus mordax; F, claw of Hadrurus hirsutus; G, sting of same; H, sting of Anuroctonus phaiodactylus; I, tarsus of Hadrurus hirsutus; J, sting of Vejovis hirsuticauda.

10. Hand much longer than broad; fingers plainly longer than the hand; cephalothorax in front of eyes not granulate........*Vejovis punctipalpi.*
Hand nearly as broad as long; fingers barely longer than hand; cephalothorax in front of eyes granulate........*Vejovis boreus.*

11. The rows of small teeth on the fingers of the claw are flanked by rows of similar teeth; about 16 to 25 pectines........ 13
The rows of small teeth on the fingers of the claw are not flanked by rows of teeth, but sometimes these rows overlap........ 12

12. The rows of teeth overlap; fingers one and a half times longer than hand; no tooth under the sting; body mostly unicolorous.. *Tityus tenuimanus.*
The rows of teeth do not overlap; fingers twice as long as hand; a tooth under the sting; body and legs more or less maculate; cauda of male especially long........................ *Isometrus maculatus.*

13. A distinct tooth below sting; fingers but one-fourth longer than hand; median keel of the fifth caudal segment reaching to tip. (Fig. 81, A B)........................ *Centrurus californicus.*
No distinct tooth below sting; fingers one-half longer than hand; median keel of fifth caudal segment lost in the general granulation; cauda more slender. (Fig. 81, C D)........................ *Centrurus exilicauda.*

Opisthacanthus lepturus Pal de Beauv

This is a large, very dark-colored species, with very large claws, and a very small tail; it occurs in the American tropics, and has been taken from the islands off the Californian coast.

Diplocentrus keyserlingi Karsch

This is a Mexican species of which there are specimens in the Marx collection labelled "California." It is nearly black. There is another Mexican species closely similar in appearance, but with the cephalothorax smooth, not granulate; it is *D. whitei* Gerv., and may possibly be taken in California.

Broteochactas allenii Wood

This is a small and short species, with large hand and very short fingers; it was described from Baja California, but I have seen specimens from Ft. Tejon, Calif.

Hadrurus hirsutus Wood

This is our largest species of scorpion; it is reddish yellow, or brownish, and unmarked; the legs and palpi are noticeably long-haired. Specimens have been seen from Indio, Tulare County, Salton, San Bernardino County, the Mohave Desert, and Palm Springs.

Uroctonus mordax Thorell

This is a very dark-colored species, with large claws, apparently rather common in central and northern California; specimens are from Lakeside, Lake Chabot, San Francisco, Fresno County, Sausalito, Camp Meeker, Sonoma County, Napa County, and Santa Rosa Island.

Anuroctonus phaiodactylus Wood

This is rather larger than the last species, of a red-brown color, rather hairy, and peculiar on account of the swollen sting in the male. Specimens are from Witch Creek, and Cuyamaca Mountains, both in San Diego County, from the Mohave Desert, and Claremont.

Vejovis punctipalpi Wood

A reddish brown species, with strongly ridged claw. Specimens from San Bernardino County, Death Valley, Santa Margarita Island, and San Diego County.

Vejovis boreus Girard

This species is smaller than the last, and of more northern distribution, occurring in Washington, Idaho and Montana, but I have seen specimens labelled "California."

Vejovis spinigerus Wood

This species is easily known by the smooth tail striped with black. Specimens are marked "California."

Vejovis hirsuticauda Banks n. sp.

Reddish brown. Densely acutely granulate almost all over; granulate in front of eyes; four complete granulate keels on dorsum of last abdominal segment; the submedian keels below complete and widely separated; cauda slender, strongly keeled; beneath, the submedian keels are strong and granulate; the fifth segment is extremely long, one and three-fourths times as long as the fourth segment, keels strong to tip; the vesicle is very slender, and bears many very long hairs beneath, almost forming a brush; the sting is only slightly curved; there are 15 pectines; the pedipalpi are rather short, the hand a little longer than broad, with strong, granulate keels; fingers rather shorter than hand. Length 1¼ inch. From San Bernardino County, California.

Isometrus maculatus Linne

This species occurs all through the tropics, and I have seen specimens from Santa Barbara and Santa Catalina Islands. It is a slender species with long tail, and more or less maculate with dark brown.

Tityus tenuimanus Banks n. sp.

This species has been taken at Buena Vista Lake. It is yellowish brown in color. The pedipalpi are slender, the hand but weakly keeled and not granulate, the fingers fully one and a half times longer than hand, the eye-tubercle is broad, and the eyes large; from the tubercle is a row of granules each side to front margin, and on sides a row, indented behind and connected to opposite row near posterior edge of cephalothorax; the lateral ridges on first two segments are connected in front, the last segment has five rows of granules, the median not reaching behind, beneath the outer ridges are short; the tail is rather stout, the fifth segment with prominent serrate lower edges; no tooth below sting. Length 2 inches.

Centrurus californicus Wood

This is a quite strongly granulate species, often showing two dark stripes on the body. It has been taken at Lake Tule, and in Lake County.

Centrurus exilicauda Wood

This species is similar to the last, but more slender in all its parts, especially the palpi and tail. It is fairly common in Lower California, and has been taken near San Diego.

BEES OF THE GENUS COLLETES FROM MEXICO

CHARLES W. METZ

Recently, when looking over a lot of Colletes from Mexico, in an effort to identify them, I was struck by the confusion in which the Mexican species of this genus have been thrown by the descriptions of the early writers. A large number, if not most of the known Mexican Colletes, were described by Mr. Frederick Smith from specimens in the British Museum, and described so briefly and superficially that it is impossible to identify the species without access to the types. The only way in which these species can be straightened out now is by new descriptions, and it is with the hope of forming a basis for this that the present paper is prepared.

Only twelve species have been included here, but as eleven was the total number given by Prof. T. D. A. Cockerell in his catalogue of the Mexican Apidæ in 1899, I presume that these twelve include a good portion of the known species, besides several that are undoubtedly new.

Since the male genitalia furnish the best specific characters available in this genus, I have figured them for each species of which I have males. As can be seen by the figures it takes only a glance to distinguish species in this way, and what is more, a few sentences will suffice to describe them so that anyone can determine specimens from the descriptions. On working out the genitalia I have followed the example of Mr. Myron H. Swenk, in his admirable paper on, "Specific Characters in the Bee Genus Colletes."

There are several sets of characters used in the earlier descriptions that seem to me to be the cause of much of the confusion which now exists. The coloration of the nervures in the wings, the color of the antennæ (whether or not lighter underneath), and even the color of the pubescence when it is pale, is very variable in many cases and should never be used to distinguish species, except in the case of the pubescence when the difference is very marked. The exact length of the insect is another feature that varies greatly in individuals of the same species and sex. All of these characters have been included in the present paper in order that the descriptions may be complete, but they are used, as supplementary, rather than as diagnostic characters.

It is not the expectation of the writer that all of the species herein described will prove new, but that each description will be as complete a one as possible of that species. For example, *C. dilatata* strongly resembles the description of *C. nautlanus* Ckll.; but as the male of *C. nautlanus* is unknown, I am describing both sexes under the name *C. dilatata,* and if they prove to be *C. nautlanus,* then so much the better for that incompletely described species.

The specimens in this lot were collected near Gaudalajara, Mexico, during July, August, and September, 1909, by Messrs. Crawford and McConnell.

Colletes recurvata n. sp.

FEMALE—Black. Length 11 mm. Head a trifle broader than long. Face clothed with rather short, white, or pale yellowish, pubescence, mixed with black on vertex. Eyes converging at base. Clypeus nearly nude, convex, depressed in a median groove; covered with long shallow punctures, forming longitudinal striæ; truncate at end. Supra-clypeal area sparsely punctured. Malar space very short, not over one-sixth as long as broad. Vertex quite closely punctured with punctures of two sizes, differing from even puncturation of face. Antennæ short, black; scape slightly punctured.

Thorax—Covered in front and on sides with short, dark ochraceous hairs, sometimes thickly, but more often sparsely mixed with black on mesothorax, and sides of scutellum. Mesothorax covered with large round punctures, quite close together in front, becoming more sparse as they approach the rather large, almost impunctate disk. Scutellum with large, sparse punctures over entire surface. Postscutellum thickly covered with large shallow punctures, giving a rugose appearance. Metathorax covered with long, dense, pale yellowish pubescence on sides, noticeably lighter, and finer than that of scutellum. Superior face of metathorax normal, with the usual dozen or more shining pits; posterior face with enclosure funnel shaped, shining, and smooth except for a few transverse ridges, which are not very noticeable. Enclosure broad, only 2-2½ times as long as wide at top. Lateral faces with very large, shallow, rectangular, pit-like punctures, forming rugæ. Mesopleura densely punctured, with large round punctures; clothed with rather sparse ochraceous pubescence, becoming white underneath.

Abdomen—Rather long, convex, suboval, rather pointed at apex. Apical margins of segments with fasciæ of short, sparse, white hair. A few longer black hairs on last two or three segments, often with ferruginous on venter. All segments thickly and finely punctured; these punctures on first segment a little larger and slightly more scattered than on others. Apex of first segment depressed.

Wings—Sub-hyaline, nervures almost black, stigma same. Tegulæ very dark, not noticeably punctured.

Legs—Entirely dark; posterior femora clothed with long, silky, golden pubescence; tibæ with shorter, lighter, denser pubescence. Tibial spurs golden brown, not pectinate, but microscopically ciliate. First tarsal joint about three times as long as wide (Fig. 72 D.), much golden hair on inner side. Apical tufts of all tarsi golden. Claws reddish, medially toothed.

MALE—General appearance similar to female, but a little smaller, more slender, more densely haired, and with an abundance of white hair on under parts of head, and lower sides of thorax.

Head—Densely clothed with long pubescence on face. No black hair on vertex. The change from strong, close punctures of face to the mixed punctures of vertex very abrupt. Antennæ longer than in female, but still rather short. Third joint longer than fourth, equals fifth. All joints of flagellum except fourth a little longer than wide. Malar space longer than in female, about one-fourth to one-third as long as wide.

Thorax—More densely haired, pubescence longer, no black hairs. Impunctate disk lacking, although punctures are slightly separated on a small area of the apex of the mesothorax. Scutellum and post-scutellum as in female. Metathorax with lateral posterior faces smooth, and finely sparsely punctured, instead of being rugose.

Abdomen—Similiar to female. Punctures larger and less dense; more white hair on first segment.

Wings—Nervures and stigma not so dark as in female.

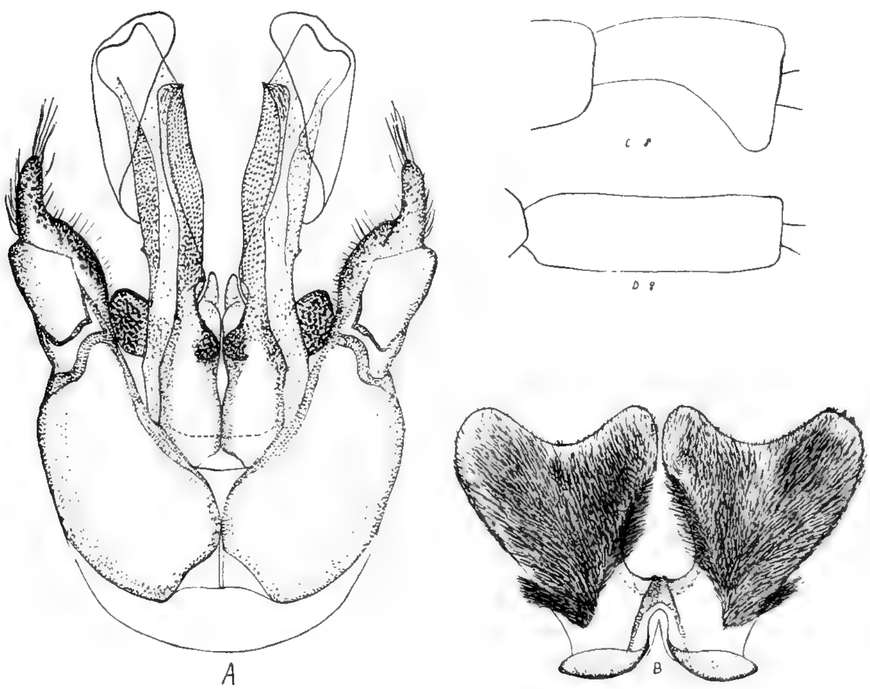


Figure 72. Colletes recurvata.

Legs—Pubescence on posterior femora sparse, white; on femora of other legs very long and dense; in distinct contrast to pubescence of thorax. First joint of hind tarsi short, the apex exceedingly wide, almost equal to length, and inner margin curving in abruptly to a narrow base (Fig. 72 C.). First joint of tarsi of other legs long, four or more times breadth. Claws apically cleft.

Genitalia (Fig. 72)—Stipes notched, apical part of medium length, slightly curved inward; long hairs at apex. Sagittal rods slender, slightly curved outward; membranous wings at apices quite long, recurved. Volsella prominent. Seventh ventral plate with two wings; each quite broad, with broad, rounded, shallow emargination at apex. Almost the entire surface of each wing is covered with rather long, spiny hairs; although the apex and central portion are more sparsely haired. A tuft of very long hairs projects outward from base of the hairy portion of each wing.

Type locality—Guadalajara, Mexico. Described from eight specimens.

Colletes dilatata n. sp.

FEMALE—Length 9-10 mm. Stout, black with griseous pubescence. Head broader than long, eyes converging below. Face sparsely covered with griseous pubescence, sometimes nearly nude; thickly covered with medium sized punctures. Clypeus broad, convex, shiny, with large, long, shallow punctures, forming longitudinal striæ, depressed into a median sulcus in middle, truncate at apex. Mandibles dark, reddish at tips. Malar space very short, about one-eighth as long as broad. Supra-clypeal area smooth except for a few fine punctures around margin. Antennæ black, sometimes brown beneath. Vertex shining, smooth except between ocelli, where it is finely punctured. Hair on vertex almost entirely black. Hair on under side of head white, not dense; that on mouth parts, golden yellow.

Thorax—Stout, rather shiny. Mesothorax covered anteriorly and on sides with short griseous pubescence, covered with large, round punctures, more crowded anteriorly, entirely lacking on a large disk. Apical margin with a narrow band of small punctures. Scutellum, covered on sides with tufts of longer hair, the black quite conspicuous and mostly inside of the patch of white. Anteriorly smooth and shiny, the sides and posterior half with a few very large, round punctures. Postscutellum—sparsely pubescent, almost nude, closely punctured, rugose. Superior face of metathorax normal, with ten or twelve rectangular pits. The posterior face has the enclosure funnel shaped, the neck rather narrow, the bowl divided by a number of ridges forming more or less noticeable pits joining those of the superior face. Lateral areas of posterior face closely punctured with large shallow punctures, the sides with rather long pubescence, mostly light colored. The mesopleura are shiny, with large round punctures, and a few very small ones between; pubescence sparse, long and white. Prothoracic spine, long and sharp. Wings hyaline; nervures and stigma dark; tegulæ, black.

Abdomen—Stout, shiny, wide at base, suddenly narrowed at apex; first segment almost smooth anteriorly, becoming finely, densely punctured toward apex; remaining segments finely, closely punctured. Abdomen practically nude except for the sparse white pubescence on the anterior part of first segment, and the white fasciæ on the apex of segments one to five. The first fascia is quite narrow; the rest rather broad. On the fourth and fifth segments are a few spiny black hairs, becoming yellowish on the sixth. Pubescence on under side of abdomen rather dense, and of an ochraceous color, except for the faint, lighter colored fasciæ.

Legs—Stout, dull black; first tarsal joint stout, about two and one-half to three times as long as broad. Pubescence on inner side of hind femora long, white and silky, that on outside shorter. Tibial scopa white and dense. The apices of inner tarsi clothed with golden hairs. The tibial spurs are long, and yellowish; the inner ones finely pectinate. Claws light, medially toothed.

Male—Similar to female, but smaller; no black hairs on thorax. The male is easily distinguished by the last joint of the antenna, which is greatly dilated and flattened. Head—Similar to female but face covered with long white pubescence. Malar space about one-third as long as broad. Antennæ long; flagellum, black above, light brown beneath, except last joint which is entirely black. The last joint is about twice as long as the others, and about two-thirds as wide as long. Joint three is shorter than four; four equal to five; all beyond three twice as long as broad, except last. The vertex of the head is finely double-punctured. Under part of head covered with dense, long, white pubescence.

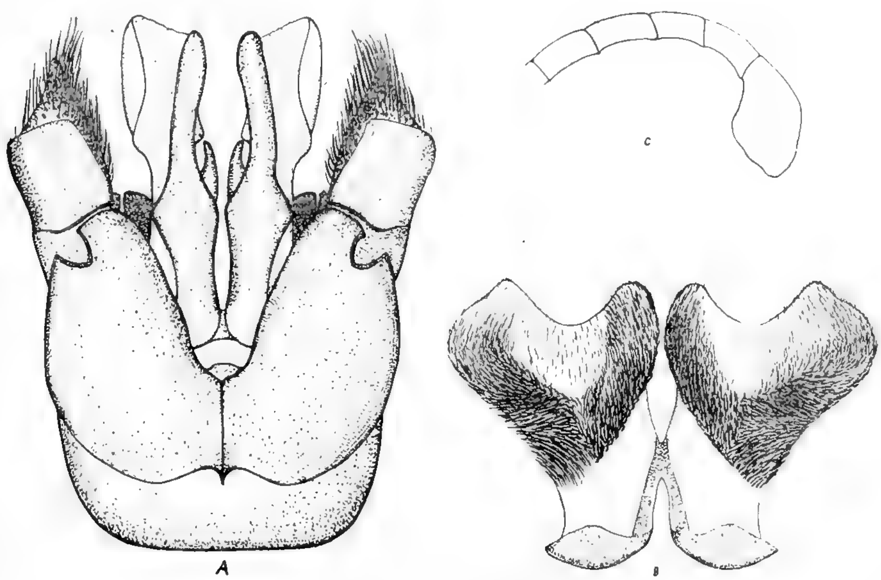


Figure 73. Colletes dilatata.

Thorax—Similar to female, but more densely pubescent, no black hairs. The scutellum is similar to the female, but besides being punctured the surface is roughened by minute wavy lines. The metathorax is similar to that of the female, but bowl of enclosure not so noticeably divided into pits.

Abdomen—Same as in female, except for a little denser pubescence, and slightly less dense puncturation. Underneath, the abdomen is covered with more, and longer hair, than in the female; the fasciæ on under part being very dense and long.

Legs—Similar to female, but hind femora not densely haired; hind tibiæ with tuft-like fringe of very long, white, silky hair on posterior edge; tarsal joints sparsely haired; first joint much narrower than in female, being from one-third to one-fifth as wide as long, and slightly broader at apex.

Male genitalia (Fig. 73, A)—Stipes notched, third joint short, stout, thickly haired; second joint also thickly haired, on inner side. Sagittal rods long, rather stout, medially expanded; membranous wings broad and recurved at apex. Volsella quite prominent. Seventh ventral plate fan shaped; each wing with a broad, rounded emargination at apex, densely haired in a V shape, extending along the margins; but almost no hair in the apical median space. No tufts of hair anywhere.

Type locality—Guadalajara, Mexico. Described from three males and fifteen females.

Colletes lineata n. sp.

MALE—Length 10 mm. Black, rather slender; pubescence, brownish. Head—A little broader than long, eyes converging below, but margin almost straight. Face densely clothed with rather dense and long ochraceous pubescence, noticeably darker on clypeus and base of antennæ. Clypeus convex, thickly punctured, but not striate, except a portion near margin; punctures smaller and closer medially. Malar space one-fourth to one-fifth as long as broad. Tips of mandibles reddish. Face punctured; vertex very thickly so. Antennæ solid black; scape short with dark ochraceous hairs; third joint shorter, broader, and more densely covered with minute black pubescence than other joints of flagellum; remaining joints about twice as long as broad. Hair on under side of head long, dense, same color as the lighter part of facial pubescence.

Thorax—Dull, covered with rather short brownish hair, except on sides of metathorax, where it is long and light. Mesothorax covered with rather large round punctures, thicker anteriorly, sparse on medium sized disk. Scutellum with larger punctures, well separated in front, thicker on posterior half. Postscutellum rugose. Superior face of metathorax shining, with a number of rather narrow pits. Posterior face shining, enclosure funnel shaped; neck rather narrow, about twice as long as wide at base; lateral faces with very large, pit-like, shallow punctures, forming rugæ, or irregular widely separated ridges. Mesopleura densely punctured; hair beneath tegulæ same color as on thorax, becoming longer and lighter beneath. Tegulæ black. Wings hyaline, nervures brownish.

Abdomen—Ovoid, not very shiny; pale, usually white fasciæ on all segments except last. All segments densely finely punctured except first, which has fewer. First segment with pale brownish hairs, more dense anteriorly and laterally. Hair underneath sparse and dark, except for continuation of fasciæ.

Legs—Black; pubescence on posterior femora long, whitish, darker and shorter above; that on tibiæ shorter, denser and lighter. Tibial spurs golden yellow. First tarsal joint long, four or five times as long as broad; apical hairs on tarsi slightly golden. Claws reddish, apically cleft. First tarsal joint on anterior and middle legs narrower than on posterior legs.

Genitalia (Fig. 74)—Stipes notched, apex long and slender, curved slightly inward, apical half with long hairs. Sagittæ long, broad at base; apical half narrowed, and elbowed in middle, the ends pointing outward. The membranous wing of each saggita reaches the entire length of the narrow half. Volsella medium sized. Seventh ventral plate—Two long wings, each with a short outward projection and dense patch of long hair at base; in front of this is a patch of short heavy spines. A line of spiny hairs extends from near this patch diagonally inward across the wing. The apical half of the wing is covered with sparse hairs, longer on interior apical margin. No emargination at apical edge of wing.

Type specimen one male. Type locality—Guadalajara, Mexico.

Colletes volsellata n. sp.

MALE—Length 9 mm. Head broader than long; eyes converging below. Face including clypeus densely covered with long, ochraceous pubescence. Clypeus convex, not very shiny; punctures shallow, forming faint striæ. Face

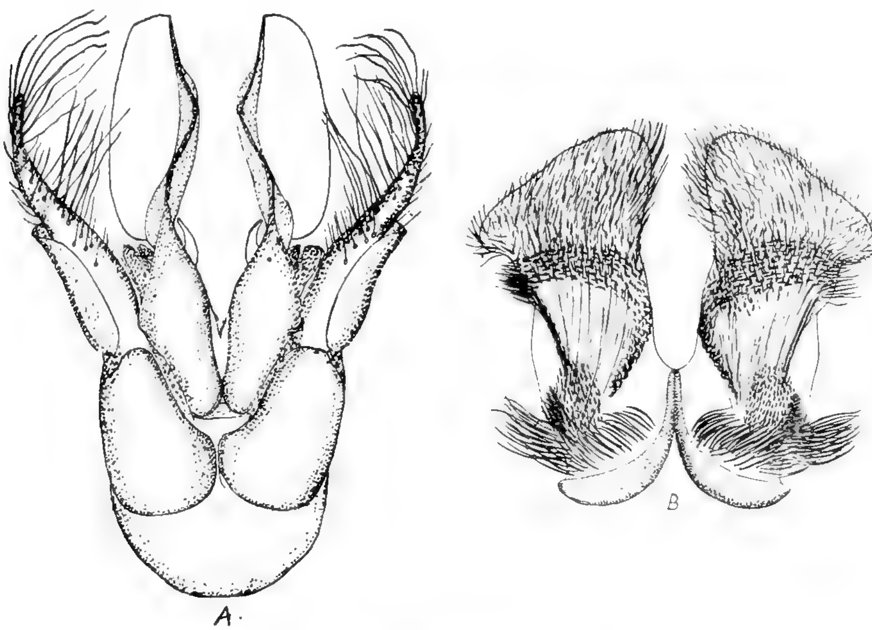


Figure 74. Colletes lineata.

finely punctured. Vertex almost nude, and coarsely punctured. Malar space about one-fourth as long as broad. Mandibles red tipped. Under part of head with white beard. Antennæ entirely dark; scape punctured; joint three not much over half as long as four; four and remainder about one and one-half times as long as broad.

Thorax—Black, shiny, covered with light ferruginous hair, long on sides and on scutellum. Mesothorax with large, round, sparse punctures, crowded anteriorly, almost entirely wanting on large disk. Scutellum with very large round punctures on posterior half, the anterior part smooth and shiny; posterior and lateral margins with fringe of long hair. Postscutellum rugose. Superior face of metathorax with the usual rectangular pits rather broad; long, light hair on the sides. Enclosure shining, broadly funnel shaped, almost triangular. Lateral spaces sparsely, finely punctured, and shining. Mesopleura closely punctured with large round punctures, smaller anteriorly; colored hair of dorsal surface gradually becoming white beneath. Prothoracic spine prominent, sharp. Wings hyaline; nervures and stigma light, almost yellow. Tegulæ brown in center, yellowish on edges.

Abdomen—Rather slender, black, not shining, finely, densely punctured, first segment less densely so. Apices of segments with broad, yellowish fasciæ. Apical margins of segments one and two depressed.

Legs—Dark brown or black, except tarsi, which incline toward yellowish brown. Posterior femora with long white floccus. Tibiæ with short sparse, white to golden, pubescence. Tibial spurs yellow, finely serrate. First joint of posterior tarsi long, four times as long as broad; rest of joints long also. Claws yellow to brown, apically cleft.

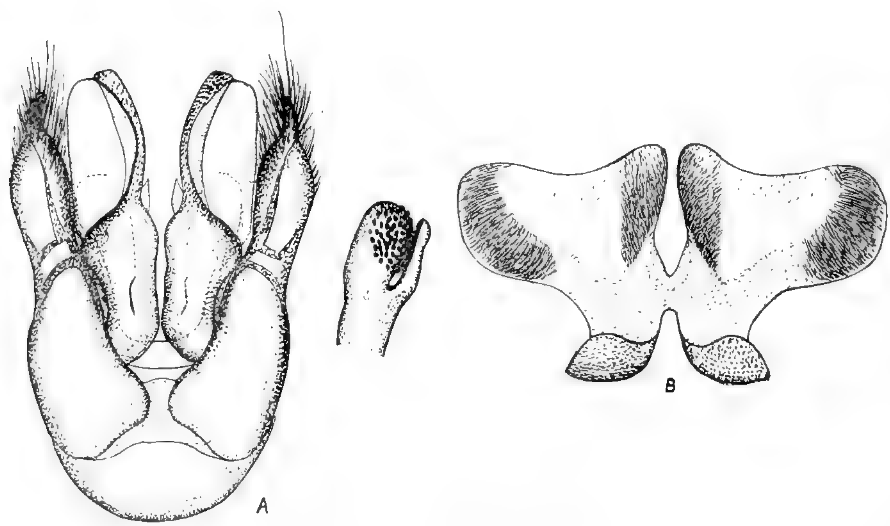


Figure 75. Colletes volsellata.

Genitalia (Fig. 75)—Stipes notched; apex rather short but slender; this and central part densely covered with long, fine hair. Sagittal rods long, slender, curved outward. Membranous wings large, rounded, extending almost to base. Volsella, exceedingly large and conspicuous. Seventh ventral plate short and broad; each wing narrow and nude at base, apically expanding broadly; the inner and outer margins with patches of hair, the inner patch coarser and more spiny. The apical portion between the hair patches is almost transparent, but the basal portion is darkened.

Type locality, Guadalajara, Mexico. Described from two males.

Colletes guadalajarensis n. sp.

MALE—Length 7 mm. Black, with white or pale yellowish pubescence. Head broader than long; eyes prominent, converging below, inner margin concave. Face with long, white, sparse plumose hairs. Clypeus with broad shallow punctures, larger, forming striæ, near end; truncate at end. Mandibles black, red at tips, blunt, very slightly toothed. Supraclypeal area with small round, well separated punctures. Face similarly but more closely punctured. Vertex with larger punctures, and very sparse ochraceous hair. Top of head nearly smooth, and nude. Antennæ black; joint three two-thirds as long as four; joint four and the remainder a little longer than broad. Scape slightly punctured. Malar space very short, not much more than a line at base of mandible. The under part of head clothed with fine white pubescence.

Thorax—Shiny; hair rather short and tinged with ochre on mesothorax; on the sides and on metathorax it is longer, lighter, more branched but not plumose. Mesothorax with large round, well separated punctures, thicker anteriorly, laterally and along posterior margin; a very few on the shining disk. Scutellum shining, covered with very large round punctures, more crowded along posterior margin. Postscutellum narrow, with large shallow round punctures giving a rugulose appearance. Superior face of metathorax

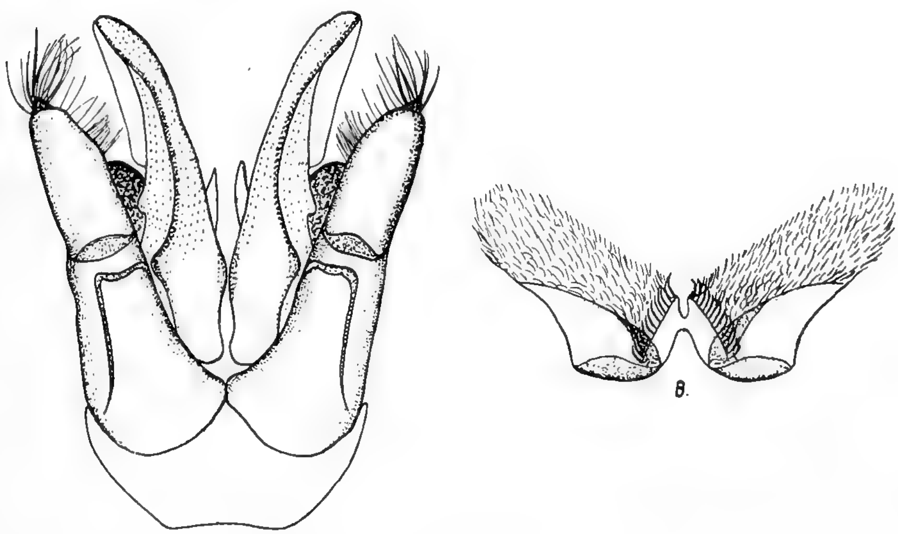


Figure 76. Colletes guadalajarensis.

with the usual shining pits. Enclosure funnel shaped, bowl broad, but lower part narrow. Lateral faces shining, rough, with a few medium sized round punctures. Sides with long white pubescence. Prothoracic spine very short but pointed. Mesopleura double punctured, with very large round punctures, quite close together, but with very minute punctures between; pubescence sparse, long, white. Wings hyaline, nervures and stigma brown. Tegulæ shining, dark brown to black.

Abdomen—Shining black, with very few fine punctures on first segment, but more on the rest, nowhere thickly punctured, however. White pubescent fasciæ on apices of segments one to five. First segment with a few long white hairs.

Legs—Black to dark brown; tarsi lighter, becoming reddish brown on apical tarsal joints. Hair on posterior femora long, white, plumose; that on tibiæ white and spiny. Apices of tarsal joints with yellow, spiny hairs. Tibial spurs long, dark yellow. Claws ferruginous to yellow, apically cleft. First joint of hind tarsi rectangular, about four times as long as broad.

Genitalia—(Fig. 76.). Stipes stout, notched; apex very short and blunt, covered with tuft of long hair. Inner margin of middle portion with few long hairs. Sagittal rods long, extending one-fourth of their length beyond the stipites. Membranous wing extending back to near the end of the volsella. Volsella very large and prominent. Seventh ventral plate very small and broad; each wing extending diagonally outward, instead of straight forward. Entire anterior portion haired. On the inner margin of the basal portion is a sort of ridge, crowned with a row of long, curved spines.

This species may be found to be near *C. prosopidis* Ckll., or some allied species. The very short malar space would indicate that it is not *C. prosopidis,* however.

Type locality, Guadalajara, Mexico. Described from two males.

Colletes moctezumensis n. sp.

MALE—Length 8 mm. Head broader than long; eyes converging below. Face and under side of head covered with long white pubescence, in contrast with ochraceous of thorax. Clypeus black, convex, striate punctate, with shallow punctures, and faint median sulcus. Supra-clypeal area similarly punctured. Apex of clypeus truncate, depressed. Face finely punctured; vertex coarsely so with close round punctures. Hair on vertex sparse, yellowish. Malar space longer than wide. Mandibles dark, reddish at tips. Antennæ long, black; flagellum reddish brown beneath; scape punctured; joint three long as four; four and remainder one-third longer than broad.

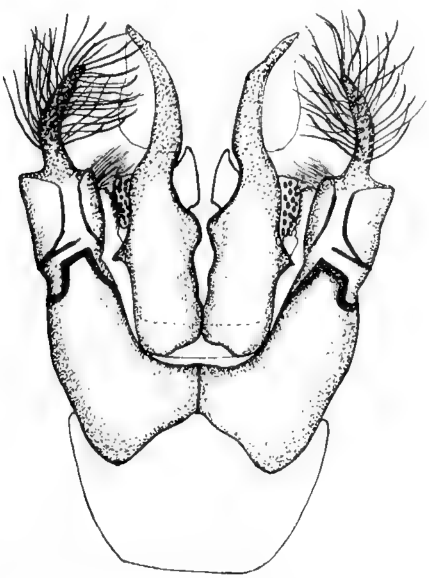
Thorax—Black, clothed with dark ochraceous to ferruginous pubescence, longer and thicker on sides and on outer margin of scutellum; paler on metathorax. Mesothorax distinctly but not thickly punctured with medium sized, round punctures almost lacking on the disk. Posterior two-thirds of scutellum with large round punctures, quite close together; anterior part smooth but not shining; posterior and lateral margins with long hair, nearly covering scutellum. Postscutellum rugulose; the rugæ of anterior part pit like. Superior face of metathorax with usual shining pits. Enclosure of posterior face broadly funnel shaped, shining; lateral faces surrounding it shining, with broad shallow punctures forming rugæ. Prothoracic spine short, sharp. Mesopleura coarsely punctured, covered with long white hair, contrasting with colored hair of thorax. Wings hyaline; nervures and stigma yellowish. Tegulæ brown, with yellow edges.

Abdomen—Shining, densely punctured, with small round punctures, slightly farther apart on first segment. Anterior part of first segment with a few long white hairs. All segments have broad, thick, yellowish, fasciæ, except last. The last three segments have a few white spiny hairs.

Legs—Dark brown to black. Posterior femora with long, silvery white floccus. Hair on posterior tibiæ similar. First joint of hind tarsi four to five times as long as broad. Tarsi lighter than other joints. Claws apically cleft.

Genitalia—(Fig. 77.). Stipes notched, quite robust, except apical part which is long and slender, and covered with long hairs. Central part with tuft of five hairs on inner margin. Sagittal rods long, slender, curved outward; wings extending about half way down. Volsella quite large and prominent. Seventh ventral plate consisting of two long, slender wings, pointed at inner apex; each with triangular patch of bristle-like hairs near apex. From each wing extends a transparent membrane, about as large as the wing itself, back toward the base. It is possible that this membrane is not always present, but in the specimen I have mounted the membranes are firmly attached near the tips of the two wings.

Type locality—Moctezuma, Mexico. Described from one male.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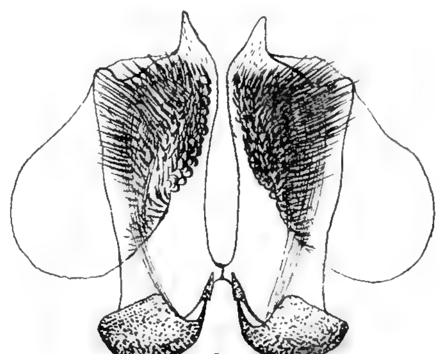
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Figure 77. Colletes moctezumensis.

Colletes macconnelli n. sp.

Male—Length 8 mm. Head broader than long; eyes converging below. Face clothed with long, white to faint yellowish, pubescence. Clypeus black, shiny, convex, striate punctate, striæ becoming more pronounced toward apex; end truncate, depressed. Supra-clypeal area also striate punctate. Malar space as long as broad. Entire face and vertex thickly punctured; the punctures on vertex much larger. Hair on vertex sparse, yellowish. Antennæ entirely dark brown to black; scape punctured; joint three two-thirds as long as four; four and the remainder about the same size; each a little longer than broad. Under part of head clothed with long white hair.

Thorax—Black, not very shiny; covered with fluffy yellowish to brownish pubescence, varying with the individual; hair on sides in front lighter, becoming darker on mesothorax, and rich brown on the scutellum, in some specimens. Mesothorax with medium sized round punctures well separated; thicker anteriorly, but very sparse on a good sized disk. Scutellum with large, round punctures quite close together, except on a narrow space along anterior margin. Along posterior and lateral margins is a dense growth of long, brownish hair which is quite noticeable. Postscutellum rugosely punctured over entire surface. Superior face of metathorax normal, shining, with the usual large narrow pits, some of which are divided by one or two cross ridges. Enclosure funnel shape, quite broad. Mesopleura with large round, well separated punctures, becoming more dense on dorsal part, covered with sparse white pubescence, in contrast with the yellowish of the upper parts. Prothoracic spine sharp. Wings hyaline; nervures and stigma light brown. Tegmina testaceous.

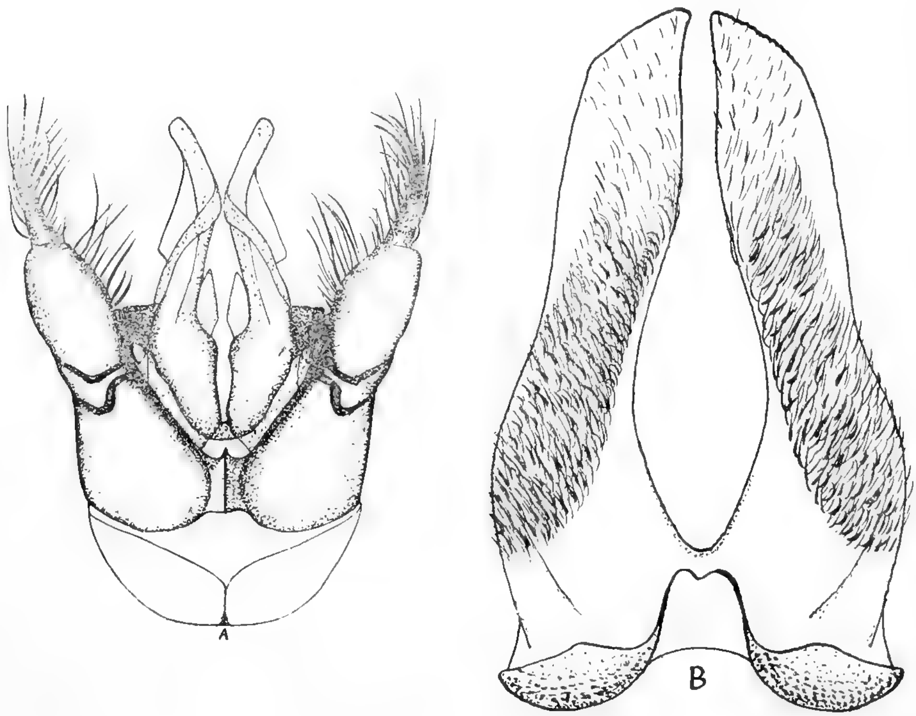

Figure 78. Colletes macconnelli.

Abdomen—Rather slender, black, densely punctured; punctures on anterior part of first segment slightly farther apart than the others. All segments with white fasciæ. First segment with a few yellowish white hairs on anterior portion. Last two or three segments with a few spiny golden hairs. Ventral surface sparsely haired; the hair on faciæ much longer at sides than in middle.

Legs—Black; posterior femora with sparse, long white hair; remainder with short, sparse, white hair, becoming yellowish on tarsi. Tibial spurs long, lemon yellow, coarsely serrate. First joint of hind tarsi same width throughout, about four times as long as broad. Remaining joints short and broad Claws yellow, apically cleft.

Genitalia (Fig. 78)—Stipes notched; apex long, slender; this and inner margin of central portion with long hairs. Sagittal rods long, slender, bent at center, curving outward; expanded at base. Wings membranous, not large. Volsella large and prominent. Seventh ventral plate-wings very long and narrow; with a dense patch of spiny hairs extending nearly full length of each. Remaining portions nude.

Described from three males.

Type locality—Guadalajara, Mexico.

Colletes delicata n. sp.

MALE—Length 8 mm. Very similar to *C. macconnelli* in general appearance, but is shiny, has very short malar space, no punctures on abdomen, and has very different genitalia. Head slightly broader than long; eyes con-

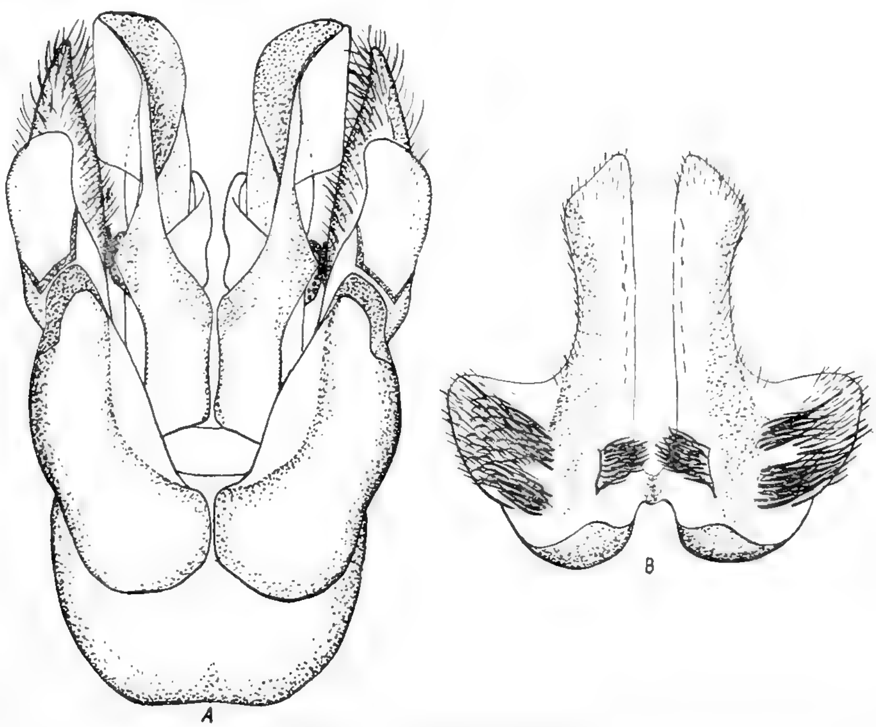

Figure 79. Colletes delicata.

verging below. Face covered with long white or yellowish pubescence, varying with individuals. Clypeus striate punctate with median sulcus, truncate and depressed at end. Mandibles brownish red at ends. Puncturation of head similar to that of *C. macconnelli,* except that space on sides back of ocelli is practically impunctate. Malar space short, about one-sixth as long as broad. Antennae similar to *C. macconnelli,* but joint three longer than four, and four much shorter than five. Thorax similar to *C. macconnelli,* except as follows: Punctures on mesothorax more sparse; none of the pits on superior face of metathorax divided; lateral spaces bounding enclosure of metathorax sparsely punctured instead of rugose; tegulae dark brown; surface of thorax shining.

Abdomen also similar to *C. macconnelli,* but is very shiny, lacks punctures, or only has very sparse fine punctures; has black hairs on apical segments instead of golden. Legs similar to *C. macconnelli,* but first joint of hind tarsi shorter and broader, being about two and one-half to three times as long as broad.

Genitalia (Fig. 79)—Stipes notched; apical part short and blunt; this and inner margin of middle part covered with rather short hairs. Sagitta long, but stout; tip curved out; wing short. Seventh ventral plate small delicate; each wing expanded into a broad lobe at base. The almost transparent and practically hairless forepart of the wing is long and narrow, and has a darkened portion along the outer edge. On the outer part of the basal lobe there is a large patch of hair; while on the inner part is an erect knob-like protuberance covered with hair.

The coloration of the hair of this species is very variable, running from pale yellow in some to rich brown in others.

Described from five males.

Type locality—Guadalajara, Mexico.

Colletes subdilatata n. sp.

Female—Resembles in general appearance the female of *C. dilatata,* but differs as follows: Malar space shorter, being a mere line. Mesothorax with much smaller punctures, and no impunctate disk; the punctures being over entire surface. The black hair of the mesothorax much less noticeable; the light hair ochraceous instead of white. Punctures on scutellum very much smaller, and much more numerous, covering practically the whole surface. Mesopleura with smaller punctures, sparse above, forming striae in center. First abdominal segment punctured all over, instead of merely at apex. First joint of posterior tarsi much stouter, shorter, and broader, being less than twice as long as broad. With the exception of the floccus the hair on the posterior femora and tibiæ is dark, noticeably different from *C. dilatata.* It is quite possible that this may prove to be the female of *C. delicata,* or *C. macconnelli,* as it resembles both, but I have provisionally separated it. It has the punctured abdomen of *C. macconnelli,* but lacks even a moderately long malar space. The puncturation of the thorax also resembles that of *C. macconnelli,* but that of the head is like *C. delicata.*

One specimen which I have has almost no punctures on the first abdominal segment, and fewer on the other segments, but as it is identical in other respects, I consider it a form of this species.

Described from three females.

Type locality—Guadalajara, Mexico.

Colletes capitata n. sp.

Female—Length about 16 mm. Anterior wing 12 mm. Body rather slender; head, thorax and wings pale ferruginous; abdomen dull black with white fasciae; no black hairs on thorax; no white hairs on body except fasciae on abdomen. Head broader than long; eyes prominent, converging below, inner margin convex. Clypeus large, broad, shining, convex, with sparse golden hair, and large, shallow, confluent punctures forming irregular striae; median sulcus narrow, deep; apex depressed, subemarginate. Mandibles large, blunt, entirely black, with few golden hairs. Supra-clypeal area with a rectangular median space smooth, remainder with dense large punctures, smaller basally. Space along eye margins and around antennae with dense, long, dark ochraceous hair. Vertex almost nude. Face densely punctured; punctures becoming larger and confluent near vertex. Along the inner margin of each eye, from the vertex half way down the face is a space that is depressed very much, is dull black, and almost entirely lacking punctures. A narrow space across vertex and along lateral margins of outer ocelli, is smooth and shining; behind this the punctures become dense, and of two sizes. Occiput with fringe of rather long ferruginous hair. Malar space short, one-eighth to one-sixth as long as broad. Antennae short; scape long, smooth, with a few golden hairs at apex; flagellum brown beneath; joint three one and one-half times as long as four; four shorter than five; all but third and last shorter than broad. Under side of head with sparse long ochraceous hair.

Thorax—Densely covered with short ferruginous pubescence, becoming long and pale on sides, metathorax, and scutellum; mesothorax black, rather shiny, densely punctured with large round punctures, crowded over entire surface, except a small impunctate disk. Scutellum shining, densely punctured, except anterior margin, with large punctures; hair on sides long, light; inside of this, hair is dark, rich brown. Postscutellum rugulose. Superior face of metathorax with pits not clearly defined, having a wavy appearance. Enclosure of posterior face shining with wavy irregular surface like that of superior face, funnel shape, neck narrow; lateral faces bordering enclosure roughened with minute wavy lines, giving peculiar appearance like microscopic pits over entire surface. Mesopleura with large punctures; hair long and plumose, almost white. Wings darkened almost to ferruginous; nervures and stigma ferruginous; tegulae ferruginous. Prothoracic spine short and sharp.

Abdomen—Densely punctured and microscopically wrinkled; punctures dense on basal and apical margins of segments. First segment is not truncate, but tapers off at base; punctures dense except on tapering part. The punctures are more dense and smaller near both margins of the segments. The apical fasciae of segments one to five are rather broad; the pubescence is pure white, quite short and down-like; often broken on the first two segments. The last three segments have many black, spine-like hairs, becoming dense and of a brownish color on the last segment. On the dorsal surface the hairs are sparse, long, and golden.

Legs—Stout, black; pubescence entirely ochraceous to ferruginous, or golden; floccus on the posterior femora long, dense, plumose, ochraceous; hair on posterior tibiae almost spine-like. Tibiae stout, broad at apex; spurs golden. First joint of the hind tarsi rectangular, broad, being one-third as broad as long. Pubescence of tarsi golden, spine-like. Claws sharp, medially toothed.

This species is very conspicuous, being large, with colored pubescence and wings of the same shade. The peculiar sculpture of the face, and the white abdominal fasciae easily distinguish it. On all the specimens I have the hair of head and thorax is all colored, that of fasciae on abdomen being the only white on the body.

Described from four females.

Type locality—Guadalajara, Mexico.

Colletes bombiformis n. sp.

Female—Measurements: Length 13 mm.; thorax, 4¼ mm. long by 4¼ mm. broad; abdomen, 6½ mm. long by 5 mm. broad; wing, 10½ mm. long; head, 3¼ mm. long by 3¾ mm. broad. Entirely black, except pubescence of face, very robust; thorax as broad as long; abdomen truncate or slightly convex at base.

Head—Broader than long; eyes nearly parallel; inner margins concave. Clypeus shining, very convex, covered with sparse brown and white hairs, deeply punctured, the punctures forming striae that curve in toward a narrow, rather deep groove down the center, apex subemarginate. Supra-clypeal area with large well separated punctures. Mandibles large, dark, blunt. Malar space narrow, being one-eighth to one-sixth as long as broad. Face covered with rather sparse, plumose, light brownish to gray hair, with some black on sides, and vertex; entire surface, including vertex, rather densely punctured with various sized punctures, all smaller than those on supra-clypeal area. Antennae black; scape long, shining, slightly punctured near end, with short, black hair on inner side; flagellum rather stout; joint three one and one-half times four; four equal five; all except four longer than broad. Under surface of head with sparse brown and black hairs mixed.

Thorax—Deep black, shining; all hair black, plumose, rather long, much longer on sides, metathorax and scutellum. Mesothorax with rather large, round, well separated but not sparse punctures, farther apart on disk. Scutellum with much larger punctures, very close together except on narrow strip along anterior margin. Post-scutellum rugulose. Superior face of metathorax shining with rectangular pits of various widths, all minutely covered with faint wavy lines. Posterior face with enclosure funnel shape; the top with pits similar to those of the superior face, those in middle much wider than long, those on sides longer than wide, the whole forming a sort of an arch occupying most of the bowl of the enclosure; neck of enclosure narrow; lateral faces rugose. Mesopleura with large round punctures and a somewhat brownish tinge to the black hair in places. Wings darkened; stigma small; it and nervures black; first submarginal cell of uniform width throughout, long as second and third combined. Tegulae shining black, smooth except for a few small punctures, with a fringe of light hair on outer edges.

Abdomen—Very stout, black, shining, no fasciae; a few long black hairs on base and sides of first segment; sparse short black hairs on other segments, becoming long and spine-like on apical segments. Punctures very few and small on first segment, and confined largely to apical margin, more but rather sparse on other segments. The apex of the fourth segment is broad, band-like, smooth and shining.

Legs—Robust, black. Floccus on posterior femora long, black, plumose; tibiae with long black hairs; spurs long, black, lighter at tips; first tarsal joint on posterior legs, broad, short, two and one-half times as long as broad, with rather long spine-like hairs; other tarsal joints longer, lighter, with hair almost golden on apices; claws reddish to golden, medially toothed.

This may be *C. aethiops Cr.,* but the pubescence of the thorax is not "short," and not "slightly mixed with pale on face," but is long on thorax and almost entirely pale on face. It also lacks any "palish pubescence on apical margins of segments."

Described from one female.

Type locality—Guadalajara, Mexico.

Colletes frontalis n. sp.

FEMALE—Head broader than long; eyes convex below; inner orbital margins concave. Pubescence of face peculiar; that of clypeus sparse, not plumose, white and golden mixed; space between clypeus and orbit on each side, and fringe on upper margin of supra-clypeal area silvery white and rather plumose; on each side of the supra-clypeal area, and just inside of the white fringe around the supra-clypeal area the pubescence is rather short and gray to ochraceous, with a few long black hairs on the outer margins. Area between and just back of antennae with rather long gray to ochraceous hair. The vertex and well down on the front is almost nude except for a few black hairs. The patches of silvery white on each side of the clypeus in contrast with the rest give the face a peculiar look, noticeable at a glance. Clypeus convex, broad, shining, truncate at tip; no noticeable sulcus; punctures quite large and shallow, forming longitudinal striae that are so prominent that the punctures can hardly be distinguished in some places. Mandibles very large, dark reddish, blunt, with golden hairs; mandibular lobe comparatively small, rounded, not toothed. Malar space one-eighth as long as wide. Supra-clypeal area very finely lined, not punctured. Face with large round punctures, close together. Vertex with very small sparse punctures; inter-ocellar area with larger ones. Scape of antennae long, sparsely punctured with few black hairs at apex; joint three one and one-half times as long as four; four shorter than the following ones. Flagellum sometimes brownish beneath.

Thorax—Stout, black, not very shiny. Mesothorax with large, deep punctures over entire surface, as close together as they can be in front, but little more separated posteriorly; pubescence short, gray to ochraceous, mixed with black, but black not prominent, longer on sides. Scutellum with hair on outer margin longer, almost white; inside of this is sparse fringe of black. Scutellum sparsely covered with round punctures of various sizes, mostly large; more crowded posteriorly. Postscutellum narrow, concealed by dense, long, ochraceous to white hair; punctures shallow and close together, giving rugose appearance. Superior face of metathorax with broad rectangular shining pits. Enclosure of posterior face shining, funnel shaped, bowl broad and rather shallow, with two rows of shallow pits forming an arch across the top. Sometimes the pits are obscure, but the arch is evident. Neck of enclosure narrow. Lateral faces of metathorax shining, smooth, or sometimes rough-looking, with sparse round punctures and a few short hairs. Prothoracic spine short, sharp. Mesopleura with very large round punctures, pubescence long, silvery with black intermixed. Wings clouded, nervures and stigma black, or dark brown. Tegulae dark, with golden hairs.

Abdomen black, not very shiny; base squarish; densely punctured, except first segment, which is less so at base and medially; apical segments with black and golden spines; segments one to four with white pubescent fasciae, not noticeable on the fifth; first segment with considerable long white hair. Under part of abdomen usually solid black, with no continuation of fasciae.

Legs—Black, stout. Floccus on posterior femora sparse, white; all rest dark brown, almost black. Tibiae with more sparse but dark hair; becoming a little lighter at tips. Tarsi lighter, less dense, tinged with golden. Posterior tibiæ large, stout. First joint of posterior tarsi stout, rectangular, twice as long as broad. Tibial spurs very stout, almost black on posterior legs, lighter on others. All tarsal joints on posterior legs stout, all but first triangular, about as broad as long. Claws reddish, medially toothed. Anterior femora with long white hair.

The legs, especially the hind ones, appear very stout and dark, almost black, except for the brownish to ochraceous edges to some of the joints, caused by the lighter tips to the hairs, or to the angle at which the light strikes.

Described from four females.

Type locality—Guadalajara, Mexico.

This may prove to be *C. griseus Sm.*, but it is impossible to tell from the meagre description of that species.

NOTES ON CALIFORNIA COCCIDÆ V

E. O. ESSIG
HORTICULTURAL COMMISSIONER OF
VENTURA COUNTY

Fiorinia fioriniæ var. japonica Kuw

FEMALE SCALE (Fig. 82)—Is a golden brown with a decided ridge running down the middle of the dorsum. In shape it is long and narrow, being 2 mm. long and ½ mm. wide. The scale outline containing the body proper is shown in Figures 82, C. and D. The body is very much smaller than the outside scale; oval to oblong in shape.

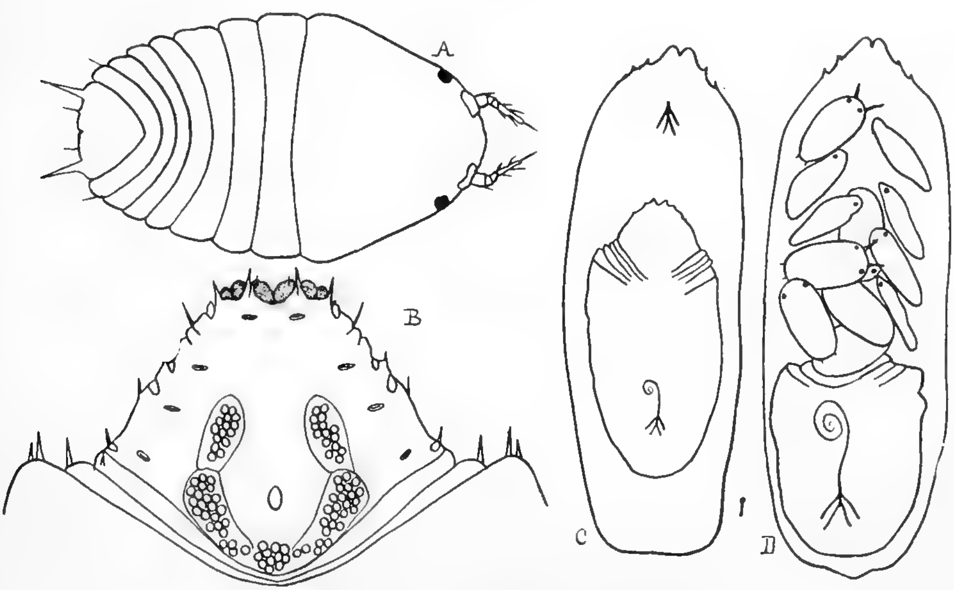

Figure 82. Fiorinia fioriniae var. japonica.

Pygidium (Fig. 82 B.)—The mesal lobes rather small and rounding, with a small hair or spine on each. A large spine separates each lobe from the second pair. The second lobe is divided to form two rather distinct lobes. There is a faint trace of a third divided lobe, but this is very obscure. A large spine separates the second from the supposed third. Four other spines appear on the margin to the first segment, and other spines follow as shown in the figure. There are few tubular spinnerets, in many forms not any showing. Usually there are four or five on each side of the pygidium. The circumgenital glands are all run together in most specimens and it is hard to draw a distinction between the lateral and median group. The approximate numbers are as follows: lower laterals—14 to 16; upper laterals—21 to 27; median—9 to 12.

According to the mounted specimen shown in Figure 82, D., it would appear that the young were born alive and crawl from beneath the shell as in the case of the ovoviviparous forms. The young body (Fig. 82A) resembles the young of most scale. The whole thorax is apparently undivided while the abdomen is markedly segmented. The antennæ are rather short and stout with the normal number of spines. The pygidium has two very distinct and stout spines—one on either anal lobe, with several smaller spines also. The eyes are black.

Food plants—*Podocarpus chinensis,* Pinus.

Habitat—A native of Japan, but shipped into this state on nursery stock; the described species was collected at Bakersfield and sent to this office by Mr. Edw. M. Ehrhorn when he was Quarantine Commissioner at San Francisco.

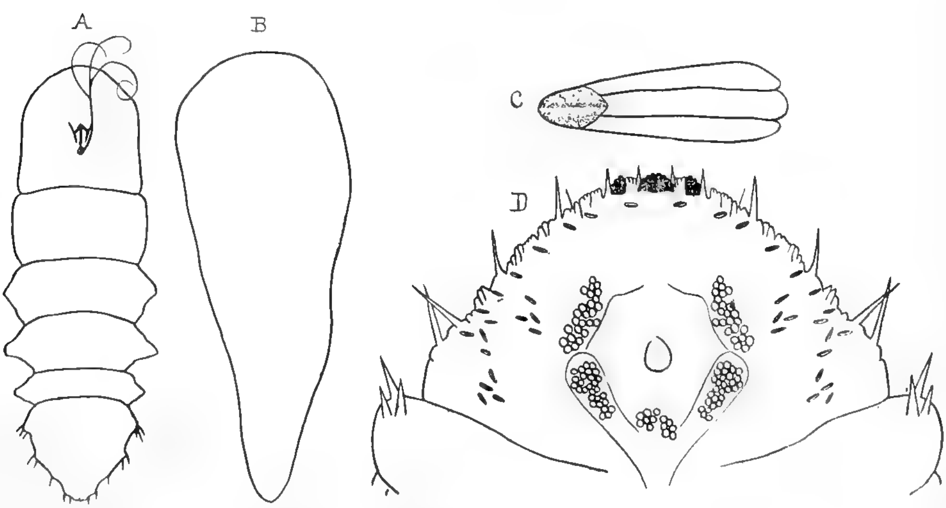

Figure 83. Hemichionaspis aspidistrae.

Hemichionaspis aspidistrae Sign

Female Scale (Fig. 83, B)—Long and narrow, differing greatly in shape. Some are oyster-shaped while others are straight with all the possible graduations between these two. In general, however, the body-end is nearly pointed and the scale gradually widens to the posterior end which is the widest and rounded. Length 2 to 2.5 mm., width about one-third the length. Color—Straw to a deep brown, and in extreme cases almost purplish-black. Exuvia about as long as the width of the body at its widest place, with a distinct ridge running down the dorsum.

Female Body (Fig. 83, A)—Nearly as long as the shell and deeply segmented. Color—yellow to brown.

Pygidium (Fig. 83, D)—None of the lobes very prominent. Median divided in the middle, but fitting together to form one well rounded mesal lobe. Second pair serrate and more or less divided into several as are all of the lobes. There are rudiments of a third, fourth and even fifth pairs of lobes all serrate and apparently divided into three lobes. The three teeth or lobes are pronounced on the mesal and second pair. The spines are unusually long and stout. They are distributed as follows: One between the mesal and second pair, this one small; one between the second and third pair, larger than the first; one between the third and fourth, and one between the fourth and fifth, both of these are very large. There are two more very large spines before the last segment of the abdomen is reached, and on this segment are three such spines. The tubular spinnerets are numerous and thickest between the anal opening and the lateral margins of the pygidium. The circumgenital glands are arranged in groups as follows; lower laterals—23 to 26, upper laterals—28 to 30, median—10 to 13.

Male Scale—Resembles the male of the genus Chionaspis. Color—white, with the exuviæ yellowish-brown. There are three distinct lobes to the male case as shown in the cut (Fig. 83 C). The length is from one-third to one-half that of the female. Adult form was not obtained by the writer.

Food plants—*Aspidistra lurida,* Orchids, Ferns, Orange, Mango, Fig, Pepper tree, *Acacia melanoxylon, Davallia moorei, Cocos plumosa, Cyanotus, Areca catechu, Platycerium,* etc.

Habitat—The writer's specimens were taken from Platycerium and Boston Fern in a Pomona greenhouse. It has been reported in quarantine at San Francisco and from the following other places: France, England, India, Formosa, Japan, Ceylon, Australia, Brazil, Trinidad, Canada (greenhouse), Massachusetts, Washington, D. C.

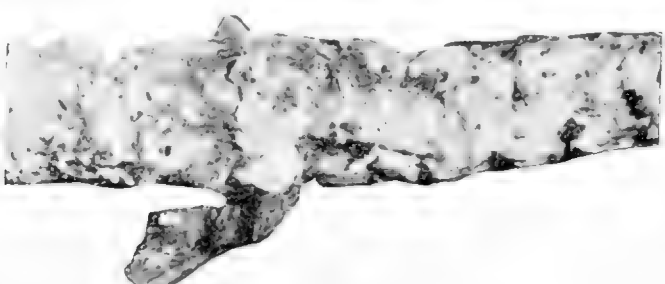

Figure 84. Aulacaspis rosae.

Aulacaspis rosæ (Bouche) **Rose Scale**

Female Scale (Fig. 84)—Nearly oblong to round, with irregular margin. Diameter 2 mm. Color—nearly white or gray, with exuviæ yellow or brown. Texture very thin and fragile.

Female Body (Fig. 85 B)—Brown, turning red when boiled in KOH, larger at the anterior end and tapering towards the posterior, more or less triangular. Body segmented near the pygidium as shown in the cut. A large dark spot marks the location of the mouth parts.

Pygidium (Fig. 85 A)—Lobes not very well developed. Mesal serrate and approximate at base, but diverging. The second pair is distinct with inner lobe largest. Of the smaller third pair the same is also true. The fourth pair is not at all distinct and the fifth pair entirely wanting. All of the lobes are markedly serrate. The spines are prominent and distributed as follows; short one between the mesal and second, but this is longer than the lobes; one between the second and third; one between the third and fourth and two more on the margin of the pygidium towards the anterior end. These spines are all large. On the abdominal lateral margins are from two to three stout spines. The tubular spinnerets are few in number—six to seven on each side of the anal opening. The circumgenital glands or spinnerets are arranged in the following groups: upper laterals—19, lower laterals—24, median—15.

Male Scale—Resembling that of the *Hemichionaspis aspidistrae* already figured. It is white, tri-lobed, and about half as long as the female scale. Adult form not obtained.

Figure 85. Aulacaspis rosae.

Food plants—Infesting the canes of the Rose, Blackberry, Raspberry, Loganberry; also the Grape, Strawberry, Myrtle, Pear, Ailanthus, Cycas, Mango, etc.

Habitat—Common in many parts of this state and particularly harmful to berries in Ventura County. It has also been reported from Europe, Japan, Australia, New Zealand, Hawaiian Islands, Demerara, China, Fiji, Chili, West Indies, Mexico, Canada, New York, Florida, Ohio.

Treatment—The Blackberry, Raspberry and Loganberry of this county are often greatly damaged by this scale. Working on the canes near the base or even to the crown of the roots as it does, it takes some care in applying remedial measures. Kerosene Emulsion or Distillate sprays are effectual, but I have found the Crude Carbolic Emulsion more effective upon this insect. Remove the soil to the crown of the roots and apply the spray in the winter when the canes are bare and dormant. Cover with soil after the application so as to keep roots protected. Apply again as often as the scale appears, being careful each time to spray down as far as the scale go on the canes.

Diaspis bromeliae Kern. Pineapple Scale

FEMALE SCALE—Nearly circular, flat, with more or less uneven margin; diameter, 2 mm.; color nearly white, with first exuvia yellow.

FEMALE BODY (Fig. 86 B)—The general shape is that of most of the members of this genus—it being oval at the anterior end and tapering towards the posterior end—nearly triangular. The color is a light yellow to almost brown, with a faint tinge of blue or purple in some. Diameter of the body—taking the longest measurements possible—rarely exceeds 1 mm.

Pygidium (Fig. 86 A)—Mesal lobes separated by two distinct spines; depressed on the inner margins. Secondary lobes divided or forked and depressed on the outer margins. Third pair of lobes and fourth pair like the second—bifurcate and depressed or serrate on the outer margin. Spines are stout and prominent; arranged as follows: two between the mesal lobes, one between the mesal and second pair, one between second and third pair, one between third and fourth pair—also a slender spine or hair. Seven very stout spines between the fourth pair and the last abdominal segment preceding the pygidium, two on this last segment. Tubular spinnerets numerous and distributed over nearly the whole surface of the pygidium.

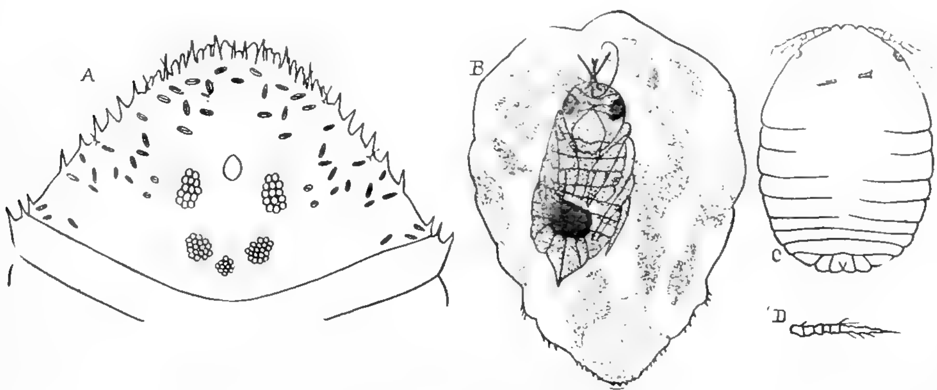

Figure 86. Diaspis bromeliae.

Distribution of the circumgenital glands is as follows: Lower laterals—12 to 15; upper laterals—17 to 19; median—10 to 13.

The female body shown in the cut is parasitized—the nearly full grown parasite showing plainly.

Young (Fig. 86 B)—Oval or nearly round, flat, slightly segmented towards the posterior end. Antennæ six—articled and normally haired. Legs very small—not showing when viewed dorsally. Anal lobes without spines.

Food plants—Pineapple, *Bromelia, Pinguin, Hibiscus, Canna, Ivy, Billbergia zebrina, Olea fragrans.*

The described specimen was taken from a pineapple in a Pomona greenhouse, where it was quite thick. It has been reported from Europe, greenhouses in all parts of the United States, Hawaiian Islands, and Mexico

Strangely it has never been reported from Florida—the home of a great pine-apple industry.

Diaspis echinocacti cacti Comst

FEMALE SCALE (Fig. 87)—Light gray in color with a dark apex—this apex or first exuvia is usually near one edge of the shell. The diameter is from 1½ to 2 mm.

Body (Fig. 88B)—The younger form (Fig. 88 A) is nearly round, without signs of segmentation. The adult form (Fig. 88 B) is more or less heart-shaped and much segmented near the posterior end.

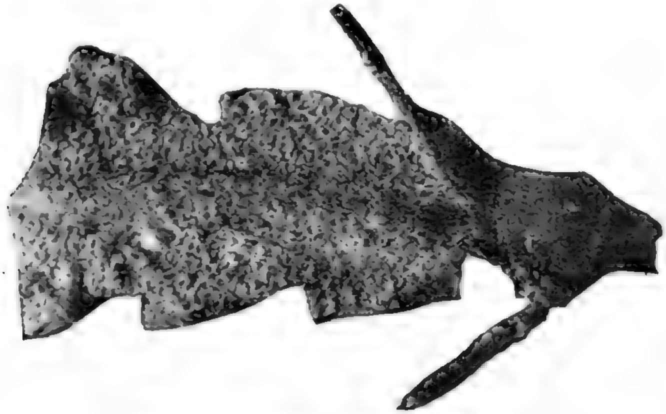

Figure 87. Diaspis echinocacti var. cacti.

Pygidium (Fig. 88 C)—Median lobes are smooth and single. Second pair lobes are smooth and double. Third lobe is a single smooth lobe. Fourth lobe is double and smooth. There is also a rudimentary fifth lobe. Between the two median and also between the median and the second pair lobes are two fumbriated plates. Between the second and third lobes is a single stout spine; one spine between the third and fourth; and two between the fourth and fifth. There are four more spines before the first segment. Spinnerets are very numerous all over the surface of the pygidium. Median groups consist of 14 to 16, laterals nearly the same number. The tubular spinnerets are widely distributed.

MALE—Resembles the male pupacases of all the genus Diaspis. They consist of a small dark body, and a long white sac with three parallel lobes running the entire length of the sac. The adult form was not obtained.

Food plants—*Cereus giganteus, C. macrogonus, Echinocactus.*

Habitat—This specimen was taken at Guadalajara, Mexico, by D. Crawford. It has been reported from greenhouses in northern United States, New Mexico, Brazil, India, Mauritius.

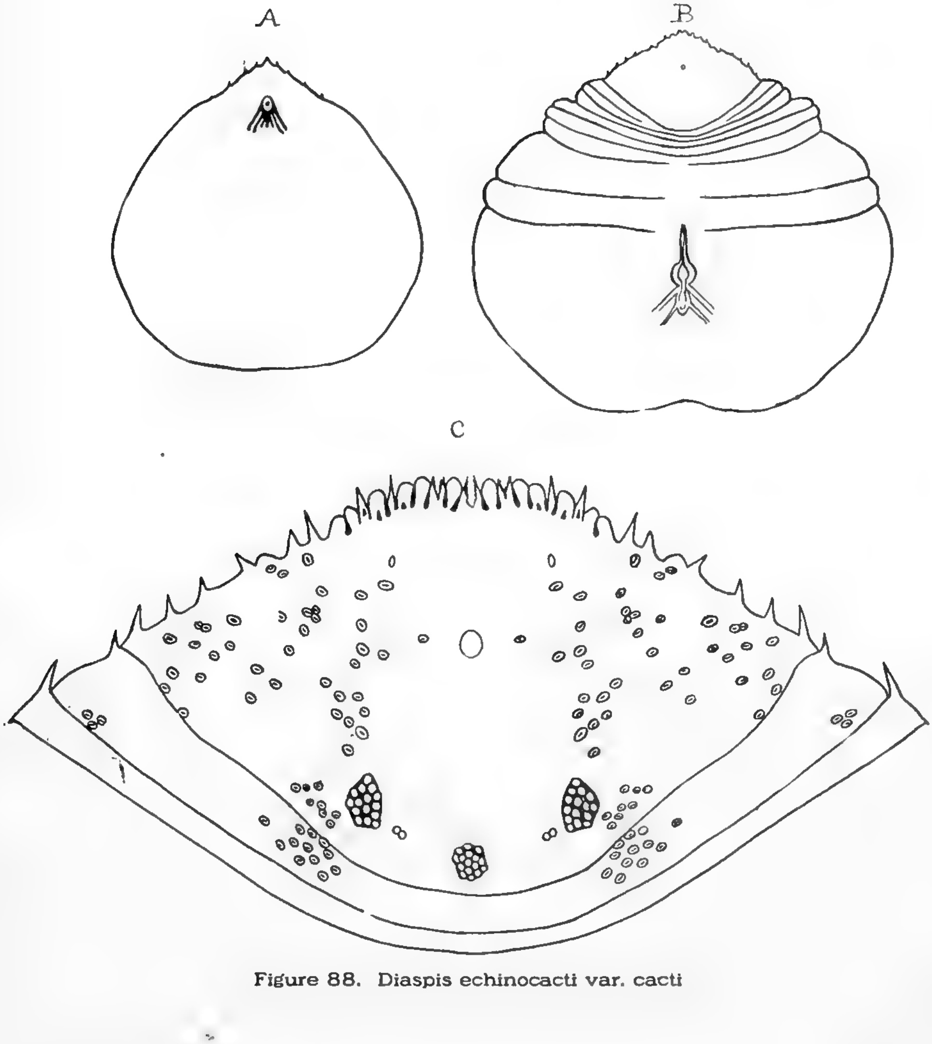

Figure 88. Diaspis echinocacti var. cacti

Saissetia hemisphaerica (Targ)

Hemispherical Scale

This scale (Fig. 89) is very widely distributed, especially in the regions along the coast. In this county (Ventura) it is very numerous along the entire sea-border, feeding on a great variety of plants. The photo shows a normal condition of a Bignonia infested with this scale, growing on the grounds of the County Court House.

It is a special greenhouse nuisance, working on nearly all the ferns, palms, etc., and has been distributed on such stock.

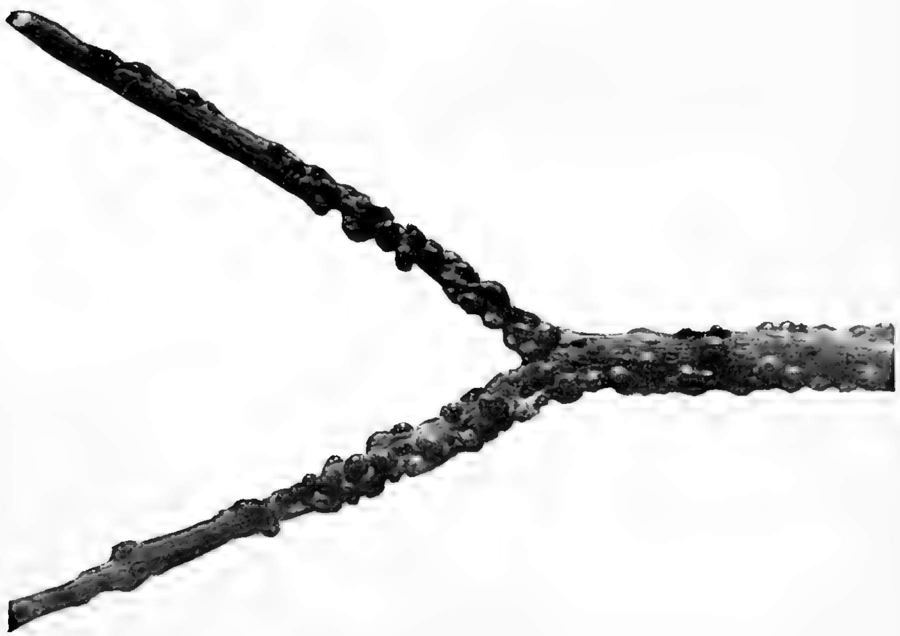

Figure 89. Saissetia hemisphaerica.

The citrus trees do not escape its attacks, but no serious damage has been done to them. The scales usually settle around the edges of the leaves and are easily recognized by their smooth, hemispherical, brown bodies. At some periods of the year it infests these trees almost as badly as the Black Scale, but is not as persistent. This is especially true in the localities of Ventura and Oxnard. In the interior it is seldom found on the citrus trees at all, and few orchardists know of its existence.

In the greenhouses it is usually handled with sprays such as Kerosene Emulsions, etc. Fumigation will get it in the orchard.

The parasite of the Black Scale, *Scutellista cyanea,* works on this scale also with about the same efficiency.

Pseudococcus nipæ (Mask)

The Host Index to California Coccidæ, by Prof. C. F. Baker and the author, shows it to feed on the following California plants: Maiden-Hair Fern, *Aralia sieboldi,* Betel Nut, Ghost Plant, Boxwood, *Camellia,* Orange, Pomelo, Citron, Lemon, Cocoanut Palm, Ferns, Geranium, Oleander, Boston Fern, Peach, Pepper Tree, Nightshade.

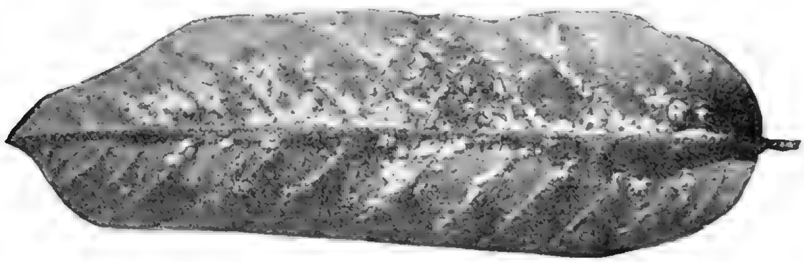

Figure 90. Pseudococcus nipae.

Habitat—Found in practically all parts of the world.

FEMALE (Fig. 90)—The covering of the dark body is a creamy white, and in texture greatly resembles that of *Ceroputo yuccae* (Coq.), especially the

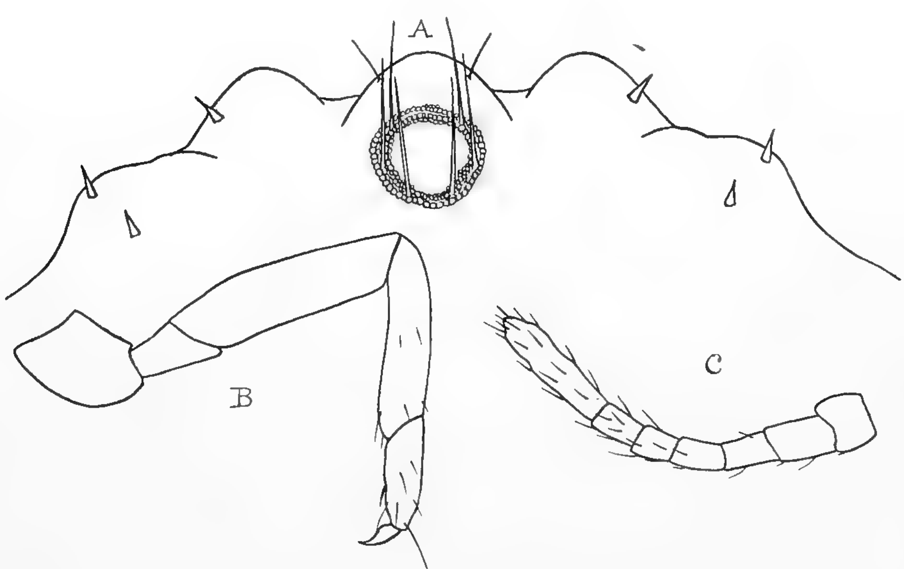

Figure 91. Pseudococcus nipae.

young forms. The forms obtained seem to be the winter broods according to the peculiarity of the antennæ which are 7-articled on all of the specimens obtained. This may also be due to the fact that no fully matured adults were taken. Whatever the case may be, I am only able to present the material as it came to me.

Antennae (Winter form) (Fig. 91 C)—7-articled; the comparative lengths of the respective articles, beginning with the longest, are as follows: 7, 2, (3, 4), 6, (1, 5). All of the articles are normally hairy.

Legs (Fig. 91 B)—Coxa and tarsus coequal, femur a little longer than the tibia. Tibia nearly twice as long as the tarsus. Only a few hairs on the tibia and tarsus.

Pygidium (Fig. 91 A)—Furnished with six circumanal spines, but no spines in evidence on any of the anal lobes. There are two small hairs on the median lobes. On the first lobe is one stout spine and two such spines on the second lobe.

Male—The adult form has not been obtained. The pupa cases are about 1 mm. in length, cylindrical, and snow white. They are seen in great numbers on the guava leaf in the photograph (Fig. 90).

Food plants—Crawford found this very abundant on the Guava. It has been reported on *Nipa fruticans,* and palms.

Habitat—Collected by David Crawford on Guava in the neighborhood of Guadalajara, Mexico. It was also taken by others from Demerara, Mexico.

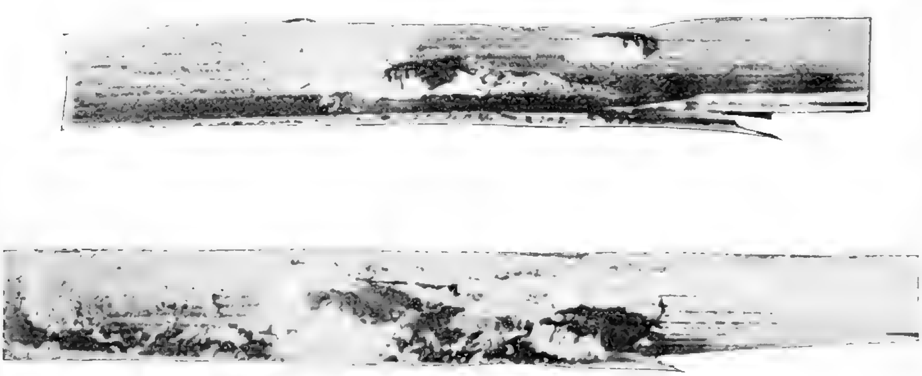

Figure 92. Ripersia smithii.

Ripersia smithii n. sp.

Adult Female (Fig. 92)—Body decidedly long and narrow or elongate-elliptical in form. Length 4 to 6 mm.; width 1.5 to 2 mm. Color, pinkish to slate. The waxy covering is very fine and scarcely hides the color of the body. The waxy appendages are rudimentary and imperfect and the segmentation indistinct. When boiled in KOH the body first becomes pink and later perfectly colorless and transparent.

The antennae (Fig. 93 A) are 7-articled and normally placed on the head. They are very distinctly seen with the unaided eye in some specimens. Many specimens were examined with three normal ones drawn and showing the following formulæ:

One specimen—7, (1, 2, 4), 6, 5, 3.
One specimen—7, 1, (2, 4), 6, 5, 3.
One specimen—7, (1, 2), 6, 4, 5, 3.

The antennæ on the same specimen usually agree, but these often differ to a marked degree.

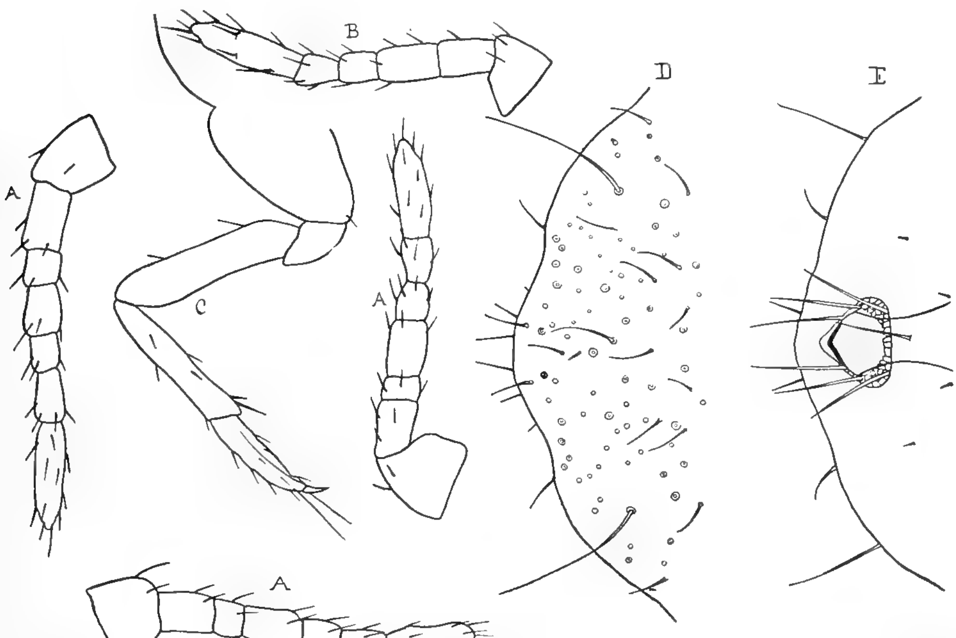

Figure 93. Ripersia smithii.

Legs (Fig. 93 C)—Normal, with few hairs. Coxa large and as long as the tibia. Femur longer than tibia. Tibia one-third times the length of the tarsus. Claw normally curved.

Pygidium (Fig. 93, D and E)—Normal with six anal spines. In one specimen there was a spine just before the anal opening (Fig. 93 E). This is not usually present. Lobes not prominent—with no spines in adult form—a few short hairs. In the young there are two short stout spines and several hairs forming a sort of tuft. The ventral surface has very few hairs or spines. The dorsal surface has many hairs and two long lateral hairs or spines, these appear on the lobes of the younger forms.

There is a great difference in the pygidium of the respective ages, but all adults examined were egg-laying and the largest obtainable.

Eggs—Elliptical, very small, yellow in color. Laid in a white, cottony or waxy secretion—usually in masses beneath the female body, but at times in large irregular masses filling the entire culm of the infested grass. This shows in the photo (Fig.).

Young—Of the same general shape as the adult. Color almost white—sometimes dark pink. Antennæ (Fig. 93 B) sometimes 6-articled, with first three articles co-equal. Normally haired. Pygidium with two spines on lobes, 6-circumanal and two stout spines on lobes forming tufts.

Habitat—Found in many sections of this county (Ventura) feeding upon the Wild Rye, *Elymus condensatus*. It may be found between the blades and

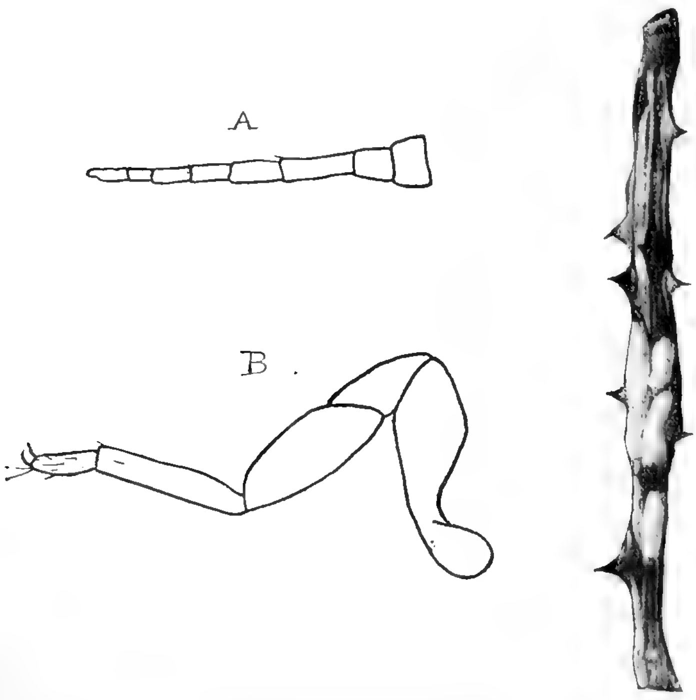

Figure 94. Lichtensia parvula.

the culm or within the culm if there is a place for entering—such an entrance is sometimes afforded by holes bored through the culm by the larva of a moth. Within the culm the eggs are often massed in great quantities and the young crawl out upon hatching.

The tips of the culms are usually more liable to be infested than any other part of the plant, where the last blades form an axil.

Due to its habits of life, the bodies are very flat to admit them between the close fitting blades and the culm. Here the eggs are usually laid in oblong masses, beneath the female.

The first specimens were taken in July, 1909, when they appeared to be quite plentiful. Last month (March, 1910) they were still to be found, but only in limited numbers—however, all stages were present. A search made on other plants and on the roots of the Wild Rye revealed none.

A small lady bird beetle was found feeding upon it in considerable numbers at first, but later search revealed none of these for identification.

It seemed at first likely that this species was *Ripersia festucae* Kuw., but there are plenty of characters different enough to make it a new species. It is named in honor of Mr. P. E. Smith, who was probably the first to discover it and to whom I am much indebted for this and other good things.

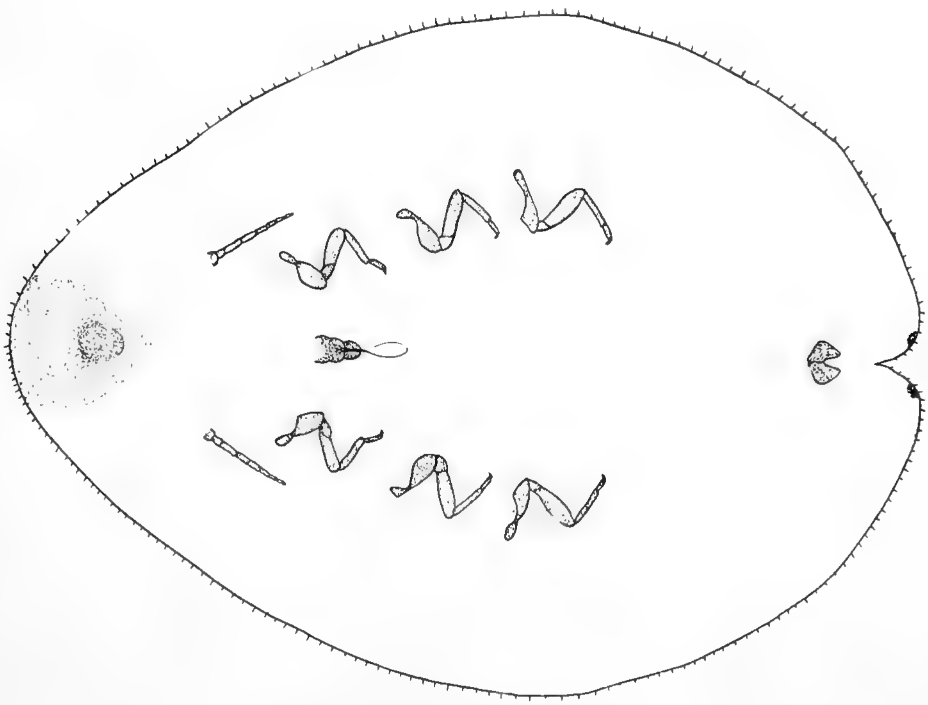

Figure 95. Lichtensia parvula.

Lichtensia parvula (Ckll)

ADULT FEMALE (Fig. 94 C)—This scale resembles greatly the genus *Pulvinaria,* as the photograph shows. The general color is the same, the body being dark and the long cottony egg-sac, white. The length of the entire Scale varies from 10 mm. to 14 mm.

Body Proper (Fig. 95)—About one-third the length of the scale. The color is dark brown. Shape—oblong to oval. A row of short spines extends entirely around the lateral margins of the insect.

When boiled in KOH the body becomes transparent except the anterior end, the anal opening, and the appendages. The general texture of the body appears fibrous and large muscles are attached to the legs.

Antennae (Fig. 94 A)—Remain brown, have very few hairs, and are 8-articled.

Legs (Fig. 94 B)—Also remain brown and are nearly glabrous. Coxæ are very large and are nearly as long as the femur. The femur and tibia are coequal, and twice as long as the tarsus.

Anal Opening—Is the same as that of the genus Lecanium, consisting of two somewhat triangular lobes on either side of the aperture proper.

Food plants—Reported by Crawford on Mesquit (*Proposis juliflora*), on *Mimosa* by Cockerell.

This form was collected, by David Crawford, from the hills around the city of Gaudalajara, Mexico, last summer and is one of the many interesting forms sent by him.

APHIDIDÆ OF SOUTHERN CALIFORNIA IV

E. O. ESSIG

Aphis gossypii Glover

Winged Viviparous Female (Fig. 96 A)—Length 2 mm., width 0.7 mm.; wing expansion, 7.8 mm. *Prevailing color*—dark slate, but a woolly secretion gives it a whitish appearance. In mounted specimens the general tone is dark-brown; the thorax darker than the abdomen, which may even appear green. *Head* narrower than thorax, twice as wide as long. *Compound eyes* coarsely granulated, red, with prominent terete tubercles just behind the outer margins. These tubercles extend at right angles to the margin. *Antennae* (Fig. 96 B) do not arise from frontal tubercles, two-thirds as long as the body, 6-articled.

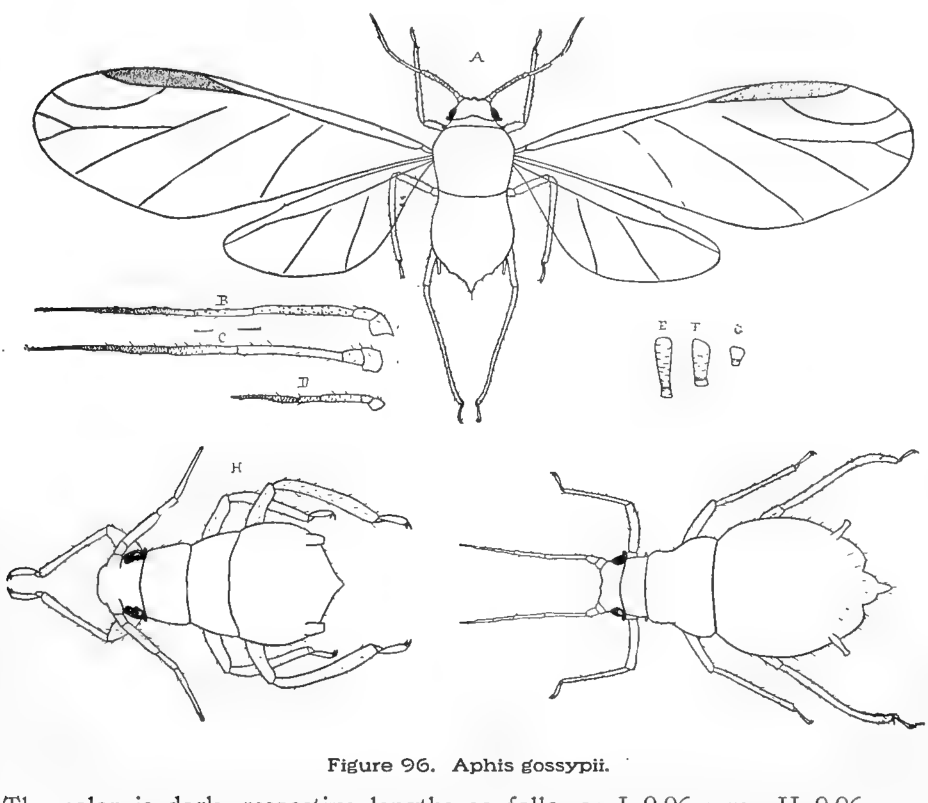

Figure 96. Aphis gossypii.

The color is dark, respective lengths as follows: I 0.06 mm., II 0.06 mm., III 0.5 mm., IV 0.2 mm., V 0.15 mm., VI 0.3 mm. The sensoria are distributed very freely over article III and sparsely over IV. There is one on V and several marginal in the nail-like process of VI. All articles are somewhat hairy. *Prothorax*—with a small lateral tubercle. *Rostrum*—reaches to mesothoracic coxæ. *Abdomen*—covered with a cottony wax, which gives it a whitish color in the living forms. This does not show in the cut. Slightly hairy. *Cornicles* (Fig. 96 E)—Somewhat incrassate, dark, as long or longer than the style. *Legs*—moderately long and hairy. Wings—hyaline with a dark stigma. *Primary*—length, 3.5 mm., width 1.2 mm. *Sub-costal,* straight. *Stigma,* dark, long, narrow, and nearly rectangular in shape. *Stigmal* arises from center of stigma, and is curved gradually to the margin of the wing. *Third discoidal*—straight, does not arise from the sub-costal, twice forked, the first and second branches arising from the fork not far from the wing-margin. *Second discoidal*—Curves slightly toward the body. *First discoidal*—also curves toward the body. *Secondary*—Length, 1.5 mm., width, 0.5 mm. *Sub-costal* extends to wing tip. *First* and *second discoidals* nearly the same length and nearly straight. *Style*—conical and hairy.

(Vein terminology changed as follows—Cubitus to sub-costal; radius to stigmal; obliques to discoidals.)

Apterous Viviparous Female (Fig. 96 I)—Length 3 mm., width 1¼ mm. Color, dark brown to almost black. Differs from the winged form as follows: Body very much more robust and has appearance of some members of the Genus Lachnus. *Antennae* (Fig. 96 C) without sensoria except in the nail-like process. Cornicles (Fig. 96 F).

Nymph of Apterous Viviparous Female (Fig. 96, D, G, H)—Resemble greatly the adult, but are much lighter in color. The cut shows the principal characteristics. This form was collected by C. H. Vary of Pomona. It was infesting orange trees of that locality very badly, and promised to do severe damage. The general appearance was very much of a Lachnus and so I marked it until it was studied out. The cottony covering and short antennæ led to this belief. The wing structure and general characteristics undoubtedly place it in the genus Aphis. Ashmead had named this species *citrifolii* and *citrulli,* as found on orange and melon. Forbes had named the cucumber form, *cucumeris,* while Weed again named it *forbesi.*

Food plants—(After Theodor Pergande, in Insect Life, Vol. VII, p. 313) Purslane (Portulaca oleracea); Shepherds-purse (Capsella bursa-pastoris); Pepper-grass (Lepidium virginicum); Amaranthus sp.; Dock (Rumex crispus and other species); Burdock (Lappa major); Dandelion (Taraxacum dens-leonis); Pigweed (Chenopodium album); Wormseed (Chenopodium anthelminthicum); Plantain (Plantago virginica); Chickweed (Stellaria media); Morning Glory (Convolvulus sp.); Three-seeded mercury (Acalypha virginica); Button-weed (Diodia teres); Ground Ivy (Nepeta glechoma); Red Clover (Trifolium pratense); Indian Strawberry (Fragaria indica); Mallow or Malva (Malva rotundifolia); Cultivated Strawberry (Fragaria); Dwarf Bean (Phaseolus nanus); Spinach (Spinacia oleracea); Hop (Humulus lupulus); Cotton (Gossypium herbaceum); Pear (Pyrus comminis); European Dogwood (Cornus mas); Orange (Citrus aurantium and other varieties).

Chaitophorus populicola Thos

In Vol. I, No. 4, December, the following measurements of *Chaitophorus populicola* are correct: Length 1.5 to 2 mm., width 1 mm., wing expansion 7 mm. Primary wings, 3 mm.; secondary, 2 mm.

CALIFORNIAN EMESIDÆ (*Hemiptera*)

C. F. BAKER

These remarkable insects are constantly being brought to the attention of both entomologist and layman. Mr. Banks has recently given a synopsis in "Psyche" of all of the known species of the United States, including California. However, several common Californian species do not appear in his synopsis, and three of these are apparently new to science.

Herewith we present a complete synopsis of the genera and species of the State, so far as they are known to us. With the new species presented in this paper, the Californian list is as follows:

1. *Ploiariopsis reticulata* Baker.
2. *Ploiaria californiensis* Baker
3. *Ploiariodes californica* Banks.
4. *Barce banksii* Baker.
5. *Emesa brevicoxa* Banks.

TABLE OF CALIFORNIAN GENERA

(After Banks)

The Arizonian *Luteva* is included since it will probably be found in California.

A. Trochanter I bearing two small spines; tibia I not half as long as femur I.
 B. Antennae hairy .... *Ploiariopsis.*
 BB. Antennae not noticeably hairy .... *Ploiaria.*

AA. Trochanter I without spines.
 B. Tibia I nearly as long as femur I.
  C. Prothorax shorter than head and sub-connate with mesothorax .... *Ploiariodes.*
  CC. Prothorax longer than head and distinct from mesothorax. *Luteva.*
 BB. Tibia I hardly one-half as long as femur I.
  C. Tylus very prominent; prothorax distinctly separated; head fully one-half as long as coxa I .... *Barce.*
  CC. Tylus not prominent; prothorax not distinctly separated; head less than one-half as long as coxa I .... *Emesa.*

Ploiariopsis reticulata n. sp.

Length of body 9 mm. Dark brown, mesonotum with two paler streaks. Antennae straw colored with basal article and region of second articulation piceous, the two long articles thickly covered with long soft hairs. Coxae and tibiae I pale, the former once banded, the latter dark towards tip. Legs II and III straw colored with three small dark bands on femora. Wings rather heavily reticulated with dark smoky lines and spots in the cells, the veins unmargined, the markings along the median area distally becoming merged into a broad dark stripe.

Femur I (Fig. 97, H, I, J) with about five large spines and fourteen small ones. Tarsus I just reaches the spined tip of coxae. Head longer than prothorax, the eyes very large and prominently bulged below lower margin. Prothorax strongly constricted posteriorly, the hind margin strongly prominent all around. Frontal lobe of head strongly swollen and broadly rounded.

This very pretty species is common at Claremont, California. Our specimens collected partly by C. F. Baker and partly by Charles Metz. It is nearest *hirticornis,* but differs in coloration of wings, in the spineless head, prothorax much shorter than mesothorax, etc.

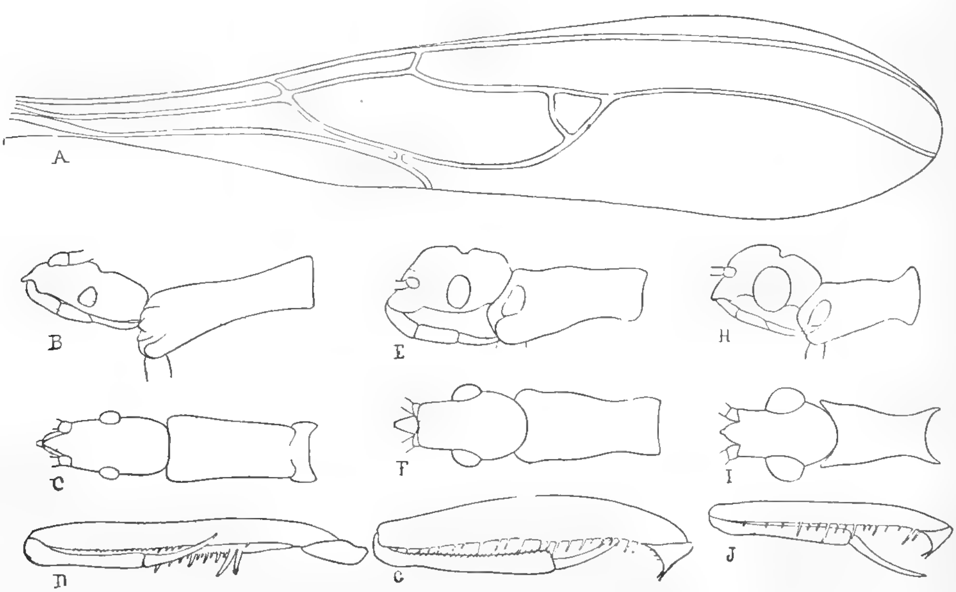

Figure 97. B-D, Barce banksii; E-G, Ploiaria californiensis; A, H-J, Ploiariopsis reticulata

Ploiaria californiensis n. sp.

Length of body 9 mm. Dark brown, legs and antennae pale yellowish, a stripe under femur I, spot under tip of tibia I, region of second articulation in antennae, and tips of tarsi, dark brown. Beak not distinctly banded. Wingless.

Head spineless. Pronotum (Fig. 97, E, F, G) almost exactly the length of head as viewed from above. Femur I with about six or eight large spines, and about sixteen small ones. Tarsus I does not quite reach the spined tip of coxa. Tibia I strongly haired within. Prothorax somewhat constricted posteriorly, but none of the margins or angles prominent. Face with a strong transverse furrow at base of tylus.

Taken at Claremont, California. Differs from either *carolina* or *texana* in armature of femur I, proportions of head and thorax, etc.

Ploiariodes californica Banks

Specimens taken by me near Stanford University a number of years ago fit the description of Banks, which description is, however, extremely brief.

Barce banksii n. sp.

Length of body 10 mm. Body pale brown, the legs lighter. Femur I with a twice interrupted brown band beneath, tibia I white banded at center and with a brown tip. Femora II and III with a single brown band preceded by a white band, near tip. Tibiae II and III with two small white bands near tips. Mesonotum rather strongly tricarinate. Our specimens are wingless.

Femur I (Fig. 97, B, C, D) grooved beneath and with about four large spines, the two proximal of these very large, and in addition many small ones. Tarsus I reaches about three-fifths the length of femur. Head a little shorter than pronotum, the eyes very small. Pronotum with a sudden constriction at sides near posterior border. The last ventral segment in the male broadly rounded apically below, as viewed from the side, and projecting strongly caudad of the last dorsal.

Taken in the mountains near Claremont, California, by C. F. Baker. Nearest to the eastern *fraterna*, but differing in genital and other characters.

Emesa brevicoxa Banks

Our largest and most abundant species. Often congregates in large numbers about barns and sheds, groups frequently resting in one place with very little movement, for many days consecutively, in the Fall.

AMERICAN PSYLLIDÆ I (Triozinae)

D. L. CRAWFORD

Although the Psyllidae have been quite thoroughly studied in Europe, chiefly by Dr. Franz Low, still the knowledge of the group in America is very scanty. A few papers have been published by E. A. Schwarz and by the late Mr. Riley and others, but no attempt has been made in America to systematically study this most interesting and important group as a whole. The large collection of Psyllidae presented to Pomona College by Prof. C. F. Baker, and also the extensive C. F. Baker collection from the National Museum at Washington are now before me for systematic study. These collections include specimens from the majority of the states, and also from Mexico and Central America.

In this first paper, I present a provisional key to the genera and species of the subfamily *Triozinae,* together with the first installment of descriptions of the new species. Although the key is only provisional and will probably be extensively revised before the completion of the work, still I have chosen what seemed to me after very careful comparative study of the two collections to be the best diagnostic characters. It is quite possible that a few of the American species will be found to be identical or closely related to some European forms; representatives of many of the European species have been placed at my disposal, but not enough of them to make a systematic comparison.

In making the synopsis of genera of the subfamily, I am unable, from Mr. Scott's characterization of his genus *Petalolyma,* to find any generic differences between that genus and the typical genus *Trioza.* From the brief and wholly inadequate descriptions of *Trioza diospyri* Ashmead, *T. magnoliae* Ashmead and *T. pyrifoliae* Forbes, it is impossible to include these in the synopsis of species; it seems quite probable, however, that *T. magnoliae* is closely related to *Paratrioza arbolensis n. sp.*

In this and subsequent studies, the term *facial cones* is applied to the conical structures projecting outward or downward from the face; the term *frontal plates* is applied to the flat discal area of the upper anterior portion of head, whether that area is raised plate-like or not.

SYNOPSIS OF THE GENERA OF THE SUB-FAMILY TRIOZINÆ

A. Radius longer than basal portion of subcosta.
- B. Facial cones entirely wanting. Fore femora long and distinctly broadened .... *Rhinopsylla* Riley.
- BB. Facial cones not entirely wanting.
  - C. Labrum very large and distinctly visible below and between facial cones; facial cones extremely short and very broad and broadly rounded when viewed from in front, with antennae inserted near their base; cones slightly projecting beyond insertion of antennae. .... *Paratrioza* n. gen.

CC. Labrum not visible from in front below the facial cones; facial cones at least moderately long and acute, and more or less divergent. Wings usually rather pointed apically, sometimes broadly rounded.......... *Trioza* Forster, and *Petalolyma* Scott.

AA. Radius shorter than basal portion of subcosta; discoidal portion of subcosta almost wanting.......... *Ceropsylla* Riley.

SYNOPSIS OF THE GENUS PARATRIOZA

A. Frontal plates distinctly raised plate-like; head and thorax conspicuously striped, usually black and white, or yellowish white; without emargination between frontal plates. Thorax distinctly arched.

  B. Anterior ocellus not visible from in front, under projecting frontal plates. With distinct fovea on each frontal plate posteriorly.
  .... *Paratrioza ocellata* n. sp.

  BB. Anterior ocellus quite distinctly visible from in front; frontal plates not projecting so much. Without marked fovea on frontal plates.

    C. Stripes around frontal plates and on thorax white or nearly white.
    .... *Paratrioza pulchella* n. sp.

    CC. Stripes orange colored, not very conspicuous.
    .... *Paratrioza pulchella flava* n. var.

AA. Frontal plates not raised plate-like. Head and thorax not striped as above. Thorax scarcely arched; pronotum scarcely depressed.

  B. With deep emargination between frontal plates. Radius shorter than second cubital. Pronotum not arched.

    C. First marginal cell larger than second; first cubital scarcely as long as first furcal; wing very acute apically. Labrum not conspicuously protruding, closely lying against ventral surface of head. Body large, greenish yellow throughout.
    .... *Paratrioza arbolensis* n. sp.

    CC. Marginal cells subequal; rather small. Labrum very conspicuous, subpetiolate and globose. Frontal plates deeply depressed obliquely, with a deep emargination anteriorly at median suture, and anterior ocellus at apex of emargination. Color of body black to brownish yellow, rather small. Two basal antennal segments rather stout.......... *Paratrioza antennata* n. sp.

  BB. Without deep emargination between frontal plates. Pronotum heavy and strongly arched. Facial cones (lobes) quite large and globose. Radius longer than second cubital. Body small, greenish yellow.
  .... *Paratrioza medicaginis* n. sp.

SYNOPSIS OF THE GENUS TRIOZA

A. Pronotum rather broad and not depressed below anterior margin of mesonotum; mesonotum broad anteriorly and not subtriangular.

  B. Wings rounded or roundly pointed apically. Radius longer than second cubital; fourth furcal about one-third as long as second cubital.
  .... *Trioza collaris* n. sp.

BB. Wings pointed apically. Prothorax broader than usual.

C. Radius shorter than second cubital. Discal area of vertex with a deep fovea on each side of median suture posteriorly; pronotum with a distinct pit on each side; facial cones subhorizontal. Wings more or less clouded or blotched.

D. First marginal cell much larger than second; fourth furcal less than one-fourth as long as second cubital. With a large macula covering second marginal cell and part of cubital cell. Wing not acutely pointed at tip. .... *Trioza maculata* n. sp.

DD. Marginal cells subequal; fourth furcal fully one-third as long as second cubital; wings somewhat clouded, but without distinct maculae or spots; wings acutely pointed at tip. .... *Trioza acutipennis* n. sp.

CC. Radius very much longer than second cubital. Pronotum without pits; discal pits less pronounced. Facial cones horizontal. Wings not clouded........ *Trioza bakeri* n. sp.

AA. Pronotum depressed; mesonotum roundly pointed anteriorly and more elevated than pronotum.

B. Facial cones not vertical, distinctly visible from above.

C. Radius distinctly shorter than second cubital.

D. Wings with dark maculae and bands; body dark with lighter areas. Facial cones rather small and subacute. .... *Trioza maculipennis,* n. sp.

DD. Wings clear, not blotched.

E. Facial cones short, stout and very blunt at tip. Second marginal cell extremely large; fourth furcal nearly as long as second cubital; wings very large and acutely pointed. .... *Trioza latipennis* n. sp.

EE. Facial cones normal; second marginal cell not unusually large.

F. Body small, greenish yellow throughout. Frontal plates depressed longitudinally in center, elevated along median suture; facial cones not acute. Radius very short, not longer than basal and discoidal portions of subcosta combined........ *Trioza viridis* n. sp.

FF. Body medium, orange colored. Frontal plates depressed obliquely; facial cones acute. Radius almost as long as second cubital. .... *Trioza frontalis* n. sp.

CC. Radius as long as, or longer than second cubital.

D. Wings more or less pointed apically. Frons and facial cones black; discal area of vertex quite deeply depressed. .... *Trioza nigrifrons* n. sp.

DD. Wings distinctly rounded apically.

E. Wings clouded; marginal cells unusually small; first and third furcals very short, second and fourth longer. .... *Trioza tripunctata* (male) Fitch.

EE. Wings clear; marginal cells normal.

F. Frons and facial cones whitish. Radius about as long as second cubital........ *Trioza albifrons* n. sp.

FF. Frons and facial cones not whitish.

G. Radius about as long as second cubital; second cubital short; first marginal cell larger than second. Anal abdominal segment white, the rest dark........ *Trioza rotundipennis* n. sp.

GG. Radius much longer than second cubital; marginal cells subequal. Abdomen entirely light colored........ *Trioza similis* n. sp.

BB. Facial cones vertical, or nearly so, scarcely visible from above.

C. Facial cones more or less divergent. Marginal cells subequal and of medium size.

D. Genital segment of female very short, without exserted ovipositor blade.

E. Wings slightly but distinctly fulvous, roundly pointed apically; margin of clavus (anal angle) usually heavy and black. Discal portions of vertex broadly depressed on each side of median suture; facial cones quite strongly divergent. Abdomen usually greenish white ventrally, darker dorsally........ *Trioza fulvida* n. sp.

EE. Wings not fulvous, distinctly transparent and shining.

F. Facial cones quite strongly divergent.

G. Facial cones moderately acute at tips.

H. Frontal plates yellow around margin and along median suture; facial cones long, usually somewhat subvertical. .... *Trioza varians* n. sp.

HH. Frontal plates not yellow as above.

I. Frontal plates depressed as in *T. fulvida*; cones quite vertical, medium in length........ *Trioza fulvida similis* n. var.

II. Frontal plates with small fovea posteriorly; cones subvertical, quite long. .... *Trioza longicornis* n. sp.

GG. Facial cones not moderately acute, quite blunt at tips.

H. Posterior margin of vertex narrowly elevated over entire width; frontal plates deeply depressed, often dark colored. Radius usually at least as long as second cubital........ *Trioza aurantiaca* n. sp.

HH. Posterior margin of vertex not narrowly elevated over entire width, only over discal areas of frontal plates; frontal plates not deeply depressed, usually light colored. ....*Trioza aurantiaca frontalis* n. var.

FF. Facial cones not strongly divergent, and not contiguous.

G. Wings with dark bands or stripes.

H. Wings with a broad brownish band on cubital margin from tip of wing to near base. ....*Trioza marginata* n. sp.

HH. Subcosta and anal angle with a black band or stripe for entire length. Radius very short........*Trioza californica* n. sp.

GG. Wings clear, without bands or stripes. Head with eyes about as wide as thorax.

H. Wings moderately broad and not very acute apically. Frontal plates scarcely depressed.

I. Facial cones rather straight on inner margin and almost contiguous; frontal plates scarcely notched at median suture on anterior margin. Body usually light colored........*Trioza salicis* Mally.

II. Facial cones distinctly conical, more diverging than in *T. salicis*. Frontal plates quite deeply notched at median suture. Body usually dark brown to black........*Trioza nigra* n. sp.

HH. Wings slender and quite acute apically; first furcal very short. Facial cones short, slightly diverging, usually straight on inner margin. Body small. ....*Trioza minuta* n. sp.

DD. Genital segment of female quite long, with or without an exserted ovipositor blade.

E. Wings striped; radius and first and second cubitals with a brown band on both sides; third furcal much shorter than fourth furcal. Facial cones rather large and blunt at tips, moderately divergent. ....*Trioza tripunctata* Fitch

EE. Wings without stripes; third and fourth furcals subequal.

F. Wings with four large black spots on dorsal margin easily visible to naked eye, one on margin of each marginal cell, one on margin of cubital cell and and one on anal angle. Facial cones medium, moderately divergent............*Trioza quadripunctata* n. sp.

FF. Wings without four spots easily visible to unaided eye.

G. Female with long exserted ovipositor blade.

H. Prothorax large, only slightly depressed below anterior margin of mesonotum. Ovipositor style nearly twice as long as terminal abdominal segment, and very slender and acute. Body and wings large. ....*Trioza longistylus* n. sp.

HH. Prothorax not large, much depressed below mesonotum. Style not longer than terminal segment. Body and wings small. ....*Trioza nicaraguensis* n. sp

GG. Female without exserted style.

H. Frontal plates with a long oblique groove.

I. Facial cones slender, acute and strongly divergent............*Trioza sulcata* n. sp.

II. Facial cones rather acute and only slightly divergent. ....*Trioza sulcata similis* n. var.

HH. Frontal plates without oblique furrow.

I. Anterior ocellus in median notch of frontal plates and slightly visible from above. Frontal plates with fovea posteriorly....................*Trioza fovealis* n. sp.

II. Anterior ocellus under projecting frontal plates and not visible from above. Frontal plates scarcely depressed..................*Trioza assimilis* n. sp.

CC. Facial cones contiguous for entire length and very acute. Body very slender; head fully as broad as thorax.

D. Third furcal longer than margin of cubital cell. Frontal plates black in center, bordered with yellow; cones long, slender, yellow, except black at tips. ....*Trioza immaculata* n. sp.

DD. Third furcal and cubital margin about equal. Frontal plates entirely black; cones medium in length. ....*Trioza laticeps* n. sp.

GENUS TRIOZA

Trioza californica n. sp.

(Fig. 99, A, B, G, H, I), (Fig. 98, A).

Length of body, 2 mm.; length of forewings 3.35 mm. General color dark brown to orange; head almost black, darker than thorax; abdomen greenish white ventrally, dorsally as dark as thorax; legs uniform reddish brown; antennae brown to black, except segments II-III whitish. Head and thorax finely punctate.

Head not strongly deflexed; with eyes, almost as broad as thorax, slightly and finely punctate; vertex posteriorly nearly straight, somewhat arcuate; discal area of frontal plates obliquely and broadly depressed, elevated along median suture posteriorly and emarginate anteriorly; frontal plates not raised plate-like; facial cones moderately large, rather acute, not strongly divergent, almost vertical, quite densely hirsute. Antennae inserted beneath the slightly projecting vertex, filiform, except two basal segments large, subglobose. Eyes large, hemispherical; anterior ocellus imbedded at angle of facial cones.

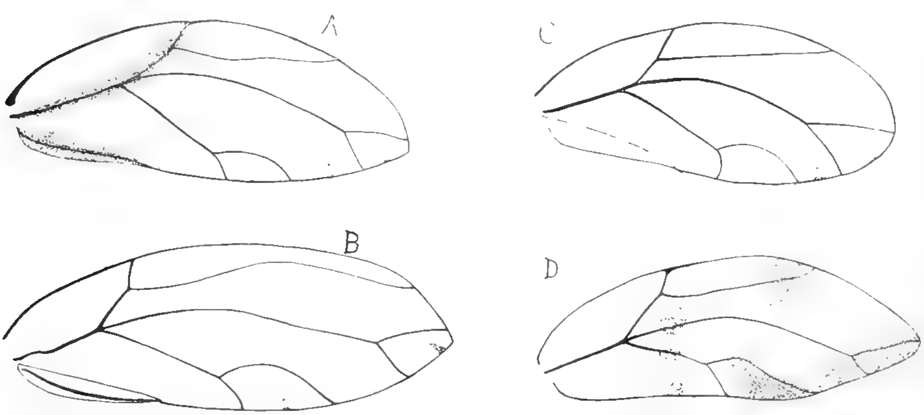

Figure 98. A, Trioza californica; B, T. bakeri; C, T. rotundipennis; D, T. maculipennis.

Thorax arched, distinctly punctate. Pronotum depressed below dorsulum and head; dorsulum strongly ascending posteriorly, about as long as scutum. Wings hyaline, about two and one-half times as long as broad, broadest across middle, subacute apically; subcosta and anal angle bordered on both sides with black band, giving appearance of one long-curved stripe and one shorter one; radius shorter than second cubital; marginal cells quite small; apex of wing distinctly within second marginal cell; venation reddish brown, except subcosta.

Female—Genital segment not long, scarcely twice as long as preceding segment; dorsal plate somewhat longer than ventral plate; arched, and acute at the tip; both plates hirsute. Male—Genital segment reflexed dorsally, large, hirsute dorsally in the center.

Described from seven males and one female, taken by C. F. Baker, near Claremont, Calif. (mountains). Co-type in National Museum, Washington.

Trioza bakeri n. sp.

(Fig. 99, C, D, J, K, L), (Fig. 98, B).

Length of body about 2.2 mm.; length of forewings 3.5 mm. General color brown with fulvus; head brown, except frontal plates fulvous yellow; dorsulum posteriorly, median dorsal portion of scutum, and scutellum fulvous; rest of thorax brown; abdomen whitish ventrally, black dorsally; antennae yellow, except terminal segment black.

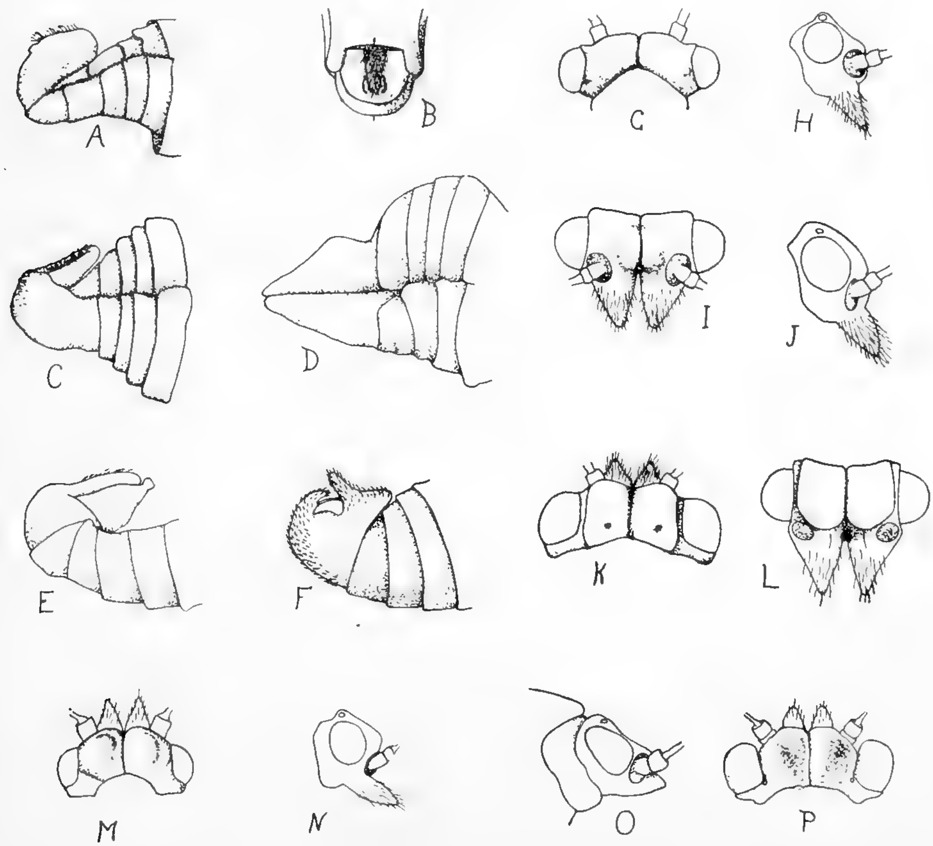

Figure 99. A, B, G, H, I, T. californica; E, M, N, T. rotundipennis; F, O, P, T. maculipennis; C, D, J, K, L, T. bakeri.

Head not deflexed, but continuing uniformly the descending arch of thorax and head, almost as broad as thorax; frontal plates large, flat, pubescent, distinctly raised plate-like, with a small, deep fovea posteriorly on each side of median suture; facial cones black, subhorizontal, projecting forward beyond frontal plates, acute, quite strongly divergent, and moderately hirsute. Eyes not hemispherical, somewhat flattened. Antennae twice as long as width of head, inserted near base of cones, without; two basal segments larger, subglobose, the rest filiform, terminal segment slightly clavate.

Thorax arched, rather coarsely punctate and finely pubescent or pulverulent. Pronotum large, broad, somewhat arched; pubescence almost as long as on frontal plates; not depressed below dorsulum and head; dorsulum broad anteriorly, ascending posteriorly, nearly as large as scutum. Wings hyaline, two and two-thirds times as long as broad, broadest across middle, acute apically, apex within second marginal cell; first marginal cell a little larger than second marginal; radius longer than second cubital, curved midway; venation brown to black.

Female—Abdomen very broad dorso-ventrally, strongly arched dorsally. Genital segment hirsute, fully as long as four preceding segments, subacute apically; both plates of equal length; style not exserted. Male—Abdomen broad basally, strongly converging. Genital segment very long, nearly as long as four preceding segments; genital plate reflexed dorsally; claspers elliptically arched, closely lying on genital plate, hirsute.

Described from one female and two males, taken by C. F. Baker near Claremont, Calif. Co-type in Nat. Museum.

Trioza rotundipennis n. sp.

(Fig. 99, E, M, N), (Fig. 98, C).

Length of body 1.9 mm.; length of forewing 2.9 mm. General color reddish brown to orange; head brownish, except margin of frontal plates light; prothorax whitish; meso- and metathorax mostly reddish brown; abdomen brown except genital segment white; three basal antennal segments white, the rest black.

Head not deflexed; with eyes, fully as broad as thorax; frontal plates subhorizontal, slightly and finely pubescent, elevated plate-like, broadly depressed discally, and deeply emarginate anteriorly at median suture; facial cones black, moderately large, acute, almost horizontal, strongly divergent and very sparsely and briefly hirsute. Eyes scarcely hemispherical, rather flattened. Antennae fully twice as long as width of head, inserted somewhat above cones, without; two basal segments short and stout, the rest filiform; III very long, longer than IV and V combined.

Thorax quite strongly arched, punctate, not pubescent. Pronotum depressed below dorsulum and head, lighter in color than the rest of the thorax; dorsulum rather acute anteriorly, ascending strongly especially anteriorly, about as long as scutum. Wings hyaline, about two and one-fourth times as long as broad, broadest across first marginal and radial cells midway, very broadly rounded apically; radius very short, but fully as long as second cubital, which is only twice as long as fourth furcal; marginal cells about equal; venation yellow.

Male—Abdomen quite broad basally, dorsal segments descending and almost disappearing on anal half of abdomen. Genital segments partially reflexed dorsally, larger than preceding segment; genital plate reflexed; claspers laterally opposed, fully as long as genital segment, acute at tips, moderately hirsute.

Described from two males, taken by C. F. Baker near Claremont, Calif. (mountains). Co-type in Nat. Museum.

Trioza maculipennis n. sp.

(Fig. 99, F, O, P), (Fig. 98, D).

Length of body 1.7 mm.; length of forewings 2.85 mm. General color reddish brown to dark brown or black; head fulvous brown; thorax darker, somewhat mottled; abdomen almost black; intermediate antennal segments tipped with black, terminal segment black, the rest yellowish brown.

Head somewhat deflexed; with eyes, almost as broad as thorax; frontal plates raised plate-like, large, broadly depressed obliquely, slightly elevated along median suture, scarcely emarginate anteriorly, quite pubescent; facial cones fulvous, short, subacute, strongly divergent, almost horizontal and sparsely hirsute. Eyes large, hemispherical. Antennae fully twice as long as width of head, filiform, except two basal segments; third segment very long.

Thorax not strongly arched, coarsely punctate. Pronotum depressed below dorsulum and head, rather light colored; dorsulum pubescent, acute anteriorly, strongly ascending on anterior half, posteriorly, and the rest of thorax not very strongly arched; scutum very slightly pubescent anteriorly. Wings angulated and acute apically, about two and two-thirds times as long as broad, broadest subapically; semihyaline, not fully transparent, with several brown maculae in apical half covering both marginal cells and part of cubital and radial cells; first marginal cell much larger than second; radius straight, shorter than second cubital; venation yellowish brown.

Male—Abdomen quite long and stout. Genital segment as long as two preceding segments, rounded apically and not reflexed; genital plates small, slightly flexed anteriorly; penis exserted toward claspers; claspers large, bilobed, laterally opposed. Genital segment and plates very densely pubescent.

Described from two males, taken by C. F. Baker in San Mateo County, California.

WEST COAST NEWS NOTES

[In this department we hope to give in most numbers of the Journal some idea of the doings and movements of western entomologists, notices of publications of interest to western students, notices of entomological meetings, etc. To this end, we hope that students or collectors will send in all items of entomological interest about themselves or others. Mr. Grinnell will be very glad to answer any questions or help anyone in any way, by letter or personally. Address, Fordyce Grinnell, Jr., 572 N. Marengo Ave., Pasadena, Cal.]

Mr. D. W. Coquillett of Washington, D. C., is visiting in Los Angeles during this spring.

Mr. Wm. M. Mann of Stanford University is studying and collecting myrmecophilous insects, especially Coleoptera, and has already found some very interesting forms.

Prof. T. D. A. Cockerell describes a number of new Californian bees in the Annals and Magazine of Natural History, London, for January, 1910.

One wing of the County Historical Museum and Art Gallery about to be erected in Agricultural Park, Los Angeles, will be occupied by the collections of the Southern California Academy of Sciences.

The March meeting of the Pasadena Entomological Society was held at the residence of Mr. Karl R. Coolidge, in Pasadena. Mr. Wm. Schrader, of Los Angeles, reviewed some of the interesting experimental work of Standfuss, on the Lepidoptera; and alluded to some of his own work.

Mr. Francis X. Williams of San Francisco has been appointed assistant curator of the Snow Entomological Collections of the University of Kansas. On his way to Kansas he stopped for a few days' visit in Pasadena.

Prof. Herbert Osborn of the Ohio State University was a recent visitor at Pomona College.

Mr. D. L. Crawford expects to spend another summer in Mexico, collecting in some of the Southeastern States.

The Palos Verdes Marine Laboratory of Pomona College at Portuguese Bend—a very favorable point on the coast of Southern California—will be opened during the coming summer. This laboratory is intended especially to supplement the work of the Department of Biology of Pomona College, but it will be open to any students or investigators desiring to work at this point.

Dr. F. E. Blaisdell and Dr. Edwin C. VanDyke are planning a collecting trip for Coleoptera to the high Sierras of Middle California.

Mr. G. W. Kirkaldy died in San Francisco, February 2d. He was a good student of the Hemiptera, and was commencing a monumentous catalogue of the Hemiptera of the world, published by Felix L. Dames, Berlin, Germany.

From January to April, the Oakland College of Medicine, Oakland, Cal., offered a course in Tropical Diseases and Medical Parasitology to graduates and practitioners of medicine, under the direction of Dr. Creighton Wellman.

Mr. Grinnell will be glad to get any number of specimens of *Limenitis lorquinii and Limenitis (Heterochroa) californica* from any part of the Pacific Coast, for the study of the mimetic relations of these two species. Exact date and locality *should be on each specimen.*

Mr. V. L. Clemence and Mr. Karl R. Coolidge have canceled their proposed trip to Mexico this year, and instead have gone to Southern Arizona to collect for about three months; most of the time will be spent in the Huachuca Mountains.

Mr. W. H. Stultz of Minneapolis has been in Pasadena for the winter and spring. Mr. Stultz collected many Lepidoptera for the work of Packard and Grote.

The Open Court Publishing Co., Chicago, has reprinted the classic, "Experiments on the Generation of Insects," by Francesco Redi, of Arezzo, translated from the Italian edition of 1688 by Mab Bigelow. Illustrated with 44 full page, 16th century drawings. Cloth, $2.00. Edition of 1000 copies.

The Vitascope is a new instrument for observing living insects, etc., without disturbing them, at a distance, under high magnification, which can be varied from 10-60 diameters. It is being put on the market by Newton & Co., London.

Messrs. James A. G. Rehn and Morgan Hebard are authors of An Orthopterological Reconnaissance of the Southwestern United States. Part III. California and Nevada. From the Proceedings of the Academy of Natural Sciences of Philadelphia, pp. 409-483. Oct. 1909. It is a very fully annotated list, with descriptions of several new species, principally Californian, and descriptions of localities visited. During 1909 Messrs. Rehn and Hebard collected an additional lot of 10,000 Orthoptera, including more new and interesting species.

Dr. William Morton Wheeler's "Ants, Their Structure, Development and Behavior," has just been published by the MacMillan Company, N. Y., and forms a part of the Columbia University Biological Series. The price is $5.00.

The department of tropical medicine in the State Journal of Medicine, conducted by Dr. Creighton Wellman, is interesting and suggestive. In a recent number are sections on Zoology and Medicine, Leprosy in California, Our Small Rodents, Hookworm Among Us, and a Suggestion. And in an editorial on Scientific Work on Plague, there is reviewed the most important recent publications of the U. S. Public Health and Marine Hospital Service. A résumé of the more important of these are given. A good number are in the Journal of Infectious Diseases, the Public Health Reports, Parasitology, Journal of Medical Research, etc.

"Medical Zoology is rapidly coming to its own. Since the recognition of specific causes of disease, bacteriology was the first to ally itself with clinical medicine and for a time threatened to divide the field with the pathologist. But there has been and still is an increasingly significant tendency to admit and study the effects of animal organisms in disease with the same thoroughness with which bacterial affections are observed. A considerable part of this is to be credited to students of tropical medicine. Portions of protozoology, formerly regarded as an academical science; helminthology, long looked upon as a distinct and isolated branch of natural history, and entomology, which was for centuries tolerated as a hobby of dilettantes, have gradually become co-ordinated into a logical science which touches and explains a goodly fraction of the important diseases of mankind. The study should be taught systematically and thoroughly in every medical school in the country instead of being touched upon in a desultory manner by the bacteriologist, pathologist or clinician."—Dr. Creighton Wellman, in the California State Journal of Medicine.

Pomona College Journal of Entomology

Volume II SEPTEMBER 1910 Number 3

FUMIGATION STUDIES III

ESTIMATING THE CUBIC CONTENTS OF FUMIGATION TENTS

BY WRIGHT M. PIERCE

Perhaps no other single feature of ordinary contract fumigation has contributed more to the utter uncertainty of results, than the common practice of assigning dosages by guess-work. Woglum has shown that this method gives results varying 50 per cent even in cases of men who are confident of their ability to guess right every time. Our own observations in this vicinity show that the guess-work method may readily furnish variations of hundreds of cubic feet. Combine this practice with that of working as near as possible to the minimum dosage for a given scale and it will be

Figure 100. The use of the marked tent under favorable circumstances

realized how very great are the chances for uneven results for "shots" that do not hit the mark. Contractors have not taken very kindly to the system of marking tents, and estimating tree by tree after the tents were on. It requires a lot more time and work. Formerly it was a common practice for the estimator to prepare a schedule of the orchard and go through it rapidly, marking, offhand, the dosages for all the trees, and thus one man could serve several crews in this respect. Sometimes where the orchard ran fairly uniform, the contractor would dismiss the whole matter in a very easy way—by prescribing a uniform dosage for the whole orchard.

When we have become convinced that the guess-work system of estimating is a most uncertain and costly one for the grower, and the Morrill

Figure 101. Even though these tents were marked, anything like accurate estimating would be impossible

or any other system of marking the tents is generally adopted, it will still require great care and judgment to keep within bounds the possible margin of error. We wish to show in this article that in careless hands there are almost as great possibilities for error with the marked tents as without them. Accuracy in the use of marked tents presupposes a tent of fairly symmetrical form sloping the same on all sides, to be measured over the top and around the base, well illustrated in Figure 100. If the trees were all absolutely symmetrical, and the top growth of the same density everywhere, this method would be child's play. But, unfortunately, this is rarely the case. Our trees are usually unsymmetrical, and there is the utmost variation in the density of the top growth. The density of the top growth

Figure 102. These trees appeared to be of uniform size before the tents were put on

Figure 103. Showing good and bad use of ringed tents

determines in large part how the tent will hang. Over and over again we have seen rows of trees appearing to the eye of any observer almost identical in size and form, that showed differences of hundreds and hundreds of cubic feet when the tents were thrown. The trees in Figures 101 and 102 looked almost perfectly uniform before being tented, though afterwards wide variations were very evident, and these tents were "fired" in just the shape shown in these photographs, the dosages of a necessity most uncertain by any method.

A great deal may be done to overcome the very uncertain element introduced by the unsymmetrical form of trees, by careful attention to pulling

Figure 104. This tree would be hard to tent, even with an unringed canvas

the tent into some shape after being thrown. A little pulling will often entirely correct the form of the top, while a little attention to gathering the slack in around the base may save hundreds of cubic feet. It is far more difficult to do good work with tents attached to rings as may be readily seen by an examination of Figures 103 and 104. In the smaller trees wasted space and variation in form may be even more evident than in the larger trees (Figure 105). It thus becomes very certain that in careless hands the marked tents may give as variable results as the old guess-work, whereas in careful hands, marked tents make possible a far more accurate dosing.

The foregoing facts seem to make it very evident that:

1. *Trees should never be estimated until tents are on them.*

2. *Marked tents offer the only possible means known to us for correct estimating, as has been shown by Morrill and Woglum.*

3. *Marked tents are an advance over old methods only when care is taken to shape them up as symmetrically as possible after they are placed on the tree.*

4. *Close estimates should be made on every tree separately, but a good generous margin over this should be allowed so as to be sure of thorough and effective work.*

Figure 105. Trees easy to tent but carelessly covered

SPRAYING FOR THE CITRUS MEALY BUG

E. O. ESSIG
HORTICULTURAL COMMISSIONER
OF VENTURA COUNTY, CALIFORNIA

From time to time articles have appeared with reference to handling the citrus mealy bug by fumigation and parasites. Fumigation was certainly given an excellent test in this county, and while, through persistent endeavor, it has accomplished much good, yet to the average orchardist this method is beyond reach. The best work was done in a ten-acre lemon orchard belonging to the Teague-McKevett Co. just east of Santa Paula. Adjoining the old ten-acre orchard, this company planted some 240 acres of young lemon trees, and when the mealy bug was found to exist in the old orchard, the owners sought to exterminate it at any cost to prevent its spreading into the young grove. Former County Commissioner P. E. Smith started this work during the fall of 1908 and it had been carried on until the present time. The first tree-to-tree inspection showed 200 trees infested with mealy bug. After this inspection the entire orchard was fumigated, the dose used being in accordance with Woglum's Dosage Schedule No. 1. A second inspection some two months later showed 75 trees still infested and all these trees as well as those adjacent to them were fumigated as at first.

The third inspection, not being so careful, showed only a few trees infested and these were fumigated with a dosage double that used in Dosage Schedule No. 1. The results of this fumigation looked very favorable.

Three months later a very thorough inspection was made, the time required for the ten acres being six weeks. This inspection showed over 100 trees infested, some of them with eggs only, while others apparently supported only a single individual. The fourth fumigation was carried on differently from any work recorded on the mealy bug. Instead of a double dose being given at once, as was used in the third fumigation, a single dose was given as is the usual custom. After one hour exposure this dose was repeated, thus making the dosage double that outlined in Woglum's Dosage Schedule No. 1 and the exposure two hours. It was believed that this would surely get all of the insects which the one hour exposure and one dose did not kill. The results were indeed very satisfactory. So much so that the fifth inspection, which was even more careful than the fourth, revealed only four trees slightly infested. These trees were fumigated with the same system of dosage as soon as they were found by the inspector. A later inspection has revealed no mealy bugs, but only after some time, yet, can we make sure of this. The work shows that the reduction of the pest is exceedingly great and that through repeated fumigations the pest can be practically exterminated in an orchard, but the cost would make it absolutely prohibitive in a large orchard, which was badly infested in all parts. To demonstrate this the double dosage and double exposure system was carried into a very badly infected orchard. The results were little better than what was obtained by a single dose and one hour exposure. In many cases only about 50 per cent of the female bugs were killed, while the percentage of the eggs remained unknown. The cost of the single time for an average lemon tree, including labor and tents, was nearly $1.50.

Believing in a three hour exposure and a triple dosage, an owner of a badly infested orchard, wished his orchard so treated. After two nights' work a halt was called to await an inspection so as to get some idea of the results obtained. An inspection followed which showed as many as 40 individual mealy bugs on a single tree. The work was stopped and a closer inspection made which resulted in the work being dropped. The cost per tree was near $2.25 and the results very poor.

It was after this and other work, that my attention was turned to some other means of combating the mealy bug, than by fumigation or the use of the already promising parasites which were working very slowly. To sprays I turned first, believing that a mixture could be found which would do the work. Sprays seemed advisable for the following reasons.

1. At most times of the year the mealy bugs are scattered over the tree in the most exposed manner. Only during the winter months are they massed and more or less protected by their numbers.

2. The only protection afforded to these soft-bodied insects is a thin, white, waxy covering. The requisite for a successful spray would be the power of penetrating and dissolving this waxy coat.

3. A spray which would kill the adults would exterminate all the eggs on the tree at the time of spraying.

4. Weather conditions are more favorable for spraying in this country than for fumigation, because of damp nights, east winds, etc.

With these things in mind, work was begun with both wet and dry sprays. The section chosen was an average-aged lemon orchard very badly infested with mealy bug—a section of about two acres, and where parasites had not been introduced.

The work was carried on during the months of January, February, and March, when the trees were more or less dormant, and when the mealy bugs and eggs were massed in great clusters on the trunks, limbs, leaves, and fruit of the trees. The results were so good that beginning July 1st, over 100 acres will be sprayed and steps taken to make a general cleaning up of the entire mealy bug district. Of course there are many things yet to be perfected in regard to the time for spraying and the manner of application, but with an efficient spray to work with, these details will develop only with experience and time.

Even the following experiments are in no wise perfected, but shall serve to show simply how far the work has been carried to the present time. The work is only begun, and from time to time, I shall be able to furnish a great deal more material upon this subject.

In all the spraying experiments, the one dominant aim was to find a solution which would effectually dissolve the waxy covering of the scale body and egg masses and so kill the insects through contact. The effect on eggs seemed especially good, for the egg masses soon dried up after the first spraying and disappeared. At this time of the year great masses were located upon the trunks of the trees and these were totally destroyed with the one application.

This experimental work was carried on with a small hand spray pump and a hand duster. The first results were naturally unsatisfactory, but all the promising sprays were afterwards applied with a power sprayer and the results were infinitely better.

Powders

A special hand blower, Leggett's Champion Duster, was purchased for the application of powders. Wherever such a powder was used, a most liberal application was made, so as to get the best results possible. The doses were repeated several times in course of the three months of experimental work. Due to the waxy secretion of the mealy bug, the powders were unable to effectually reach the insect body and kill through contact. The work was entirely unsatisfactory and I am safe in saying that nothing worth while was accomplished. The following powders were used:

FLOWERS OF SULFUR.

These were blown upon the trees with the duster in great quantities early in the morning while the dew was heavy on the trees. The results obtained were entirely unsatisfactory—many of the mealy bugs were seen a week after the application, crawling with the sulphur upon their backs.

DEHYDRATED LIME.

Dehydrated lime was blown upon the tree as was the sulphur. Many of the mealy bugs were dried up where the lime was heaped upon them in great quantities. It was very difficult to make the lime stick, for as soon as it was dried out by the sun the wind blew much of it from the trees. Especially was this true on the underside of the leaves and fruit. Generally speaking, this is not an effectual remedy at all for this pest. In a very damp country it might be much more effectual, but here it is unpractical.

UNSLACKED LIME.

Unslacked lime was pulverized and blown on the damp trees early in the morning. This might be effective if the mealy bugs were also damp, but such is never the case because of their waxy secretion. The lime cannot be heaped upon their bodies in quantities large enough to do effective work. In Florida it is said that unslacked lime is very effective. This may be due to the much moister climate than we have here. Especially is it hard to get the lime to cling to the mealy bugs on the undersides of the leaves and fruit.

FLOWERS OF SULPHUR AND DEHYDRATED LIME.

Flowers of Sulfur and Dehydrated Lime were mixed in equal parts and applied in a manner as either alone. The results obtained were no better than those of the other dry sprays.

In our work the powders were not effective at all and could not be compared to the work of some of the wet sprays. Should they kill through bodily contact, it would be extremely hard to reach the mealy bugs hiding under the bark and smut, or those within the navels of the orange fruit. In badly infested orchards, a great deal of honey-dew is deposited upon the foliage. Upon this honey-dew, the smut sometimes grows to be 1-32 to 1/8 of an inch thick. Where it cracks, mealy bugs enter and hide themselves beneath this protecting coat. A powder cannot reach them here and great numbers are so overlooked. It was therefore necessary to find a mixture which would remove this smut and expose the pests to the direct mercy of the liquid spray.

KEROSENE.

A test was made on one tree with pure kerosene. The tree was a four-year-old and naturally rather small. It was very badly infested with egg-masses, larva, and adult female mealy bugs. Fearing serious results to the tree, only 1½ gallons were applied with the small hand spray pump. The mealy bugs were killed instantly as soon as the kerosene came in contact with their bodies. The wax on the bodies and egg masses was immediately dissolved allowing the oil to penetrate into all parts of the insect bodies. In no case did an insect crawl or move after the spray had touched it. Most of the bodies turned brown or red, and after a day began to shrivel up.

The smut was also removed from the leaves and fruit of the tree, so that a day after the application the tree looked much fresher and brighter than did any of its neighbors.

This work indeed looked marvellous, because nothing had been tried which seemed to instantly kill any number of mealy bugs at any one time, and this being also the first experiment tried in this investigation. The belief was that the tree would be defoliated and the buds killed by the pure kerosene, but after one month, not a leaf was dropped and no ill effects to the tree were noticed. Because of the expense and the probable injury which might occur under different circumstances, this spray gave way to a more economical spray and one which appears to be very effective without the least sign of injury to the most delicate foliage and buds. I refer to the Carbolic Acid Emulsion which is discussed at the end.

It is interesting to note that a 25 per cent mechanical mixture of kerosene and water applied to this same tree and to other trees a month later caused a great dropping of leaves and a decided yellowing of the foliage.

A 25% MECHANICAL MIXTURE OF KEROSENE AND WATER.

Following along the line of the above experiments with pure kerosene, a mechanical mixture of kerosene and water was tried. The mixture giving the best results was a 25% mixture. To keep it thoroughly agitated it was applied with a power pump at a pressure of 200 pounds, and mechanically agitated all of the time. Some twenty trees were sprayed with not at all satisfactory results. The leaves were dropped and those which remained turned to a sickly yellow color. The killing power of the spray was very poor—the water caused the oil to gather in globules as soon as it hit the foliage or fruit and did not penetrate into the waxy covering of the insects. Only upon the trunks of the trees did we get any results worth while—and these results were obtained with all the sprays tried.

GASOLINE.

To test a stronger and more volatile solution, gasoline was tried with hope that it might evaporate before any real damage was done to the tree, and yet kill the mealy bug. Accordingly 2½ gallons were applied to a large tree. It was impossible to cover the entire tree with so small a dosage, but the desired tests were obtained. After two days the leaves began to curl up and dry upon the tree without falling to the ground. The burning was severe to the fruit as well as to some of the new growth. The killing power was good, but not so good as that of the kerosene. The experiment only shows that this liquid is too severe for a tree's insecticide in its pure state, though it has excellent killing properties.

RESIN WASH.

Formula for the stock solution:

Resin	5 lbs.
Caustic Soda (Lye)	1 lb.
Fish Oil	1 pt.
Water to mix	2 gals.

This stock solution was diluted to make a number of tests, which are recorded as follows:

Stock solution diluted with water 1 to 48:—Several trees sprayed with this mixture showed unsatisfactory results, because the waxy covering of the mealy bug seemed to resist it completely. In other words, it would not dissolve the waxy covering at all, and hence was impracticable.

Stock solution diluted with water 1 to 24: While this mixture was the best obtained for the mealy bug, and really gave good results, it did not show up as well as did some of the sprays which follow. Its adhesive power is good, but the power of penetration not so good as the emulsions.

Stock solution diluted 1 to 12 and 1 to 6: These mixtures were little more effective than the less powerful ones, and much more expensive.

None of these mixtures seemed to do the least bit of damage to the foliage of the trees.

POTASSIUM BICHROMATE.

The killing power of this chemical, when dissolved in water and applied alone, or when added to other solutions, is remarkable. When dissolved in water it has no particular affinity for the waxy covering of the mealy bug, but the deposit left upon the insects upon evaporation makes great havoc among them. In every case the killing was excellent no matter how mixed, but the foliage of the tree could not resist it. The fruit also was badly pitted and spotted wherever a drop gathered and the mineral was deposited.

The mixtures used were as follows:

(1)	Potassium Bichromate	10 lbs.
	Water	200 gals.
(2)	Potassium Bichromate	1 lb.
	Carbolic Acid Emulsion	200 gals.

The potassium bichromate was also added to Lime Sulfur in limited quantities, but in every case it caused spotting, burning, and dropping of foliage. Its use as a spray for citrus trees is therefore impractical and unwise—and the experiments show this.

TOBACCO EXTRACT.

Tobacco extract and caustic soda were mixed as follows:

Tobacco Extract (Ky. Tobacco Co.)	½ pt.
Caustic Soda	1 lb.
Water to mix	2 gals.

This stock solution was diluted 1 to 3 and applied with a hand pump. The results were the poorest which were obtained and the use of the tobacco extract likewise proved of no use.

Another formula as follows was tried with no better results:

Soap	½ lb.
Black Leaf	½ gal.
Water	5 gals.

BOILED LIME-SULFUR SPRAY.

The effectiveness of the lime-sulfur spray as an insecticide has been well demonstrated along many lines. It was therefore only natural that it should be given a trial on the mealy bug.

Accordingly a special prepared mixture was tried and gave promise of such good results that the manufacture of a spray in the orchard, here, was begun. It was necessary, first of all, to get a spray strong enough to kill the mealy bugs.

The most successful combination made was according to the following formula:

Unslacked Lime	50 lbs.
Flowers of Sulfur	50 lbs.
Water to mix	40 gals.

The usual method of mixing the material was as follows:

The lime, when slacked, was first added to the 40 gallons of water in the iron kettle. The sulfur was then added and stirred when the water began to get warm. As soon as the mixture began to boil the sulfur was thoroughly mixed. All was then allowed to boil for several hours and stirred repeatedly. Another method of mixing is to make a paste of the sulfur before adding it to the lime and water. The mixture was strained through a fine sieve and diluted 1 to 20 before using. This made it a cheap, easy spray to apply, but one severe on the hands and face of the men handling the nozzles.

The first work was done, with this spray, in January, before the new spring growth began to appear. A careful watch was kept to see that no injury was being done to the leaves or fruit of the trees, and at this season no damage whatever was noticed, in the packing house or in the field. The mealy bugs at this period were massed upon the trunks of the trees, on the foliage, and between the touching fruit. Two applications were necessary to destroy these large masses of insects, for the first simply killed all on the outside, while the second, some time later, killed what remained. Then, too, the first application removes a great deal of the smut from the foliage and exposes the insects hiding under it. These are killed with the second application. The egg masses on the trunks were absolutely eradicated by the first application, while it was necessary to make many applications to clean up a dirty tree. In our work here three applications practically cleaned up an entire orchard. At the present time, some three months since the last application, it is hard to find a single mealy bug in the orchard so sprayed, but this is not due to the lime-sulfur spray alone—in fact the spray discussed as the Carbolic Acid Emulsion proved to be the most efficient.

In March, with the coming of the new and tender growth on the lemon trees, we found a serious objection to this spray. It stuck particularly well to this new growth and was so strong that it killed wherever it struck. Every tree thus sprayed was deprived of all the new growth which it touched, and further work with this spray had to be given up. Perhaps when the growth becomes more hardened it may again be used, for it has never injured the buds or the fruit in any way. Fortunately, however, the Carbolic Acid Emulsion Spray has all of the advantages of this spray, and does not injure the tenderest growth, and is perfectly harmless to the men using the nozzles.

CARBOLIC ACID EMULSION.

The most satisfactory of all the sprays used in combating the citrus mealy bug is the Carbolic Acid Emulsion. This is probably due to its penetrating qualities which enables it to dissolve the waxy covering of the mealy bug and to come in contact with the naked body.

The formula used in mixing up this spray is as follows:

Crude Carbolic Acid	5 gals.
Whale Oil Soap	40 lbs.
Water (Hot)	40 gals.

The 40 gallons of water are first poured into the cooking kettle and allowed to boil. While the water is getting hot, the whale oil soap is cut into fine pieces, so as to make it dissolve easily, and added to the water. When the soap is all dissolved in the hot water, the carbolic acid is added, and all is allowed to boil for a short time to insure thorough mixing. The whole operation requires less than one hour. The contents make about 43 gallons of rich stock solution. For spraying, the stock solution is diluted one to twenty of water, thus making approximately 860 gallons of spraying material. The stock solution will keep indefinitely, but is preferable fresh When diluted with water it makes a perfect emulsion and can be applied with any spray pump, since an agitator is not needed. When the stock solution is allowed to stand for some time it is best to stir it up before diluting it for spraying.

The resulting spray is very easily handled, it needs no agitation, no straining, is easily and simply made, does not rot the hose or rust iron pipes, and is perfectly harmless to the eyes and hands of the sprayers.

Applications: In spraying for insects which are protected by a wooly, cottony, or waxy covering, it is essential that an adequate force behind the spray be employed. In the case of the mealy bug it is absolutely necessary to have a power spray pump. This will enable the sprayer to develop the power necessary. In our work the least pressure used was 100 pounds and the most satisfactory pressure 250 pounds. A three nozzled spray seemed to give the best results, for a thorough drenching could be given any spot instantly, and the top of the tree could be more effectively reached. With such a spray there is little danger of missing any considerably surface of the tree, a thing to be guarded against, for every spot untouched means not a few mealy bugs left alive on the tree for the next year. This can be avoided only by thorough work and regular applications. If a few insects are left in a secluded place it will not be long before the young are born and the adults die, or the adults themselves, may move to a more favorable place. The young always move away from the parent and often rove extensively after hatching. The life cycle is quite long, lasting from six to nine months, so three applications of spray within this time will surely eliminate most of them. In a badly infested orchard an application should be made once every two months until the conditions are made much better.

In the experimental and field work where the trees were normal in size, and badly infested with eggs, larvæ, and adult mealy bugs, 15 gallons were given to each tree, at an application.

Cost of Spraying: In large quantities the cost of materials is as follows:

Crude Carbolic Acid	25c per gal.
Whale Oil Soap	6½c per lb.

A mixture of 43 gallons of stock solution according to the above formula would cost $3.85. This stock solution makes 860 gallons of spraying material less than ½c per gallon. Using 15 gallons per tree this would make the cost near 7c a tree for a single application. After the first two sprayings it would not be necessary to give such a large dose, which would cut down the expenses somewhat. The labor would probably cost less than the cost of chemicals per tree.

Comparing spraying with fumigation, every argument of expense is with the former, and the results are certainly greater in proportion to the cost, for each application and as many applications are necessary for fumigation as are for spraying at a cost of about five times as much every time.

Time for Spraying: In a badly infested orchard the work should be taken up just as soon as possible so as to eliminate all of the insects exposed. After two or three successive sprayings within six or seven weeks, a regular system should be followed, just as we fumigate regularly for black scale.

In the late fall, during the months of October, November, December, and on into January, the mealy bugs and their eggs are massed in great numbers all over the tree and fruit. Spraying during these months is somewhat difficult, but these are the advantages:

1. Nearly all of the eggs which would produce new broods for the coming year would be destroyed. While the young continue to hatch throughout the entire year, there is a period in the spring when the egg masses, which were deposited in the fall, hatch and the young come forth in great numbers just in time to attack young growth. Therefore spraying in the winter is very effective in preventing these spring broods.

2. In the winter the lemon tree has its minimum amount of foliage, the tree is more open and offers greater opportunities for effective spraying, especially in respect to the large limbs, upon which are massed the most of the eggs.

3. In the winter months the tree will stand more than in the spring months. This was demonstrated by the Lime-Sulfur spray, which killed the new spring growth and did no injury at all to the tough, leathery growth of the winter. The hot weather in the summer is injurious to a sprayed tree. It has been proven that a tree cannot stand near as strong a mixture of distillate and water in the summer time as it can in the winter. This is true to a great degree with regard to any spray.

As was pointed out above, the young begin to appear in great numbers as soon as the new growth starts. These young insects seek first the tender growth and the young fruit buds. Upon the former they settle indiscriminately while on the latter they settle just around the base of the young fruit. I have counted as many as 150 individuals around a single young lemon.

At this period all infested trees should be given a liberal application, in order to preserve the new growth and setting lemons; the greater number of the latter will soon drop unless the pests are removed. In case the fruit matures, the mealy bugs develop with it until, when it is ready to pick, it is so scarred as to be fit only for third grade when it might have been first. While the carbolic acid emulsion did spot the younger, reddish growth, no material damage was done at this period, which should prevent spraying. Later in summer, after the young growth hardens a little, is a more favorable time to spray, except that the foliage is very dense and thorough work difficult.

What has been said above pertains particularly to the lemon trees. The oranges shall now be considered.

Navel Orange Trees: Mealy bugs usually show up in the greatest numbers in the navel end of the fruit. In fact this may be the only place where they can be found. Here they find the skin thin and are able to extract the juices easily while at the same time the navel affords secure protection. In half-grown oranges, I have found the insect working nearly to the center of the fruit. As they work in, the female deposits her eggs behind her, thus completely closing the end of the orange. In a single navel thousands of eggs are deposited, while only those at the extreme end are exposed. The "working-in" process often causes a great deal of dry rotting. In one orchard about 15% was thus destroyed. The pests lodged in the navel are removed with the fruit, and it is impractical to spray except at the following times:

1. Just after the fruit is well set and continue, if necessary, until the fruit attains the size of a walnut: At this period the mealy bugs are mostly young and are scattered individually over the trees. It is useless to spray after the navel is large enough to afford extensive shelter, for this is where the insect is sure to lodge as soon as possible.

2. After the fruit is picked: It is a plain truth that the mealy bug, on the citrus trees, is a fruit feeder. For this reason it appears in greater numbers upon the lemon trees, for lemons bear fruit throughout the entire year, and afford the most favorable conditions.

After the oranges are removed from the trees, it is difficult to find the mealy bug in any considerable numbers. *Of course many go with the fruit,* but enough egg masses are left upon the trunks and limbs of the trees to infest the coming crop of fruit. And the pest will not show up again until the fruit is well set. This period of inactivity, due to lack of food, has led many to believe that the pest left the tree, to show up only at certain periods of the year. Not remembering the conditions from year to year, many orange growers believe that the mealy bug may disappear for a year before it again shows up. This is not so true with the lemon grower. While the insect is not so numerous in the summer months, it is always present, and a constant source of worry. It may be found upon the orange trees, but, being small and not so active, is more difficult to find than when you have only to look into the navel of the fruit.

To show this preference for the fruit the following experiment was carried on in the laboratory: Several two-year-old lemon trees, and seedling orange trees, were enclosed in cloth cages and kept in excellent condition. Large numbers of infested lemons and oranges were placed at the base of the trees. In no case did the mealy bugs leave the fruit, until it had become shriveled and tough-skinned. And when the young did take to the tree their development was extremely slow. In two cages, I have had mealy bugs infesting the young lemon trees since October. The young hatched out in great numbers in a month later and fairly covered the foliage of the tree. To date (June 7) not a single adult insect can be found, while there are still a few small individuals. This is not true on other plants, where they develope perfectly upon the foliage. Thus they linger upon the orange trees until the fruit appears when they begin to develope very rapidly. Conditions may vary elsewhere, but this one thing is very noticeable here.

Valencias and Seedling Trees: As in the case of the navels, the mealy bugs gather at the blossom end of the fruit, where they deposit a great many eggs. In the seedling, however, little or no protection is afforded except against the weather. The damage to the fruit is slight and the insects are easily removed in the washer. The greatest damage done is causing the black smut to grow upon the fruit and thus necessitate washing and over-handling.

Spraying should be carried on as for navel trees, but can be continued until the fruit is quite large, if necessary.

In general it is more difficult to spray an orange tree than a lemon, to do good work, because the foliage on the former is much denser and orange trees are more often allowed to grow down to the ground, thus making it very hard to reach all of the interior of the tree. Then, too, many of the seedlings are very large trees, and require a tremendous dose to cover all of the leaf surface. A lemon tree infested with mealy bug is usually very destitute of foliage and this openness makes spraying an easy matter.

All trees can be successfully cleaned up if the work done is thorough and persistent. *To spray whenever the mealy bug is found upon a tree is a very good motto.*

Number of Applications: As every sprayer knows, it is impossible to reach all parts of a tree at a single spraying. In combating so serious a pest as the mealy bug it is therefore necessary to make a number of applications to get results.

In a badly infested orchard three sprayings should be made within two or three months. The orchard will then be freed from serious smutting and the fruit will be hardly scarred. But the work must not be stopped. The mealy bug is a pest which can hardly be eradicated, for it has too many host plants. Parasites are going to do good work as soon as they get started, but the man who wishes to keep this pest down can do so by first cleaning up the orchard as stated and then spray once or twice a year with the carbolic acid emulsion. *The main thing is to keep fighting.* That is the only way to get rid of any kind of infection, whether it be weeds, fungous or insect pests.

Spraying and Parasites: It is not the aim of this office to belittle the work of parasites in any way. We have set aside a large section of badly infested lemon trees for their work alone. Every chance should be given any natural agent which tends to destroy the mealy bug. At the present time the parasites in this section are doing excellent work and it is hoped that their good work shall keep on.

For checking the spraying work, several rows on the edge of the reserved portion, where there were few parasites, were treated so as to compare them with those left to the parasites. No report can be made on this for several years, in order to give the predaceous friends a fair show.

The adult ladybird beetle easily escapes the spray. It was noticeable how rapidly they took to wing or fell to the ground and crawled away as soon as the fine spray struck them. But the larvæ never escape. In the case of the *Cryptolaemus* and *Scymnus* larvæ the covering is a dense white, cottony, material like that of the mealy bug, and they are just as susceptible to the spray. Many escaped but the greater number were killed with the mealy bugs.

The effect of the Carbolic Acid Emulsion upon the Honey-Dew Fungus: It is evident that the thick coating of smut upon the foliage, which grows on the honey-dew, secreted by the mealy bug, is a great detriment to the function of the breathing organs of the leaves and to the photosynthetic action within the leaf. Probably no scale insect is more prolific in the production of this honey-dew than is the mealy bug. Of course the greatest damage is to the fruit, because the scrubbing in the washer, necessary to remove the smut, greatly reduces the keeping qualities of the fruit. This is especially true in regard to the lemons, which must be subjected to a long period of curing. The following letter from Mr. Robert Ramsey of N. W. Blanchard's Packing House gives some idea of the damage to the fruit caused directly by the citrus mealy bug:

"Mr. Essig. Dear Sir: In accordance with your request for data concerning the probable percentage of loss on oranges and lemons that can be traced to the presence of the mealy bug, have made an analysis of two years' results as follows:

LEMON.

Increase in the proportion of culls to selects in 1909 over 1908	7%
Increase in house decay in 1909 over 1908	65%
Increased cost per packed box handling in house 1909 over 1908	13.4%

ORANGES.

As to oranges it is very difficult to ascertain just how much decay was due to mealy bug, because of the fact that in previous years, with no mealy bug, weather conditions have made the fruit soft and non-keeping and on the other hand, this past year with mealy bug, the fruit has kept better than for years (1910). It is significant, however, that the cost per packed box of handling in the house in 1909 over 1908 is considerable greater, as follows:

Increase in cost of handling per packed box in house 1909 over 1908...17½%

Trust these figures, which are taken from the records, may prove of some use to you, and if there is any other information that you desire, that we can furnish, advise and will look it up.

Yours truly,

R. S. Ramsey."

To ascertain the effect of the sprays upon this smut, the fruit from the sprayed trees was carefully separated in lots according to the spray used. All the lemons which were coming into the packing house from the mealy bug sections of the orchards were washed with much difficulty, and required a great deal of hand scrubbing after they left the washer. The cost therefore was very great, simply in the washing of the fruit, regardless of the loss through decay.

Two lots of fruit were separated and data recorded of the sprayed lemons as follows, from report of Mr. T. Dougherty, foreman of the Blanchard Packing House:

THOSE SPRAYED WITH LIME-SULFUR SPRAY.

"Wash very clean and easy. No visible marks or spots from effects of spray. No hand brushing required."

THOSE SPRAYED WITH THE CARBOLIC ACID EMULSION.

"Washed very clean and easy, requiring no hand brushing, although almost completely covered with smut and mealy bugs, the latter seemingly all dead. No spots from spray."

The significance of this report can only be appreciated when one knows the real conditions of the fruit referred to. It was taken from a section which was as badly infested with mealy bug as any, and the fruit was thickly coated with black smut and honey-dew.

It was estimated that the benefits derived from the spray in cleaning the fruit alone, paid for the cost of spraying. The carbolic acid emulsion gave the best results in this work.

Fruit which was very dirty from smut of black scale was washed in a weak solution of the carbolic acid emulsion in the packing house washer with very good results. The kerosene, which had been used, benefited only the lemons floating on the top of the water, while the emulsion benefited all alike. The mixture was as follows:

Five gallons of the stock solution was added to 200 gallons in the washer. This amount ran one-half a day—steady washing. Only in cases of very dirty fruit has this given any very great advantages over other washing materials.

CARBOLIC ACID EMULSION AND BLACK SCALE.

Many fruit growers here believe that any spray which will kill the mealy bug will certainly slaughter the black scale, but such is not the case. The black scale, even when quite young, is not so susceptible to this spray as is the mealy bug, due to its hard coating. The black scale is protected by its hard shell which is not much damaged by this spray, while the mealy bug is protected by a cottony wax, which is readily dissolved by it. Therefore this spray is not recommended for black scale, although it may kill a great many of the young insects.

PRACTICAL SUGGESTIONS.

1. *Use every means to get rid of the citrus mealy bug at any COST.*
2. *Spray as soon as you can, and as often as necessary.*
3. *Use fresh and good material. It can be had at about the above quoted prices. Write for quotations to any reputable chemical supply house.*
4. *Do not think that because you do not kill all the pests at one spraying that the spray is not good. Remember that this is a very difficult pest to combat.*
5. *Use a power pump.*
6. *Write to this office for any information desired regarding this pest.*

PRESENT STATUS OF MEALY BUG SPRAYING AT SANTA PAULA.

Since writing the article on spraying for the citrus mealy bug, we have sprayed at Santa Paula some twenty acres. During this work many of the practical and unpractical phases of the work was brought out, which shall be taken up under various heads.

Pressure: Great difficulty was found in keeping a high and constant pressure with run-down spray pumps. This work is very particular and the pump must be overhauled at the beginning of the spraying season so that the best possible results may be obtained. The pressure should never be less than 200 pounds. In many cases where it went as low as 100 pounds or even 140 pounds the results were not satisfactory. The high pressure not only penetrates the cottony protection better, but it whirls the leaves and enables the sprayer to hit every part of the tree. Much of the poor results obtained were usually traced right back to this cause, which though a small thing, is extremely important in spraying for the mealy bug.

Application: There is always fault found with the application of sprays. Either the sprayers are careless or, as found in some cases here, did not wish to do the work, so pushed it as rapidly as possible, giving each tree only half the required dosage. By careful work we found that if applied rightly, the Carbolic Acid Emulsion did excellent work, so if you get poor results look up this matter. Few men enjoy spraying and farm hands like to see it finished as soon as possible. Sometimes it was necessary to go over the work twice in order to get beneficial results at all, and in those cases we found that the first dosage given was less than half which the sprayers were instructed to use. Careless spraying is useless.

Material: The commercial materials used must be carefully examined, for we have found some unfit for anything.

As a rule the crude carbolic acid was good, but if it is allowed to stand in wooden barrels in the hot sun for any length of time it is liable to evaporate and escape, leaving a concentrated liquid which is disastrous to the spraying apparatus because it collects in the hose and stops up the nozzles, and to the trees because it may drop the leaves.

With the whale oil soap we found considerable trouble. In all we have handled some three tons and find two distinct grades. One is a light brown and is good, while the other is very dark—nearly black—and is worthless. Out of the last ton some 400 pounds were set aside and will be shipped back to the factory. The trouble with this poor grade seems to lie in that it will not form an emulsion, no matter how much is used. Several tanks were sprayed out before the mixer was aware of the difference, which showed up immediately on the trees. No harm was done to the foliage or to the mealy bugs. Therefore in view of this experience you are advised to avoid dark whale oil soap. It is not good.

General Results: At times the work proves very encouraging, while again it does not show up well, but I am satisfied that all poor work lies with the above named faults. Spraying citrus trees for anything is difficult, and doubly so when spraying for the mealy bug. The pest is bad and hard to kill. *Remember it cannot be killed with reckless spraying. Good work always shows up in the results. Remember this in your spraying work.*

THE NATURAL ENEMIES OF THE CITRUS MEALY BUG II.

BY E. O. ESSIG
HORTICULTURAL COMMISSIONER OF
VENTURA COUNTY, CALIFORNIA

Coccinellidæ

Among the ladybird beetles come many of the predaceous enemies of the mealy bug, and because of their great importance to the entire field of Agriculture and Horticulture in combating especially the Coccid and Aphid pests, we have been studying as many of its species as possible. To my knowledge there are no works in the state dealing with the accurate distinguishing of the larval and pupa forms and to this end this study is being attempted. To the practical observer the larvæ and pupæ are rarely associated with the correct adult. Since it is the larva that we expect to do most of the good work, we should be able to distinguish it immediately. At present we have at Santa Paula the following ladybird beetles as enemies of the mealy bug; *Cryptolaemus montrouzieri, Rhizobius ventralis, Rhizobius lophantha, Scymnus guttulatus,* and several others not determined. These we shall consider first. In order to better understand the descriptions let us look first at the general characters of the larvæ.

Family Characters of Larvæ of Coccinellidæ*

Larva six-footed, with ventral side of the body straight—an adaptation for crawling on a plane surface. Abdomen with nine segments, the last containing an anal tube which is used in locomotion.

Spiracles are located as follows: One pair on the mesothorax and a pair on each of the first eight abdominal segments. These spiracles are situated on the lateral margins near the middle of the segments, and extend to a considerable distance within the body.

Head small, hard, narrower than pro-thorax. Epistoma large at the fore part widening from a narow front towards the crown of the head where it becomes almost circular. Clypeus distinctly separated from the frontal by a well defined suture.

Ocelli protruding, situated on a triangle just behind the antennæ.

Antennæ situated on the lateral anterior angles of the head just back of the base of the mandibles; three-articled, very small and retractible. The of the base of the mandibles; three-articled, very small and retractile. The inserted on the exterior margin of the second. It is shorter, more slender than the second and usually terminates in a point.

Mouth-parts small and not extended. Labrum membranous, irregular on the front, extending between the lateral angles of the clypeus, which is much more chitinous. Mandibles strong, somewhat triangular, nearly as wide at the base as long, sharp-pointed, but generally bifurcate at the point, with a tooth on either side or with one on both sides near the base.

*Geo. W. Dimmock—Algunas Coccinellidae de Cuba, 1905.

Maxillaries inserted under the mandibles; basal maxillary sclerite is short, indefinite, and inserted on the head; the second maxillary sclerite is flattened, large, extending forward and uniting the greater part of its length with the second sclerite of the labrum. The exterior lobe does not exist. The interior lobe is carnose, widening, provided with an appendage of two articles, slightly inclined, and situated on the apex of which are some hairs or bristles. Maxillary palpi three-articled, large, strong, hard, conical, slightly bent, and provided with a few bristles. The third article of the palpus is large, and conical with the point obtusely rounded and provided with conical sensoria-like structures. The second sclerite of the labrum is large, widening, and unites on the under side with the maxillary stipe. The stipes of the diverging labial palpi are united. The labial palpi are inclined slightly upward, conical, strong, two-articled, the apical article is conical, largest and well-rounded at the point, which is provided with numerous conical sensoria. Without ligula.

Thorax with three distinct segments. Prothorax longer and narrower than the mesothorax and metathorax which are almost equal.

Legs consisting of coxa, trochanter, femur, tibia, and claw. Coxa short, conical, length less than one-third the width of the base. Trochanters much shorter and narrower than the coxæ. Femur large, nearly cylindrical, curving slightly inward, much longer than the coxa, where it unites with the trochanter it is small and obliquely truncate permitting great flexibility in the joint. Tibia large, nearly cylindrical, sparcely bristly on the exterior surface and densely bristly on the interior; generally longer than the femur and claviform in shape. Claw one on each leg, curving downward and inward and thickened at the base.

Abdomen straight, more or less flattened, wider than the thorax and gradually tapering posteriorly; with nine distinct segments. The last segment is generally much narrower than the other eight. Anal tube membraneous and retractile; can be extended and is used in locomotion.

Habit active, and usually living upon plants infested with Aphids, Coccids, and other small insects on which they feed. Usually diurnal.

Larva moult four times in development.

For convenience the larvæ of the family were placed in five groups by Dimmock, as follows:

1. Larvæ with tubercles producing bristles. These larvæ are great Aphid feeders. A few are adorned with brilliant colors. The shape is generally fusiform with the body flattened. The nymphs are bare.
2. Larvæ with short stout spines, some having very small spines or bristles. Generally flattened and fusiform; adorned with many bright colors; great Aphid feeders; nymphs usually bare. The larvæ of *Exochomus* forms a transition from this group to the next, the larvæ of which are mostly Coccid feeders and the nymphs remain in the larval skins in transforming.
2. Larve with short, stout spines, some having very small spines or bristles. The nymphs remain in the skins of the larvæ in changing to adult.

4. Larvæ with large branched spines, and small branching spines or bristles. Larvæ are oval or somewhat elongated and are herbivorous. The nymphs remain partially within the skins of the larvæ in their transformations.
5. Larvæ with skins for the secretion of white filaments. These larvæ vary in their food-habits; the nymphs remain within the skins of the larvæ.

Family Characters of the Nymphs of Coccinellidæ*

Color—The colors of the nymphs of the family Coccinellidæ are generally showy, this show of colors being the reason of their being called this name. Like the larvæ they are protected from the ravages of insectivorous animals by offensive secretions. In consequence these insects, during their transformations to the adult, remain in exposed places. The distribution of the marks vary considerably within the same species, but the color is one of the chief characteristics in their classification.

Antennæ—These are small and inconspicuous like those of the larvæ. In the nymphs they are hidden from the dorsal view, being bent under the prothorax dorsally and posteriorily from the point of insertion. The tips of the antennæ extend upon the femur of the first pair of legs.

Elytra—These are large, and when viewed dorsally with one of the elytra turned sufficiently on its base, the surface of the abdomen may be viewed as, in the case with the nymphs of the Coleoptera in general. The elytra commonly hide the dorsal surface and almost all of the sides back to the third abdominal segment. They are somewhat bent until they meet in a median line and usually hide the greater part of the posterior feet. Such a peculiarity is mentioned by Letzner (1857). The marking of the elytra of the nymphs do not correspond to that of the adult, but is an important character of the nymphs and should be mentioned in all descriptions of them. The marking is somewhat variable within the species, but this character is very essential and is usually constant.

Spiracles—Those of the thorax are hidden. Those of the first five abdominal segments are prominent, and those of the remaining segments are smaller. In the nymphs of *Chilochorus* the margins of the spiracles of the first abdominal segments are formed into a prolonged conspicuous tube.

Surface—Smooth, downy, or bristly, according to the species. The nymphs, in descriptions, are characterized by their colors and the distribution of the down and bristles.

Dorsal View—The head is not visible from a direct dorsal view, due to the fact that it is completely bent under the ventral surface of the prothorax.

Prothorax—Equal to or exceeding in length the mesothoracic and metathoracic joints but doubled ventrally nearly at right angles to the axis of the body. The position when viewed ventrally appears like the transverse segment before the mesothorax and elytra; larger than the metathorax.

Mesothorax—Trapezoidal in shape and narrower and much shorter than the prothorax; its width is greater than its length, the anterior margin is greater than the posterior, and the base of the elytra are united at the converging lateral margins.

**Geo. W. Dimmock in Report of Estacion Central Agronomica, Cuba.

Metathorax—Crescent-shaped with the convex surface towards the front; equal to or slightly exceeding the mesothorax in length and greater in width. Much narrower on the posterior margin than on the anterior.

Abdomen—Commonly very convex along the median line; somewhat flattened out on the lateral joints (sutures between the segments). In many of the nymphs there is a deep suture between the segments 3 and 4, 4 and 5, 5 and 6, and sometimes between 6 and 7. These transverse sutures or joints, permit a greater flexibility of the abdomen, in virtue of which the nymph is able to raise itself almost perpendicular to the surface to which it is attached and to repeat this motion in a regular manner, when it is molested. This is to frighten its enemies. The lateral portions and the flattenings of the abdominal segments are prolonged sometimes, more or less, by spines, which is true of some segments of the nymphs of the genus *Anatis.*

Anal Appendage—Absent, but the apex of the abdomen is prolonged to a point forming in many of the nymphs an anal fork which is sometimes folded under the dorsum. This anal fork first observed by Letzner (1857) serves to hold the nymph in the skin of the larva and is easily broken when the nymph is forced violently from its binding, leaving the abdomen rounded. This anal fork (morphologically considered) is like that of the nymphs and larvæ of the *Cassidini,* a subfamily of the Chrysomelidæ.

Ventral View—Head small, border of the anterior margins of the prothorax as it occurs in many of the nymphs of the Clavicornia. The large maxillary palpi, which are easily distinguished by the terminal article which is nearly triangular or the shape of an axe. The rest of the mouth-parts are not very conspicuous. The antennæ are visible from both sides of the head, resting in the cavity formed by the lateral margins of the prothorax.

Feet—The pair of anterior feet and the mesothoracic ones are doubled contiguously below the anterior part of the nymph, but are so small that the knees do not protrude from the sides of the nymph. The femur forms nearly a right angle with the main axis of the body. The metathoracic feet are almost hidden by the elytra.

Cryptolaemus montrouzieri

Eggs—Are orange-colored and long, tapering to a point at both ends. They are laid on end and stand together like a bunch of cigars. There are from 4 to 12 in each bunch, and they are laid on various parts of the tree, on the bark of the limbs and trunk in hidden places, on the leaves and even on the stems of the fruit. The eggs hatch out very soon. It has been impossible to keep those collected in the field from hatching for over one week. The eggs probably remain for sometime in cold weather, but under favorable conditions should hatch within two weeks.

Larvæ (Fig. 106 A): Hatch all at about the same time, and immediately go in search of food. The first born have little covering, and the legs are very prominent. Length about 1 mm. Form, oblong to oblong oval. The body when covered with the white, wooly secretion is of various shapes, but usually longer than wide. The length of the body proper when fully

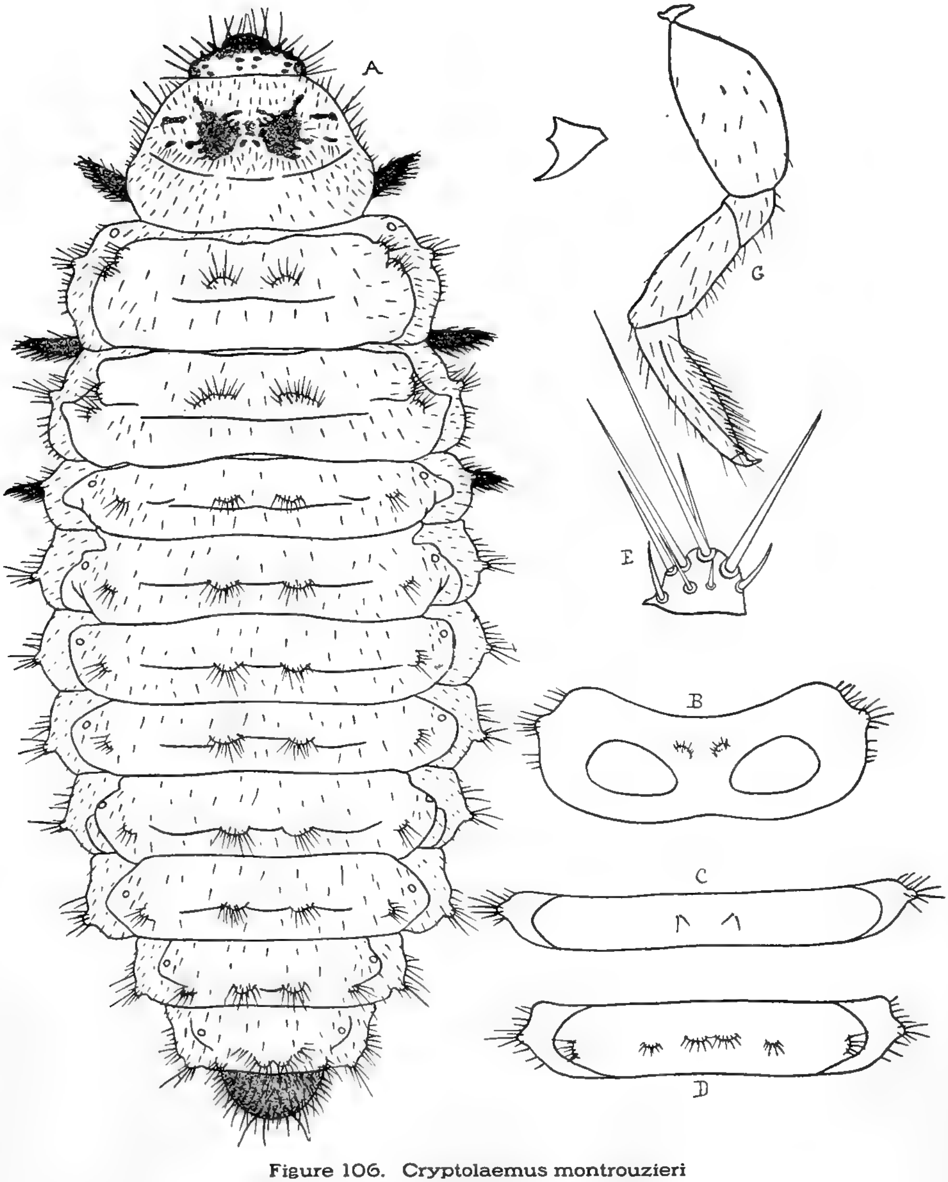

Figure 106. Cryptolaemus montrouzieri

developed averages about 1 cm., but with the woolly secretions as seen in the orchard some are twice as long as this. The width is about one-third the length of the body, but this may be very different in some specimens. I am using only average measurements. The woolly covering secreted by the larva is snowy-white. The covering is arranged in long filaments, each filament arising from the dorsal and lateral spine areas and extending in all directions. When attacked the larva immediately curls up showing only a woolly mass. Few insects care to eat through this secretion to get at the body, so the attacks of other insects are few. The body is yellow, sometimes approaching a very dark shade. The dorsum of the head and ninth abdominal segment are nearly black, as are also the femur, tibia, and claw of the legs. On the dorsum of the prothorax are two large black blotches and many smaller ones. The entire body is covered with long and short spines. The following description is of the body with the wolly secretion removed:

Head—As long as the piothorax, but much narrower. Color, dark on the dorsal side. Covered with long hairs or spines. Antennæ, three-articled, tapering greatly from base to the tip; retractile. All of the articles are nearly equal in length. I is much wider than II, II is twice as wide as III. Mandibles (Fig. 106)—Strong: bifurcate at the point, with tooth on the inner margin near the base. Maxillary palpi, three-articled, the epidermis may be extended at the point of insertion to make them appear four-articled. Articles I and II are nearly equal in length, III is nearly as long as both I and II. Article I is wider than long, and much wider than II; article II is also wider than the length and wider than III; III is very narrow and much longer than either I or II. Labial palpi, two-articled and small; articles nearly equal in length but I is wider than II.

Thorax—Gradually tapering from the head to the metathorax which is the widest part of the body. Prothorax much wider than the head, and narrower than either the meso or metathorax. Color, yellow with two large cloudy blotches and several smaller ones on the dorsum. Spines on posterior margin. Mesothorax very short, yellow, with two large spine areas near the middle of the dorsum, and two spine areas on either side of these. On the lateral margin is a large spine area. The large breathing spiracle is on the anterior lateral margin. Metathorax agrees with the mesothorax in arrangement of spine areas, but is wider and has no spiracle.

Abdomen—Nine segments, all tapering from the first to the posterior segment which is much narrower than the other eight. All are yellow except the dorsum of the ninth segment, which is dark. On the dorsum there are two median spine areas, two more or less lateral or dorsal (one on each side of the two median) and a lateral area on each margin of the first eight abdominal segments. On the ventral side there are five ventral spine areas and two lateral areas on each segment. (One of the two lateral areas on each margin is the lateral area seen from above.) The 16 spiracles are situated along the margin of the abdomen. A spiracle situated on the anterior lateral margin of each of the first eight abdominal segments. The ninth segment is covered with many long spines or hairs.

Legs (Fig 106G)—Coxæ longer than broad and much larger than the femur. Yellow in color, and more or less hairy. Trochanter small, yellow or dusky in color and hairy. Femur short and heavy. Dark in color and hairy. Tibia about as long as femur, dark, with many hairs or spines on the interior margin. Claw well curved, with a rounded process near the base.

The larvæ pass through four moults in their development. They exist in the orchards here the year around, but during the months of January, February, and March there were very few actually working. At this time (April 12th) they are beginning to appear in great numbers and all are actively working on the mealy bug. They reach their greatest efficiency during the month of September, and then appear in the greatest numbers. Last year none of their work was noticed until that time. Later, in the last of October and the first of November they collected in great numbers in the cracks of the tree and on the trunks to pupate. The larval stage, of course, is the beneficial stage—i. e., the stage when the insect preys the most upon the mealy bug. It is also the stage of cannibalism, for the larvæ greedily devour the eggs and smaller larvæ of their own kind. The mealy bug is wholly devoured. The larvæ when small, prefer, however, the young or the eggs of the mealy bug, and the larger mealy bugs when it is full grown. The benefits obtained from this insect in one year is wonderful, though there have been few of them introduced.

Pupa (Fig. 107 G)—The nymph is covered with the woolly, white skin of the larva, and leaves this skin in perfect shape. One must examine all the cases carefully to ascertain whether they contain nymphs or not. Color, white, externally viewed, due to the larval skin which protects it. The body proper is yellow, without any markings. Average length is 5 mm. (of the body proper. Lateral margins of abdomen covered with areas of short, stout curved spines. Figure 107 H shows one of these areas. The wing margins and the posterior margin of the prothorax are also spiny. All of the spines are simple. Dorsum of abdomen covered with scattering hairs or spines. Anal appendages cylindrical and bluntly pointed at the apex.

The nymphs first begin to appear in considerable numbers about the first of October and continue to exist until the first of January. A few specimens may be found at nearly any period except from February 1st to June 1st. The larva crawls into any secluded place to pupate, but may also be found in great numbers on the tree trunks. They have been found in dry leaves, on tree props, under the scaly bark, and late in the fall great numbers fall from the tree to the ground and pupate on the under sides of the dry clods. On the tree trunks they are often massed in great clusters of several hundred individuals. Quite a percentage of the nymphs do not develop, but dry up and die. In some masses as high as 20 per cent thus perished. So far as known nothing preys upon this insect here except the larva of its own kind or of other ladybirds, but in these cases the pupa is generally safe.

FIELD NOTE MADE AUGUST 17.

We are at present finding plenty of eggs of *Cryptolaemus montrouzieri.*

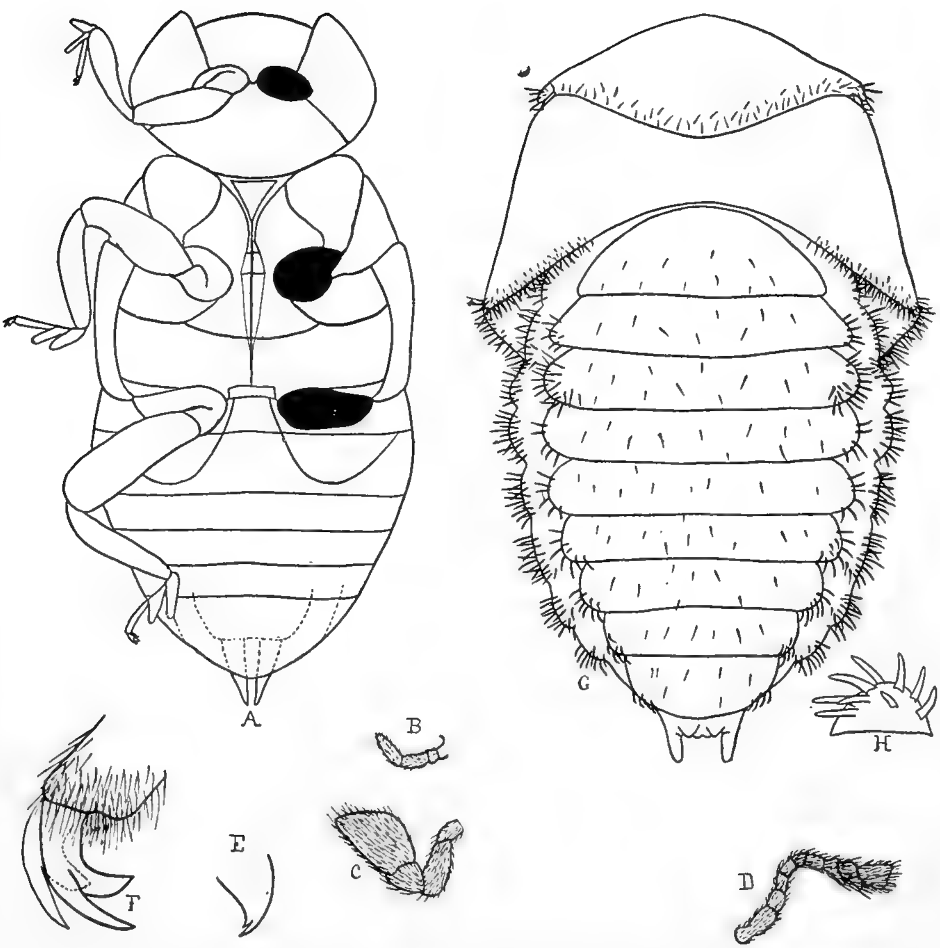

Figure 107. Cryptolaemus montrouzieri

They are lemon yellow, oval, and about .5mm. long. They are deposited separately over and among the mealy bug egg-masses.

At the present date this insect is doing most excellent work. It has practically cleaned up large areas of the infested orchards, and is multiplying in countless numbers.

ADULT—(Fig. 107 A)—Form elongate-oval. Entire body pubescent. Color of head, prothorax, abdomen, and posterior tips of the elytra are salmon-red; the remainder of the body is black. Length, 5 mm.; width, 3 mm. Head, very small. Eyes, coarsely faceted and black. Antennæ, short and hairy. Mandibles, bifid at tip. Prothorax, slightly narrower than mesothorax and metathorax, not extending to cover head. Mesothorax and metathorax nearly equal in width. Coxæ not approximate. Trochanter small and narrow. Femur stout and co-equal with tibia, which is much narrower. Tarsus three-articled. Claws bifid.

Adults appear in goodly numbers throughout the entire year, but are more numerous in the Spring than at any other time, this being the egg-laying season. They are very active, and fly a great deal. When disturbed they immediately take to wing or drop to the ground and fly or rapidly crawl away. In our spraying work we noticed that they rapidly left the tree before any harm was done to them by the solutions.

This insect was introduced into this county by Mr. P. E. Smith during his year as commissioner in 1909, from San Diego County. They did not show up very well until in the Fall of that year, when they appeared in considerable numbers. Since then every opportunity has been given to them. They are set aside in a badly infested orchard away from sprays and fumigation and close watch kept of their work and habits. Breeding cages have been built to aid in their distribution. In the badly infected orchard spoken of, several rows are now being sprayed (these rows happen to be where few of the beetles are working) to measure the efficiency of the parasites with that of sprays. This work shall be continued until late in the Winter and the results carefully noted. Because the mealy bugs works on house plants, in nurseries, on ornamental and even the mountain trees in our canyons, it is absolutely necessary that we have an effectual parasite for it, and it is my belief that the greatest good is to come from this beetle, for it is now doing a wonderful work in the orchards, and is rapidly spreading over the country.

Very little literature is obtainable on this insect (*Cryptolaemus montrouzieri* Mul.) so I present herewith all at hand:

"*Cryptolaemus montrouzeri* (The latter name is usually spelled montrouzieri). This is another of the Australian Coccinellidæ. It is the natural enemy of the mealy bug. It has been introduced into the Hawaiian Islands, where this pest was so bad in the coffee plantations as to almost threaten the total destruction of the crop, and it has done such good work that the pest has been practically cleaned out. Successful efforts have also been made to establish it in the coffee plantations of Central America, where the mealy bug has also appeared in destructive numbers."—John Isaac in "Bug vs. Bug," 1906, page 14.

"*Mealy Bug* (*Dactylopius adonidum,* Signoret). This mealy bug has made its presence felt in some portions of the State. It congregates in large numbers in portions of the tree, especially among the clusters of fruit.

"Treatment—This insect is effectually destroyed by the ordinary washes used for scale, and by the ladybird *Cryptolaemus montrouzieri,* lately introduced. This ladybird is as effectual in destroying the mealy bug as the *Vedalia* and *Novius* are in devouring the cottony cushion scale."—B. M. Lelong in "Culture of the Citrus in California," 1902, page 262.

"Of the other insects imported by Mr. Koebele, two are worthy of mention. One of these, *Cryptolaemus montrouzieri,* is an important enemy of several Coccidæ such as the mealy bug, *Pulvinaria,* etc. This is the species which was introduced in Hawaii, and has been so successful there in ridding coffee plantations of *Pulvinaria psidii.* It is being reared in confinement and distributed in portions of Southern California, where the mealy bug is an important pest, and specimens brought to Washington have demonstrated their usefulness by cleaning orange trees in the hot-houses of the Department of Agriculture of mealy bugs. It gives promise of being a valuable outdoor enemy wherever the climate is favorable, and in the North and East will be a valuable indoor means of controlling soft scale." By C. L. Marlatt. In "Year Book of the Department of Agriculture," 1896, page 226.

Extracts from Bulletin No. 1 of the Claremont Pomological Club, issued at Claremont, Cal., Feb. 15, 1909:

"However, the predacious insect that has controlled the pest (mealy bug) in San Diego is the *Cryptolaemus montrouzieri,* a ladybird. It has done wonderful work there and should be introduced after fumigation. They can be secured of Mr. Austin, San Diego, upon payment of his services." By P. E. Smith.

"The first time that we had the bug it did not spread much. We introduced the parasite—the *Cryptolaemus*—together with it—." "In consequence of its remaining on the trees throughout the Winter, the *Cryptolaemus* increased very considerably, so that last Summer . . . it was present in immense numbers. When fumigating last Fall, I set aside three patches of about an acre each in different parts of the orchard where the mealy bug was bad and the *Cryptolaemus* most abundant. I did this for the purpose of preserving and multiplying the latter. In this we were successful, and after the orchards had been fumigated the *Cryptolaemus* seemed to spread pretty well over them. At the present time there is very little mealy bug to be seen, and the general condition of the orchards in that respect is infinitely better than it was last Spring and Summer." By R. C. Allen.

"We have been devoting a good deal of attention to this pest (mealy bug) the last season and we have at present a ladybird *(Cryptolaemus montrouzieri)* that does good work on it, working in about the same manner as the *Novius cardinalis* does on the cottony cushion scale, although it is not so thorough in its work, being a slower spreader and requiring more attention in this respect." By E. K. Carnes.

Extracts from Pomological Bulletin Vol. No. 2:

"Peculiar conditions in San Diego county have enabled the most efficient predatory insect attacking mealy bugs in California, *Cryptolaemus montrouzieri,* to become firmly established in that region, so much so that it can be collected in numbers practically all the year round, experience has also show that in perhaps three years out of four its work is as complete in that region as that obtained by any mechanical means of control, thus I consider Mr. Allen justified in the course he has decided to adopt. It is further true that in this same locality of which I have just been speaking, as recently as the 14th of last October, when *C. montrouzieri* had increased in such numbers that I was able to obtain 1,000 in the space of an hour, and when the work of cleaning up the mealy bugs was considered remarkable, there were more mealy bugs on each tree in this orchard than there are in the entire infestion here at Claremont." By Frederick Maskew.

Rhizobius ventralis

Eggs—Are small, cylindrical, and pointed. They are deposited in egg-masses and among the mealy bugs. In the case of black scale, they are deposited under the adult female shell—usually few at a place.

Larvæ (Fig. 108 A)—Hatch from the eggs some two weeks from the time of deposition. The first born are very small and somewhat inactive. Form, oblong and somewhat narrow; tapering towards the tail-end. Length of average 6 mm., width 2.5 mm. Color, dark brown to black. Body very rough because of many small ridges, and large spine areas. The spine areas are located as follows: Lateral areas—two extremely large areas on each abdominal segment, these are also present on the margins of the prothorax, mesothorax and metathorax; two smaller spine areas on all of the abdominal segments, and two large areas on the prothorax, mesothorax and metathorax.

Dorsal areas—Two median areas on all of the first eight abdominal segments, and a large area on the ninth.

The spines are all simple. On the median spine areas, there are two large spines and several smaller ones; on the remaining areas there are numerous large and small spines. The rough skin is shown in the enlarged drawing of the spine area. The entire body is covered with the short spines. Around the spine areas the color is somewhat lighter than the body, as is also true of a streak down the middle of the thorax. This streak forks at the base of the head, each fork extending to the lateral margin just back of the eye. A dark streak extends down the middle of the dorsum. The ventral side is a dark yellow color. When disturbed, the larvæ emit a sticky yellow fluid. Head shorter than thorax, and half as wide, very dark in color; covered with spines. Antennæ three-articled. Article I as long as II and III; twice as wide as II; and many times as wide as III. Article III not as long as II, and half as wide; with a long spine at apex. Article II has a large, stout spine arising at its apical end beside article III. This spine is longer than article III. Mandibles bifurcate at the point, with a long curved tooth near the base of the inner margin. Maxillary-palpi appear really four-articled. Article III (the apical according to Dimmock) is much longer than the article II or I, and is much narrower. Labial-palpi two-articled; article I wider and shorter than II. Thorax gradually growing wider from the head to the first abdominal segment. Prothorax much wider, and longer than the head. With large spine area on each half and a rudimentary lateral area. With a lighter streak on middle of dorsum. Mesothorax wider and shorter than the prothorax; with spine areas the same, but not so large. Metathorax slightly wider than the mesothorax, but little longer. Spine areas the same. Abdomen nine segmented, the second being the widest and the ninth very much the smallest. Legs short and stout. Coxæ much longer than broad, longer than femur or tibia. Trochanter normal. Femur nearly co-equal with tibia. Claw well curved with enlargement at the base.

The larvæ are to be found in great numbers in the egg masses of the mealy bug, or crawling about on the tree. This stage may be found at any season of the year, although in no great numbers during the winter months. During the months of October, November, and December, they are present in the greatest numbers and do the most work. The work is done very slowly and while the larvæ appear in great numbers it is difficult to see the results. This is probably due to the fact that they move about very little and their food requirements are not as great as for the more active species. It was noticeable that great numbers were trapped by tanglefoot bands on the trunks of the trees, where they usually collect in the greatest numbers and feed upon the egg masses here, rather than upon the fruit, although they are found on all parts of the tree. This insect was introduced for black scale (*Saissetia oleae*), but it seems to prefer the mealy bugs when they can be had. I have seldom found them working on the black scale which infested trees covered with the mealy bug. So far the only enemies known are the Green Lace-Wings (Chrysopa) which destroys many of the younger larvæ.

Pupa (Fig. 108 B)—The nymph is covered with the dark spiny skin of the larva. Average length, 4 mm.; average width, 2.5 mm. Color same as the larva. Surface of body smooth, but covered with short spines or hairs. Anal appendages peculiarly the shape of a human foot, with the toes turning in. The nymphs appear in the greatest numbers during the later months (November, January,) and are very scarce during the months of June and July. The moult lasts from two weeks to one month, and occurs in a hidden protected place under the bark, in curled leaves, or any such favorable places. Where sacks were tied around the limbs to prevent wire stays from cutting into the bark, great numbers of this stage were found hiding underneath the sacking.

The greater percentage of the nymphs develop normally. I have never found any partially developed forms.

Adult (Fig. 108 C)—Slightly oval to nearly round in form. Color, black, but due to the pubescent covering, often appears grayish, shiny and sometimes appearing to be slightly mottled. The abdomen is salmon-colored.

Head very small, and deeply inserted; pro-notum covering a considerable part of the eyes. Eyes coarsely faceted. Antennæ, long with club, serrate and three-articled. Maxillary-palpi, securiform. Mandibles, bifid. Prothorax small, with broadly rounded angles. Prosternum flat. Prosternal coxæ widely separated, with two converging carinæ. Meta-coxal plates entire, very short—shorter than the segment. Epipleuræ moderately wide and more or less concave, descending externally, internally margined. Epistoma transversely truncate and simple at apex. Abdomen six-segmented, with sixth segment visible in both sexes. Last segment very small. Claws bifid.

The adults are scattered throughout the entire county, and may be found at almost any season, without difficulty. As was stated above, the insect was introduced for black scale by Albert Koebele during his second visit to Australia in 1891. It was introduced into the Santa Barbara citrus

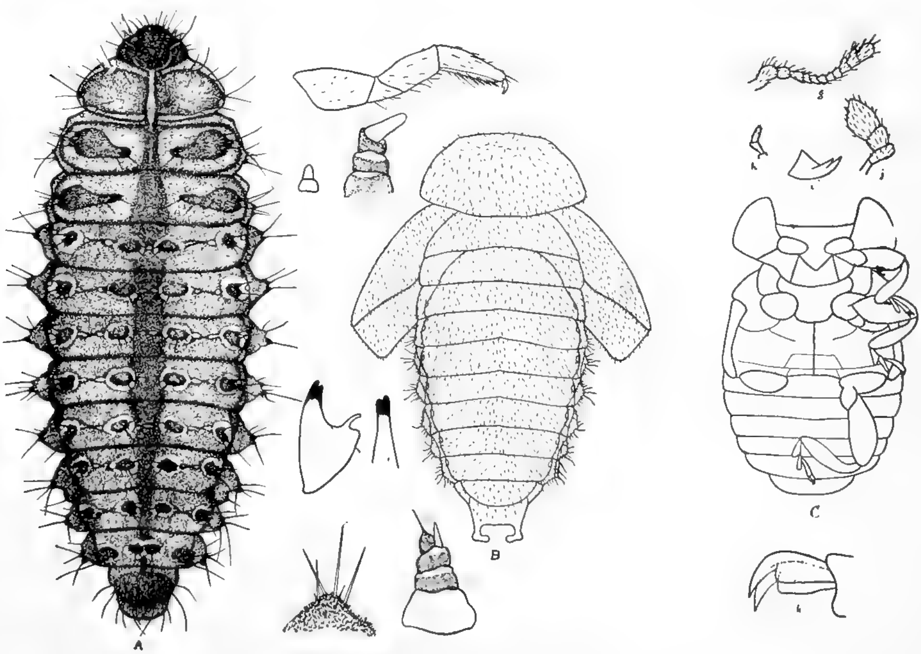

Figure 108. Rhizobius ventralis

district the same year and in 1893 Mr. Koebele makes the following report concerning it: "On my visit to Santa Barbara during September last year, I found this insect on the increase, and expected that they would soon become numerous. I have been more than pleased, on this last visit, to find that the beetles can now be found by the millions. The first orchard visited was the one in which the first beetles received by Mr. Cooper were liberated upon 49 trees in the center of the orchard. At that time those trees were all black and covered with *Lecanium,* but they are now free of scales. The rest of the orchard had been sprayed last year with kerosene emulsion, but the trees have again become full of Coccids. The beetles are present in such numbers, however, that it will be but a few weeks until the whole orchard will be clean. The upper orchard, where beetles were liberated at the end of May last year, is practically free of scales, and from here the Rhizobius have spread to the central orchard and can be found by hundreds upon every tree. The beetles were seen in copulation everywhere, and on nearly every branch the females were seen thrusting their eggs under the old scales. It will be but a very short time until every tree is clean of scales, and no time should be lost in collecting and distributing this valuable insect to all parts of the State. . . . This beetle is one of the most common Coccinellids in Australia, preying chiefly upon *Eriococcus, Rhizococcus,* and various *Lecaniini,* and upon these last it could always be found in New South Wales on my last trip. On my first trip I forwarded this insect to Los Angeles from South Australia and Victoria, where it was erroneously supposed to feed upon Icerya. Within two years at the longest, I believe, that the various *Lecanii* in California (and Florida) will have succumbed to the ferocity of this little beetle."—Insect Life, Vol. VI., page 27, Nov., 1893.

"The Pacific Rural Press of July 21, 1904, however, quotes a statement made by Mr. T. N. Snow in the Santa Barbara Press as to the progress of this ladybird in the orchard of Mr. Ellwood Cooper, at Ellwood, Cal. According to this account a little more than two years ago 50 specimens of *Rhizobius ventralis* were placed in this orchard, where they multiplied so rapidly that in October, 1893, Quarantine Officer Alexander Craw was able to secure there 500 colonies, numbering more than 10,000, for colonization in various parts of the State. On June 27, 1894, Mr. Craw, it is reported, again visited this orchard, and found not one black scale left of the army which had been there, the Rhizobius having made a perfect clearance. Mr. Craw is reported to have expressed to Mr. Snow his belief that by next November there would not be a black scale remaining in Ellwood."—Insect Life, Vol. VII, page 48, Sept., 1894.

"*Rhizobius ventralis* (Black ladybird). This is also an Australian ladybird, introduced by the State Board of Horticulture through Mr. Koebele, and is one of the natural enemies of the black scale (*Saissetia* [*Lecanium*] *oleae*). This ladybird was introduced for black scale, and was generally distributed by the State Board of Horticulture wherever that pest was found. It was one of the most promising of the many importations of beneficial insects and took hold of its work with a vigor that gave promise of soon extirpating one of the worst of the California scale insects. Wherever it was introduced in the coast counties of the State, it increased with wonderful rapidity and the scale as rapidly disappeared, and in those sections it still continues to do good work, but efforts to establish it in the interior counties have not met with as good success, the heat probably being too intense for the young larvæ. This insect, however, is well established all over the State, and in many sections is as abundant as any of our native species. Wherever it is abundant, it is a chief factor in keeping in check the destructive black scale."—John Isaac, in "Bug vs. Bug," page 10. Report of State Horticultural Commission, 1906.

The above reports would seem to indicate that by this time the black scale in the coast counties would have disappeared, but such is not the case. The following account taken from the minutes of the Ventura County Board of Horticulture, June 27, 1894, records the introduction of this insect into Ventura County:

"Persuant to adjournment, T. A. Rice and J. F. McIntyre met at Ellwood Cooper's ranch today. In company with Mr. Cooper and Mr. Alexander Craw, we made a thorough inspection of the two orchards where the new black ladybird, *Rhizobius ventralis,* was first placed and found that the ladybird had apparently exterminated the black scale in those two orchards. We also visited other orchards where the ladybirds were recently introduced and found the beetles and larvæ very numerous.

"We are much indebted to Mr. Cooper for the hospitality received, and for allowing us to collect a large quantity of the beetles and bring them to Ventura county."

J. F. McIntyre, *Secretary.*

From this report we find that the black ladybird beetle has been in this county for a little over 16 years. It was well scattered over the county at an early date for we find in Insect Life, Vol. V, page 364, July, 1895, where Mr. J. F. McIntyre sent a number of specimens from Fillmore to the Department of Agriculture. It would naturally be expected that the black scale would be fairly diminished in this county, but such is not the case. At this time we have some of the worst infections I have ever seen in all parts of the county and especially along the coast, where the damp climate is especially conducive to propagation of this pest. In all of these orchards the beetle can be found in considerable numbers, and they have been molested very little by fumigation or spraying. It is therefore interesting to note that in the orchards infested with the citrus mealy bug, it has been found in the greatest numbers and seems to render the most service.

That they work on the mealy bugs and not the black scale alone has been proven by experiments in breeding cages where they have been confined and fed on nothing but mealy bugs. I have reared a goodly number of them in my office during the past year in such a breeding cage. During the month of May a large shipment of mealy bug infested fruit was sent to Honolulu to meet Mr. Geo. Compere who was bringing to this State internal parasites for this pest. The material was taken out of the orchards here without thought of our own natural enemies, and when it arrived in Honolulu the box contained only a great number of the *Rhizobius ventralis,* which had eaten up all of the mealy bugs en route. They breed very rapidly, when protected, and with other natural enemies, promise to aid very greatly in cleaning up the mealy bug in Ventura County.

THE NOCTUIDAE OF CALIFORNIA II

BY JOHN D. SMITH, D. SC.

A chapter on the *Hypeninae* or, as they are better known the *Deltoids* of California, might be made almost as brief as that traditional one concerning snakes in Ireland. Up to the present time, out of some one hundred described species, less than a dozen are known to occur in California. Personally, I do not believe that this is a correct statement of actual conditions; for while the bulk of the species are, undoubtedly, members of the boreal and humid transition zones, nevertheless species extend into the arid regions of Arizona and New Mexico, and there seems to be no good reason why the wooded mountain ranges of California should not have a characteristic fauna representing this sub-family.

The essential characters as stated in the table of sub-families are that the secondaries have vein five as strongly developed as any other; that it runs parallel to vein four, and that the palpi are more or less prolonged; either extending sickle-shaped above the head or pointed straight forward like a snout. Elongated palpi occur elsewhere in the Noctuids; but the Deltoid palpus can be in almost every instance recognized by having the scales pointing upward from the upper surface, forming a sharp edge like the blade of a knife. In the other groups the scales are directed downward, and the back of the knife-blade is up.

The species are usually slight, never very robust, the vestiture very loosely attached so that it rubs easily, and perfect cabinet specimens are the exception rather than the rule. They vary in their manner of life, but are mostly inhabitants of low vegetation. Some of them come under the head of "Grass Moths" and are started up readily during the day; others fly among the underbrush of open woodland, somewhat like Geometrids, for which they are sometimes mistaken. They rarely fly to light in numbers, and only a few of them are attracted to sugar; which may, perhaps, account for their scant representation in collections. Their larvæ vary greatly in habit, some of them feeding normally on foliage, others occurring in ant's nests and among dead and decaying vegetation. One species is associated with the Florida "Gopher" or land tortoise.

The head is always small but distinct and sometimes even prominent; front never modified, eyes usually globose, naked, ocelli present in all our forms. A pointed frontal tuft is quite usual, especially in those forms in which the palpi are directed forward, snout-like. The thorax is moderate or slight, usually with smooth vestiture, rarely tufted in any way and never prominently so. The abdomen is rather long, cylindric, smoothly scaled, with a series of small dorsal tufts in the Hypenid series only. There are three series or tribes in the sub-family, distinguishable as follows:

Palpi slender, upcurved along the front; anterior femora of the male thickened at base, else the leg normal.......... *Heliini*

Palpi slender, upcurved; or straight or oblique, with upright scaly vestiture, making them blade-like; fore-legs of male always modified and tufted, tibia always abbreviated and with a long anterior process .... *Herminiini.*

Palpi straight or oblique, with upright scaly vestiture which is transversely compressed; anterior legs of male not modified........................*Hypenini.*

In the tribe *Heliini* the genius *Epizeuxis* is the only Pacific Coast genus, and that is represented in California by two species. *E. occidentalis* Smith, was described as a variety of the common eastern *lubricalis* Geyer; but is probably a good species. It is a smooth, yellowish-smoky species with a silky lustre, the median lines dentate, diffuse, and more in the form of bands than lines. The maculation of primaries is continued on the secondaries and the species expands about an inch and a half. I have no definite localities for this species and examples are very rare in collections.

E. cobeta Barnes, is a somewhat smaller, rather broader-winged, decidedly more mottled species. The darker tints are chocolate brown, and the pale shadings over the transverse lines are yellow. The type of maculation is identical for all the species. The locality given is Southern California, and I have only two examples from Dr. Barnes from that region; but the species extends also into Arizona, and I have several samples from that State.

Three species that occur in Arizona should also occur in the arid regions of California, and I quite expect a representative of the small forms, typified by the eastern *rotundalis.*

The tribe *Herminiini* is one of very great interest because of the wealth of secondary sexual characters that occurs in the male, and because of the variation that occurs in the venation of the primaries. This latter centers about the accessory cell, which tends to become, and, in several genera actually is, lost; the veins usually arising from it becoming modified in several ways.

The sexual modifications begin with the antennæ which are simple or ciliated in the female; but never in the male. They may be pectinated, sometimes so strongly as to be almost plumose; they may be twisted or furnished with distorted joints at basal third; they may have two or three of the joints toward the middle furnished with stout spine-like processes; or there may be a tuft which may or may not cover an excrescence or other modification.

The palpi are not infrequently tufted in the male, and sometimes these tufts of hair pencils are enormously exaggerated and extend back half the length of the body or more.

The wing-form is sometimes different in the sexes, and the primaries may even be split in the male while they are entire in the female.

The most usual and characteristic modifications are found on the forelegs, on which we may have a small hair-pencil only, attached to the inner side of the tibia, or on which we may have every segment or part modified into a sheath for a tuft or pencil until, when spread out it is almost impossible to recognize the parts.

Of the *Herminia* or *Zanclognatha* type, so rich in Europe and in the eastern United States, not a species is recorded from California, and none nearer than New Mexico. It would seem as if some of the species of this type should certainly occur in the Sierra Nevada region. So the genus *Bleptina* should almost surely occur in the State.

There are two recorded species of *Tetanolita* Grote. This genus has the head rather small, front with a pointed, inter-antennal tuft. The palpi are long, curved upward, a little flattened, quite closely scaled, the third joint long and pointed. The antennæ are moderate in length, in the male with lateral bristles, at basal third with a tuft of hair which covers two slightly dilated joints. The fore-legs of male have the coxa long, stout, outwardly emanginate at base; trochanter about a third as long as femur and, combined with the latter, a little longer than the coxa; femur with a short hair pencil and a lateral fringing of specialized scales near tip; tibia reduced to a huge process which covers a mass of specialized scales and a pencil of dark hair; tarsi long, slender and hardly functional. The wings are broad, similarly marked, the lines extending continuously over both, the outer margin slightly marked or angulated at middle.

Tetanolita palligera Smith, is a dirty powdery luteous, tending to more yellowish. The markings are all obscured and the pale sub-terminal line which runs through the darker terminal area is the only distinct feature of the wing. It expands a little less than an inch and is recorded from Napa County, Panamint Valley and Knightly Valley.

Tetanolita greta Smith, is similar to the preceding in appearance; but is pale ashen gray, the median lines narrow and crenulated, the sub-terminal line white, denticulated. It is of about the same size as the preceding and my examples come from San Diego (Field).

The genus *Renia,* with its large and characteristic species seems altogether unrepresented on the Pacific Coast. It does extend well into Arizona, however, and I quite expect to receive it from the southeastern borders of California.

The *Hypenini,* unlike the *Herminiini* which run to dirty yellows, are dark and sombre in color. They are somewhat more robust than usual and, contrary to the general rule, the males are much more heavily built than the females. So the forewings tend to narrow while, as the hind wings become more ample, they lose the transverse maculation, and the lines of the forewings are not continued across them. There are no secondary sexual characters except the generally larger size, darker color and more obscure maculation of the male.

The leading genus is *Bomolocha* Hbn., and of this only a single species is credited to California.

Bomolocha vega Smith, is a moderate sized, broad-winged species, with the structural characters of the group well marked; deep smoky brown in color, the transverse lines well marked and with well-defined yellow shades beyond the t. p., and s. t. lines. The sub-terminal line is quite irregular and has the outer edge very sharply defined. It was originally described from New Mexico; but I have two examples from Southern California.

The genus *Hypena* Schrank, is the only one that is better represented in California than in the east. In this genus the primaries are narrow, elongate, the outer margin squared or even a little angulated at middle, the secondaries large, broad, without maculation of any kind. The palpi are longer and projected more directly forward than in *Bomolocha,* and the species look more like exaggerated Crambids than like any other noctuid genus.

As all the species occur on the Pacific Coast, and *humuli* may yet be found in Northern California, a synopsis of all the species may be given.

Outer margin of primaries not angulated at middle.......................................*humuli.*
Outer margin of primaries more or less outwardly bent at middle.
  Palpi not excessively long; t. p. line with an outward bend in the sub-median interspace ....*decorata.*
  Palpi excessively long; t. p. line without outward bend or angle in sub-median interspace.
    Base of ground yellow; s. t. space yellow, size larger.........*californica.*
    Base of ground gray; s. t. space bluish gray; size small............*modesta*

Hypena humuli Harris, is a dull brown species, tending to grayish, without contrasting maculation and sometimes almost even in color. The forewings are less parallel than the other species and the outer margin is even, without trace of angle. The transverse posterior line is irregularly sinuate and bent, outcurved over the reniform, with an outcurve in the sub-median interspace, and an inward tooth on the internal vein. The larva of this species feeds on hop, is of some economic importance, has been found in British Columbia and Washington, and is more than likely to occur in California if the hop vine occurs or is cultivated there.

Hypena decorata Smith, is the most brilliant species of the lot. The ground color is a rich red-brown with blue relieving scales, and the maculation is contrasting and generally well-defined. The palpi are stouter than usual and distinctly shorter than in the other Pacific Coast species, and the angulation in the outer margin of the primaries is less marked. The transverse posterior line is even, a very little sinuated to the sub-median interspace, where it forms an outward tooth, followed by one of equal length inwardly on the internal vein. It thus differs from both of the following by the outward tooth above the inward one. It is also a little the largest of the species, reaching 1.35 inches in expanse.

As to localities they are very indefinite and the species is distinctly rare in collections.

Hypena californica Behr, is a little smaller than *decorata* and more quiet in color. It is reddish or darker brown over a yellowish base; the pale colors always yellowish, never bluish. The contrasts are as a rule well marked, especially in the female. The palpi are very long, and the angle at middle of outer margin of primaries is distinct. The t. p. line is characteristic; it is almost upright, a little denticulated on the veins, without sinuation in the sub-median interspace, but with a deep inward tooth on the internal vein. This seems to be the most common and widely distributed of the Pacific

Coast species, and extends northward to Vancouver and into British Columbia.

Hypena modesta Smith, is the smallest of the species, expanding scarcely over an inch or less, and it has, proportionately, the longest palpi and the best marked angle in the outer margin of primaries. It is of a quiet, almost pearl gray in the male, somewhat powdery; in the female a little more reddish, with better defined markings, the s. t. space with a markedly blue-gray tinge which can scarcely be called contrasting. The t. p. line is absolutely rigid, without curve or bend to the internal vein, where there is a moderate inward tooth.

The actual record of Californian *Hypeninae* is therefore, as follows:

Epizeuxis Hbn.
E. OCCIDENTALIS Smith.
E. COBETA Barnes.

Tetanolita Grote.
T. PALLIGERA Smith.
T. GRETA Smith.

Bomolocha Hbn.
B. VEGA Smith.

Hypena Schrank.
H. DECORATA Smith.
H. CALIFORNICA Behr.
H. MODESTA Smith.

Note: It is my desire to take up the series in a somewhat systematic manner if the necessary material can be secured. The *Mominae,* including *Panthea, Charadra* and allies, and the species of *Acronycta* will therefore be undertaken next if possible. The Californian species of *Acronycta* are not well known, and their limits are distinctly doubtful. Any help that I can get in the way of loan of material will be appreciated, and will collectors please remember that *one* specimen does not represent a species. There ought to be at least a male and a female and, in this genus, a series is almost imperative. I will gladly return unique specimens loaned me for study, except in the case of undescribed species. The completeness of this series of papers depends largely upon the co-operation of California collectors.

A PHYTOPTID GALL ON ARTEMISIA CALIFORNICA

H. V. M. HALL

Eriophyes californica n. sp.

Body cylindrical, length .14 mm., and this is three to four times the diameter. The shield (Fig. 109A) is broadly crescent shaped, its horns pointing to the sides and a little caudad. The dorsal seta (Fig. 109 B) is a little less in length than the depth of the body. The head is short, the legs short and stout. The claws are longer than the tufts which appear as groups of short, blunt bristles. The number of rings in the abdomen varies

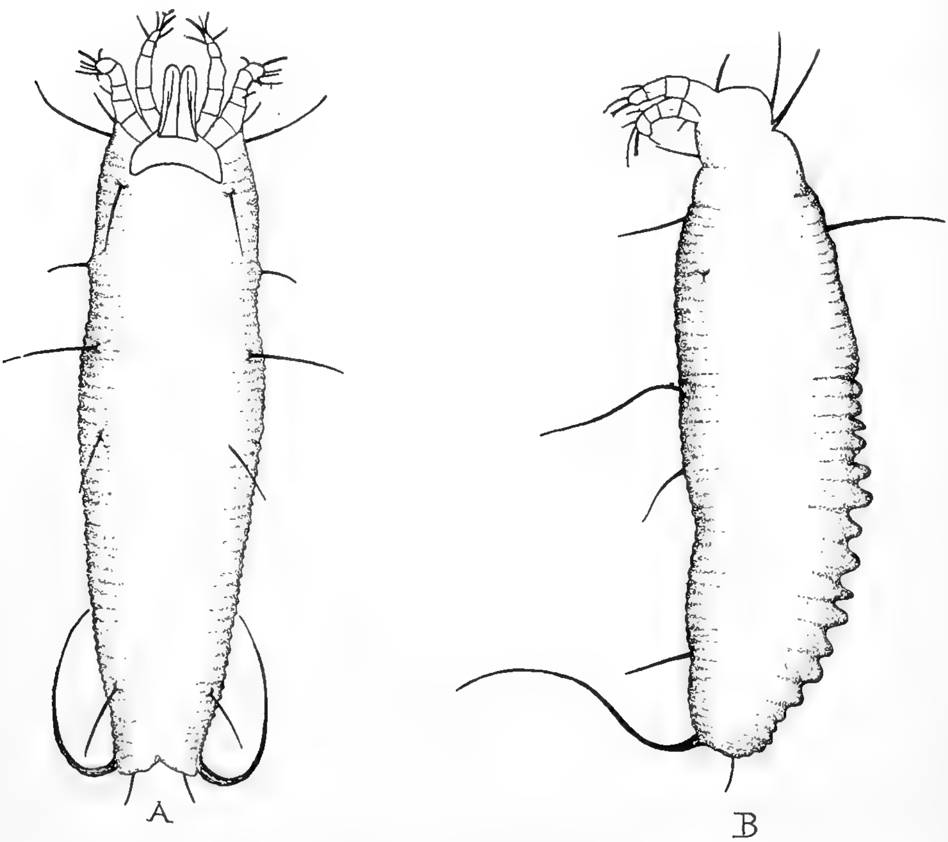

Figure 109. Eriophyes californica

from 49 to 56. A side view shows that many of these rings run together along the dorsum, and there form larger, very salient wrinkles. The caudal setæ are nearly half the length of the body and fairly stout; between and above these are two short fine bristles. Other minor characters will be evident from the figures.

This mite causes a white or pinkish swelling on one side of the leaf of *Artemisia californica.* At the infected point the leaf is often bent or sometimes sharply folded. The gall is composed of a woolly mass of tangled fibres and stands out from two to four times the thickness of the leaf. The general shape of the gall is indefinite, several gall areas often running together. Very abundant at Claremont, California, on *Artemisia californica.*

This species appears to be entirely distinct from the *Eriophyes artemisiae* Can., of Europe.

A NEW SPIDER

BY KARL R. COOLIDGE

Epeira labyrinthea grinnelli n. var.

Differs from the typical form, in the decidedly increased size, in the coloration being more pronounced on the head, cephalothorax and abdomen; the bands of the legs, particularly on the femora, are wider and heavier; the abdomen is wider and more pointed apically, more rounded basally, forming an inverted cone, at the apex of which well underneath are the spinnerets.

Habitat—Specimens from Palo Alto, Santa Clara County; Pasadena, Los Angeles County; Lompoc, Santa Barbara County. *E. labyrinthea* Hentz ranges throughout the entire United States, and south through Mexico and Central America into the northern parts of South America. It also occurs commonly in the Barbadoes and West Indies. As McCook has previously noted and figured (Amer. Spid., vol. 3, pl. VII, Figs. 12, 12a, 1893), Pacific Coast and tropical representatives differ considerably from those of the Atlantic seaboard, and are, I believe, worthy of good subspecific rank, to which I have above given the name *grinnelli,* for my friend Mr. Fordyce Grinnell, Jr., of Pasadena, California.

ON ARGYNNIS ATOSSA EDWARDS

BY KARL R. COOLIDGE

Argynnis atossa was first described by W. H. Edwards in his Butterflies of North America, Vol. 3, 1890, the types (Plate VIII) coming from Tehachapi, California, at an elevation of about 4000 feet. I am not aware that any additional captures have been recorded in literature, although Holland (Butterfly Book) figures a male on Plate XIII, which is presumably one of the types. Mr. W. G. Wright* states that "*atossa* is a species that I have never met, although I have hunted over the ground where it is said to fly, both before and after it was found."

The peculiar yellowish coloring of *atossa* above, the dimidiation of the anterior marginal line and of the usual marginal and discal spots are indeed striking, and with its pallidness of the undersurface and lack of silver spots on the secondaries beneath, it has been placed close to *adiaste* Behr, with which, however, I fail to see that it has any special affinity.

In June, 1905, Mr. Fordyce Grinnell, Jr., took an argynnid on Mt. Pinos, at about 5000 feet altitude, which is absolutely referable to the published figures of *atossa.* Mt. Pinos is about a hundred miles in an air line from Tehachapi. The example was taken in company with *eurynome* Edwards, then flying commonly, and of which I am convinced that *atossa* is but an extreme pallid individuant, not worthy of even aberrational rank. The *eurynome* markings are distinctly traceable and, moreover, Wright says of *macaria* Edwards, which with *laura* Edwards, I take to be synonyms of *eurynome;* "There is a peculiar feature in *macaria* that does not appear in any other California *Argynnis,* namely, that in some specimens there is a paling or fading out of the basal part of all wings from the body half way across the wings. . . . This feature is seen in about one-third of the specimens of *macaria* that I have ever seen." Recently in conversation with Mr. Wright he informed me that he had, through correspondence, learned the exact habitat of *atossa* and had searched assiduously for it, but without success. The chaotic state of some of our rhopalocerous genera, such as *Argynnis, Melitaea, Lycaena, Thecla,* and worst of all *Pamphila,* is due to the fact that too little attention has been paid to precise and exact data, and from the publication of species without sufficient geographical series. *A. clio* Edwards, *bischoffi* Edwards, *opis* Edwards, and *artonis* Edwards, will all probably prove to be but geographical forms of *eurynome.* *A. launna* Wright is a pallid individuant of *eurynome,* (*laura*), somewhat corresponding to *atossa.*

*Butt. West Coast, pp. 139, 141, 1905.

SOME VARIATIONS IN THE WINGS AND ANTENNÆ OF TRIFIDAPHIS RADICICOLA Essig

E. O. ESSIG

The winged form of *Pemphigus radicicola* as described in the POMONA JOURNAL OF ENTOMOLOGY, March, 1909, page 8, and later classified as *Trifidaphis radicicola* by G. Del Guercio in the October number of the same Journal, was described from one rather imperfect specimen. During the entire spring and summer of 1909 a constant search was maintained with the result of finding but one winged form. The apterous forms were obtained in abundance.

On the 13th of April, 1910, while in a lemon orchard at Oxnard, I chanced to pull up a nightshade which was infested with this Aphid. One winged form remained on the roots. Digging into the ground where the plant grew, I was able to obtain some hundred winged specimens from this single plant, to say nothing of the many apterous individuals. In pulling up the plant the winged forms are scraped off because of the friction caused by their wings and remain in the ground.

Thus with a goodly number of specimens I have been able to note some interesting variations in the wings and antennæ in particular. In all over fifty individuals were mounted and studied with results which might be expanded even more, in the future. These results have been recorded in the form of drawings which are presented with this article (Fig. 110).

Variations in the wings (Compare Fig. 110): In order to have some system in presenting this material I shall take each vein and make note of its particular variations.

Cubitus or Subcostal. Normal in all wings.
Radius or Stigmal.
A. Slightly curved and not touching the stigma.
B. Sharply curved near stigma, from which it arises.
C. Short, sharp curve from stigma, from which it rises.
D. Well rounded curve near stigma, from which it rises.
E. Indefinite curve from stigma to tip.
H. Normally curved and arising from stigma.
G. Normally curved not arising from stigma.
H. Normally curved and arising from stigma.
I. Normally curved and arising from stigma.
J. Normally curved and arising from stigma.

Obliques or Discoidals. These veins are somewhat confusing What is present I believe to be as follows: First and second obliques arising from or near the same point and diverging towards the margin; third oblique, of which but a remnant is present. I believe this to be the third because in one wing of one specimen (h) there is a remnant uniting with this to form a fork.

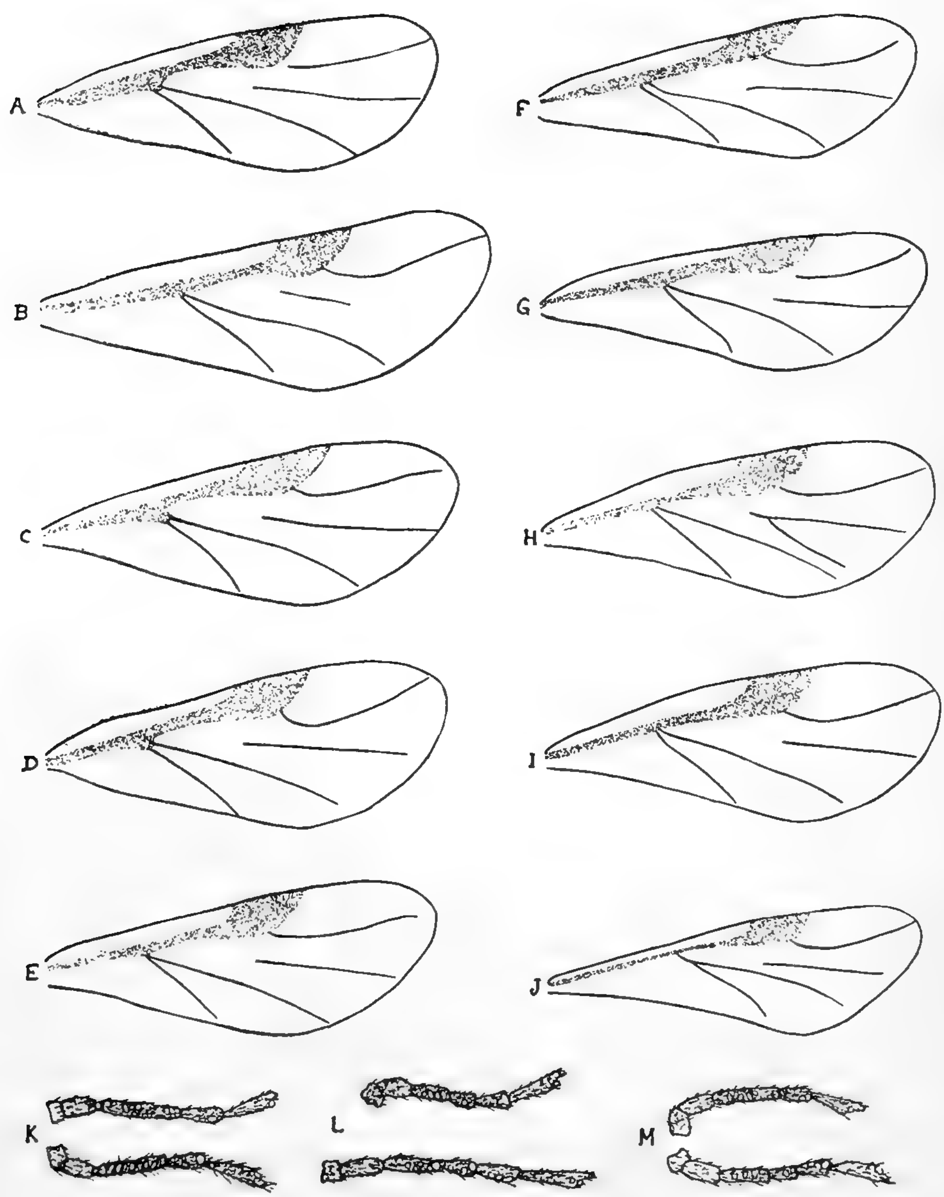

Figure 110. Trifidaphis radicicola

First and Second Obliques or Discoidals.

A. Arising from an extension of the pigment of the subcostal, but not from same point. Normally curved.

B. Arise from pigment nearer the same point than in A.

C. Arise from a prominent extension of the pigment near the same point.

D. Nearly the same as A.

E. Arising from no extension of the pigment from the same point.

F. Arising from no extension of the pigment from different points.

G. Nearly same as in B.

H. Nearly same as in F, only veins are straighter.

I. Same as in B and G.

J. The two are united for quite a distance from the pigment as one vein. They then fork and diverge to the margin. The other wing of the insect to which this belonged was normal as I.

Third Oblique or Discoidal.

A. Slightly curved and normal in this species.

B. Very short remnant near the stigma. A rare occurrence.

C. Normal vein.

D. Normal vein.

E. Normal vein.

F. Normal vein, but interior tip rather low.

G. Normal vein.

H. Forked, so as to make the first and second forks of a normal aphid wing. The other wing of the individual having this wing, was normal as I.

I. Normal vein.

J. Normal vein, but crowded, probably due to abortive growth.

It might be said that a great many of the individuals are very small and abortive, but the wings, though small, are usually normally developed. Of the drawings presented these were not included except the one marked J.

Variations in the Antennae. (Fig. 110, K, L, M.)—There is a frequent variation in regard to the number of articles—the normal being six and others five. The one described, as referred to above, had only five articles. This change is due to a division of the third article, which may be accomplished in only one of the antennæ of any individual. Two such specimens have been presented, Fig. 110, K and M, are antennæ of two individuals, having one five-articled and one six-articled antennæ. Unfortunately the one described had two five-articled antennæ only.

Figure 110 L, shows the normal antennæ, though there is some difference in size due to the difference in the size of the specimens.

Since this form has apparently never appeared on plants above ground it might seem probable that the wings are not used in flight, and hence the rudimentary structure of the veins. Time and study, however, only can prove that this is not some migrant form. At any rate the insect is very interesting and offers a splendid opportunity for studies in variation.

WEST COAST NEWS NOTES

[In this department we hope to give in most numbers of the Journal some idea of the doings and movements of western entomologists, notices of publications of interest to western students, notices of entomological meetings, etc. To this end, we hope that students or collectors will send in all items of entomological interest about themselves or others. Address: Mr. Fordyce Grinnell, Jr., 572 N. Marengo Ave., Pasadena, Cal.]

Prof. V. L. Kellogg of Stanford University delivered a course of lectures at the Summer Session of the University of California.

Prof. R. W. Doane and Mr. E. H. Rust have been at Whittier during the summer, studying scale insects, fumigation, etc.

Mr. V. L. Clemence and Mr. K. R. Coolidge had a very successful collecting season in Ramsay Cañon, Huachuca Mts., Arizona, obtaining a lot of interesting Lepidoptera, Coleoptera, Spiders and other groups.

Mr. James E. Cottle of San Francisco spent the summer vacation at Sweet Brier Camp, Shasta Co., Cal., "Cottle's Domain." He reports: "Butterflies fly high here. Am doing some good collecting."

Mr. Francis X. Williams, of the University of Kansas, formerly of San Francisco, is making an entomological survey of Kansas this summer.

Mr. C. W. Herr is collecting a large number of interesting Lepidoptera in the Priest River region of northern Idaho, which are being studied by Mr. Grinnell.

Mr. K. R. Coolidge is planning to leave for Chili, as arachnologist in the National Museum there. We congratulate him on this chance to widen his experience.

Mr. W. C. Martin is collecting Lepidoptera at Switzer's Camp, in the mountains near Pasadena.

Vol. I, Article I, Bulletin of the Public Museum of the City of Milwaukee, is a catalogue of the Odonata of North America, by Richard A. Muttkowski, issued June 27, 1910. It consists of 206 pages; and will be of great use to students of this order.

Prof. H. C. Fall, of Pasadena, made his usual pilgrimage to Boston, "the hub of the universe," during the summer.

Dr. A. Fenyes of Pasadena made a collecting trip to Vancouver Island during the early summer.

Mr. D. L. Crawford's work in Mexico this summer has been attended with remarkable success. His operations have extended to Vera Cruz, Oaxaca, Jalapa, Cordoba, Cuernavaca and elsewhere, and into Chiapas and Guerrero.

Recent visitors to the Department of Biology of Pomona College have included Dr. W. H. Dall of the United States National Museum, Dr. Wm. Barnes of Decatur, Ill., and David Fairchild and P. R. Dorsett of United States Department of Agriculture

Mr. E. J. Newcomer of Palo Alto, spent his vacation at Lake Tahoe, again; his article in the June and July numbers of Entomological News, is a valuable contribution to zoogeography.

In the July number of the Canadian Entomogolist, is an interesting article by John Russell, on Butterfly Collecting, near Hope, British Columbia. It is a type of article entirely too rare of late; we need more of them.

Book catalogues of recent date are: Junk's Bulletin No. 7, Bibliotheca Entomologica, No. 107, of Felix L. Dames, Berlin; Gerhard's Catalogue, No. 41 (June, 1910), all containing interesting items for the entomological bibliophile.

A new entomological journal has been started in Germany, the Deutsche Entomologische National-Bibliothek, Rundschau im Gebiete der Insektenkunde mit besonderer Berücksichtigung der Literature. Began with the June number.

There have been over twenty scientific societies in California, devoted to natural history, including of course entomology. The names, offices, and members would be interesting, historically, and would furnish much material for the history of science on the West Coast.

Mr. Wm. Bollerman of Pasadena made a trip to the mountains of Ventura County during the early summer.

Mr. W. M. Mann of Stanford University, after attending the session of the Seaside Laboratory at Pacific Grove, stopped for a day in Pasadena (July 18) on his way to Arizona, to collect especially *Aleocharinae* for Dr. Fenyes; and other insects. He is doing good work in faunistic and ecologic entomology, especially with eurymecophilous insects.

Miss Julia D. E. Wright, secretary of the Santa Clara Valley Entomological Club, is spending a few months at Vancouver, B. C.

The Catalogue No. 473, of the firm of R. Friedländer & Sohn, Berlin, comprises the valuable and extensive library of the late Dr. O. Standinger; it consists of 86 pages and 3500 titles, and is a rich collection. There are some fine numbers, including: Hy. Edwards, Pacific Coast Lepidoptera, 30 nos. compl., at 12 marks; Boisduvals' Lepidopteres de la Californie, 1852 and 1868, at 4 marks each; Clemens' Synopsis of N. Amer. Sphingidæ, 1859 at 7 marks; and many other items.

Mr. Wm. M. Davidson has been collecting insects around Stanford University, Cal., for the university collections, during the summer.

Mr. J. C. Bridwell, of the Oregon Agricultural College, has been appointed Instructor in Entomology in the University of California.

Mr. Wm. Schrader of Los Angeles is continuing his experimental work with the Lepidoptera, with enthusiasm, and is adding some new apparatus. He has obtained some curious and significant forms of *Junonia coenia, Dione vanillae,* etc.

In the University of Colorado Studies, Vol. VII, No. 3, March, 1910, Cockerell and Robbins have a very useful contribution, An Introduction to the Study of Rocky Mountain Bees. It should prove useful to a beginner in California.

In the Bulletin of the Southern California Academy of Sciences, for July, 1910, Vol. IX, No. 2, page 68-71, Mr. Fordyce Grinnell, Jr., has an article: Additions and Corrections to the List of Southern California Butterflies.

Dr. Wm. Barnes of Decatur, Ill., was a visitor in Pasadena on August 3. Dr. Barnes has one of the best collections of *Lepidoptera* in the United States.

During the session of the Behr Natural History Laboratory, many interesting insects and plants were collected which will be worked up gradually

A later communication from Messrs. Mann and Coolidge (July 29), is from Naco, Sonora, Mexico. They report "collecting good." With two such enthusiastic collectors in such a little known region, a lot of new and interesting things should turn up.

"Berkeley, July 25.—An extended trip through the mountains and out of the way places of Sonoma County has resulted in the capture by Prof. Charles Fuchs, in charge of the entomological collection at the University, of a number of unique insects which have never before been classified. The tiny bugs have not as yet been sorted and arranged in the University collection, but Professor Fuchs believes that several of the specimens will prove of great worth to entomologists."—San Francisco Call, July 26, 1910.

In the Entomologists' Record and Journal of Variation, there is an interesting sketch on Entomologists and Entomology at Oxford. Under the direction of Prof. E. B. Poulton, "the collections have now assumed a vastness that makes all the available rooms appear hopelessly insufficient"—and further, usefulness "is the predominant note struck when one begins to examine the material in the collection in detail. *The System of labeling** makes most of the specimens of the highest scientific value, and whether the specialist be studying variation, phenology, or geographical distribution, he finds a wealth of accurately labeled material which is of the greatest importance for his work." We need such a collection or collections on the Pacific Coast, for the preservation of large series of *accurately labeled* specimens, from every locality, which will be of great use to the student of bionomics, in a few years when the nature of the country will undoubtedly be changed by the commercial activity of today. Series of variable species collected at different places in different years, will prove immensely useful. Experimental work will not lead to the satisfactory solution of evolutionary problems. We must study things in their natural environment, and only in that way can we arrive at a correct idea of species—formation. In other words, we need more collectors and collections, and one or two large collections for the accumulation of specimens for bionomic work.

*Italics are mine.—F. G.

Pomona College Journal of Entomology

Volume II DECEMBER 1910 Number 4

THE CITRUS MEALY BUG

(*Pseudococcus citri*) Risso.

BY E. O. ESSIG.

Horticultural Commissioner of Ventura County, California.

GENERAL HISTORY AND DISTRIBUTION IN SOUTHERN CALIFORNIA.

It is claimed by good authorities that the mealy bug first made its appearance in this State on the Granger Place, in the Paradise Valley, just north of National City, and that it spread from this locality to the adjoining country. That it came from Florida is very probable, having been introduced with nursery stock about the year 1880. To-day, only a remnant of the old Granger orchard is left, but the mealy bug has a firm hold upon many citrus groves in San Diego County. Sometime near the year 1904 this pest made its first appearance on the large Sweetwater Ranch at Bonita, and has been a source of trouble ever since. A recent trip, by the writer, to this locality revealed the fact that, in spite of much that has been accomplished by predaceous and parasitic insects, the mealy bug still plays an important part in many large orchards, and in some the pest is very bad.

In Orange County, the mealy bug has been known to exist in limited numbers since the year 1898 in a few localities, but only during the past few years, has it become a menace. It is now generally distributed but is still scattering.

The same conditions exist to-day in Los Angeles County. Here it may be found in nearly every city greenhouse and scattered over a large citrus growing territory, but not so serious as in San Diego or in Ventura Counties. The process of distribution has been long and slow, and *only a very accurate tree to tree inspection can reveal the extent of the infestations.*

Few counties have ever suffered from the attacks of this pest, as has Ventura County. It was first observed in a greenhouse at Santa Paula, during the year 1897, and was introduced on common greenhouse plants. For many years it was never noticed in the citrus orchards, and when it did appear in these orchards, it was regarded as a harmless greenhouse scale, which could not thrive out-of-doors. It took just 12 years for it to become adapted and generally distributed, and then it threatened to ruin the entire citrus industry near Santa Paula. From this point it has been carried on picking boxes to much of the surrounding territory and is now a general pest in all of the Coast region. (Fig. 111.)

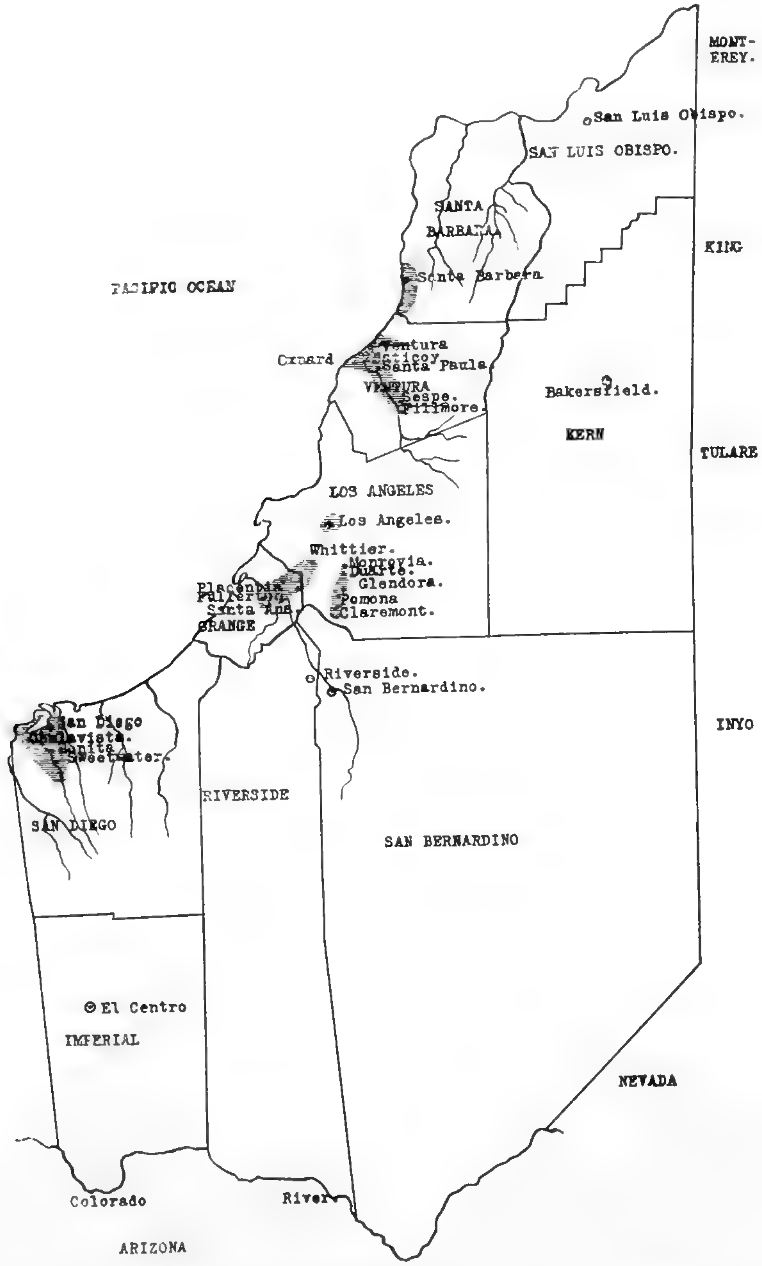

Figure 111.

Distribution of Pseudococcus citri in Southern California. Shaded areas show regions containing mealy bugs in greater or less numbers.

Two years ago the mealy bug was reported in two orchards in Santa Barbara County, but to date Mr. C. W. Beers, Horticultural Commissioner, informs me that after a close inspection, not a single insect is to be found in these orchards. It does exist, however, in the greenhouses and flower gardens in that City.

A general summary of the present distribution is as follows:

County	*Locality*	*Extent*
SAN DIEGO	San Diego	Greenhouses.
	Chula Vista	Orchards—slight.
	Bonita	Orchards—bad.
	National City	Orchards—slight.
	Sunnyside	Orchards—slight.
ORANGE	Santa Ana	Florists—slight.
	Fullerton	Orchards—bad.
	Placentia	Orchards—bad.
		In only limited districts.
LOS ANGELES	City of Los Angeles	Greenhouses.
	Monrovia	Orchards—limited.
	Duarte	Orchards—limited.
	Glendora	Orchards—limited.
	Claremont	Orchards—limited.
	Pomona	Greenhouses.
	Whittier	Yards—few.
VENTURA	Santa Paula	Orchards—bad.
	Saticoy	Orchards—few.
	Oxnard	Orchards—few.
	Ventura	Orchards—few.
	Sespe	1 yard.
	Fillmore	I greenhouse.
	Nordhoff	1 yard.
SANTA BARBARA	City of Santa Barbara	Florists and yards.

GENERAL DISTRIBUTION.

In practically every greenhouse in California and in the United States. It has been reported from the various states in the United States and from foreign countries as follows: Florida, Texas, Louisiana, Arizona, New York, New Jersey, Massachusetts, Philippine Islands, Mauritius, Jamaica, Hawaii, Brazil, Europe, and Canada.

DESTRUCTIVENESS.

It has been but a few years since entomologists considered the common mealy bug (*Pseudococcus citri* Risso) as simply a troublesome greenhouse pest, which would scarcely be able to thrive in the orchards, though it was early recognized as a feeder on citrus trees in Europe. To-day citrus growers in Southern California are seeking everywhere for methods and means of holding this pest in check, for in many localities it has proven a dreadful scourge. Because of its resistive powers and large variety of host plants, it cannot but be regarded as one of the very worst citrus pests known, not excepting the white fly or the orange maggot. For a number of years the mealy bug has been known to be a disastrous pest; yet no definite orchard work, other than the introduction of parasites, has been accorded to it by State or Government.

Some time ago Morrill, who shortly became entomologist for Arizona, passed through this county and saw the condition of the orchards which were infested with the mealy bug. As entomologist of a new citrus region he destroyed a shipment of nursery stock which was infested with this pest, and is now standing lawsuit for his action. If the citrus growers can but realize the importance of keeping out such dangerous pests, the action of this entomologist would be highly praised by grower and nurseryman alike.

That I am not the only one who is throwing out warnings regarding the mealy bug is seen from the following extracts:

"Regarding the mealy bug (*Pseudococcus citri*) will say that I believe this is one of the most troublesome of citrus pests and this last season we have had reports from several new sections where it has made an appearance. When it comes to fumigate against this pest we find it a very hard pest to kill, requiring a very strong dosage to kill them and even the excessive dosage has failed in many cases—and while in some cases, where the pest was taken in time—a strong fumigation has practically eradicated them, again they seem to be as bad in 30 days as before the fumigation." E. K. Carnes, Director of the California State Insectary, in Bull. 1, Claremont Pomological Club, p. 13 (1909).

"From close observation in a badly infected district, I would say that the mealy bug is by far the most damaging and dangerous pest in the Southland. I believe that the citrus industry is threatened by the invasion of this insect as it has not been threatened since the ravages of Icerya purchasi, before it was checked by its natural enemy the Novius (Vedalia) cardinalis. In prolificness, in endurance to hardships, in power to spread, and to do damage no pest in the South is nearly its equal." P. E. Smith. In Bull. No. 1, Claremont Pomological Club, p. 6 (1909).

"The mealy bug will do more damage to the citrus groves than any pest yet discovered, except the white fly. It has done \$75,000 or \$100,000 damage in Santa Paula. . . . We should quarantine against the mealy bug at once and then form an association and raise money and buy the infected trees and destroy them." C. E. McFadden, in Cal. Cul., Dec. 23, (1909).

"At the present time the citrus mealy bug is furnishing the greatest cause for alarm witnessed for many years. In fact many of our best economic entomologists and our most observant growers fear the menace as they have none other unless it were the white scale." J. W. Jeffrey, State Com. of Hort., Cal., in L. A. Times Magaz., Feb. 6, (1910).

"In California it (mealy bug) is most abundant and destructive in San Diego and Ventura Counties, but occasionally it is met with in nearly all sections of the southern part of the State."

"The mealy bugs are noted for their resistance to sprays and fumigation. Their waxy coverings and secretions tend to prevent sprays from penetrating to affect them and they are able to withstand hydrocyanic acid gas at strengths two and three times as great as that required to kill most other scale insects. Experience to date seems to show that satisfactory control by either method is impracticable. In California reliance for the control is at present centered on natural enemies." A. W. Morrill, Ent. of Ariz., in Circ. No. 7, Ariz. Hort. Com. (1910).

"This (mealy bug) is one of the most serious pests on citrus trees at present and we are sorry to say seems to be on the increase in spite of all measures of control." O. E. Bremner, Sec. State Hort. Com. of Calif. in Destructive Insects and Their Control, p. 32 (1910).

From the foregoing it will be seen that something should be done immediately upon finding mealy bugs in or near any citrus locality. Those districts which are at present ignoring the mealy bug in spite of its presence are sure to pay the penalty. Too much stress cannot be laid upon the matter of thorough inspection of infected districts and of quick and speedy eradication at any cost.

QUARANTINE.

The general excuse for allowing the mealy bug to pass unmolested has always been that there was no way, yet known, by which to effectually cope with it. While this excuse is perfectly valid if considering the matter of complete extermination, it has been invalidly employed as an evasion of the entire problem of control. Regardless of everything pertaining to the methods of extermination, the matter of quarantine should have been forced as soon as the mealy bug was found out to be an orchard pest. Even to-day we find the most thoughtless, and absolutely unexcusable carelessness exercised by many of the County Horticultural Commissioners and their Inspectors regarding it.

As stated before the pest to-day exists in practically every greenhouse in Southern California. No one is responsible for its existence; but those in power should be held responsible for its ready and careless distribution from these places.

At the least we may follow out some of the following important quarantine measures:

Tree-to-Tree Inspection. No one who owns an old orchard is absolutely sure what pests it may contain. In order to ascertain the distribution of pests, it is therefore necessary to effect a systematic inspection of all infected and uninfected districts. This can only be done by a tree-to-tree inspection performed by inspectors who know their business. If it is properly done, the results are sometimes marvelous. The following work actually done may serve to illustrate:

During the summer of 1909, a tree-to-tree inspection was made of the Claremont, Pomona, North Pomona, and San Dimas Districts. Most of the territory was supposed to be free from serious pests. During the first month mealy bug was discovered in the Claremont district, miles from any district known to be infested with this pest. Before the end of the season, purple scale, red scale, and yellow scale were located in a number of places where they were never thought to have existed.

In Ventura County the mealy bug was thought to be the only real dangerous pest. Purple and red scales were known to exist in only two localities. A tree-to-tree inspection located mealy buy in 6 localities where it was not known to exist. Red scale in two new localities and purple scale in two districts miles from the known infestation.

Infestations—The owner of every tree or orchard, which is infested with mealy bug, should be served with an official quarantine notice forbidding him to remove, give away, or sell any fruit without first getting a permit from the Horticultural Commissioner, or his deputies.

Infested fruit cannot by law be shipped to any other district within the State, and it should not be shipped to any citrus district outside of the State, unless thoroughly treated and hand washed in a 30% solution of denatured alcohol and inspected by a lawful inspector after treatment. To the Eastern market the owner takes his own risks in shipping such fruit.

Picking Boxes. In a district partly infested with this pest, every box which is used as a regular picking box, or which has ever been in a packing house which handles infested fruit, must be thoroughly disinfected just before entering the orchards. These boxes may be treated in any of three ways, viz., fumigated, emerged in denatured alcohol (30%) or steeped for 20 seconds in water maintained at a temperature of 170° F.

For fumigating, an air-tight compartment may be constructed in the packing house with a top ventilator at the roof. Four ounces of cyanide per 100 cubic feet is sufficient to destroy all life. The boxes should not be removed except when taken directly to the orchards.

A large tank should be filled with denatured alcohol if this method is to be used to insure the complete immersion of every box.

If hot water is to be used a constant fire should be kept under the water tank, so as to maintain a constant temperature.

Picking boxes should not be allowed to be shipped from an infested to a clean district under any circumstances, neither should new boxes filled with fruit be allowed to enter a clean district from an infested area, even though the fruit came from an uninfested orchard. All exchanges of fruit or boxes from infested districts must be prohibited.

Picking Crews—A picking crew should not be allowed to work in a district partly infected with mealy bugs unless under these conditions:

1. All clean orchards must be picked consecutively before entering those infested.
2. Every orchardist must furnish his own ladders, picking sacks, etc.
3. Every grower having mealy bug in his orchard must furnish the members of the picking crews with jumpers, overalls, and caps to be worn only while picking his own fruit.
4. An intelligent and careful man must direct the movements of the picking crew to see that the above regulations are carried out.

Nursery and Greenhouse Stock. All imported nursery stock must be rejected and returned to the place from whence it came. Too great care cannot be exercised in this matter.

DESCRIPTION OF FEMALE.

Larvae (Fig. 112). The larvæ, after the time of hatching, pass through three distinct stages or moults, before they become adults. During the first stage the nymphs average 0.4 mm. in length, and 0.19 mm. in width. They vary from straw-yellow to orange in color, are oval in shape, and are quite active. The antennæ are large for the size of the body, are 7-articled, and

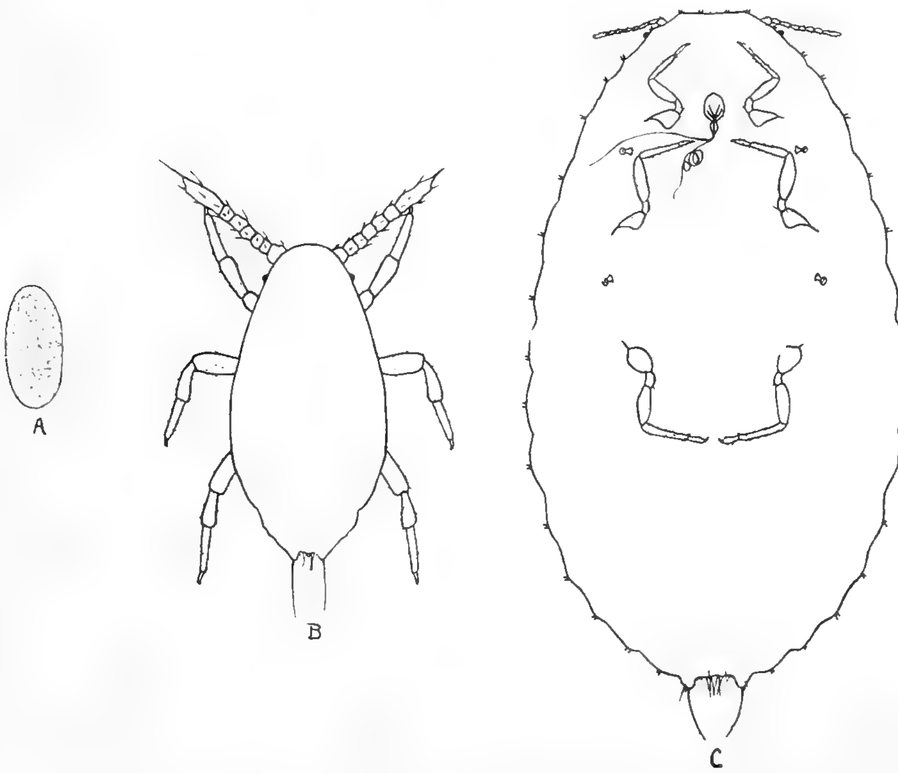

Figure 112. Female of Pseudococcus citri.
A, egg; B, young female in second instar; C, ventral view of adult female to show antennae, legs, rostrum, spiracles, and lateral spines.

clothed with hair. The abdomen is divided into 8 rather distinct segments, while the remainder of the body-segmentation is obscure. The eyes are small, black, and project beyond the body. The legs are large and ungainly. Coxæ, femora, and tarsi all longer than the tibiæ. During the second stage the nymphs have attained 0.635 mm. in length and 0.3 in width. Otherwise they cannot be told from the first stage. The third stage is so much like the adult form that the difference cannot be distinguished, except for the size. This form has an 8-articled antennæ. From the first stage up through the development, there is a gradual acquisition of the white powdery covering, which completely covers the adult female.

Adult (Figs. 113 and 114). The adult mealy bug, as its name suggests, is completely covered with a thick, white, cottony wax. The body segmentation is distinctly visible through this covering, though the latter completely hides the body color. On the ventral surface the covering is very thin or wanting. At the margins the waxy-covering extends outwardly in the form of white filaments or plates. There are 17 lateral filaments on each side.

Figure 113. Adult females and egg masses of Pseudococcus citri.
(Pom. Journ. Ent., Vol. I, No. 2, Fig. 31.)

At the posterior end there are 2 long filaments, nearly one-fourth the length of the body, and several shorter filaments extending backward. From every lateral spine group or large spine there arises a filament. By counting these we find 34 lateral filaments on the same number of small spine areas, which comprise 2 short spines each, 2 long posterior spines arising from the spines on the anal lobes, 2 short filaments arising from the short spines on the anal lobes, and 6 filaments arising from the six circumanal spines. The average length of the adult female is 3 mm., and the average width is 1.5 mm. Some are much larger. A brown mid-dorsal longitudinal band is a common characteristic of the adults.

The color of the body is light yellow, turning darker in the more advanced egg-laying forms. When boiled in KOH the body contents first become cardinal and finally change to an amber or yellow color. When the contents have been removed the appendages and body wall become perfectly transparent and colorless after they have been cleared in clove oil or in xylol.

Figure 114. Adult females of Pseudococcus citri.
(Pom. Journ. Ent. Vol. I, No. 2. Fig. 32.)

Antennae (Fig. 115 A). While the articles of the antennæ vary to a marked degree, yet much use can be made of them in determining the species. From careful microscopic measurements the following formulæ were derived: 8, 3, (2, 1, 7) (4, 6, 5) and 8, 3, 2 (1, 7) (4, 6, 5). In Insect Life, Vol. vii, No. 2, p. 172 (1894), Mr. G. C. Davis offers the following in regard to the antennal articles: "In *destructor* the basal and terminal segments are of equal width and broader than the others. The terminal segments are not nearly truncate. The following shows the length of the different segments beginning at the base. The measurements are made by using the micrometer; 1—3.5, 2—5, 3—5, 4—3, 5—4.25, 6—3.25, 7—4.5, 8—10."

From these measurements the following formula may be derived: 8, (2, 3), 7, 5, 1, 6, 4.

In the Entomological News, Vol. xiii, No. 8, p. 257 (1902), Mr. Geo. B. King makes the following interesting statements regarding this matter: "Again take the common mealy bug (so-called) of our greenhouse, *Dactylopius citri* (now *Pseudococcus citri*). Prof. Comstock described the antennæ and says joint 8 is longest, twice as long as 3, 2 and 7 equal, 5 and 6 equal, and 4 shortest. I have tried my eye with the following results: 8 and 3 longest; 3 distinctly shorter than 8; 1 and 2 next longest and about equal; 5 a little longer than 4; 6 and 7 shortest and about equal."

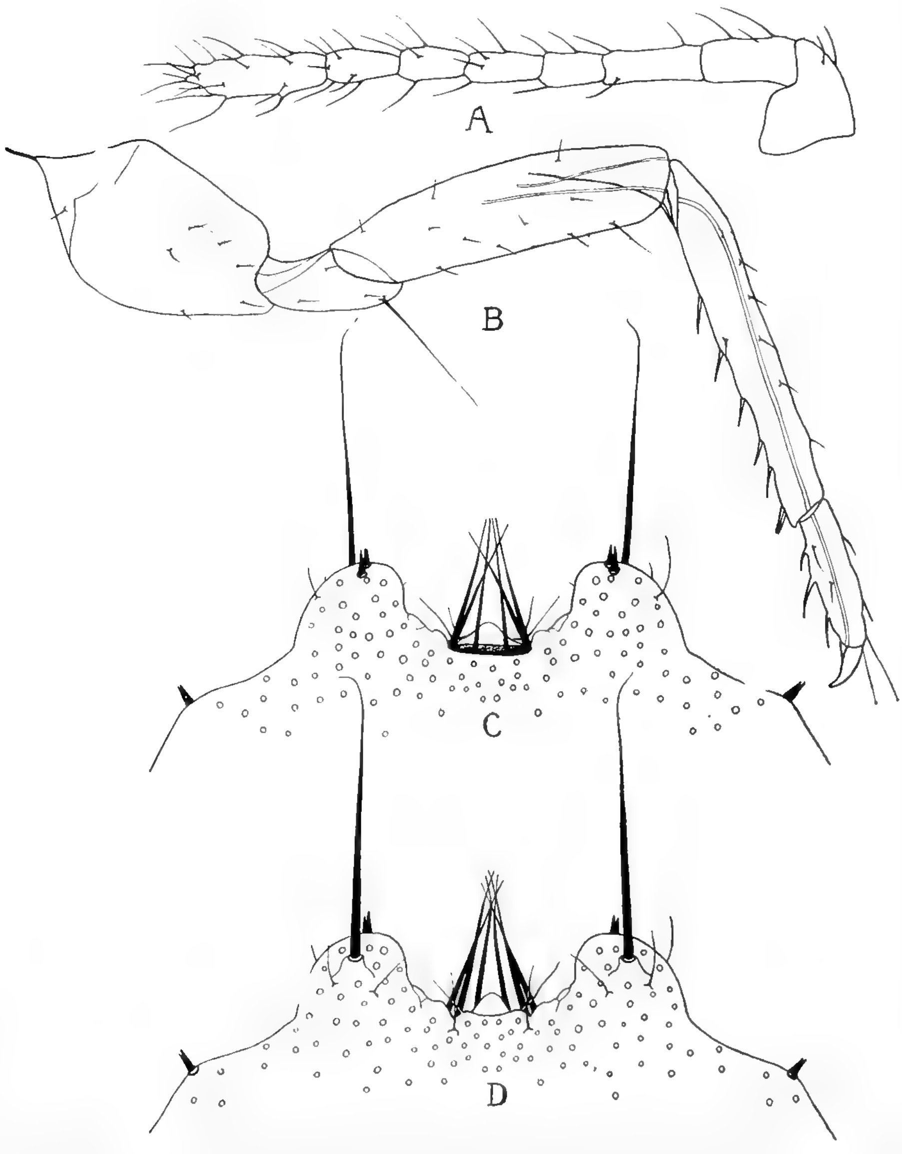

Figure 115. Female of Pseudococcus citri.
A, antenna; B, leg; C, dorsal surface of pygiduim; D, ventral surface.

"A careful measurement with a micromillimeter gives the following results: joints 1, 2, 3, 4, 5, 6, 7, 8; 96, 88, 96, 68, 80, 81, 44, 104."

"The formula of Comstock's measurements with the eye 8, 3, (2, 7), (6, 5), 4 omitting joint 1; of these by myself with the eye 8, 3, (1, 2), 5, 4, (6, 7), and with the micromillimeter 8, (1, 3), 2, 6, 5, 4, 7. This, I believe, is the first time that the true measurements of the antennal joints of *Dactylopius citri* have been given." From all of the above it is readily seen that there must be a large degree of variation in the antennal articles of different individuals. The mounting, and the position of the insect upon the slide, no

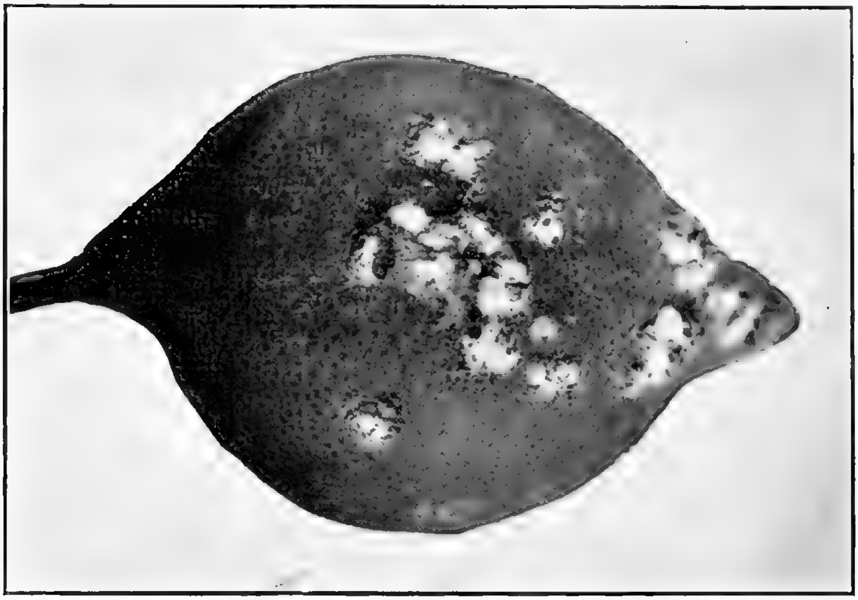

Figure 116. Egg Masses of Pseudococcus citri on Lemon.
(Pom. Journ. Ent. Vol. I, No. 2, Fig. 18.)

doubt, plays a very important part in these determinations. For general work the eye measurements (taken by the eye through a microscope) must be used by the average student for ready reference. In combining all of the formulæ of eye measurements we may fix a more exact formula as follows: 8, 3, (1, 2, 7), (5, 6), 4. The combined number of antennal articles equals about one-ninth the length of the insect's body.

Rostrum—Short, stout, and in two distinct divisions, the basal division being much broader than the apical. The rostral loop is nearly half as long as the body.

Spiracles—There are two pairs of breathing organs; the first pair is located on the ventral surface nearly midway between the prothoracic and the mesothoracic coxæ; the second is located nearer front than midway between the mesothoracic and metathoracic coxæ, on the ventral surface.

Legs (Fig. 115 B). Normally long and hairy. Coxæ longer than broad, nearly as long as the femurs. Trochanters narrow and not more than half as long as the coxæ. Femurs stout, shorter than tibiæ. Tibia long and slender, twice as long as the tarsi, slender and spiny on the inner margin. Tarsi with a few stout spines in inner margin. Claws normal.

Pygidium (Fig. 115 C and D). Covered over the surface with a large number of circular pores, which are common to this genus. Anal lobes with 1 large spine and 2 small, slender spines on the ventral surface, and with 2 short stout spines and 1 hair-like spine on the dorsal surface, of each lobe. Circumanal spines—normally six, which are half as long as the spines of the anal lobes. On the ventral surface, just in front of these spines, are two pairs of slender hair-like spines. A distinct conical cauda projects backwards just below the 2 most dorsal of the spines.

The *eggs* (Fig. 116) are elliptical oval in shape. *Color*—Straw yellow, amber, "corn" or light yellow. *Surface*—smooth and somewhat glossy when the covering threads are removed. *Size*—Average length 0.34 mm., average width 0.17 mm. They are deposited in large masses, and are intertwined and bound together with fine, white, cottony threads, which are secreted and exuded by the female during the process of egg-laying. The eggs are deposited in cracks, and crevices of the trees, on the fruit, especially where there are clusters, in the navel of oranges and the blossom end of seedlings, under the calyx, and in any other place which may afford shelter and protection for them.

THE MALE.

Larvae (Fig. 117 a). The first born are difficult to distinguish from the females of the same age, but the male larvæ developes much faster and is soon told by its rather long, smooth, dark-colored body, and by the disappearance of the mouth parts after the first moult. There are 4 moults before the adult stage is attained. The antennæ are 7-articled and are sparsely covered with hair. There are two dark marginal eyes which are retained throughout the entire development.

Nympth (Fig. 117 b and c). When the brood is nearly one-third grown the males seek a sheltered place, usually in an egg-mass, to spin their cocoon in which their transformation is to take place. The cocoon varies from 3 to 4 mm. in length, is nearly cylindrical in shape, and is spun with very fine white cottony threads, such as cover the egg-masses. The nymph, if undisturbed, remains perfectly quiet throughout the moult, but if the cocoon is destroyed at any stage, it immediately moves away to find a more suitable place to make another. With age the body becomes dark in color, the wing buds, and then the wing pads appear and the large red dorsal and ventral eyes appear. A few short spines appear on the lateral margins of the abdominal segments. The pygidium appears somewhat darker than the rest of the body.

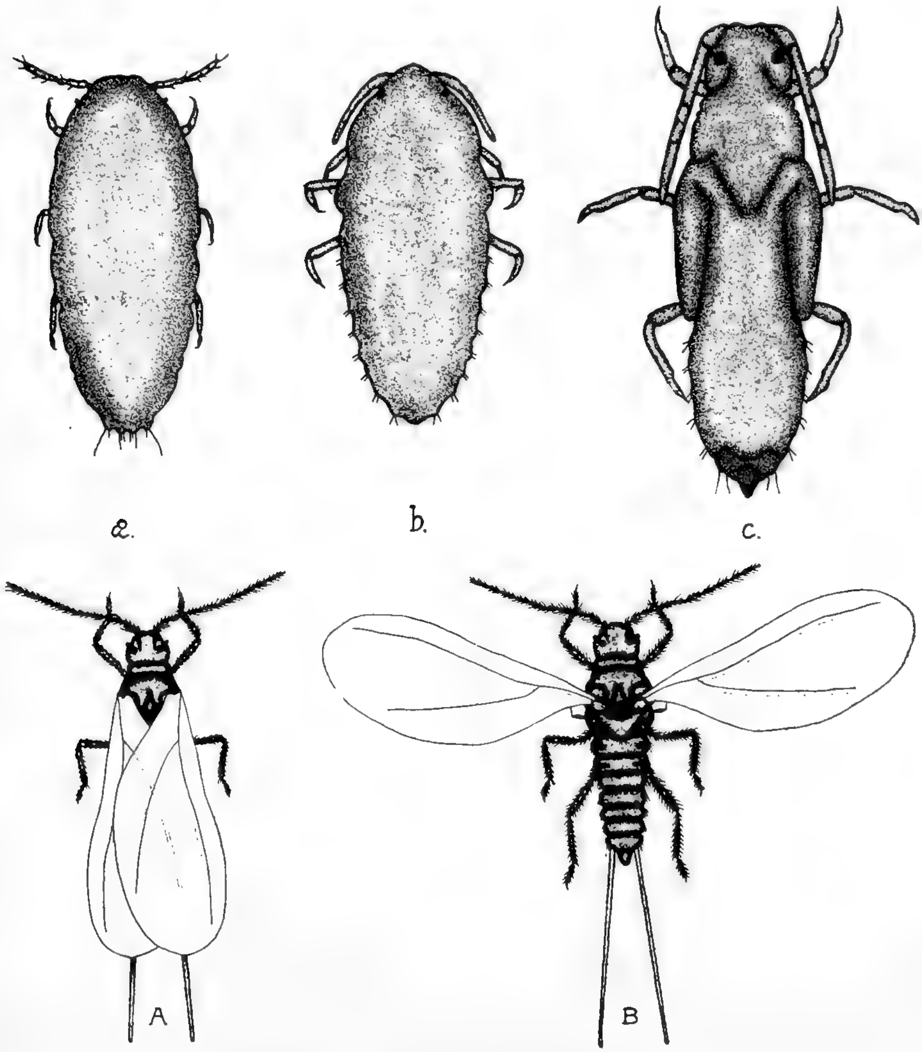

Figure 117. Male of Pseudococcus citri.
a, larva during first instar; b, larva during second moult; c, nymph during last stage. A, B, adult male.

Adult (Fig. 117 A and B). Are very delicate and small, measuring on the average but 1 mm. in length. They are of amber-brown color, covered with enough of the cottony way to give them a gray appearance. *Head*—Wider than the prothorax with 2 dark blotches extending backward from the base of the antennæ. *Eyes*—Besides the two dark marginal eyes, retained from the larval stage, there are two large red eyes dorsally and a similar pair ventrally. *Antennae*—10-articled, dark in color, and very hairy. *Thorax*—is well differentiated and shows large wing muscles. A dark band connects the bases of the wings. A prominent scutellum extends to the abdominal segment. *Abdomen*—tapers posteriorly, the last segment being much narrower than any of the rest. The lateral margins carry a few hairs. The posterior segment, next to the end of the abdomen, bears two long spines which, when clothed with the white cotton, make the long white anal filaments. These are nearly as long as the body and project backward. *Wings*—As in most of the male coccids, there are two wings, with the two characteristic veins in each. The wings of the male mealy bug are from a milk white to a faint bluish color, and are carried flat upon the back as seen in the cut. *Legs*—Are dark, as are the antennæ, and are very hairy. (Fig. 118.)

Figure 118.

Cocoons of male Pseudococcus citri (the large white masses); also larvae of female (the small white individuals).

LIFE HISTORY.

Very little has been done toward the working out of the life history of the citrus mealy bug. In fact, as yet, no one has followed it at all in its various stages in the orchard. Mr. G. C. Davis, of the Agrc. College, Mich., has worked out the following in the greenhouse, and published it in Insect Life, vii. No. 2, p. 168 (1894).

"The female of our commonest mealy bug, *Dactylopius destructor* (now *Pseudococcus citri*) is very prolific, laying usually not more than 400 eggs, but may vary in number from 300 to 600. Each egg is slightly oblong and about 0.25 mm. in length. The color is light straw yellow, with small particles of the white waxy secretion covering each one. Over the whole egg mass is a white flocculose network of waxy threads which cover the eggs and quite effectually protect them from attack by other insects. The female commences secreting these threads some hours before egg laying begins, and continues secreting as long as the mass of eggs increases. A female before laying her eggs will be about 2.5 mm. wide and 4 mm. long, but when through there is nothing left of her but a little dry wrinkled piece of lifeless skin and a mass of eggs back of her that will measure two or three times as much as she did a short time before. The female feeds all the time she is depositing her eggs, and no doubt lays far fewer eggs when forced to do so with no food accessible. The eggs first laid will remain farthest from the female and beneath, she moving ahead as the mass grows. The mass also raises her until toward the last her position is often nearer vertical than horizontal."

"Quite a number of females of various sizes were placed in a jar to see how long they would live with no food. There was moisture enough for their needs, and the temperature was a little above what it would be in a comfortable dwelling house. The smaller ones, which were not over a quarter grown, moulted on the second day and on the third were mostly dead. Many of the larger ones moulted the day the smaller ones died. Some of the smaller of them lived a few days longer and then died, but the most of the larger ones began very soon to deposit eggs. One of the largest of the number was carefully watched, and it was found that the eggs increased at the rate of about 36 every twenty-four hours. Egg laying lasted only four or five days, instead of ten days or two weeks as usual, when the female shriveled and died, leaving from one hundred to one hundred fifty in each mass. The most of these eggs were fertile and hatched in about a week after they were placed there. None of the females were full grown, and the experiment shows that the mealy bug will still strenuously endeavor to propagate its kind from immature specimens when food is wanting. Another lot of specimens were placed in a cold room under otherwise similar conditions and all sizes remained dormant for a long period with no apparent injury."

"It requires from one to two weeks for the eggs to hatch, according to the temperature. As a usual thing the young mealy bugs from the eggs first laid will hatch some days before the female has finished laying. They are very active and, like other young bugs, appear to be mostly antennæ and feet. They do not venture out from under the flocculent covering for several days, and before they do they have assumed a partial mealy coat resembling considerably the parent. The antennæ are six-jointed in the female and seven-jointed in the male larvæ."

"On the fourteenth of April a single gravid female was placed in the laboratory on a Coleus plant. Since that time two generations have been reared from the one specimen. This would make about two months for each generation, but, where the temperature is like that maintained in a conservatory, this period is shorted two weeks. We may say then that in general the time required for development is from six to eight weeks."

"The young grow very slowly for the first two or three weeks and the growth is very uneven. Should one look at them for the first time when three or four weeks old he would declare that they could not all belong to the same brood, as there is such a great difference in their size. The difference is maintained from this on, so that it is impossible to tell where one generation begins and the other ends. There will be all sizes, from the ones just hatching to the female forming a woolly mass. About half of the brood are regular enough, however, so that one can, with a little care, trace the generation through its development."

"When the mealy bugs become about a third grown, perhaps one out of every eight or ten will be seen to travel off a little apart from the rest and begin to construct a light fluffy cocoon around itself. It is the young male preparing for his transformation to the winged state. The material of which the cocoon is constructed is similar to that used by the female in covering her eggs, except that the thread is finer and more downy. The cocoon is oblong in shape, being from one to two mm. in length and half as thick. The construction is alike throughout, with no hard portions except the cast off skin which is left behind. The transformation is very rapid, taking as nearly as I can ascertain, only three or four days, or a week at most, when the two-winged male comes forth with quite a difference in appearance from what it possessed before. The males are very delicate and slender, measuring less than a millimeter in length and with an expanse of wings from 2 to 3 mm. The flight is slow and steady, and although they are so very minute, when one has become acquainted with their appearance on the wing, he will readily recognize them and can easily catch them by a quick thrust of the open hand. The body is an olive brown, and is more or less flecked with the mealy covering. At the extremity of the abdomen are the two white anal filaments nearly as long as the body itself. The wings are milky white, extremely fragile, and with only the two customary veins. There are now ten segments to the antennæ instead of seven. The mouth parts are either wanting or are very rudimentary. Perhaps the most interesting change is in the placing of the eyes. On the top is a pair of large dark red eyes with a lighter ring of red around them. On the under side of the head, separated nearly as far as they can be from the ones above, is another similar pair. On the sides of the head are the two dark eyes, the same as seen in the immature stage."

"Mating with the half grown females occurs soon after the males issue. Someone has said that the anal filaments are used for mating, but observation in several cases has not shown this to be the case, the filaments merely extending backward out of the way."

In the Canadian Entomologist, Vol. xxxix, No. 8, pp. 284-287 (1907), Robert Matheson presents the following most important article:

The life-history of the male of *Dactylopius citri* (*Pseudococcus citri*) has been worked out by Reed in 1890 at Cornell University. His results are embodied in an unpublished thesis., Berlese, '93, in "Le Cocciniglie Italiane Viventi Sugli Agrumi," pp. 23-33, has given a more detailed account of the male's life cycle. It may be well to give here a brief summary of their work before describing the transformations of the female.

MALE STAGES.

The young nymphs moult for the first time in from 10 to 22 days after hatching. During the first stage it is impossible to separate the males from the females by their external characters, and only just previous to this moult can they be distinguished. Berlese has shown that, that the future mouth-parts of the female which is about to shed its skin, are coiled spirally just beneath the transparent cuticle. In the males no developing mouth-parts can be observed, and those which they possess disappear at the time of the first moult. These facts can be observed just before the moult.

The cast skins usually remain attached to the caudal extremity of the male nymphs. In the second stage the male nymphs are sluggish in their movements. They usually seek out some secluded spot and, in about ten days, begin spinning their cocoons. The spinning of the cocoon occupies about two days, and, shortly after its completion, the second moult occurs. This cast skin is, in a day or two, pushed out at the caudal end of the cocoon. It is during the second stage that the beginning of the wings and halteres may be noted. They appear as small papillæ on the mesothoracic and metathoracic segments.

The third moult occurs five days after the second, and in a week later they moult for the last time. The perfect winged insects emerge from the cocoon in from three to four days after the fourth moult.

FEMALE STAGES.

The life-history of the female is in marked contrast to that of the male. Neither Reed nor Berlese, nor any previous worker, succeeded in determining the number of moults in the female. Reed supposed there were three, whereas Berlese, reasoning from analogy with the male, considered there must be at least four.

As is generally known, each female lays from 150 to 200 eggs. These eggs are enclosed in a waxy secretion, produced by hypodermal glands. These glands are situated on the ventral surface of the abdominal segments. The first nymphs appear in from 10 to 18 days after the commencement of the egg-sac. Only a small number of those hatched from a single egg-sac are males. The young nymphs on hatching remain a short time within the egg-sac, and, on leaving it, spread rapidly over the leaf, settling in large numbers along the mid-rib and at the joints of the stems. As previously pointed out, it is impossible to separate the males from the females during this stage.

FIRST NYMPHAL STAGE.

At time of hatching, the young nymphs are about 0.4 mm. long, and from 0.18 mm., to 0.21 mm. wide, bright yellow to orange in color, oval in outline, slightly narrowed at the caudal end and rounded at the cephalic end. The appendages look large and clumsy in comparison with the size of the body.

The abdomen is distinctly divided into eight segments, the transverse sutures being distinct on both dorsal and ventral surfaces. The divisions of the thorax are not so distinct. The transverse sutures cannot be distinguished on the venter, and only with difficulty on the dorsum. The suture separating the head from the thorax can be seen only on the dorsal surface.

The antennæ are about 0.16 mm. long, situated on the ventral surface of the anterior end of the body. The bases of the antennæ are not contiguous, and small hairs are scattered over their entire surface. They are divided into seven segments. The basal one is triangular in outline and quite short. The seventh segment is the longest, longer than the three preceding segments taken together, oval in shape, and ends in an apical tubercle, upon which is inserted a stiff hair, almost as long as the segment itself.

The cornea of the eyes projects from the sides of the head. The black pigment is well developed, showing prominently on the ventral surface.

The legs are well developed and strong, especially when compared with their condition in the adult.

SECOND NYMPHAL STAGE.

The first moult occurs from 10 to 22 days after hatching. It is just before this moult that Berlese could distinguish the males from the females by the absence of developing mouth-parts.

After the first moult the females are about 0.625 mm. in length, 0.3 mm. in width; bright orange in color, somewhat rounded at the anterior and posterior ends.

The antennæ are 0.19 mm. long, and have seven segments. The basal segment is quadrangular in outline and quite short. The seventh is the longest, being nearly as long as the three preceding taken together.

It is difficult, if not impossible, to separate the first and second nymphal stages, except by rearing them and noting the time of moulting. The characters of length and size of antennæ are of doubtful value, and not to be depended upon. The antennæ of a nymph, near the latter part of the first stage, measured over 0.19 mm. This is the length usually found in the nymphs at the beginning of the second stage.

THIRD NYMPHAL STAGE.

The second moult occurs, on the average, about 15 days after the first.

The antennæ now consist of eight segments, and are 0.264 mm. in length. The basal segment is quadrangular in outline, and the eighth is nearly as long as the three preceding taken together. The character and the number of the antennal segments readily distinguish this stage from the preceding ones, but are absolutely of no value in separating it from the mature or last stage. In other characters they do not differ materially from those of the preceding stages.

As all previous workers have considered the antennæ in the first nymphal stage as consisting of only six segments, I would like to draw attention to the fact that in all specimens which I have examined there were seven clearly-defined segments in the first and second nymphal stages and eight in the third, as well as in the adult female.

ADULT FEMALE.

The third and last moult takes place, on the average, about 13 days after the second. I found it very difficult to secure many observations on the exact time of this moult on account of the roving habits of the nymphs under observation.

After this moult the females do not usually move about, but remain practically motionless. Egg-laying commences in from 15 to 20 days later, and continues from 10 to 14 days. An interesting observation worth recording is that the females are usually not of a uniform size at the time when they commence egg-laying. This has been pointed out by Reed in his thesis, and I had many opportunities of verifying his observations. Often what I, judging from the size only, considered were nymphs in the third stage would prove to be mature females and commence egg-laying.

To the preceding accounts may be added the following orchard observations taken at Santa Paula, Ventura County, California, during the years 1909 and 1910:

EGGS AT SANTA PAULA.

The egg-laying in the field certainly differs from that seen in the laboratory where the temperature is more uniform. It covers a period from two weeks to one month. For breeding material, I keep infested fruit on damp sand and under such conditions the egg-laying usually requires but two weeks. On fruit placed in jars, where it soon begins to wither, the egg-laying may occupy but 10 days or even less, while mealy bugs placed in boxes, jars, or cells without food, deposit most of the eggs in one week. Under extreme unfavorable conditions, such as excessive heat and dryness, the eggs are laid in the course of three days. The conditions of egg-laying also influence the time for hatching. Under the most favorable conditions the eggs first laid begin to hatch about the time, or a little before, the last eggs are deposited. This accounts for the great difference in the sizes of the individuals from the same brood. Conditions also influence the number of eggs deposited by an individual female, the facts being that under extremes, such as lack of food for the adult, or excessive heat, the number of eggs laid are greatly reduced, in such cases to one-half or even one-fourth normally laid.

There is no marked egg-laying season, but the bulk of the eggs are laid in the fall during the months of September, October, November, and December. At this season the mealy bugs seem to be thickest and are more noticeable than at any other season. The insect evidently prefers to pass the winter in the egg stage, although large numbers of all stages appear during these months. The idea of massing the eggs in great clusters for protection against other insects, birds, and weather, seems to be carried out perfectly by the mealy bug, for during these months much of the fruit, the limbs, and the foliage may be entirely wrapped in cottony egg-masses. Large streamers hang from the fruit in badly infested orchards, so that the eggs may be gathered in handfuls. The position for depositing the eggs is determined by the condition of the fruit upon the trees. There is no doubt but that the mealy bug prefers the fruit to the foliage. The lemon tree, being a constant bearer of fruit is subject to greater attacks than are orange trees from which all of the fruit has been removed at some season of the year. The eggs are deposited in the navels and at the blossom ends of the seedling fruit, as long as there is any fruit upon the tree, in much larger numbers than upon the limbs and leaves, but as soon as the fruit is removed the masses begin to appear in great numbers upon the trunks and large limbs in the center of the trees where there is more protection afforded. On a lemon tree a few of the eggs are deposited upon the trunk and limbs of the tree, but the greatest masses appear in the fruit clusters on the leaves near the fruit. Very few eggs are to be seen during the months of May, June, and July, and it is usually at this season that the grower believes that the mealy bug has left.

That the eggs are deposited in the ground for winter protection has never been proved. I have searched very thoroughly to test this assertion and have found but very few eggs in the ground, and these were on the base of the trunk at the surface of the ground. If the eggs are laid upon the roots in the ground, the young upon hatching would naturally crawl up the tree trunk to begin feeding, when the proper time came in the spring for them to do so. To test this, we put tanglefoot bands around several acres of trees and left them there for one winter and the early part of the summer. No mealy bugs were caught worth mentioning on either side of the sticky band.

The egg is the hardest stage in the life history of the pest to deal with. In the fumigation work and in the spraying experiments, the large egg-masses resisted the most. For testing the efficiency of hot water as an insecticide for dipping mealy bug infected boxes, it was found that at 158° F. all of the insects were killed, while it took 164° F. to kill all of the eggs.

Eggs. In regard to the number of eggs laid by this insect, Mr. John J. Davis published in the Entomological News, xix., No. 8, p. 383 (1908), the following article:

"The following table gives the actual counts of the numbers of eggs in twenty egg-masses of *Pseudococcus citri*. They were collected on Salvia in a greenhouse at Urbana, Illinois, March, 1907. The table shows a wide range in the numbers per egg-mass, namely: 147 to 414; but as will be seen in the successive averages, there was little divergence from the final average."

"The 'corn' or clay-colored eggs are laid in a mass beneath and spreading beyond the tip of the abdomen in an entanglement of white cottony secretion. They are elliptical-oval, somewhat glossy, and measure 0.309 to 0.326 mm. in length, and 0.146 to 0.180 mm. in width. The average, from 15 eggs measured, was 0.313 mm. in length by 0.164 mm. in width.

PSEUDOCOCCUS CITRI (*Risso*).

No.	No. counted per mass.	Successive Totals.	Average per Egg-mass.	Max.	Min.	Range
1	354	354	354			414
2	346	700	350			
3	210	910	303.3			
4	157	1067	266.6			
5	414	1481	296.2	414		
6	208	1689	281.5			
7	346	2035	290.7			
8	302	2337	292.1			
9	166	2503	278.1			
10	319	2822	282.2			
11	292	3114	283.1			
12	159	2373	272.7			
13	391	3664	281.8			
14	180	3844	274.5			
15	206	4050	270			
16	399	4449	278.1			
17	266	4715	277.3			
18	147	4862	270.1		147	
19	292	5154	271.2			
20	329	5483	274.1			147
20		5483	274.1	414	147	267

In the orchards of Southern California conditions are very favorable to the growth of the mealy bugs, and never have I seen egg-masses in a greenhouse that will begin to compare in size with those found in the combined clusters on the citrus fruit. It is very conservative to say that the number will reach 500 for some individuals. As yet I have never noticed any considerable number of unfertile eggs. At least 99% of all eggs deposited will hatch and 95% of all the hatched young, under normal conditions, in the orchards, will live to reproduce. In jars, without food all of fifty adults produced eggs that hatched and 50% of the half-grown produced eggs that hatched, but in the case of the latter the number of eggs per individual equalled only about one-fourth that of the adult.

FEMALE LARVAE AND ADULTS AT SANTA PAULA.

Because of the overlapping of all stages from the larval form to the adult, I have deemed it necessary to consider these forms together as one. (Fig. 119.)

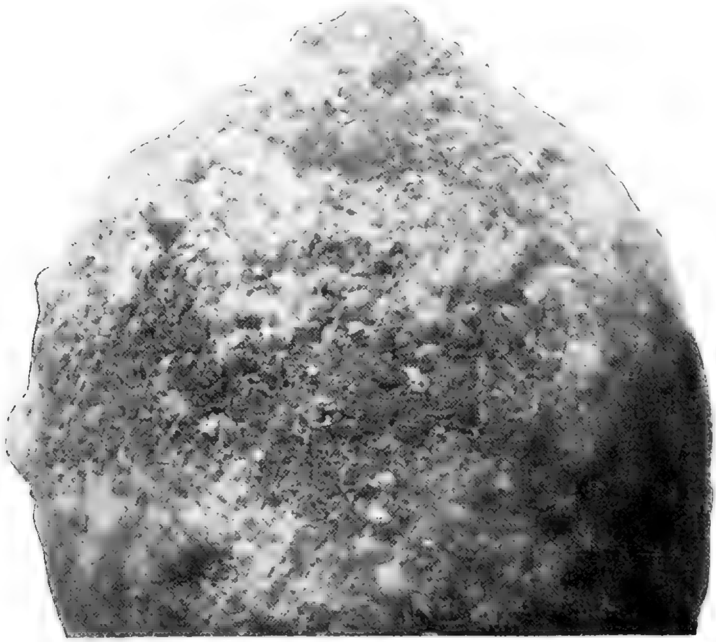

Figure 119.

A lemon showing three broods of mealy bugs, before the fruit dried up. This is somewhat of a remarkable picture, for it shows what may be expected of the mealy bug.

The fact that most of the eggs are deposited during the early winter months would at once lead us to believe that during the early spring there would be a tremendous hatching of young, and such is the case in normal weather. If the winter is warm the broods appear just as in the summer and there is a constant hatching all of the time. Even during the coldest weather a great many young appear. With the coming of the new growth and young fruit in the spring, come the hoards of newly hatched mealy bugs which settle at once upon the most delicate foliage and around the calyx of the young fruit. It is upon the fruit that the greatest damage is done, for the pests will remain with it until it is killed and drops or until it is ruined as a commercial product. From the time that the foliage begins to harden the mealy bugs seem to decline and during the hot summer months are not noticeable unless the orchard is badly infested. Then beginning with September the adults appear in great numbers and begin to deposit eggs. The young upon hatching exude the honey dew which causes so much black smut upon the foliage. While there are many individual broods throughout the year there is always the marked winter season when the numbers of all forms is greatest. The following orchard notes serve to trace the general field development in a badly infested orchard at Santa Paula. The notes begin in the fall of the year 1909 and have been continued throughout the year and should give field conditions accurately:

Sept. 7, 1909.—Mealy bug beginning to show up very numerously. A large number of immature and adult insects, but few egg masses.

Sept. 30, 1909.—Egg masses becoming numerous in the navels and flower end of the oranges, causing some of the navels to rot. Particularly bad in two navel orchards and in a large seedling orchard.

October 30, 1910.—Eggs masses abundant upon orange and lemon trees, and upon the foliage and fruit. Trees becoming very black due to smut. Lemons worse infested than orange trees.

Nov. 24, 1909.—All through this month the mealy bugs seem to show up more than at any other time. Great masses of adults collect on the fruit, while the trunks of the trees are covered with masses of eggs.

Dec. 1, 1909.—Navel oranges are badly infested and are rotting at the navel end, because of the work of the insect. In many cases the injury extends to the center of the fruit. A large percentage of the fruit is cracking at the navel end and the rot is spreading. The McKevett orchard, though fumigated last month, shows similar results, but the mealy bug has been greatly reduced.

Dec. 30, 1909.—Great numbers of egg-masses on the fruit and trunks of the trees. Rainy weather does not seem to retard the development of the mealy bug.

Jan. 30, 1910.—Conditions of the mealy bug as bad as during the two preceding months. Smut very bad because of damp weather.

February 28, 1910.—Conditions in the lemon orchards very bad. Great clusters of egg-masses on the fruit, leaves and branches. On the orange trees the branches are covered with egg masses, which seem to be waiting for spring to hatch.

March 30, 1910.—Clusters of egg masses begin to disappear as the eggs are hatching very rapidly. Still many clusters remain. Young are settling upon the young growth.

April 29, 1910.—Young mealy bugs appearing in great numbers. Masses upon the tree trunks are breaking up and disappearing, but large clusters remain between touching lemons.

May, 30, 1910.—Young still hatching, but not in very great numbers. Egg-masses gradually disappearing.

June 30, 1910.—All of the young appear to be hatched, except on the fruit of some lemons, which were very badly infested. No living eggs remaining upon trunks of the trees. Young hard to find in the orange groves.

July 30, 1910.—Only young individuals to be found and they are beginning to settle upon the young oranges. No full grown adults to be readily found. No egg-masses at all.

August 30, 1910.—Young and half-grown mealy bugs appearing in considerable numbers on the fruit of the orange and lemon trees. More numerous than last month. No egg-masses.

The almost complete disappearance during the summer months, had led many to believe that the mealy bug had left the trees, but upon close examination it will be found that the young are there, but hid away in cracks and crevices upon the orange trees waiting for the fruit to set. Upon the lemon trees they are settled around the stem, under the calyx, or between lemons, and also upon the tender sucker growth.

MALE NYMPHS AND ADULTS, AT SANTA PAULA.

The young male usually selects an egg mass under which to transform. This is probably for two reasons; viz., to find protection, and to be able to perform his sexual duty without any great traveling, for it is probable that the male flies very little until after copulation. In nearly every egg mass there is to be found a developing male, even though the egg mass is only a few days old. Since the copulation takes place while the female is less than or when she is half grown, the transformations of the male must be more rapid than that of the female, and this accounts for the advanced stages of the male in the egg masses. As soon as the cocoon is left behind the male searches out those ready for mating, before the thought of flight is entertained, and in the large egg-masses many of the males never get an opportunity to fly.

Though a delicate insect, the male is capable of long flights. In cages, I have observed individuals constantly upon the wing for one hour before lighting, and then repeat the same operation. That they fly a great deal was shown by tangle foot bands in remote parts of the infested orchards. On a single 2-inch band, thousands of the male mealy bugs were sticking and on every band in a 50-acre seedling orchard the same thing was observed. How many males the bands succeeded in capturing it is hard to estimate, but the matter of reproduction by the females continued unhampered.

While most of the males transform under the egg masses, during the early breeding season in the fall when there are no egg-masses, except those just being deposited, the males may be found in great numbers pupating upon the leaves. The accompanying cut, showing the male cocoons, was photographed from a tree which was swarming with the transforming males.

HOST PLANTS.

Host Plants of Pseudococcus Citri (Risso) *in California.*

Begonia. Only in greenhouse.—Ehrhorn.
Bignonia sp.—Baker & Essig.
Bouvardia sp.—In greenhouse.—Essig.
Callistemon lanceolatus (Bottle Brush).—Baker & Essig.
Ceanothus integerrimus—In Mountains.—Essig.
Citrus aurantium (Orange).—Baker & Essig.
Citrus decumanus (Pomelo).—Baker & Essig.

Citrus medica (Citron).—Baker & Essig.
Citrus limonum (Lemon).—Baker & Essig.
Coleus sp.—In greenhouse.—Baker & Essig.
Cucurbita pepo (Pumpkin).—Baker & Essig.
Cyperus alternifolius.—In greenhouse.—Ehrhorn.
Erythea edulis (Guadalupe Is. Palm).—Essig.
Euphorbia pulcherrima (Poinsettia).—Baker & Essig.
Filicales (Ferns).—Baker & Essig.
Fuchsia sp.—Baker & Essig.
Nerium (Oleander).—Essig.
Paeonia sp. (Penny).—Baker & Essig.
Passiflora violacea (Purple Passion Flower).—In greenhouse.—Essig.
Strelitzia regina.—Essig.
Strelitzia gigantea.—Essig.
Solanum douglasii.—Baker & Essig.
Tradescantia multicolor (Variegated Wandering Jew)—In greenhouse.—Essig.

Host Plants Outside of California, Not Given in Above List.

Nicotiana tabacum (Tobacco).
Coffea arabica (Coffee).
Gossypium sp. (Cotton).
Hedera helix (English Ivy).
Ipomoea. sp.
Solanum jasminioides (Jasmine).
Habrothamnus sp.

ENDURANCE.

We have seen in the life-history of the mealy bug that its enduring qualities are unusually great and that it is able to reproduce its kind under the most extraordinary circumstances. In order to control it in the greenhouse, in the orchards, or in the nurseries, it is important to know something of these qualities so as to act accordingly. We cannot intelligently cope with a pest until we understand every phase of its life history.

Lack of Food.—Starvation hastens development and reproduction. Under normal conditions an adult female might not deposit her eggs for some weeks, but if taken from the food supply would begin egg-laying within 24 hours and will retain vitality enough to continue to lay eggs for at least two weeks. Under such conditions life, from the time the female is first removed from food until the last egg is hatched, may be retained for 30 days. In case of the apparently half-grown females, 70% are able to reproduce exactly in the same manner as the full-sized adult, the only difference being that the smaller form is not able to produce as many eggs as the large ones. These facts simply mean that a female from the time it is half grown to maturity, if carried into the orchard on clothing, boxes, ladders, etc., has 30 days in which to find lodgment upon a tree or to produce young which may finally do so. The liability to lose all of her offspring is very slight, under common methods of orchard practice.

If the food supply is merely reduced by drying out of the fruit, the rate of reproduction is more rapid than under the more adverse conditions, for there is more vitality displayed in all broods. The following interesting experiment was carried out in the laboratory.

In a glass jar was placed a lemon, taken from a tree which had just been fumigated (Oct. 7, 1909). There were eight living individuals, all of which appeared to be but half-grown. The jar was labeled and set away in a perfectly dry place to prevent the rotting of the fruit. No apparent changes were evident until the lemon began to dry and shrivel, and then egg-laying began rapidly. Within a short time scores of young began to appear. This continued until at least three distinct broods appeared. On January 19, 1910, the accompanying photo (Fig. 119) was taken. In order to make the necessary enlargement, only half of the lemon could be photographed, but it shows well the conditions three months after the lemon was placed in the jar. Still more appeared until the rind became perfectly dry, when the younger forms began to die. All forms were not dead until March 1st, 1910. This shows what might be expected from a single infested orange or lemon that might be dropped into a clean orchard.

Heat.—During the dry, hot months, of the late summer, the mealy bugs are less in evidence than at any other season. This seems to show that the hot weather has something to do with the retarded development so in evidence. There is no doubt but that the insect prefers the damp, even climate of the coast sections to the hot dry interior valleys, but even in the hottest climates the pest thrives remarkably well. In the interior citrus districts of California and in Arizona it is always a menace. While there is no exact method of ascertaining just how much heat the insect can thrive under, the following tests may serve to show the heat death line to some degree. These hot-water tests were made to find out at what temperature, water, into which boxes, infected with the eggs, larvæ, and adult mealy bugs, were dipped, must be maintained to insure the extermination of all life.

Equipment.—A fifty gallon iron kettle surrounded by a brick wall, containing 30 gallons of water. Heated by a wood fire at the bottom. A thermometer for ascertaining the temperature of boiling liquids.

A wooden box with a fine wire-sieve bottom was used as a container for dipping infected fruit, leaves, and twigs.

The best samples of infected fruit possible were obtained for the experiments. A large number of egg-masses, larvæ, and adults infected each of the many samples used at a dipping.

Experiment:

Degrees of Temperature F.	C.	Exposure No. of Seconds	Results
92	33.3	20	None killed. Many crawling.
98	36.6	20	" " " "
100	37.7	20	" " " "
110	43.3	20	" " None "
120	48.8	20	" " " "
130	54.4	20	Nearly all of the young and many adults killed. Eggs unharmed.
140	60	20	Nearly all of the young and many adults killed. Eggs unharmed.
150	65.5	20	All of young and most of the adults killed. Only a few eggs destroyed.
154	67.7	20	Two living individuals, out of many hundreds found. Many eggs still fertile.
162	72.2	20	Only a few of the large egg-masses with fertile eggs.
164	73.3	20	No life.
170	76.6	20	" "

The tests were carried up to boiling point, but no life in any form existed after 164° F. or 73.3° C. had been passed. For dipping boxes, I am recommending 170° F, or 76.6° C. in order to make sure of all of the eggs, which may be unusually well protected.

Fumigation.—The power to resist hydrocyanic acid gas, has been very definitely established in work here. (See Pomona Journal Vol. 1, No. 4, p. 1, and Vol. 2, No. 3, p. 246). The very youngest forms, including those of the first moult, first succumb and all of these may be destroyed with a very small dosage. The full-grown adult comes next, while the eggs and the half-grown forms are most resistant. The length of exposure which gave the best results was 2 hours, and the dosage, double Schedule No. 1, administered at the beginning of each hour. An air-tight tent, or an excessive dosage is not sufficient to kill all forms.

Spraying. No spray is practical that will not penetrate the cottony covering. The mealy bugs have great resistive power to everything but very penetrating oil or acid sprays. (See Pomona Journal Vol. II, No. 4, p. 246).

It might be said, in conclusion, that the mealy bug is a great resister, *but it can not effectually resist any systematic methods which are energetically and persistently waged against it.*

Birds.—Without doubt birds play a very important part in the distribution of scale insects. The fact that the orchard trees serve as roosting places for countless numbers of them, afford excellent opportunities for the young scale to crawl upon the feet and legs and be carried to other localities. The inherent tendency of most insects is to crawl up and there is no choice for the first broods but to do this, regardless of what they may be ascending. Then, too, if a bird alights in a tree which is thickly infested with mealy bug, and ever touches an egg-mass, it is sure to carry some of it away, for the clinging power of the cottony secretion which enfolds the eggs is very great. It is this which makes the distribution of the mealy bug so easy. In working with the egg-masses with a needle point, it is very difficult to prevent the eggs and adult mealy bugs, which are spinning the threads during the egg-laying process, from clinging persistently to the point.

Insects.—Ladybird beetles, including those which prey upon the mealy bug, are sure distributors of this pest. It is well known that the adult forms are not efficient feeders and are not liable to eat even the young scale and eggs which may be clinging to its legs. The predaceous forms, including *Cryptolaemus montrouzieri, Rhizobius ventralis, Scymnus guttulatus,* and *Cryptogonus orbiculus,* which pupate among the egg masses of the mealy bug, seldom fly to another tree without taking some of the eggs also. Although this may seem to be dangerous, there is no doubt but that the good done by these ladybird beetles off-sets this a thousand fold. I simply mention this as a fact and not as a drawback or as a means of discouraging the use of parasites.

Wind.—Many close observers have noticed that a dirty orchard on the windward side of a clean orchard would infect the first few rows of the clean orchard in one season. This has been demonstrated repeatedly in many localities and is the best argument that the wind is an agent in scale distribution. The young mealy bugs are very small and might easily be carried from their footing by a gust of strong wind and deposited some distance away. Just how much the wind is responsible we have no accurate means of telling, but we do know that if an orchard to the windward in infested with mealy bugs that we are sure to get it soon. It may be that the birds and insects usually fly with the wind wherever possible and that in this secondary manner the greatest amount of distributing is done.

Irrigating Water.—The white cottony covering thoroughly protects the mealy bugs and their eggs from being destroyed by water, even though completely immersed for several hours. The waxy ingredients in the covering and its ability to retain air globules enables them to float freely. If any of the mealy bugs are brushed into the furrows before irrigating, and do not get out before the water is turned on, or if any of the adults or the eggs are dropped into the running water, they may in this way be distributed from one section of an orchard to another. Infested culls, dumped into the rivers and ditches may serve to infest regions miles away. The dumping of culls in the dry river beds during the winter, if infested with any scale, should be prohibited and a strict watch should be kept by those in authority for just such acts of carelessness.

Greenhouse and Nursery Stock.—The greater part of the present distribution of the citrus mealy bug in California may be traced directly to the introduction of infested greenhouse and nursery stock. It is very probable that the first orchard pests came on citrus stock from Florida, while greenhouse plants are responsible for the infestation at Santa Paula. And no wonder the conditions exist. Nearly every greenhouse in the state is infested, and is allowed to send plants into the orchard sections of the country unmolested. Take the Southern part of the State for an excellent example. After having spent a great deal of time in the greenhouses looking into this matter, I have found that mealy bugs exist in practically every greenhouse in Los Angeles. Only to-day I turned back a shipment of plants from one of these greenhouses badly infested with the citrus variety, *and which bore a certificate stating that it was free from injurious insect pests.* In many communities these same plants are being admitted daily, and what is done to protect the orchardist who does not know? At Pomona, a district which cannot be equalled for fine orchards, mealy bug was found to exist in large numbers in the greenhouses. At Santa Ana the largest greenhouse and propagating institution has mealy bug. The infection at Claremont was traced to a greenhouse plant which had been planted near the house. N. W. Blanchard at Santa Paula states that the mealy bug was first known to exist in a greenhouse near his orchard. At Sespe the only infection was found on some orange trees growing near a private conservatory. At Fillmore the pest was found in the only greenhouse in town. Two days ago, I destroyed six large Coleus plants infested with mealy bug, which came from a florist at Santa Barbara. And so one could go on to practically every original infestation with the same results. To accuse any one in the past is folly, for the seriousness of the pest was not known, but the present conditions in many of the cities, towns, and orchard districts with regard to greenhouse stock is inexcusable.

Picking Boxes.—The secondary infestations in most parts of Ventura County may be traced directly to picking boxes. So evident is this, that in some orchards the box rows are easily recognized by the presence of this pest. At Oxnard the only infestation is in the corner of an orchard where the boxes were always piled when they were taken from the packing houses. From Santa Paula the boxes were sent to Oxnard and Ventura and both of these localities have mealy bugs. The ability of the egg-masses to cling to the boxes and of the adult female to endure hardships is responsible for this condition. To my mind this is the most dangerous method employed in a community as a spreading agent, and it was the first practice to be stopped. For methods of handling boxes, see same under head of Quarantine.

Picking Crews.—Coming later, but even more disastrous were the picking crews. They are spreaders of all insect and fungoid diseases, and while a necessity in most cases, they accomplish, as scale distributers, in a few days what would take all of the natural agents, and boxes years to do. The pickers rub through all parts of the tree and if there are any infections they are sure to come in contact with them. In case of the mealy bug, there are few chances of having picked a tree without carrying away some of the egg-sacs which adhere to the clothes and especially to the hat. Following up this method, I have seen great numbers of living mealy bugs on a single picker, who disregarded their presence absolutely. The next tree may add something to the supply or may take some away and so it is distributed from one tree to another. At times the crew is transferred to a distant orchard in the middle of the day and they take the supply of mealy bugs along. Even though the crew is not transferred directly to a clean orchard, individual members constantly wearing the same clothes may be able to distribute as they go for a week or more, before their clothes are entirely free. Too much care can not be taken when we regard the seriousness of this pest and this is one problem that is important. See same under quarantine.

Cultivators and Wagons go under the same head with the boxes and picking crews and must be as carefully guarded. Driving through an infested district with a cultivator or a wagon always brushes off mealy bugs. In this way it does not take long to infect a whole orchard. The Blanchard orchard is an excellent illustration showing the combined effects of the picking boxes, cultivation, picking, and hauling as distributing agents. All parts of the orchard were infected badly before the insect really became observable. I recently examined a wagon, in which cultivating implements had been taken from an orchard infested with mealy bug, to a clean orchard. On the side-boards were counted 5 large adult female mealy bugs. In the bed were three infested oranges which had dropped off while driving through the infected orchard. The wagon was allowed to stand all day in the clean orchard with enough mealy bugs to infect the 10 acres in the course of a few years.

Infected Fruit.—Travellers and visiting relations contribute to the spread of such pests by carrying home infected fruit or by throwing the peel along the roadside near a clean orchard. A rind thrown from a car window in a citrus orchard may be sufficient to infest a neighborhood.

KNOWN NATURAL ENEMIES.

PREDACEOUS.

Ladybird Beetles (Coccinellidæ)

Cryptolæmus montrouzieri.*
Rhizobius ventralis.
" lopantha.
Hyperasis lateralis.
Scymnus guttulatus.
" sordidus.

Lacewings (Neuroptera)

Chrysopa occulta. (Green Lacewing.)
Sympherobius angustus. (Brown Lacewing.)

PARASITIC.

Hymenoptera.

Chrysoplatycerus splendens How.
Lysiphelbus citraphis Ashm.

Diptera.

Leucopis bella Loew.

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*On page 263, Vol. II, No. 3, under the heading of Cryptolæmus montrouzieri, the first three lines should read as follows:

Eggs.—Are light yellow or lemon-colored and are very hard to find. They are oblong in shape and are deposited singly or in small clusters in the egg-masses and among the mealy bugs wherever they are found.

THE MEXICAN ORANGE MAGGOT

(*Anastrepha* [*Trypeta*] *ludens* Loew.)

By D. L. Crawford.

For many years Mexico has harbored in certain parts of her land a fruit fly whose maggot year after year has attacked the orange, mango, and guava, which fruits in many localities grow together. The origin of the pest is not yet known, but it is thought to have been imported from some point further south. It has been known to exist in certain parts of the country, chiefly the state of Morelos, for over sixty years, but very little attention was given to it until an embargo was placed on Mexican oranges by the California State Board of Horticulture shortly before the year 1900. It was first described in the year 1873 by the Austrian entomologist, Loew, and named by him *Trypeta ludens*. The generic name has been subsequently changed to *Anastrepha* instead of *Trypeta*, according to a recent determination by Mr. Coquillett of the Department of Agriculture in Washington. After the action had been taken by California prohibiting the importation of Mexican oranges, the Mexican orange growers were soon aroused. They declared repeatedly that this action on the part of our State had been taken in fear of competition from the Mexican oranges, whereas the embargo was solely for the protection of our own vast citrus industry from the introduction of the worm.

After some time had elapsed in making these objections, attention began to be directed to controlling or annihilating the pest. In 1900 Fernandez Leal, then chief of the department of agriculture, and Prof. A. L. Herrera, then head of the department of parasitology, began the task of determining the distribution of the pest, of warning the growers of the danger, and of discovering means of eradicating the insect. Bulletins were from time to time published and the farmers kept informed on the progress of these investigations. While these studies were in progress, attempts were constantly made by the Departmento de Fomento in Mexico City to remove the embargo of California and so regain the United States markets to the Mexican growers. A request was finally made that California send down an expert to go over the field with Prof. Herrera and report to our citrus growers the real conditions in order that all fear should be removed of importing the pest into this State. In accordance with this request, in 1905 the California Board of Horticulture commissioned Mr. John Isaac to this task. Through data given him by Prof. Herrera and by personal observation he was enabled to report fully on the history, distribution, and natural enemies of the pest, and on means then employed by the government in combatting it. Mr. Isaac's report on "The Trypeta ludens in Mexico," published in Sacramento in 1905, is, as far as I have been able to determine, the only account given to the public of this dreaded worm in the last five years or more, with the exception of a bare mention of it in a recent bulletin, "Diseases and Pests of the Orange in Mexico," published by the Departmento de Fomento in Mexico City.

While carrying on the regular work of the Pomona College Mexican Expedition during the past summer, an excellent opportunity was afforded for determining the distribution of this fly in many parts of Mexico. In a map showing the distribution, published by Mr. Isaac in his report, the pest is said to exist in the following localities: Morelos, Acapulco and a large part of the State of Guerrero, northwestern portion of Oaxaca, Vera Cruz and Tampico. He gives the following places as probably infested: Chiapas, parts of Campeche and Yucatan, southern end of the State of Vera Cruz and parts of Puebla. The maggots and flies were found this year in Chiapas in several localities; they are also present in the fruit districts of Cordova, Oaxaca, Jalapa and Colima. It is a curious fact that the native inhabitants of a place almost invariably say that the orange worm does not exist in that place, or if it is perfectly patent that it does exist, they try to minimize the effect of its presence as much as possible. I was told, for instance, by several fruit growers of Jalapa that the pest was unknown to that region; but it was found in abundance within a few miles of the city at Coatepec, a great fruit producing center. The presence of the worm in Colima was not mentioned by Mr. Isaac, but my native assistant, a long-time resident of that place, informed me that oranges and mangoes there have for many years been infested with it. As this is near to the growing shipping center of Manzanillo, the danger to California from this source is apt to be as great as from Acapulco if the present precautions were not continued. In addition to the places mentioned, the fly was found in more or less abundance in many of the localities recorded by Mr. Isaac. This shows that the pest is apparently on the increase and is becoming more widely distributed each year. It has been claimed repeatedly that this insect is peculiar to the tierra caliente, or hot lands, of Mexico, but its presence in the higher subtemperate lands would tend to show that it can and may adapt itself to the cooler climatic conditions.

Perhaps a brief description of the insect and its immature forms and an explanation of its method of injuring the fruit would not be out of place here. The fly is one member of a large group of fruit-frequenting flies, formerly all classed in one genus, *Trypeta*. This species is distinct from the rest in the coloration of the wings and especially in the long tube-like abdomen of the female. Across its outstretched wings the fly measures about three-quarters of an inch; the body of the female is very nearly half an inch in length; the male is shorter owing to the absence of the long tube present on the female abdomen. It is orange yellow in general color; its wings are quite clear except several yellowish brown stripes and blotches as shown in the illustration. (Fig. 120.)

Its movements are very slow and deliberate; it prefers to stay on the fruit or under side of a leaf near to some fruit; when disturbed, it usually flies to another orange not far away. During the time of oviposition by the female she walks very slowly over the surface of the orange or mango for a time, apparently selecting a favorable spot in which to deposit her eggs. This spot is usually found near the flower end, but sometimes on some other part of the fruit. When the right spot has been selected the fly bends down its long tube-like abdomen and forces it into the outside skin of the fruit and there deposits some of her eggs. When this has been completed she flies off to another orange to repeat the process. One female may infect anywhere from four to ten oranges or mangoes and often more guavas.

The eggs hatch after a certain number of days, varying with the temperature. The entire injury is done by the larvæ or maggots which eat their way through the pulp and inner tissues of the fruit, reducing that part of the fruit to a soft pulpy mass which soon decays and ruins the rest of the fruit tissue. In the orange the worm often confines its eating, for a time at least, to the inner pulp of the skin; after that it works its way on into the juicy part and passes the rest of its existence immersed more or less in the fruit liquids. The mango has a much thinner skin and therefore the boring is almost entirely in the inner fruit tissues. The presence of the worm in the mango is much more easily detected from the outside than in the orange, for the boring in the former always makes a soft spot while in the latter it may

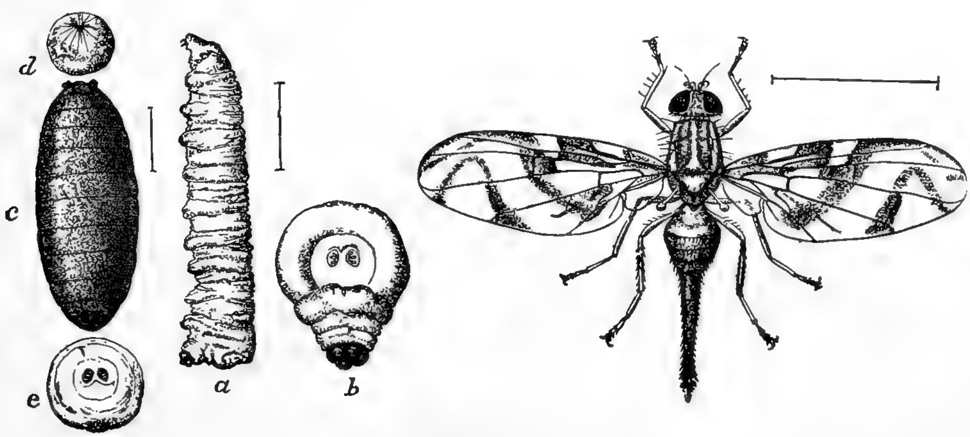

Figure 120.

Larva, pupa and fly of Anastrepha ludens. (Copied from Report of Cal. Horticultural Commission.)

or it may not. The maggot attains a length of from one-third to one-half of an inch and usually lives at least two weeks and often more before passing into the pupal stage. Four to six worms living that long in one orange work great havoc, rendering the fruit entirely useless. Before the maggots are ready for their pupation the fruit is usually so decayed that it falls to the ground. When maturity is reached the larvæ leave the rotten fruit and become pupæ either between the fruit and the ground or else slightly under the surface of the ground. I found by digging down in several places that the average depth to which the worm penetrates the earth before pupating is between one-quarter and one-half of an inch, although many were found at a depth of one inch and a few an inch and a half below the surface. After three weeks or a month the fly emerges from the pupa and from the ground to commence the work of another generation.

Unfortunately the life-history has never been worked out in the field by an expert entomologist, so that the above time lengths can not be exact. The department of parasitology in Mexico City has worked it out roughly and found that there are on an average of four generations each year. The generations are not, however, clearly marked but, instead, there are forms at all times in all stages of development. The ripening of the fruit crops makes this constant development possible. In June the mangoes are all ripening and the maggots are living in these; in the latter part of July and August the mangoes gradually disappear and the guavas begin at the same time to ripen, thus giving the flies an opportunity to continue their work; in October the guavas are replaced by the oranges. The late crop and the early spring crop are said to be continuous enough to maintain the fly. It

Figure 121.

Showing infected fallen mangoes left on the ground, thus favoring the unrestricted propagation of the fly.

is stated by Mexican entomologists that the fly has no dormant period but is continually developing and reproducing. This is put forth as a proof of the impossibility of introducing the pest into California, since they make the point that there is a long period between our orange crops. As a matter of fact, in one place or another ripe oranges may be found on our trees the year through.

The proportion of the fruit infected varies, of course, with the abundance or the scarcity of the flies in any place and at a given time. In Chiapas the infection is not great, although it is by no means negligable. In Oaxaca the late oranges and mangoes are affected quite badly while the early fruit is scarcely touched. In Cordova the same condition exists. This would seem to suggest that there is somewhat of a dormant period and a period when the mass of flies emerge. In the state of Morelos the pest is most abundant and most continuous, and it is, therefore, in this state that the work of combatting it should be centered. (Fig. 121.)

A very important phase of the study of a pest of this nature is the percentage of fruit which it destroys annually. The proportion, as suggested above, is variable in different places and times of year. I was told by the chief of the Oaxaca Experiment Station that very frequently in the late part of the season fully two-thirds of the orange crop is destroyed, but this is not true for every year. Cuernavaca, in Morelos, produces many mangoes and guavas but few oranges, comparatively. The proportion of mangoes infected by the worm is tremendous. A large part of those infected decay badly enough to fall to the ground before they are gathered for market. An equally large part are picked from the trees for market before the decay has gone very far. In one of the mango groves visited in late June, the fruit, as it was picked, was brought to a small clearing to be sorted over. The fruit which had a soft spot in it was thrown into one pile and what the sorters thought was good fruit was thrown into another. The infected pile was fully one-half as large as the other, and that, too, when one-fourth of the crop was dropping to the ground. Wishing to see if all the mangoes in the good pile were without the worm, I purchased twenty and helped the man select them. Before the twenty mangoes had been picked out, as many more had been discarded because of a tell-tale soft spot with a minute hole through the skin in the center of it. I took the twenty mangoes that had been selected so carefully and of the twenty, when cut into, found only thirteen without worms. A rough estimate from the above figures shows that fully three-fourths of the crop was infected. This is a fair type of the majority of the groves of Cuernavaca; a few are worse and a few are better. A visit to the Borda Gardens presents, perhaps, the extreme of infection. Almost utter neglect of the grove has made this a veritable insectary for breeding the flies. On the other hand, a small and comparatively well cultivated grove belonging to Sr. Gaudalupe Gutierrez shows a slightly less percentage of infection, without a doubt due to the better care of the place.

The guavas are often infected to a worse degree than the mangoes. The trees usually grow in among the mango trees so that the flies pass very readily from one to the other. To find roughly the proportion of fruit infected with the worm about three hundred guavas were opened; out of this number eighty were free from infection. In another grove one hundred and twenty-five were opened and seventy-five had no worms in them, showing a much lower percentage of injury.

Yautepec, Morelos, about sixty miles from Cuernavaca, produces many oranges and comparatively few mangoes. Unfortunately I was obliged to complete the work of the expedition and leave for California before the end of September, so that I was unable to see the attacks of the fly when the orange crop was at its best, in November. Although the season was early yet considerable picking and shipping was being done. With the assistance of an efficient guide visits were made to many orchards belonging to Sr.

Cirilo Vidal and Sr. Procopio Mejia. These orchards were all kept moderately clean and somewhat cultivated by order of the government several years ago. In all the orchards visited, wherever there was any ripening fruit, the dread fly was found in greater or less numbers depending on the amount of fruit ripened. Decay had hardly progressed far enough to cause any extensive dropping of fruit, so that statistics on this matter had to be gathered from residents. Even at that early season, however, the infection was quite general, although the worms were not far developed as yet. Inquiries from the packers at the railroad station revealed the fact that a large percentage of the fruits had worms but the fruit was shipped, nevertheless, to the Mexico City market.

Some of the growers assured me that the pest is rapidly disappearing in their section. Others, among whom was a very intelligent and well-to-do grower, Mr. Chas. A. Aragon, were sure that the pest is decidedly on the increase, and that the danger from its ravages is immense. I am not in a position to state whether or not it is decreasing, but this much can be said with great emphasis—if it has decreased in the last few years, then it must have been fearful beyond words a few years ago.

After studying the habits of the insect in its various stages of existence, the department of parasitology offered the following artificial means of combatting and possibly exterminating the pest.

1. Gather each day all the mangoes, lemons and oranges which may have fallen from the trees and deposit them in a clean corner of the orchard.
2. Destroy all fruit thus accumulated at least once a week.
3. It is preferable to destroy the fruit by burning, but it may be disposed of by burial, and when buried it should be covered with at least fifty centimetres (twenty inches) of soil.
4. As the same worm exists in the guava, this fruit should also be destroyed in the same manner.

In a report to the Minister of Agriculture in 1900 Prof. Herrera wrote: "As preventive measures I advise the burning of all the early oranges, the cleaning up of all the orchards, the substitution of wire fences for live hedges, and the burning of all fruit which ripens prematurely on the trees. It is very probable that the enforcement of these measures for two or three consecutive years in all parts of the Mexican Republic invaded by the maggot would result in its total extirpation." And yet today the insect continues its ravages apparently unchecked. Probably the first question to arise in one's mind is: have these measures been thoroughly applied by all concerned? Before answering this it might be well to see what it means to apply these measures everywhere in the infested districts. (Fig. 122.)

The usual intermixing of orange, mango and guava trees has already been spoken of. It is very difficult, to say the least, to keep a place well cleaned and cultivated which is covered in a most irregular fashion with various sorts of trees. Another difficulty is in the existence of more or less wild trees which are only occasionally visited for the fruit. The guava grows very commonly in this wild state and the mango occasionally. While these trees are often visited by the natives in the fruit season, yet it would be practically impossible to destroy the infested fruit from this class of trees for two reasons: because there would surely be many trees which would escape discovery, and because the native Indian would seldom, if ever, take the trouble to put into practice these measures of fighting the pest. These difficulties are not as great in Yautepec, however, as in Cuernavaca and many other places, and therefore the application of these measures have been quite possible. The principal orchards are planted in approximate rows, making cultivation feasible, and as a result of this the weeds can be kept out much more easily. Nearly all the fences are of wire, a few of stone, and almost none are hedges. This much has been done in the largest part of Yautepec. Burning was sug-

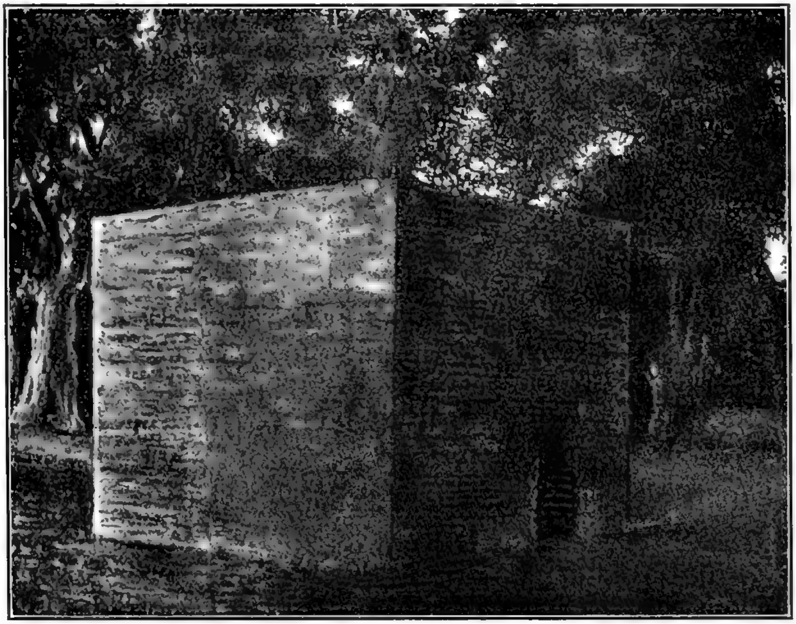

Figure 122.

One of the incinerating furnaces as originally built for this work. (Copied from report of Cal. Horticultural Commission.)

gested as the best method for killing the larvæ in the fruit. For this purpose large ovens or fireplaces were built, about six or eight feet square and about six feet high. A grate was fastened in two feet from the bottom under which a fire could be made and on to which the worm-infested fruit could be dumped. For several years this method of burning bad fruit was used more or less thoroughly with avowedly good results, but how much the ovens are used now may be inferred from their condition as shown in the accompanying photograph. If the daily cleaning up of fallen fruit were enforced today a photograph of fallen mangoes such as is shown herewith would not be possible. The fact of the whole matter is this: fighting the pest was carried on by the Commission of Parasitology for some years, up to the time, at least, when Mr. Isaac was sent down to investigate conditions; this fighting was limited to Yautepec, although Cuernavaca is only a short distance away and very badly infested; since the time of Prof. Herrera and his commission, efforts at combatting it have practically ceased. The Commission of Parasitology has passed out of existence and its functions given over to the Central Agricultural Experiment Station in Mexico City. A visit to this station soon convinced me that very little concern was felt about the pest there. Furthermore a bulletin of this station issued in 1910, Bulletin 31 entitled Diseases and Pests of the Orange, offers the following remedies, which are practically identical with those given ten years earlier: "(1) Clean the orchards thoroughly, cutting out all weeds, and substitute hedges with wire fences. (2) Gather daily the fallen fruit and burn it in incinerating ovens prepared for this purpose. (3) Rake the ground beneath the trees to displace all pupæ and expose them for chickens to eat. (4) If there are successive crops of fruits

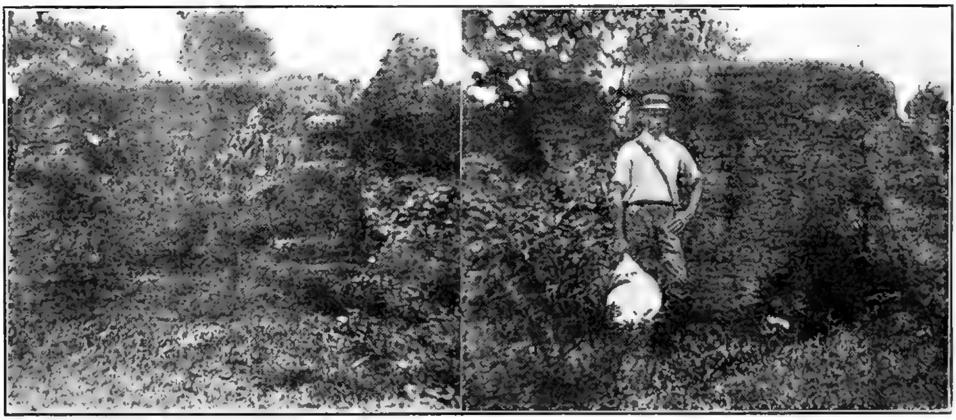

Figure 123.

Showing condition of the incinerating furnaces today. Evidently these have not been used for a long time.

attacked by the fly, such as the mango and guava, destroy one of these to break the cycle of successive generations of the pest, since the female will have nothing in which to deposit her eggs." It very often happens that a remedy is used year after year against a certain pest or plant disease, so that, therefore, there is nothing amiss in the mere fact that these are identical to those of ten years ago. The trouble lies in the fact that practically no attempt has been made in the last three years, at least, either to study the trouble further and possibly find more effective means for combatting it, or even to enforce those already proposed. I was informed of this fact by the chief of staff at the Central Experiment Station, Sr. Jose Ramirez. (Fig. 123).

In addition to these artificial means of fighting the dread fly, there has been another agency at work for many years. A parasitic ichneumon fly has been known for some time to favor the larvæ of this fly as a place in which to deposit its eggs. These eggs hatch within the body of the maggot, and the latter, consequently, never come to maturity, but die before pupation occurs. This parasite has heretofore been known as *Cratospila rudibunda.* Many specimens were taken by the writer in the very act of stinging the fruit, oranges, mangoes and guavas, and depositing eggs in the maggots. A determination on these parasites by Mr. Viereck of the U. S. Department of Agriculture places them in the genus *Diachasma;* he is unable to assign to it a specific name. The monograph of *Braconidae* by Szepligeti has no mention whatever of the name *Cratospila rudibunda.* The name heretofore known is possibly a manuscript name only and should in that case be dropped from use.

In dealing with a trouble which is very wide-spread, and in a tropical country where fruit trees attacked by it grow easily with little care and often in a wild state, and where for many reasons an artificial remedy is very hard to apply, one is very apt to favor natural control by parasites. Let us consider again the previously proposed measures as compared with new measures wherein parasitism figures mostly. Mr. Isaac in his report stated that the work of the parasite was not, as yet, very effective, since only from ten to fifteen percent of the larvæ were parasitised, but it was hoped that the percentage would increase materially in the future. Since it was impossible to stay in one place long enough to study the life-history or determine the percentage of parasitized larvæ, no definite statement can be made as to whether or not it has increased. Now if the trouble is to be removed by destroying *all* the maggots in *all* infested localities for a period long enough to eradicate the fly *entirely,* well and good. But if one spot is overlooked or if a few flies continue to exist, then the whole fight will have to be repeated. On the very face of it, it is easy to see that a complete stamping out of the pest by the above mentioned methods is utterly impossible, for reasons already given, whereas to increase artificially the number of the *Diachasma* parasites will undoubtedly reduce the trouble to a minimum *and hold it there.*

Now, as was said above, great hopes have been entertained that the parasite would increase to larger numbers, but, while entertaining these hopes, the government have simply been destroying the objects of their hope by burning or burying the parasitized maggots—except when this was not enforced. And when no fruit was being destroyed the fly and the parasite maintained their former ratio of equilibrium. This is undoubtedly the present condition of affairs. If, then, the methods formerly used have not proved entirely satisfactory and, further, have prevented the increase of parasites, and since parasitism is the most logical and effective method of controlling the pest, then some means should be devised whereby a rapid and large increase of the *Diachasma* parasites can be effected.

A very simple, economical and wholly practicable means may be found in the following suggestion: In a word, confine the parasitized maggots in such a way that the parasite can escape when it emerges while the fly must remain and die in confinement. This is very simple indeed and easily performed, but, as far as I have been able to ascertain, it has never been suggested, much less tried.

The simplest method of carrying this out is by means of a small shed built from the cheapest and handiest materials; in most places this would be adobe. It should be large enough to hold quite a large quantity of fruit without piling it up any more than is necessary, so that infested fruit could be thrown in and the larvæ allowed to mature and pupate within the shed. The shed should be absolutely without a hole or crack large enough for the adult fly to escape through. A part of one end is covered with wire screen, instead of adobe. The meshes of this screen must be 3 millimeters (one-eighth of an inch), which is just large enough to allow the parasite to escape but not the fly, as was shown by experiment. On each side of the shed, at a height of about three feet from the ground, are several openings large enough to dump the fruit through; by inserting a short flume into the openings, beveled at the end within the shed, and by hanging a bottomless canvas bag over the beveled end of the flume, a trap entrance could easily be made, so that fruit could be dumped in with no fear of the insects within escaping.

Since the increase of parasites would be in direct proportion to the amount of fruit enclosed in the sheds, as large a percentage as possible of the fruit which has fallen to the ground should be so disposed of. Of course each shed would hold only a certain amount successfully, but additions could be made to the fruit at intervals of about two weeks or more, depending on the time required for pupation. If there is a surplus of fallen fruit which can not be so disposed of, it should be gathered and burned wherever possible or feasible, thus diminishing the number of flies, at least.

A thorough trial of this in many of the localities should, without a doubt, increase the parasites sufficiently so that within three years, or possibly four, the pest would be reduced below the danger line. Minor accompanying remedies might assist enough to blot out the trouble entirely.

A carbolic emulsion should prove very effective as a spray to be used on the adult flies, which, with very few exceptions, stay on the fruit or leaves. This spray is effective enough to kill the flies which it touches, and in addition to this it leaves on the trees such an odor that the surviving flies would be kept off for some time. A third function of the same spray is the dripping down of the liquid onto the ground under the trees and undoubtedly killing many of the pupæ and transforming larvæ which may have escaped between the daily clean-up of the fallen fruit. A secondary but no less beneficial result from the application of the spray is the cleaning up of the trees and fruit, ridding them from any scale insects and accompanying smut. These latter are, of course, mere suggestions, but well worth a good trial. The formula for a good spray of carbolic emulsion is as follows:

Carbolic acid (crude)	5 gallons
Whale oil soap	40 pounds
Water	40 gallons

This stock solution should be diluted one to twenty parts with water before using it as a spray.

The question which has always been uppermost in the minds of all in this regard is this: Is there any possibility of danger from the importation of the Morelos orange worm into California? The Mexican ex-commission of parasitology have always maintained that there is not any such danger, because of our colder winters and lack of continuous fruit. Perhaps they are right in this statement, but since no proof of it has ever been made, and, further, since the flies have been bred and kept alive in an Eastern winter showing that they can survive cold, the best thing that we in this state can do is to increase our watchfulness against its first appearance. It is quite probable that further studies on its life-history will reveal the fact that a dormant period is sometimes passed through, for otherwise it simply could not exist in certain of the places investigated in the past summer. Furthermore, it could easily develop a dormant period here, or else adapt itself to feeding on other fruits as it is claimed to have done in Mexico. In any case the danger from it is very real. While it exists in Mexico there is danger of its appearance here at any day. Fruit, often with the maggots, is constantly being brought into the country in the lunch basket or the suit case, and this may be the means of its introduction. Every horticultural commissioner and inspector should be familiar with the fly and its maggot in order to discover and report its appearance at the earliest moment possible. This means that *only thoroughly competent men should be placed in office as commissioners,* and that *the citrus inspection should be made what it ought to be, instead of the mere perfunctory and superficial excuse for inspection which it now is in too many places.*

Moreover, while the pest exists, one of the chief concerns of both countries should be to wipe out the trouble and thus eliminate a great pest from the one country and the possible danger of it from the other. Mexico contains some of the finest orange and mango lands in the world, and it is possible for these industries to be brought to a high state of development there, so that it would be to the immense advantage of Mexico in several ways for her government to attack this problem most energetically. If competent men were actually sent into the field and backed by sufficient money and authority, and help from the growers, the desired object could be accomplished in a comparatively short time. The citrus industry in Mexico has a great future only with this pest stamped out, and California wishes her well in the coming development of this industry.

The great and immediate danger from the maggot is to the citrus groves of Texas, New Mexico, and Arizona. If it is permitted to gain access to these states, then it will become increasingly difficult to keep it out of California. This is certainly a case for united State and Federal action, if there ever was one.

Mr. Jeffrey, State Horticultural Commissioner, in a recent letter concerning the maggot says: "Texas is now maintaining a strict quarantine at Laredo and El Paso against this pest in particular. The horticultural authorities are co-operating with the customs service and are exercising great care in their inspections. To improve this vigilance I long ago took the matter of quarantine, fumigation and general inspection to the legal and official authorities of the State. In fact the attorney general of Texas is now considering the legalities of a plan I submitted to him to permit me to maintain a quarantine officer at two frontier points, said officer to be appointed by me and paid by California, but to receive his nominal appointment by the Texas Commissioner of Agriculture, so the quarantine deputy will be qualified to act legally. If this can be done also in Arizona it will afford the best protection we have ever enjoyed. These quarantine officers would be permitted, by arrangement with the customs service, to inspect baggage as it is being inspected for duties by Federal authority."

"The State law is inadequate. We have no authority to open baggage, hand bags, boxes, etc., coming over the International line and have to resort to the subterfuge even at San Francisco, of looking over the shoulder (by tolerance or consent) of the customs officers."

A CALIFORNIA ORANGE DOG

BY KARL R. COOLIDGE.

Quite a few species of the lepidopterous genus *Papilio* (generally known as swallow-tailed butterflies) are known to feed on, in their larval state, and be destructive to citrus trees. *P. demoleus* has at times played havoc in the orange groves of Africa, and in India *P. erithonius* sometimes does serious damage to the young budded trees. Another large and showy species, *P. erectheus,* common in the warmer parts of Australia and Queensland, is an enemy to the orange growers of those regions. In the United States, *P. cresphontes* Cramer is notorious as an orange pest in the plantations of Florida, where it is known as the "Orange Dog." *P. palamedes* Drury is also a citrus feeder, but is not abundant enough to do damage to any extent.

Other American *Papilios* are of some economic importance. *P. turnus,* the common swallow tail of the East, which has a heterogeneous assortment of food-plants, such as wild cherry (*Cerasus*), willow (*Salix*), camphor tree (*Camphora officinale*), etc., occasionally damages various forest trees. Our two west coast "tigers," *P. rutulus* Boisd., and *P. eurymedon* Boisd., are rather restricted as to food-plants. The former feeds on *Prunus, Salix, Alnus* and *Magnolia,* while the only food-plant of the latter known to me is the California Coffee berry, (*Rhamnus californica*). *P. philenor,* which occurs all over the United States but only sparsely in California, is one of the bug-bears of house-wives, who have the Dutchmans-pipe vine (*Aristolochia*) ornamenting their porches. *P. asterius,* of the Atlantic States, is responsible for considerable damage done to garden trucks, such as celery, parsnips and parsley, which belong to the *Umbelliferae,* upon which the members of the *asterius* group are almost wholly confined. It is rather surprising then to find in California *P. zelicayn* Lucas, a near ally of *asterius,* having for its food-plant citrus trees.

In May, 1909, I found *Papilio zelicayn* extremely abundant about Porterville and Lindsay, in the San Joaquin valley, and observing by chance a female ovipositing on the lower surface of an orange leaf, I was astonished to find on practically every young tree either eggs or larvæ.

Zelicayn is a widely distributed butterfly along the west coast, flying from Mexico to Alaska, and eastward to Montana and Colorado. Its normal food-plants are various species of *Umbelliferae.* About San Francisco the most favored ones are *Foeniculum vulgaris* and *Carum kelloggii.* In that region it appears to be two-brooded, but there is certainly as many as three in the San Joaquin valley, the first appearing in February. It is not necessary here to go into details of the life history, which Edwards (Butt., vol. 2, 1875; vol. 3, 1891) and others have fully dealt with. The eggs are laid singly, generally on the lower surface of the leaves, and I have seen as many as seven placed on one tree by a single female. Thus a small colony of larvæ is sometimes found on a tree, but they are strictly solitary, as are all our North American *Papilios*. *P. oxynius* Hubner in Cuba, however, is social, the larvæ being commonly found gregariously on the food-plant, *Xanthoxylum* (prickly ash).

It is quite probable that the "California Orange Dog" will in the future be of some economic importance to the orange growers of this state. The fact that the citrus industry of Tulare County is but of recent date, shows how suddenly the change from a natural to an adopted food-plant may be effected. Not a trace of *zelicayn* eggs, larvæ or pupæ were to be found on all the umbells that I observed about Porterville. Furthermore, Mr. R. W. G. Wright of San Bernardino informed in recent conversation that he has had caterpillars of *zelicayn* from orange sent to him from Riverside. No doubt the progress of civilization, destroying and exterminating, natural food-plants, has caused *zelicayn* to make this change, such as in the case of the notorious Colorado potato beetle.

A number of larvæ in various stages were condemned to parasites. A *tachinid* fly was present in a few instances, but the majority of the parsites produced were of a species of *Apanteles,* which emerges before the larvæ has attained maturity and forms a small dirty-yellowish cocoon on the leaf or stem of the plant.

As to remedies, hand-picking is by far the least expensive and most practical. The shooting of *P. cresphontes* had often been advocated, but probably affords more entertainment than benefit. Pupation apparently does not occur on the food-plant, so that the cleaning up and burning of all rubbish about the trees should destroy many future individuals.

APHIDIDAE OF SOUTHERN CALIFORNIA V

BY E. O. ESSIG

HORTICULTURAL COMMISSIONER OF VENTURA COUNTY, CALIFORNIA.

Aphis hederae Kaltenbach

Winged Viviparous Female (Fig. 124 A).—Average length, 1.5 mm., average width 5 mm., wing expansion 4.5 mm. *Prevailing color*—Shiny black throughout. In mounted specimens the color may become dark brown, due to the action of the mounting materials. *Head*—Narrower than thorax, and nearly as long as wide. *Compound eyes*—coarsely faceted, jet black, with usual terete tubercles on outer margins. *Antennae* (Fig. 124 A) arise from slight frontal tubercles, which are not prominent, three-fourths the length of the body, 6 (commonly called 7)-articled. The first two articles are very dark, while the remainder are from a dark yellow to an amber color. The antennæ vary considerable, because of the variability of the insect. The following lengths are approximate: I 0.05 mm., II 0.05 mm., III 0.22 mm., IV 0.19 mm., V 0.17 mm., VI 0.37 mm. Sensoria are quite numerous on

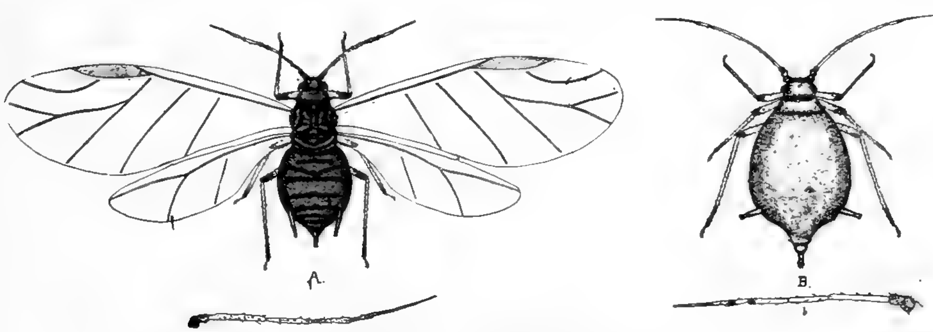

Figure 124. Aphis hederae.
A winged viviparous female; B, apterous viviparous female.

article III, four are visible on article IV, and two on article V. More are likely visible from different angles, this simply being the usual number seen looking down on the antennæ. *Prothorax* much wider than long and with a distinct lateral tubercle on the lateral margins just back of the middle. *Rostrum*—Lemon yellow in color with a dusky tip, reaching just beyond the prothoracic coxæ. *Abdomen*—Shiny black, well rounded and smooth, with few depressions to mark segmentation. *Cornicles*—Color, dark yellow or amber, cylindrical, much longer than the style and several times as long as the tarsi. They gradually taper from the base to the tip. *Legs*—Moderately long and hairy. The coxæ and trochanters are black, tips of femurs and tips of tibiæ, as well as entire tarsi are black, while the bases of the femurs and tibiæ are lemon yellow. *Wings*—Of the normal Aphis type; hyaline; stigma long, narrow, and well pigmented. Length of primary 2 mm., width 0.9

mm. Length of secondary 1.2 mm., width 0.4 mm. *Style*—Long and cylindrical—about one-third the length of the cornicles.

Apterous Viviparous Female. (Fig. 124 B). *Length*—Of average 2 mm., width of average 1 mm. This form is more robust than the winged specimens and varies from a greenish-brown to a slate color. In many specimens there are enough small waxy particles upon the bodies to give them a gray appearance. It differs from the winged form in the following: Article I and II of antennæ dark, III and IV lemon yellow, V lemon yellow with dark tip, VI with light base and remainder dark. Comparative lengths of articles same as in the winged form. Color of legs same as in winged form, except that the dusky portions are not so extensive on the tips of the femurs and tibiæ. *Rostrum*—Lemon-yellow with a dark spot just in front of the tip, reaches just beyond the mesothoracic coxæ. *Abdomen*—Very rounded and showing no dorsal segmentation, covered slightly with small, white, waxy particles. *Cornicles*—Cylindrical, slightly enlarged at mouth. *Cauda*—Extended. *Style*—Long and slender, more than half as long as the cornicles.

Nymphs of Apterous Viviparous Females—Greatly resemble the females, but are usually covered with a greater amount of the fine, white, powdery, wax.

Host Plants—English Ivy, Wirevine.

Habitat.—First located on the English Ivy on the Pomona College Campus at Claremont, Cal. Since then it has been found to exist in all parts of Southern California.

Control.—This plant louse is held in perfect check by small Braconids of the subfamily Aphidiinæ, which are abundant wherever the louse exists.

Nectarophora *pisi* (Kalt.) The Pea Aphid.

Winged Viviparous Female (Fig. 125 A). Length, 3 mm., width, 1 mm., wing expansion 11 mm. *Prevailing color,* green. *Head*—Slightly narrower than the prothorax, twice as wide as long. *Compound eyes,* red, with terete tubercles just behind the outer margin. *Antennae* (Fig. 125 C) arise from frontal tubercles, not approximate, gibbous, as is also the first article. The color is darker than the body, being brown; longer than the body, 6-articled, the lengths of the respective articles being as follows: I 0.1 mm., II 0.1 mm., III 0.9 mm., IV 1 mm., V 0.6 mm., VI 1.3 mm. The distribution of the sensoria is as follows: I and II none, III very many large scattered the whole length, IV none, V one large circular near the distal end, VI several marginal in the nail-like process. All articles are slightly hairy. *Prothorax*—Without lateral tubercles. *Rostrum*—Reaches to the mesothoracic coxæ. *Abdomen*—Very large, but well proportioned, segmented, area near middle spotted with red blotches. *Cornicles* (Fig. 125 D) cylindrical, long, dark near the distal ends. *Legs*—Long and slender, enabling the insect to travel rapidly. Distal ends of femur, tibia dark as are also the tarsi. All hairy. *Wings*—Hyaline. *Primary.*—Length, 5 mm., width, 1.7 mm. *Costal*—Nearly straight to the wing-tip. *Sub-Costal*—Straight, and well defined. *Stigma*—Dark, long, narrow, and nearly rectangular in shape. Reaches nearly to tip of wing. *Stigmal*

—Rises from near the distal end of the stigma and is regularly curved to the margin. *First* and *Second Discoidals*—Straight. *Third Discoidal*—Nearly straight, twice forked, the first fork not far from the sub-costal, the second fork near the margin of the wing. *Secondary*—Length 2.5 mm., width 0.7 mm. *Sub-Costal*—Nearly straight and extending to the wing-tip. *First and Second Discoidals*—Straight, extending from the sub-costal to the margin. *Style*—Long, stout, and curving slightly upward.

Apterous Viviparous Female: (Fig. 125 B). Length 3 mm., width 1 mm. Differs from the winged form in the following: *Antennae*—all joints

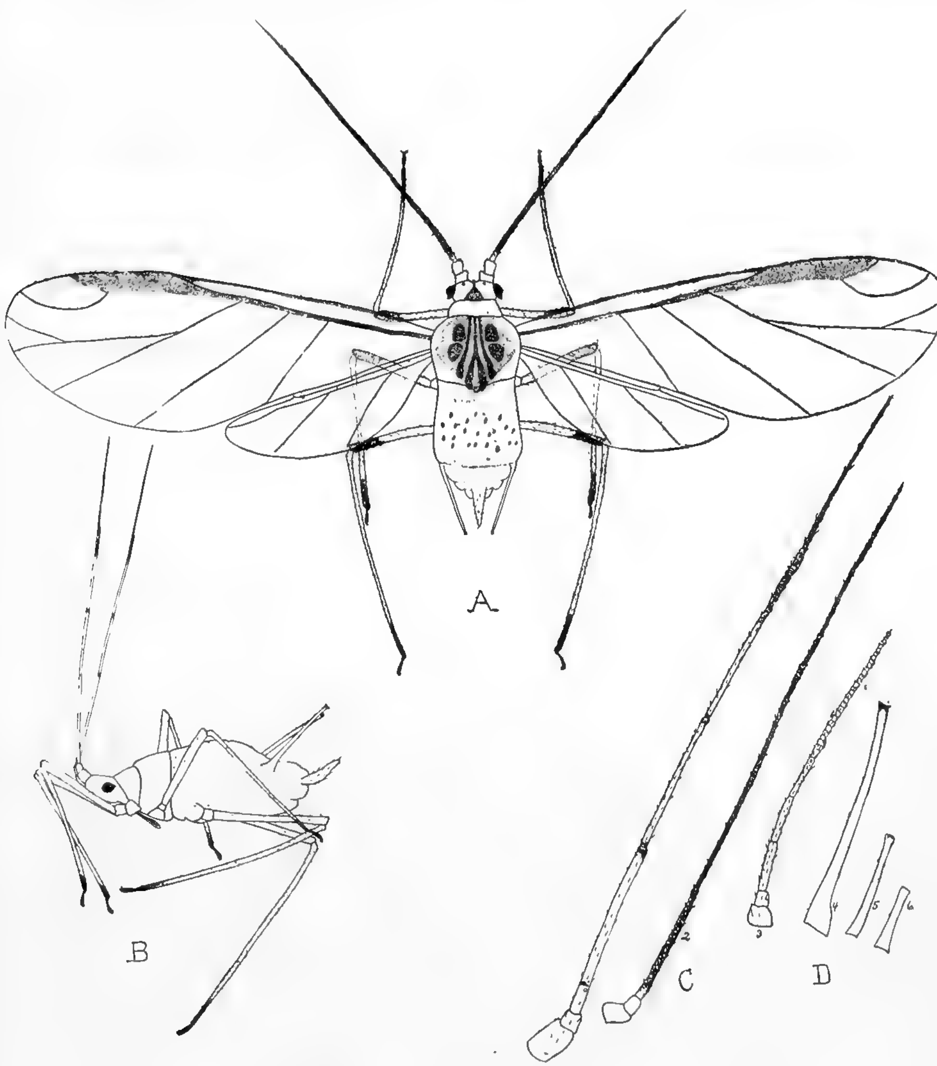

Figure 125. Nectarophora pisi.

A winged viviparous female; B, apterous viviparous female; C1, antenna of apterous female; C2, antenna of winged female; C3, antenna of young female; D4, cornicle of apterous female; D5, cornicle of winged female; D6, cornicle of young female.

and the distal end of article V and article VI are dark. Few sensoria, 3 to 5 on article III, 1 near the distal end of article V, and several small marginal sensoria in the nail-like process of article VI. *Legs*—Distal end of tibia and tarsi only are dark in color. Antennæ (Fig. 125 C). Cornicles (Fig. 125 D).

Nymph of Apterous Viviparous Females: The young of the winged and apterous forms resemble the adults in all characteristics, excepting a lack of pigment to color legs and antennæ. *Antennae* (Fig. 125 C). *Cornicles* (Fig. 125 D).

Food Plants.—Garden Peas and Vicia.

Habitat.—This form has been collected at Claremont, Pomona, Santa Ana, and in various parts of Ventura County. It is very common throughout all of the southern part of the State.

Note.—Where some other writers are considering the distal end of the antennae, from the nail-like process to the tip, as a separate article, I am considering it as belonging to the last article. Thus where there are 7 articles to this genus, I have only 6. I have not done this without some thought. I cannot see the reasons for calling this portion to which I have referred to a distinct article, when it has no definite constriction, only the off-set caused by the nail-like process.

A NEW MEALY BUG INFESTING WALNUT APPLE AND PEAR TREES

Pseudococcus bakeri, n. sp.

BY E. O. ESSIG.

HORTICULTURAL COMMISSIONER OF VENTURA COUNTY, CALIFORNIA.

Among other things that a systematic tree-to-tree inspection has revealed in Ventura County, is a mealy bug infested walnut, apple, and pear trees. At first this insect was thought to be the long-tailed variety, *Pseudococcus longispinus* (Targ.) because of its anal appendages, which are often nearly as long as the body. A great deal of excitement was caused among the walnut and citrus growers at this discovery, for it was feared that the citrus pest had now become spread over the entire orchard district of the county. A hasty inspection of all walnut and adjoining citrus orchards followed with marked results. The inspection showed that practically every walnut orchard in the county was infested with this mealy bug, but never in great or damaging numbers; and in only one case was a mealy bug found on a citrus tree in an adjoining orchard and this was evidently not the species now being described. The following field observations proved conclusively that the new mealy bug was not *P. longispinus.*

1. Its anal appendages seldom exceed two-thirds the length of the insect body, and is never longer than the body, while in the long-tailed variety, the anal appendages are much longer than the body.
2. The young are hatched from loose-egg masses much like those of *P. citri,* while the young of *P. longispinus* are born alive.
3. In no case did we find this species on citrus trees, though it occured in many orchards adjoining citrus groves. In the laboratory the live individuals, as well as the eggs, were placed upon growing citrus trees. In some cases the adults deposited their eggs before they died, while others deserted the trees. The young, as rapidly as they hatched from the eggs, crawled over the trees and the barrel, in which the tree grew, and soon died. No individual was observed to attack the foliage or branches at any time. On a walnut tree, in the same room, other individuals multiplied readily, showing that conditions were not abnormal where the experiment was being conducted.

Microscopical study revealed many other differences which are given in the description of the species further on.

The fact that it had such long anal appendages led to the decision that it was not *P. citri* Risso, but was somewhat of an intermediate form between *Pseudococcus citri* and *P. longispinus.* Its feeding habits (It was usually found feeding only upon the new bark formed around cracks or wounds on the tree trunks) led to the belief that it was the elder form of *P. obscurus* which is described by the writer in the Pomona Journal of Entomology, Vol. I, No. 2, Page 43, 1909. Microscopical comparisons prove them to be identical, but distinct from *Pseudococcus obscurus* Essig, which was described from *Opuntia*. At the time of the original description, the limited supply of both forms made it impossible to separate them as I have now done. At that time, however, it did seem very improbable that the same species found on the roots of *Opuntia,* at Los Angeles, could be synonymous with a species found working on the new bark of *Sambucus glauca* (Elder) at Santa Paula, 60 miles away. Even yet the supply of the *Opuntia* form is so limited as to make good comparisons impossible, but the accompanying drawings of the legs and antennæ bring out the main characteristics of the two forms. It might be said here that the new species from Elder, Walnut, Apple, and Pear, is much broader and covered with a greater amount of white, powdery wax than is the original *P. obscurus.*

At the same time that this insect was found were found many individuals working similarly upon the oak trees. This mealy bug was described as *Pseudococcus agrifoliae* Essig and is evidently distinct from *Pseudococcus quercus* Ehr. Thinking that perhaps the new mealy bug found upon the elder might be synonymous with the species described by Ehrhorn, and not having a mounted specimen of *P. quercus,* I sent several slides to Mr. Ehrhorn asking him if it was the one which he described from the oak. This is a copy of his letter:

Honolulu, Hawaii, July 22, 1910.

Mr. E. O. Essig,
County Horticultural Commissioner,
Santa Paula, Cal.

Dear Sir: Your letter of July 2nd, and specimens of *Pseudococcus* species on microscope slides came to hand.

I have examined your specimens with the type of *P. quercus* and I find that the antennæ are quite different, the joints being of a different shape. The derm around the anal ring contains many more glands in *quercus* and the marginal spines are stouter. In your species the antennæ are more hairy, so are the legs and the trochanter has a much stouter bristle. Your species is surely not *P. quercus.* I have no idea what it is and am sorry that I cannot help you in the matter. It will probably prove a new species.

Very truly yours,
EDW. M. EHRHORN,
Superintendent of Entomology.

The species is, therefore, named *bakeri* in honor of Prof. C. F. Baker, of Pomona College, who has aided me more in my entomological work than has any one else. It was he who first gave me a start on the genus Pseudococcus and I take great pleasure in dedicating this well defined and distinct species to him.

Description of Pseudococcus bakeri, n. sp.

Adult Female. (Fig. 126.) The general shape of the adult female is rounded oval. Length of body 4 to 6 mm., width 2 to 3 mm. The covering consists of a rather thick white, powdery way which hides the dark body, but which is not thick enough to conceal the distinct body segmentation. The lateral wax appendages are from 1 to 2 mm. long and very slender—much narrower than the width of the supporting body segment. The anal wax appendages are from one-half to two-thirds the length of the insect body.

When boiled in KOH the contents of the body become cardinal, but, when all of the excreta is removed, the internal organs become light yellow or amber in color, while the body wall appears perfectly transparent and colorless.

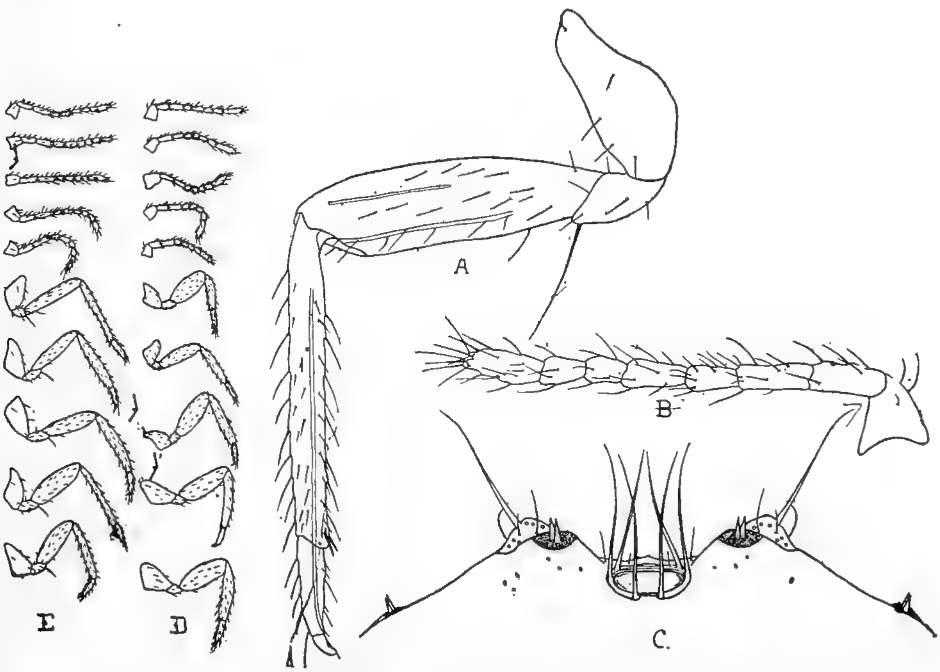

Figure 126. Pseudococcus bakeri and obscurus. A, B, C, E, bakeri; D, obscurus.

The antennæ are normally long and hairy; 8-articled in all forms. The following are the formulæ of 12 individuals (Fig. 126):

3, 2, 8, 1, (4, 5), 7, 6.
8, 1, 2, 3, 5, 6, (4, 7).
8, 3, 2, 5, 1, 4, (6, 7).
8, 3, 2, 1, 5, 7, (4, 6).
8, (3, 1), 2, 5, 7, (4, 6).
8, 3, 2, 5, 1, 6, (4, 7).
8, 3, 2, 5, 1, (4, 6), 7.
8, 2, 3, (5, 1), 4, 7, 6.
8, 3, 2, 1, 5, 4, 7, 6.
8, 3, (2, 1), 5, (4, 6), 7.
3, 8, 2, (1, 5), 4, 6, 7.
8, 3, 2, 1, 5, (4, 6), 7.

While the comparative lengths of the antennal articles are variable, several important predominating characteristics are valuable in determining the species. It is noticeable that articles 8 and 3 are usually the longest and that article 8 is, with only two exceptions, always longer than 3; in only a few instances do we find any of the remaining articles longer or as long as 3. Articles 1 and 5 are nearly equal in length, while both are longer than 4, 6 and 7. At times an article may appear short in some mounted specimens due to the angle of the antennæ on the slide, rather than due to any variation in the species. Little can be relied upon when we come to consider the comparative lengths of 4, 6 and 7 in the determination of this species, but these articles may be very important in another species. In comparative work great care must be exercised to procure a large number of normal specimens which are carefully treated and mounted or abnormal variations are sure to appear, and even then the resultant formula can only be approximate. In summing up the above comparisons, we may approximate the antennal formula as follows:

8, 3, 2, 1, 5, 4, 6, 7 or 8, 3, 2, 1, 5, (4, 6, 7).

It is noticeable that individual characteristics hold true in both antennæ of each individual. (Fig. 126).

The mouth-parts are stout; the rostral loop is about half as long as the body.

The *legs* (Fig. 126) are rather long, slender and normally haired. The comparative lengths of the articles are as follows: *Coxae* usually longer than broad. *Trochanter* narrow and one-half the length of the coxæ. With one very long spine. *Tibia* longer than femur and much narrower. *Tarsi* one-third to four-ninths the length of the tibia. *Claw* usually extends straight out from tarsus and is not well curved.

The spines of the anal lobes (Fig. 126) are as long as the circumanal spines. The inner anal lobes have two stout spines and several hairs on each. There is a continuation of these small spine areas around the lateral margins of the insect body and these mark the lateral way appendages. Beginning with the inner anal lobe and extending around the lateral margin to the middle of the anterior end of the body, the spine areas are:

13 areas of two short, stout spines and several hairs each.
3 areas of many short, stout spines and several hairs each.

In summing up we may say that there are 26 areas of two short spines and several hairs each; four areas of many short, stout spines and several hairs each posteriorly from the antennæ; and two areas of many short, stout spines and several hairs each between the antennæ. These spine areas mark, then, 32 lateral posterior, and anterior wax appendages for each insect.

Eggs. Oval in shape, smooth, lemon yellow to amber in color. Length, 5 mm., diameter about one-half the length.

They are deposited in masses similar to those of the citrus mealy bug, and are located in cracks, and wounds of the tree where they may be hidden under the rough outer bark. (Fig. 127.)

Male. This article has been delayed four months in order to include the description of the male, but after diligent searching not a single specimen has been found. Undoubtedly some individuals shall be secured in the near future and shall be described later. Demands for information concerning this new species makes it impossible to withhold this matter longer.

HOSTS PLANTS.

Elder (*Sambucus glauca* Nutt). This mealy bug was first observed upon the elder trees growing in the "washes" near Santa Paula, Cal. Its presence was first discovered by the aid of ants, which appeared in large numbers in the cracks and wounds of the trees. When the rough exterior bark was removed around these cracks and wounds, the mealy bugs were exposed in rather limited numbers, but scattered over quite a large area of the tree.

Figure 127. Pseudococcus bakeri on bark of walnut.

In all cases they appeared to be feeding only upon the new formed bark, or cambium layer, around the cracks and wounds, and were more or less concealed from view by the rough outer bark. A few were observed crawling on the outer bark, as if in search of a suitable resting place, but none were found upon the foliage of the elder trees. It is very probable that this is the native host plant, and it migrated from this to the deciduous fruit and walnut trees in the surrounding neighborhood.

Walnut (*Juglans regia*). This pest (if it may be called a pest) has been found more extensively distributed upon the walnut trees than upon any other host plant. Its work is the same upon the walnut as on the elder, but during the months of August and September, it was also found feeding upon the stems of the growing nuts, but never in any alarming numbers. It is more readily found by watching the ants than by any damage which it does to the tree, or by its numbers as is the case with most of the mealy bugs.

The inspection which was made generally over the County of Ventura, showed this mealy bug on the walnut trees at Ventura, Saticoy, and the entire district around Santa Paula on both sides of the Santa Clara River. It appeared in the greatest numbers in a small orchard near Santa Paula, but here it existed in very limited numbers. Apparently it exists only upon old trees in the older orchards, which might have been set out when much of the surrounding territory was still growing elder trees and the orchards became infested years ago. This would seem to indicate that the insect is slow to breed and not very destructive, or that it is held down by native insects.

Apple (*Pyrus malus*). On apple trees badly infested with Woolly Aphis (*Schizoneura lanigera*) were found mealy bugs in considerable numbers associated with this plant louse. The Woolly Aphis had caused many of the burls or knots on the limbs and suckers, as well as the crown roots of the tree. The new bark which endeavored to heal over these wounds afforded the desirable conditions for this mealy bug and in every case it was found feeding upon the new bark so exposed. It was especially abundant upon the suckers which were allowed to grow undisturbed at the base of the tree trunk and was found also upon the crown roots of the tree. The apple trees which were worst infested grew in a citrus orchard near the house. An orange tree and several lemon trees were less than 20 feet from the three infected apple trees, and not a single mealy bug could be found on any of the citrus trees. Fearing that they might take to the citrus trees, the owner of the property promptly grubbed up the apple trees and burned them, thereby eliminating any possible chances of infection. In a number of yards other apple trees were found likewise infested with this insect.

Pear (*Pyrus communis*). Were as generally infested as were the apple trees and in the same manner.

REMEDIES.

This mealy bug has not been a pest yet in any locality. In case they infested the walnut trees as badly as the citrus mealy bug infests the citrus trees, it would be almost hopeless to combat it with anything but parasites.

That it has never become a pest during past years is no positive proof that it will not become so in the future, so it is with care that we are keeping watch of this insect.

On deciduous fruit trees some active steps have been taken to destroy all infestations, so I may include in this article the most practical means of extermination or eradication of this pest on such trees. It is a fact that such deciduous, or other fruit trees, as are allowed to grow in the yards, around the houses or barns, and in pastures, are more liable to be infested with injurious insects than trees in a well cared orchard. If you have such trees it is necessary to either take care of them or to cut them out for your own safety, if you are an orchardist, even though you have a few deciduous trees in a citrus region. If your trees are infested with this mealy bug it may be well to heed these suggestions:

1. Cut down the trees, grub out the roots, and burn all over the hole, if your fruit trees are of secondary value to citrus growing.
2. If trees are valuable keep down all suckers and destroy the Woolly Aphis by spraying with the Carbolic Acid Emulsion. It will also kill the mealy bugs. Pour a weak solution of this emulsion around the crown of the tree at repeated intervals of two weeks.
3. Spray when the tree is dormant, using ten gallons of the emulsion per tree.
4. Be sure that the spray is applied to every crack and crevice at not less than 180 pounds of pressure. Repeat the application three times at intervals of one month.

DESCRIPTION OF A NEW SPECIES OF CICADIDÆ

BY W. L. DISTANT.
LONDON, ENGLAND.

The species of *Rihana* on which this description is based was collected near the city of Belize, in British Honduras, by Mr. James D. Johnson. It is a very well marked and beautiful form belonging to a section of the genus of which we have, more than probably, not seen the whole of its representatives in Central America. Specimens of this new species are to be found in my collection and in that of Pomona College.

Family CICADIDÆ.

Subfamily CICADINA.

Genus *Rihana* Distant.

Rihana Dist. Ann. Mag. Nat. Dist. (7) XIV p. 426 (1904).
Type *R. ochracea* Walk.

Rihana belizensis sp. nov.

Body above pale olivaceous-green, vertex with four large longitudinal black spots, one at inner margin of each eye and two central and contiguous enclosing the ocelli, front with transverse black lines on each lateral area; pronotum with two central black lines united at base, widened anteriorly and not quite reaching anterior margin, on each side of these a discal curved black line and the incisures black; mesonotum with two obconical black spots outwardly margined with castaneous at anterior margin, a larger obconical spot on each lateral area of broken and suffused coloration, castaneous with irregular black macular markings, a cruciform black spot near base, with a small rounded black spot on each side and a black spot on the anterior angles of the basal cruciform elevation; abdomen above with two black spots at base and a transverse black fascia on each of the abdominal segments; body beneath and legs ochraceous, more or less cretaceously tomentose, the sternum more densely so, the abdomen beneath with the posterior margins of the ventral segments pale olivaceous-green, their basal and lateral margins cretaceously tomentose; apex of rostrum and the tarsi black; tegmina and wings hyaline, the veins mostly brownish ochraceous; tegmina with the costal membrane olivaceous-green, the apices of the three upper ulnar areas, the apex of the postcostal membrane, and three apical longitudinal spots, fuscous-brown; wings with the margins of the abdominal area narrowly fuscous brown.

Female. Tegmina long and slender, about three times longer than their greatest breadth, length of head more than half the breadth of space between eyes; opercula oblique, their inner angles distinctly separated, their posterior margins scarcely extending beyond the base of the abdomen; rostrum reaching the posterior coxæ; anterior femora with two strong black spines beneath, one near base, the other near apex.

Length exclusive of tegmina, female, 23 mm. Expanse of tegmina 73 mm

Habitat: British Honduras; Belize (Johnson).

Somewhat allied to the Mexican species *R. virgulata* Dist.

AMERICAN PSYLLIDÆ II (Triozinæ)

BY D. L. CRAWFORD.

In studying a group which has been only locally systematized, one is apt to find that the anatomy of the species of the group is quite inadequately known. Dr. Franz Low has published an article on the anatomy of the Psyllidæ in which the nomenclature of most of the external anatomy is given. The thoracic and ventral anatomy, however, is not very thoroughly known and, therefore, not used in diagnosis. In order to bring out more clearly some of these little known characters and make them available for diagnostic use, another paper is being prepared on the external anatomy of the Triozinæ. Several structures have been noted in the course of this study which have hitherto been scarcely mentioned or figured in specific descriptions. Chief among these is a remarkable horn-like spur on each meta-coxa, and sometimes another pair distinct from these and extending in the opposite direction, (Fig. 128 i). These are present in both sexes and will perhaps offer a good character for separation of minor groups of species, at least.

In this paper the specific descriptions begun in the first article are continued. It is quite possible that a further anatomical study will reveal characters which will have to be added to these mentioned in this paper.

Trioza collaris n. sp.

(Figs. 128 A, B; 129 A; 130 A.)

Length of body with ovipositor, 2.5 mm.; without ovipositor, 2.3 mm.; length of forewing, 3.8 mm.; greatest width of forewing, 1.6 mm.; width of vertex between eyes, .44 mm.; with eyes, .72 mm. General color, greenish yellow.

Head moderately deflexed; with eyes not quite as broad as thorax; finely punctate. Posterior margin of vertex arcuate, narrowly elevated over middle half; discal area of frontal plates with a distinct fovea midway between median suture and posterior ocellus on each side, with a diverging depression extending down toward face; frontal plates not raised plate-like, scarcely emarginate anteriorly at median suture. Anterior ocellus at angle of facial cones and under the slightly overhanging vertex, not visible from above. Facial cones short, scarcely divergent, acute at tip, subhorizontal but not visible from above, sparsely pubescent. Antennæ inserted at base of facial cones, without, beneath eyes; two basal segments large, subglobose; remaining segments destroyed.

Thorax arched, finely punctate; pronotum long, not depressed below dorsulum and head. Dorsulum strongly ascending, about as long as scutum, with a light brownish stripe on each side; scutum with a double stripe on each side a little darker than ground color. Wings hyaline, about two and one-half times as long as broad, broadest across first marginal cell, rounded apically; radius longer than second cubital; marginal cells subequal; apex

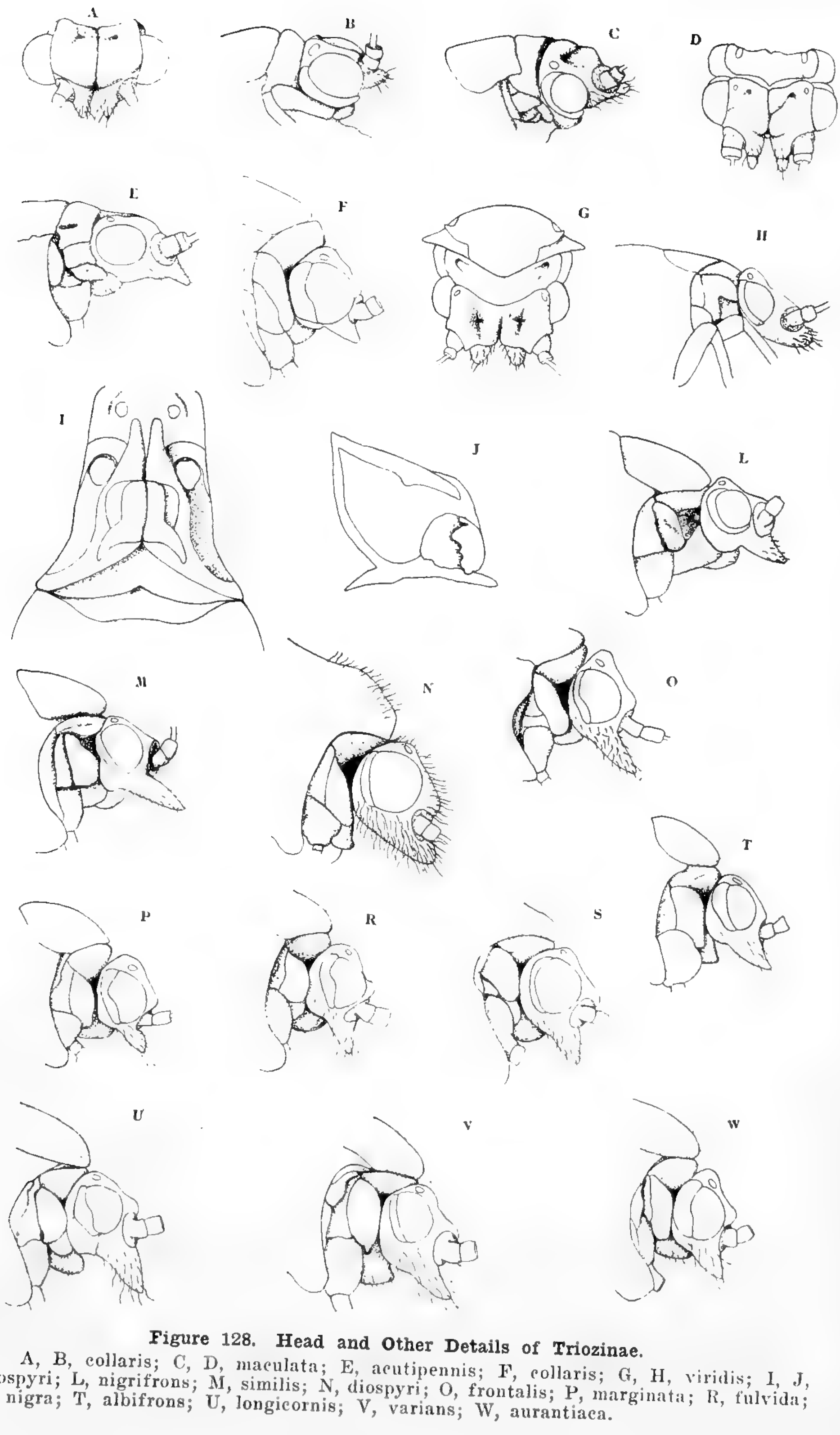

Figure 128. Head and Other Details of Triozinae.

A, B, collaris; C, D, maculata; E, acutipennis; F, collaris; G, H, viridis; I, J, diospyri; L, nigrifrons; M, similis; N, diospyri; O, frontalis; P, marginata; R, fulvida; S, nigra; T, albifrons; U, longicornis; V, varians; W, aurantiaca.

of wing at termination of fourth furcal; venation very slightly darker than wing membrane, not conspicuous.

Female—Genital segment large, fully two-thirds as long as rest of abdomen; both plates about equal in length, moderately pubescent; ovipositor exserted, almost as long as genital segment, slender, acute at tip, much darker than abdomen.

Described from one female, taken by Prof. C. F. Baker at Claremont, California (mountains).

Trioza maculata n. sp.

(Figs. 128 C, D; 129 B; 130 D.)

Length of body, 2.3 mm.; length of forewing, 3.1 mm.; greatest width of forewing, 1.05 mm.; width of vertex between eyes, .39 mm.; with eyes, .62 mm. General color greenish white, abdomen dorsally dark brown.

Head not deflexed; with eyes almost as broad as thorax; very finely punctate. Posterior margin of vertex arcuate, emarginate at median suture, distinctly elevated; with a fovea midway between median suture and posterior ocellus in each side and a diverging depression extending downward toward face, a sharp line of depression extending from fovea to near the front margin of eye and to center of median suture on each side; frontal plates not raised plate-like, emarginate anteriorly at median suture. Anterior ocellus imbedded at angle of facial cones and under the slightly overhanging vertex, scarcely visible from above. Facial cones moderately long, horizontal, visible from above, thick and scarcely divergent in basal half, smaller and more divergent in distal half, rounded apically, slightly angled outwardly at center; pubescence rather long and sparse. Antennæ inserted at base of cones without, insertion extending downward almost to center of cone; two basal segments large, subglobose, remaining eight segments filiform, dark brown at tip of each segment, the rest light brown.

Thorax only slightly arched, more coarsely punctate than head. Pronotum long, arcuate, not depressed below dorsulum and head; with a small acute projection midway on anterior margin; dorsulum horizontal; scutum slightly descending, indistinctly marked with three brownish stripes. Wings hyaline, three times as long as broad, broadest across first furcal; with a large brown macula covering most of both marginal cells and distal half of cubital cell, and another less distinct covering most of inner basal cell; radius shorter than second cubital; first marginal cell somewhat longer than second; moderately rounded at tip, with fourth furcal terminating at apex.

Female.—Abdomen dark brown dorsally, ventrally mottled brown and greenish-white. Genital segment almost one-half as long as rest of abdomen, moderately acute at tip, quite densely pubescent; dorsal plate slightly longer than ventral plate and less acute; ovipositor not exserted.

Described from one female from Arizona, in the C. F. Baker collection. Type specimen in the National Museum.

Trioza acutipennis n. sp.

(Figs. 128 E; 129 D.)

Length of body, 2.7 mm.; length of forewing, 3.5 mm.; greatest width of wing, 1.3 mm.; width of vertex between eyes, .44 mm.; with eyes, .66 mm. General color, yellowish brown, scutum with brown stripes.

Head scarcely deflexed; with eyes about as broad as thorax; finely rugoso-punctate. Posterior margin of vertex broadly emarginate; discal portion of frontal plates with a fovea near center, slightly nearer to posterior margin and median suture; frontal plates not raised plate-like, emarginate anteriorly at median suture. Anterior ocellus at angle of facial cones, slightly visible from above. Facial cones moderately long, stout, quite divergent, rounded apically, subvertical but barely visible from above, very sparsely pubescent. Antennæ inserted on basal portion of cones without and above; basal segment subglobose, the remaining segments destroyed.

Thorax slightly arched, ascending from pronotum to middle of dorsulum; more coarsely rugulose than head. Pronotum very long, not depressed below dorsulum and head; with the posterior margin arcuate, emarginate at center of receive a small projection of dorsulum; anterior margin with an acute projection at center smaller than that on dorsulum; with a fovea on each side just above the episternum. Dorsulum ascending in anterior half, the rest horizontal; scutum descending posteriorly, with five brown stripes somewhat darker than ground color. Wings hyaline, about two and four-fifths times as long as broad, broadest across first marginal cell, acute apically; with several very light brown and indistinct maculæ, one in inner basal cell beside the first furcal, another extending through first marginal cell to second cubital, a third at tip of wing in second marginal cell; radius longer than second cubital; fourth furcal terminating very near to apex of wing; venation brown, quite distinct.

Male.—Abdomen slender, larger basally; genital segment one-fourth as long as rest of abdomen.

Claspers attached to tip of genital segment, bilobate, with a projecting lobe extending posteriorly; anal segment produced dorsally into an arched process; penis between anal arch and claspers; claspers and anal arch quite thickly pubescent.

Described from one male, taken by C. F. Baker at Chinandega, Nicaragua.

Trioza viridis n. sp.

(Figs. 128 G, H; 129 C; 130 B, C.)

Length of body, 2.2 mm.; length of forewing, 2.7 mm.; greatest width, 1.2 mm.; width of vertex between eyes, .47 mm.; with eyes, .62 mm. General color light yellowish green.

Head somewhat deflexed; with eyes not as broad as thorax; finely punctate. Posterior margin of vertex arcuate, not emarginate at median suture; discal area of frontal plates with large longitudinal depression in center leaving elevated margin posteriorly and along median suture; frontal plates not raised plate-like, emarginate anteriorly. Anterior ocellus below emargination of frontal plates in angle of facial cones, slightly visible from above. Facial cones short, quite strongly divergent, rounded apically, almost horizontal, visible from above, pubescence sparce, fine and short. Antennæ inserted at base of cones without and slightly above; two basal segments large, the rest filiform, darker than two basal ones.

Thorax scarcely arched, finely punctate; pronotum somewhat longer than usual but depressed below head, ascending to dorsulum; dorsulum scarcely ascending, subequal in length with scutum. Wings hyaline, about two and one-third times as long as broad, broadest across first marginal cell, rather acute at tip; without maculæ; radial cell unusually short; first marginal cell distinctly larger than second; apex of wing distinctly within second marginal cell; venation light colored, not conspicuous.

Female.—Genital segment large and heavy, almost as long as rest of abdomen, broadly rounded apically; pubescence sparse, moderately long; style exserted, about half as long as genital segment, acute, dorsal blade overreaching ventral. *Male.*—Abdomen slender. Genital segment short, about one-fourth as long as rest of abdomen; claspers triangular in shape, broad at base, quite acute at tip; anal segment produced dorsally into a broad process, concave toward claspers, subacute at tip; pubescence moderately sparse, rather short.

Described from one female and two males, taken by C. F. Baker at Claremont, California (mountains).

Trioza nigrifrons n. sp.

(Fig. 28 L; 129 I; 130 E.)

Length of body, 2.2 mm.; length of forewing, 3.6 mm.; greatest width of wing, 1.4 mm.; width of vertex between eyes, .49 mm.; with eyes, .71 mm. General color, orange yellow, abdomen whitish ventrally, face and facial cones black.

Head not deflexed, very finely punctate; with eyes almost as broad as thorax. Posterior margin of vertex slightly arcuate, narrowly elevated; discal area of frontal plates with a shallow depression triangular in shape, the apex near posterior margin of vertex; median suture arcuately elevated, emarginate anteriorly; frontal plates raised somewhat plate-like. Anterior ocellus imbedded at angle of facial cones under the slightly overhanging vertex, not visible from above. Facial cones black, moderately long, contiguous in basal two-thirds, distal third slightly divergent, subacute at tip, subvertical and slightly visible from above, scarcely pubescent, more coarsely punctate than head. Antennæ inserted on frons slightly without and partially on base of cones; two basal segments large, remaining segments destroyed.

Thorax slightly arched, more coarsely punctate than head. Pronotum very short, depressed below dorsulum and head, barely visible from above. Dorsulum triangular, roundly pointed anteriorly, slightly ascending, almost as long as scutum. Wings hyaline, about two and two-thirds times as long as broad, broadest across first furcal vein, subacute apically; radius fully as long as second cubital; fourth furcal terminating at apex of wing.

Female.—Abdomen somewhat dilated in center; dorsal segments dark brown, except posterior borders brownish yellow; ventral segments greenish white. Genital segment short, about as long as anal segment; dorsal plate longer than ventral; both plates with a short, acute projection apically; style slightly exserted; pubescence very short and sparse.

Described from one female, taken in Gunnison, Colorado, by C. F. Baker.

Trioza similis n. sp.

(Figs. 128 M; 129 J; 130 F.)

Length of body, 2.6 mm.; length of forewing, 3.5 mm.; greatest width 1.6 mm.; width of vertex between eyes, .42 mm.; with eyes, .66 mm.; general color, light brownish yellow.

Head slightly deflexed, finely punctate; with eyes not as broad as thorax. Posterior margin of vertex arcuate, narrowly elevated in center; discal area with a fovea on each side near posterior margin and nearer to median suture than to posterior ocelli; with a narrow sulcus connecting the two fovea and an oblique depression extending from each fovea to insertion of antennæ; frontal plates not raised plate-like. Eyes not as prominent as usual; anterior ocellus at angle of facial cones, slightly visible from above. Facial cones quite long, strongly divergent, acute at tip, subhorizontal and distinctly visible from above, pubescence mostly basal, very sparse on distal half. Antennæ inserted on vertical frons above base of cones; two basal segments large, remaining segments filiform, black on apical half.

Thorax moderately arched, ascending somewhat beyond anterior margin of scutum; finely punctate. Pronotum short, depressed below dorsulum and head and scarcely visible from above. Dorsulum quite strongly ascending, roundly pointed anteriorly; both dorsulum and scutum faintly marked with light brown. Wings hyaline, about two and one-third times as long as broad, broadest across first marginal cell; rounded apically; radius longer than second cubital; fourth furcal terminating at apex of wing; venation light brown, not conspicuous.

Female.—Genital segment as long as two preceding segments, slightly deflexed; dorsal plate a trifle longer than ventral and less acute; pubescence sparse and very short.

Described from three females in the C. F. Baker collection, taken in Colorado. Type specimen in National Museum.

TRIOZA DIOSPYRI Ashmead.

Synonyms: *Psylla diospyri* Ashm.
Trioza latipennis Crawford.

(Figs. 128 I, J; 129 K; 130 L.)

Length of body, 2.5 mm.; length of forewing, 4.4 mm.; greatest width, 1.8 mm.; width of vertex between eyes, .47 mm.; with eyes, .79 mm. General color, shining black, legs partially yellow. Pubescence conspicuous.

Head moderately deflexed, very finely punctate on frons, with eyes almost as broad as thorax; pubescence moderately long and dense and covering most of head. Posterior margin of vertex sharply elevated, slightly arcuate, and emarginate at median suture; discal area with a shallow transverse depression about midway; not raised plate-like; vertex quite deeply emarginate anteriorly at median suture; anterior ocellus in emargination at angle of facial cones, visible from above. Facial cones short, broadly rounded at tip, moderately divergent, subhorizontal and visible from above, quite densely pubescent. Antennæ inserted on frons and base of facial cones, above and without; two basal segments large, remaining segments filiform, yellowish except apical segment black. Labrum very prominent, with a seta on ventral surface.

Thorax arched, slightly saddle-shaped, finely punctate, moderately pubescent. Pronotum short, depressed below dorsulum and head; dorsulum strongly ascending in anterior half, posterior half and part of scutum depressed, posterior portion of scutum again ascending somewhat; entire dorsal surface pubescent. Wings hyaline, about two and one-half times as long as broad, broadest across first marginal cell, acute apically; second marginal cell very much longer than first; fourth furcal almost as long as second cubital; radius slightly longer than second cubital; fourth furcal terminating at apex of wing or slightly below it.

Female.—Abdomen quite stout. Genital segment fully half as long as abdomen, acute apically, quite densely pubescent; dorsal plate slightly longer than ventral, less acute; genital pore elliptical, entirely exposed, almost one-fourth as long as dorsal plate. *Male.*—Genital segment short, distinctly deflexed; claspers arched, laterally opposed, simple; anal segment produced dorsally into a short projection, concave toward claspers, broadest at distal end, appearing from above bicornate.

Redescribed from thirty males and females, collected by G. R. Pilate in Louisiana, and three females collected by Nathan Banks at West Falls Church, Virginia.

This species was first described by Ashmead in 1881 from specimens taken in Jacksonville, Florida. His description as published in the Canadian Entomologist, Vol. XIII, page 222, was wholly inadequate to distinguish it from any other species. I was obliged, therefore, to omit that from the synopsis of Triozinæ. Since the publication of the synopsis I have received three determined specimens of this species from Mr. Nathan Banks. Careful comparison of these specimens with the type specimen of *T. latipennis* Crawford proves that they are identical. The name *Trioza latipennis,* therefore, must drop into synonymy.

Trioza frontalis n. sp.

(Figs. 128 O; 129 E; 130 N.)

Length of body, 2.1 mm.; length of forewing, 3.2 mm.; greatest width, 1.2 mm.; width of vertex between eyes, .41 mm.; with eyes, .71 mm. General color, brownish red, abdomen brownish.

Head slightly deflexed, with eyes about as broad as thorax, finely punctate. Posterior margin of vertex arcuate, ridged narrowly and not emarginate at median suture; discal area with an oblique sulcate depression extending

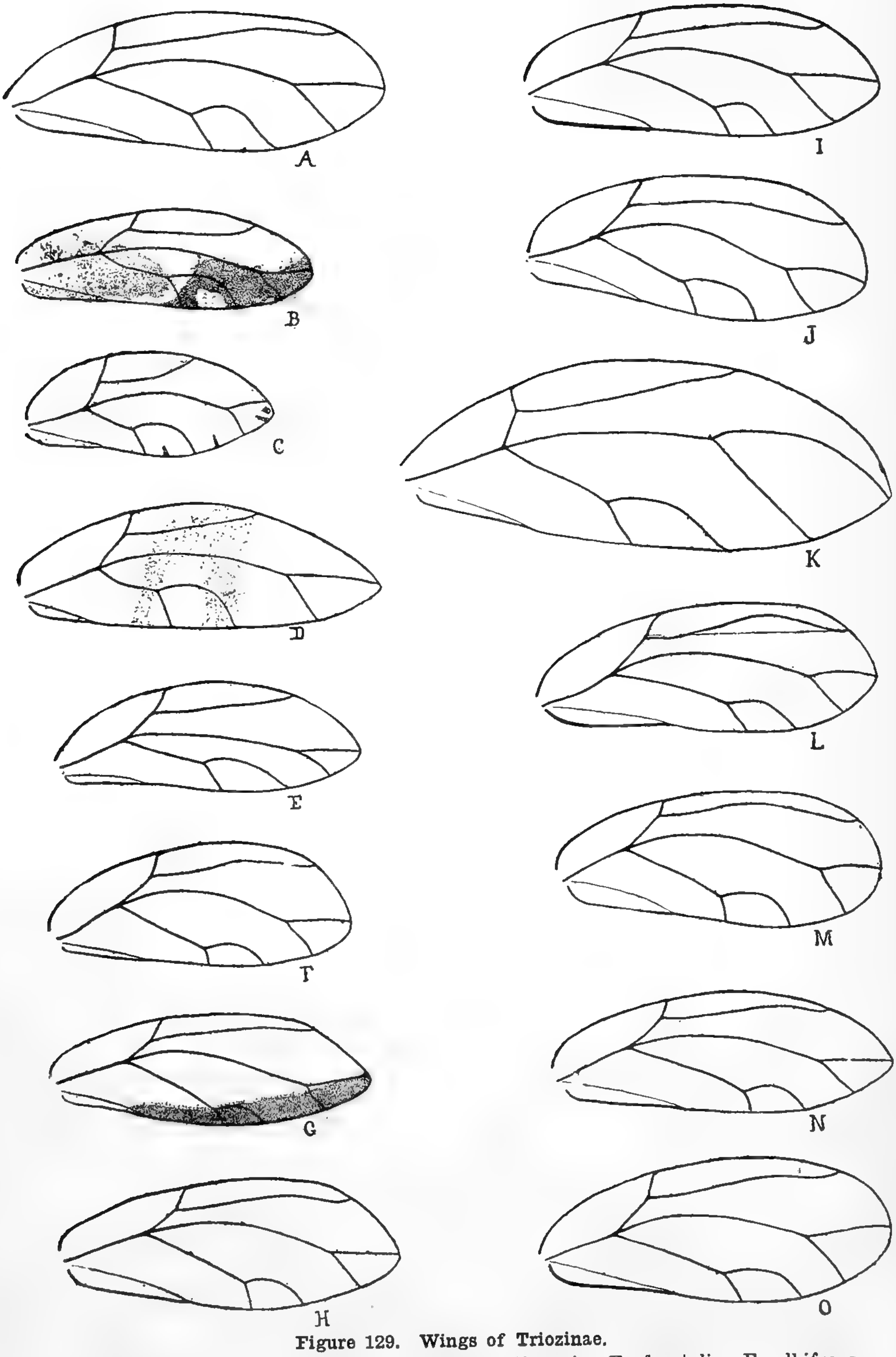

Figure 129. Wings of Triozinae.

A, collaris; B, maculata; C, viridis; D, acutipennis; E, frontalis; F, albifrons; G, marginata; H, nigra; I, nigrifrons; J, similis; K, diospyri; L, fulvida; M, longicornis; N, aurantiaca; O, varians.

from near posterior margin and closer to median suture than to posterior ocelli toward lower margin of eyes; sulcæ connected posteriorly by a shallower transverse sulcus; frontal plates not raised plate-like; vertex distinctly emarginate anteriorly at median suture, making anterior ocellus visible from above. Facial cones moderately long scarcely divergent, acute at tips, subhorizontal and visible from above, slightly pubescent. Antennæ inserted on frons between lower margin of eye and base of facial cone on each side; two basal segments large, not globose, the remaining segments filiform.

Thorax somewhat arched, slightly punctate. Pronotum very short, depressed below dorsulum and head, ascending toward dorsulum, with a fovea on each side just above episternum. Dorsulum ascending strongly, triangular, roundly pointed anteriorly. Wings hyaline, moderately slender, about two and two-thirds times as long as broad, broadest across first furcal, quite acute apically; radius distinctly shorter than second cubital; second marginal cell smaller than first; second cubital terminating at apex of wing.

Female.—Abdomen darker in color than thorax. Genital segment long, almost as long as rest of abdomen, distinctly deflexed; dorsal plate slender, quite acute, overreaching ventral plate and receding farther back basally; genital pore large, elliptical, conspicuous; pubescence very light and sparse. *Male.*—Abdomen more slender than in female. Genital segment longer than two preceding, quite stout, tapering toward tip; claspers simple, curved inward and slightly serrated apically; anal segment produced dorsally into a large, broad double projection, bilobate when viewed from the side, with a more or less distinct ridge extending from the base into each lobe; posterior lobe, viewed from behind, with two recurved flaps; upper rim of projection bordered with a fringe of about twenty-four long hairs; pubescence sparse but moderately conspicuous. (In the accompanying illustrations the claspers are shown as partially enclosed and held by anal projection, which may or not be the natural position for them in all specimens.)

Described from two females and three males in the C. F. Baker collection, taken in Colorado. Type specimen in National Museum.

Trioza albifrons n. sp.

(Figs. 128 T; 129 F; 130 M.)

Length of body, 2.0 mm.; length of forewing, 3.0 mm.; greatest width, 1.3 mm.; width of vertex between eyes, .38 mm.; with eyes, .60 mm. General color, yellowish green to greenish white, abdomen ventrally darker, apical half of antennæ and middle tarsi black.

Head slightly deflexed, with eyes fully as broad as thorax, coarsely punctate; posterior margin of vertex arcuate, not emarginate at median suture, scarcely elevated; discal area with fovea on each side between median suture and posterior ocelli near posterior margin; depression scarcely sulcate; vertex roundly emarginate anteriorly at median suture; anterior ocellus barely visible from above. Facial cones rather short, stout at base, acute, quite divergent, subvertical but slightly upcurved and partially visible from above, sparsely and inconspicuously pubescent. Antennæ inserted above base of cones, slightly without.

Thorax arched, punctate. Pronotum quite short, depressed below dorsulum and head; dorsulum quite strongly ascending, with a brownish spot on each side of median line anteriorly; roundly pointed at anterior margin. Wings hyaline, about two and one-third times as long as broad, broadest across first marginal cell, round and very slightly angulated apically; radius somewhat flexed midway, fully as long as second cubital; first furcal very short; venation inconspicuous.

Male.—Abdomen slender; dorsal segmental plates very short, reaching about to middle of third ventral segment; anal end of abdomen dorsally concave. Genital segment moderately large, semi-erect; claspers quite long, simple, laterally opposed, recurved at tips; anal projection long, spatulate when viewed from the side, anterior margin longer than posterior; upper margin with several conspicuous hairs; pubescence sparse.

Described from three males taken by C. F. Baker at Claremont, California (mountains).

Trioza marginata n. sp.

(Figs. 128 P; 129 G; 130 O.)

Length of body, 2.2 mm.; length of forewing, 3.3 mm.; greatest width, 1.2 mm.; width of vertex between eyes, .44 mm.; with eyes, .71 mm. General color, orange yellow, abdomen whitish ventrally, antennæ and legs light colored.

Head somewhat deflexed, with eyes not quite as broad as thorax, very finely punctate; posterior margin of vertex arcuate, narrowly elevated, not emarginate at median suture; discal area with an oblique and diverging depression on each side extending from near median suture posteriorly toward insertion of antennæ; vertex scarcely emarginate anteriorly at median suture, distinctly overhanging and concealing anterior ocellus when viewed from above. Facial cones rather short, subacute, only slightly divergent, subvertical and not visible from above, darker than vertex, very sparsely pubescent. Antennæ inserted between lower margin of eye and base of facial cone, a trifle within; two basal segments large as usual in genus, the remaining segments slender, filiform.

Thorax arched, finely punctate. Pronotum moderately short, depressed below dorsulum and head; dorsulum quite heavy, ascending to scutum, about equal to scutum in length, roundly pointed anteriorly. Wings hyaline, except lower margin bordered with brown stripe extending through marginal cells and from anal angle to apex of wing; a little less than three times as long as broad, broadest across first furcal; somewhat angulate on radial margin apically, quite acute; radius distinctly shorter than second cubital.

Female.—Abdomen quite stout. Genital segment very short, scarcely longer than anal segment; dorsal plate slightly overreaching ventral, arched dorsally; both plates with short, acute, beak-like projection apically; posterior dorsal surface of anal segment concave, with genital pore partially concealed

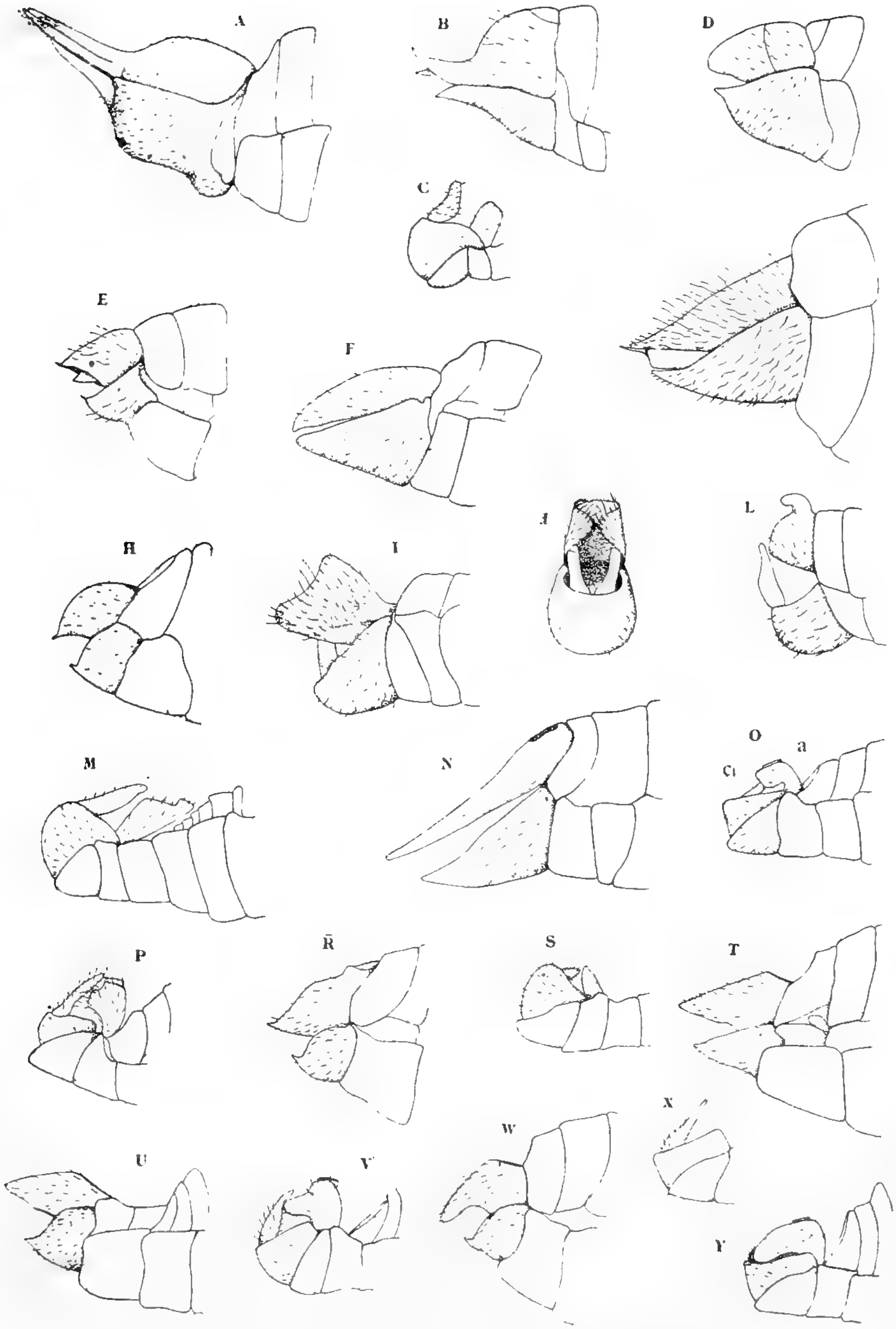

Figure 130. Genitalia of Triozinae.

A, collaria; B, C, viridis; D, maculata; E, nigrifrons; F, similis; G, diospyri; H, marginata; I, J, frontalis; L, diospyri; M, albifrons; N, frontalis; O, marginata; P, nigra; R, S, fulvida; T, longicornis; U, V, varians; W, X, Y, aurantiaca.

therein; pubescence very sparse. *Male.*—Abdomen more slender. Genital segment shorter than anal segment, subcylindrical, concave dorsally; claspers short, simple, acute and slightly toothed on inner margin apically; penis exserted between and behind claspers; anal segment concave as in female, produced dorsally into a short erect projection with two recurved flaps extending horizontally toward claspers; pubescence very sparse and inconspicuous.

Described from three females and one male in the C. F. Baker collection, taken in Arizona. Type specimen in National Museum.

Trioza nigra n. sp.

(Figs. 128 S; 129 H; 130 P.)

Length of body, 2.1 mm.; length of forewing, 3.5 mm.; greatest width, 1.4 mm.; width of vertex between eyes, .46 mm.; with eyes, .74 mm. General color, dark reddish brown to black, abdomen lighter ventrally, head quite black.

Head more or less deflexed, finely punctate. Posterior margin of vertex arcuate, narrowly elevated between posterior ocelli over inner half of each frontal plate, not emarginate at median suture; discal area of frontal plates with a shallow depression over posterior half; anterior portion roundly lobate, and distinctly projecting, emarginate at median suture. Anterior ocellus not visible from above. Facial cones rather short, moderately acute apically, divergent but not strongly so, subvertical and not visible from above, somewhat rugulose transversely, almost glabrous, slightly pubescent. Antennæ inserted at base of cones below eyes, without.

Thorax arched, very finely punctate dorsally. Pronotum very short, depressed below dorsulum and head, descending strongly toward head; dorsulum ascending to scutum, roundly pointed anteriorly and slightly overhanging pronotum; scutum broader than head, with eyes. Wings, hyaline, about two and one-third times as long as broad, broadest across first marginal cell, roundly pointed apically; radius scarcely as long as second cubital; marginal cells subequal.

Female.—Genital segment very short, scarcely as long as anal ventral segmental plate; dorsal and ventral plates of equal length, the former more acute; pubescence sparse and apical. *Male.*—Genital segment medium in size, rather upcurved; claspers simple, moderately long, slender, acute, arcuate, briefly pubescent; anal projection long, bilobate when viewed laterally, posterior lobe at right angles to anterior and erect lobe; posterior lobe, when viewed from above, composed of two recurved flaps; pubescence sparse.

Described from five males collected in Colorado by C. F. Baker; two females, apparently belonging to this species, were collected in Louisiana by G. R. Pilate, and two other males at Algonquin, Illinois, by Dr. Nason. Type specimen (male) in National Museum.

Trioza fulvida n. sp.

(Figs. 128 R; 129 L; 130 R, S.)

Length of body, 2.2 mm.; length of forewing, 3.4 mm.; greatest width, 1.3 mm.; width of vertex between eyes, .47 mm.; with eyes, .75 mm. General color, fulvous brown, abdomen lighter ventrally.

Head deflexed, with eyes not as broad as thorax, finely punctate. Posterior margin of vertex very narrowly elevated over middle half, arcuate, not emarginate at median suture; discal area with a small fovea midway between median suture and each posterior ocellus, and a shallow divergent depression extending about to anterior margin of eyes, frontal plates raised plate-like, emarginate at median suture anteriorly and sutural angle of each plate deflexed making double emargination. Anterior ocellus not visible from above. Facial cones rather long, strong divergent, acute, subvertical and not visible from above, sparsely pubescent. Antennæ inserted between base of cones and eyes; insertion cone-shaped, converging to point on each side of anterior ocellus.

Thorax strongly arched, punctate. Pronotum short, depressed below dorsulum and head, with a small fovea on each side just above pleurites. Dorsulum strongly ascending, narrowly rounded anteriorly, quite coarsely punctate. Wings subhyaline, fulvous, about two and one-half times as long as broad, broadest across first marginal cell, rounded apically but not broadly so; radius fully as long as second cubital, flexed midway; marginal cells subequal; venation brownish, anal angle black or dark brown.

Female.—Genital segment short, a little longer than anal ventral segmental plate; dorsal plate overreaching ventral, and less acute; genital pore contiguous to and about as long as anal dorsal segmental plate; ventral plate with an upcurved acute prolongation; pubescence inconspicuous. *Male*—Abdomen recurved caudad, much slenderer than in females; dorsal segmental plates depressed beyond third and scarcely visible from side. Genital segment as long as two preceding, semierect; claspers very small and short, triangular when viewed laterally; anal projection small, simple erect, about twice as long as broad and slightly broader than base of claspers; pubescence short, sparse and inconspicuous.

Described from numerous males and females collected in Colorado by C. F. Baker. Type in National Museum.

This species is apparently closely related to *T. aurantiaca.*

Trioza fulvida var similis n. var.

Although this species presents more or less gradual variations, still there seems to be a quite distinct varietal group which has the forewings hyaline and not fulvous as in the species. The structural characters are the same in both groups.

Described from several males and females taken in Colorado by C. F. Baker. Type in National Museum.

Trioza longicornis n. sp.

Figs. 128 U; 129 M; 130 T.)

Length of body, 2.4 mm.; length of forewing, 3.6 mm.; greatest width, 1.5 mm.; width of vertex between eyes, .45 mm.; with eyes, .72 mm. General color greenish yellow, notum slightly darker.

Head scarcely deflexed, conspicuously lower than dorsal margin of dorsulum, very finely punctate. Posterior margin of vertex arcuate, narrowly elevated over middle half of line between posterior ocelli; discal area with a shallow depression on each side in the shape of a spherical triangle with the bases coincident and raised slightly at median suture, and apeces near anterior margin of eyes; frontal plates raised plate-like, deflexed and emarginate at median suture anteriorly. Anterior ocellus not visible from above, imbedded between frontal emargination, angle of facial cones, and the intermediate converging antennal insertions, as in *T. fulvida.* Facial cones long, divergent, acute, subvertical but very slightly visible from above, moderately pubescent.

Thorax strongly arched, finely punctate. Pronotum short, depressed below head and dorsulum; dorsulum strongly ascending to scutum, narrowly rounded anteriorly, not quite as long as scutum. Wings hyaline, about two and a half times as long as broad, broadest across first marginal cell, broadly rounded apically; radius flexed midway, fully as long as second cubital; marginal cells rather small, subequal; venation yellowish.

Female.—Abdomen dorsally brownish gray, ventrally greenish white. Genital segment rather short, about as long as anal ventral segmental plate; dorsal plate longer and more acute than ventral; genital pore about one-fourth as long as dorsal plate, inclined toward anal segment.

Described from one female in the C. F. Baker collection, taken in Vancouver. Type specimen in National Museum.

Trioza aurantiaca n. sp.

(Figs. 128 W; 129 N; 130 W, X, Y.)

Length of body, 2.3 mm.; length of forewing, 3.4 mm.; greatest width, 1.35 mm.; width of vertex between eyes, .44 mm.; with eyes, .72 mm. General color orange, varying from light yellowish brown in some specimens to deep orange in others; abdomen ventrally and anally greenish white.

Head moderately deflexed, very finely punctate, with eyes not as broad as thorax. Posterior margin of vertex arcuate, not emarginate at median suture, slightly and narrowly elevated over middle three-fifths of line between posterior ocelli; discal area with a small shallow fovæ midway near posterior ridge, and a diverging depression extending obliquely toward front and lower margin of eyes; frontal plates slightly raised plate-like, deeply emarginate at median suture. Anterior ocellus not visible from above. Facial cones quite long, acute, only slightly divergent, subvertical and not visible from above, sparsely pubescent. Antennæ inserted at base of cones, mostly in front.

Thorax arched, finely punctate. Pronotum short, depressed below dorsulum and head; dorsal portion almost vertical, ascending to lower margin of slightly overhanging dorsulum. Dorsulum strongly ascending, acutely rounded anteriorly. Wings hyaline, about two and a half times as long as broad, broadest across base of first marginal cell, subacute apically; marginal cells subequl; venation yellowish.

Female.—Genital segment short, scarcely as long as ventral segmental plate preceding it; dorsal plate longer and lecc acute than ventral; genital pore about one-fourth as long as dorsal plate, declinate toward anal segment;

ventral segment short, produced apically into a short and acute point. *Male.*—Abdomen slender, arched dorsally, broadest across third dorsal segmental plate, the anal dorsal plate scarcely visible above ventral segmental plate. Genital segment about as long as two preceding, somewhat reflexed, with apical margin horizontal; claspers rather short, simple, slender and acute in distal half, arcuate and briefly pubescent. Anal projection bilobate when viewed laterally; the longest lobe horizontal and at right angles to the other, reaching fully to base of claspers; pubescence short, whitish.

Described from numerous females and several males taken in Ormsby County, Nevada, and Santa Clara County, California, by C. F. Baker.

This species is more or less variable in some respects and it is therefore, quite difficult to determine the line of separation between this and closely related species. Wherever a large number of specimens belonging to some common species is studied this difficulty of gradual variation is nearly always encountered. It is quite possible that these variations are slowly giving rise to new species, but while the variations are slight and grade into each other the only course possible is to class the entire group of slightly varying forms into one species. In this specific group the genital characters are the most constant and reliable for diagnosis.

Trioza varians n. sp.

(Figs. 128 V; 129 O; 130 U, V.)

Length of body, 2.1 mm.; length of forewing 3.3 mm.; greatest width of wing, 1.4 mm.; width of vertex between eyes, .41 mm.; with eyes, .70 mm. General color, dark brown to black with conspicuous stripes and bands of yellowish white; frontal plates bordered with light band; whitish band on pedicle of eye; on posterior margin of dorsulum and several stripes on dorsal surface of scutum and dorsulum; upper margin of ventral abdominal plates whitish.

Head somewhat deflexed, finely punctate. Posterior margin of vertex narrowly and sharply elevated into a ridge over three-fifths of the line between posterior ocelli; discal area with a sulcus extending parallel with median suture; margin of frontal plates elevated arcuately; when viewed from side raised plate-like; deeply emarginate anteriorly. Anterior ocellus not visible from above. Facial cones medium in length, divergent, subacute, subvertical and not visible from above, slightly rugulose, sparsely pubescent. Antennæ inserted below frontal plates, in front.

Thorax strongly arched, finely punctate. Pronotum short, depressed below dorsulum and head; with a fovæ on each side above pleurites; lighter in color than dorsulum. Dorsulum quite strongly ascending, roundly pointed anteriorly; with a stripe of lighter brown on dorsal surface. Wings hyaline, about two and a half times as long as broad, broadest across middle of first marginal cell, quite broadly rounded apically; radius as long as second cubital; first marginal cell smaller than second.

Female.—Abdomen arched dorsally; borders of ventral segmental plates lighter colored. Genital segment about as long as anal segment; concolorous with rest of abdomen except a yellow band around middle of dorsal plate; dorsal plate longer and less acute than ventral; genital pore about one-third as long as dorsal plate. *Male.*—Abdomen more slender than in female. Genital segment longer than anal ventral plate; claspers of medium length, simple, tapering, acute and recurved apically; anal projection bilobate, the posterior lobe horizontal to other lobe and composed of two lateral flaps, reaching to middle of genital segment; pubescence very short and sparse.

Described from five males and two females collected in Colorado by C. F. Baker.

THE CHILOPODA OF CALIFORNIA I

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For many years it has been clear to specialists that centipedes, millipedes, Scolopendrella, and Pauropus with its relatives must be regarded as constituting four distinct classes rather than one as covered by the term Myriopoda as prevailingly used. Since the Chilopoda are closer to the Insecta, according to present evidence, than to the other three classes, there seems much justice in the proposal to place the Insecta and Chilopoda in a larger group coordinate with one composed of the Symphyla, Pauropoda and Diplopoda. It has been proposed to call the former group the Etymochyla, the latter the Myriopoda sens. str. More recently Pocock has designated these two divisions (superclasses) as the Opisthogoneata and Progoneata, names referring to the fact that in insects and centipedes the reproductive organs open through a single duct near the caudal extremity of the body, whereas in Scolopendrella, Pauropus, and the millipedes proper, the paired genital ducts open on the anterior region of the body (mostly the second segment). In accordance with these findings the Chilopoda and Diplopoda with be treated quite apart in the present series of synopses.

The first work published upon the centipedes and millipedes of California, consists of the papers of Dr. Horatio Wood. Before his time, however, species now known to occur within the state had been described from other localities by Say (1821), Brandt (1841), Newport (1844), and de Saussure (1860). In a number of papers published from 1861 to 1867, Dr. Wood described from the Pacific coast region something over a score of species, most of these being from California. In 1869 and 1872 Humbert and Saussure published their "Myriopoda Nova Americana" and "Etudes sur les Myriopodes" in which several species occurring in California were described. In 1875 Dr. Anton Stuxburg issued a paper on North American Lithobii in which he named six new species from this state, two of them subsequently being made types of subgenera. Dr. Karsch added several species to the known fauna in 1881; and during the same year Kohlrausch published a synopsis of the known Scolopendridæ of the world in which a number of records for California are given.

By 1885, 27 species had become known from California, this being more than was listed from any other of the states at that time. Since that time further contributions touching the chilopods and diplopods of the state have been made by Bollman (1887-1889), Daday (1889-1891), Cook and Collins (1895), Cook (1899 and 1904) and the present author (1902-1910). The known fauna now includes seventy or more species; yet, considering the territory embraced, it must be said that this list represents the actual fauna very imperfectly. Attention and cooperation on the part of collectors would un-

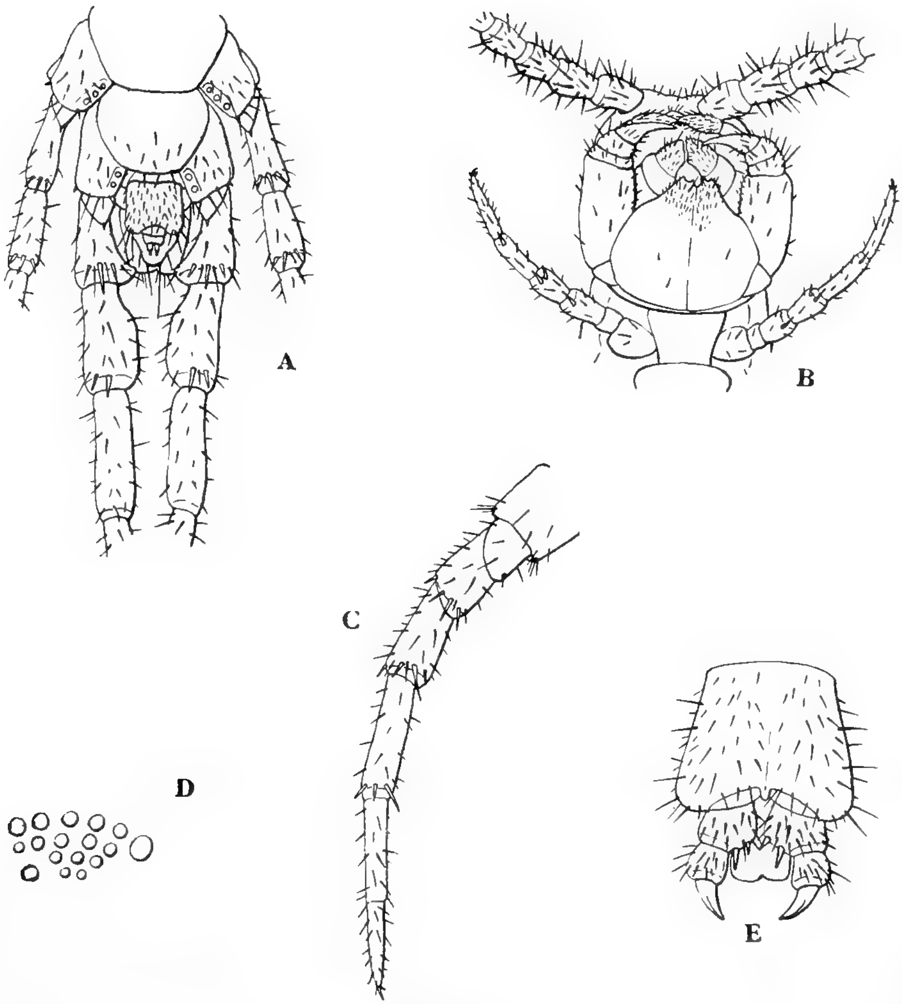

Figure 131.

A, Ventral view of caudal portion of a male of Lithobius utahensis. The figure shows the modification of the anal legs, the ventral spines of the latter, and most of those of the penultimate pair, the coxal pores of the last two pairs of coxae, and the genital appendages. B, Ventral view of head and first segment of L. utahensis, showing the prehensorial feet, prosternum with prosternal teeth overlying the mouth parts the first legs with their ventral spines, etc. C, Cephalic aspect of leg of eleventh pair of Lithobius obesus showing biarticulate tarsi, etc. D, Eye patch of L. obesus showing ocelli in four series, the large single ocellus at the right (caudal end), and at the left and below the peculiar Organ of Tomosvary. E, Gonopods of female L. obesus, showing the undivided claw, the basal spines, etc.

doubtedly bring to light many important and interesting forms. Our knowledge of the Diplopoda is especially unsatisfactory; while of the Symphyla and Pauropoda,—undoubtedly represented in the state—so far as known to the author, there have been published no records at all. The promising bionomic problems presented by these much neglected arthropods in the extensive and diversified Californian region remain essentially untouched.

THE CLASS CHILOPODA.

The chilopods are all terrestrial forms in which the body presents two main divisions, the head and the trunk or body proper. The body, enclosed in a chitinous exo-skeleton free from lime salts, is relatively long and ribbon-like, being compressed dorso-ventrally. It is divided into numerous segments

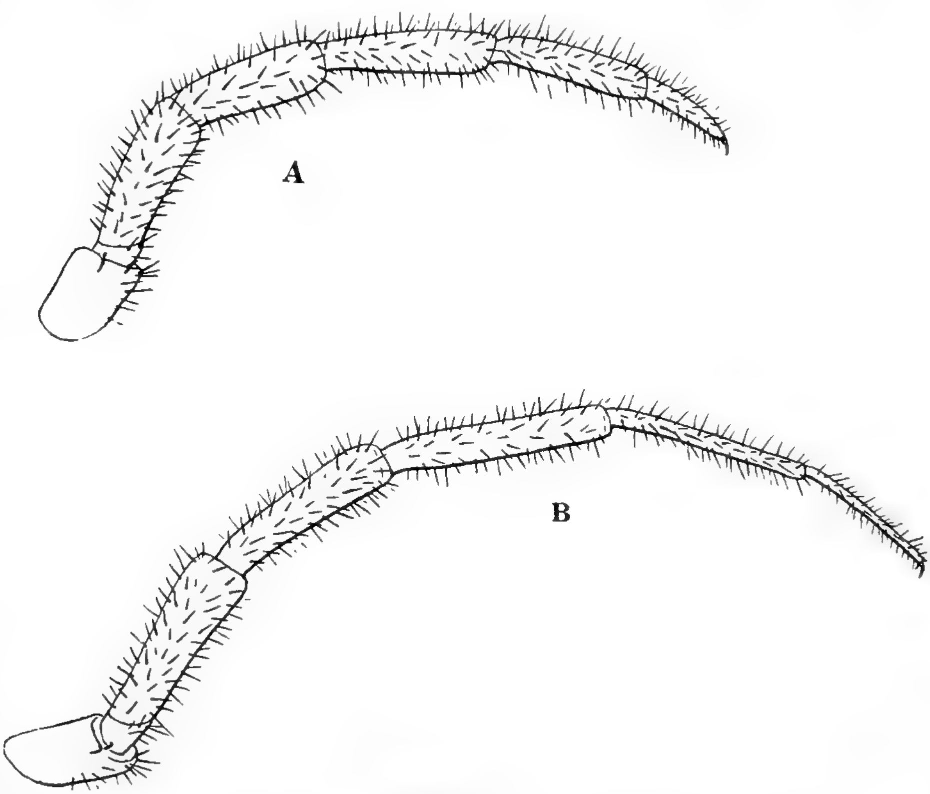

Figure 132.

A, Left anal leg of a specimen of Lamyctes fulvicornis from Naugen, Wisconsin. The specimen is 9.6 mm long. B, Left anal leg of a specimen of Lamyctes pinampus sp. nov. from Claremont, Cal. The specimen is 8.6 mm long. The figure is drawn by camera lucida on the same scale of magnification as A.

nearly all of which bear each a single pair of six or seven jointed legs. The legs are inserted at the sides of the body, being widely separated by the large sternal plates. The first pair of post-cephalic appendages are modified into "poison-jaws," commonly referred to in literature as the prehensorial feet. The coxæ of the prehensorial feet fuse in the middle line into a plate termed the prosternum, which, together with the feet proper, extends forward beneath the head. Eyes either absent or present; when present consisting of a single or of several to numerous simple ocelli, these rarely agglomerated or pseudo-facetted. Antennæ mostly long and thread-like or cylindrical, rarely club-shaped or flattened, composed of 14 (rarely 12 or 13) or more segments. The length of the antennæ like that of the legs, is mostly inversely proportionate to that of the body. The head bears one pair of mandibles and two pair of maxillæ, of which maxillæ the second constitute a labium comparable to that of insects. Stigmata always or nearly always with a closing apparatus. Tracheal system presenting anastomoses excepting in Scutigera. Genital duct unpaired, opening on the preanal segment. Anal segment enclosed in three sclerites, one dorsal and two pleuro-ventral.

Most chilopods are very sensitive to conditions of moisture; and as a result in regions like California, many forms burrow into the ground during the dry season and are to be secured only by digging down in suitable places until damp earth is reached. They abound both in inter-tropical and in temperate regions, while fewer forms exist even in sub-artic and artic territory.

Key to the Orders of Chilopoda.

a. Tracheæ opening through seven unpaired spiracles arranged along the median dorsal line; antennæ very long and many jointed; legs likewise extremely long, the tarsi composed of many segments; agglomerated or falsely facetted. Order Schizotarsia.

aa. Tracheæ opening through paired spiracles situated in the pleural region between tergite and coxæ of a variable number of the body segments; antennæ and legs moderate or short; ocelli of eyes not agglomerated or falsely facetted.

b. Trunk with fifteen leg-bearing segments. among which the tergites of the 2nd, 4th, 9th, 11th and 13th are shortened or reduced; young born with seven pairs of legs, subsequently acquiring the full number through several distinct steps or stages. Order Anamorpha.

bb. Trunk with twenty-one or more leg-bearing segments among which the tergites of none are relatively reduced or shortened; young hatched with the full number of legs. Order Epimorpha.

Order SCHIZOTARSIA.

This order includes the single family Scutigeridæ of which one genus, Scutiger, is known to occur in the United States.

Genus *Scutigera* Lamarck.

Of this genus the following species occurs in California. Most of its relatives are tropical or subtropical.

Scutigera forceps (Rafinesque.)

This form is very common in the southeastern states where it has long been known. It is widely called the house-centipede because of its frequenting houses and outbuildings where it lives upon flies and other insects which it captures with its long, lash-like tarsi. In buildings kept continuously warm it has also been found in New York and other northern states. The author took an adult of the species in Elysian Park, Los Angeles, in June 1909. This appears to be the only record from California.

Order ANAMORPHA.

One sub-order of this order is known to be represented in North America. This is the Lithobiomorpha.

Sub-order LITHOBIOMORPHA.

The members of the Lithobiomorpha are all very active and swiftly running forms quite readily recognized. The body is only moderately elongate, bearing but fifteen pairs of ambulatory legs which are all short or medium in length excepting the ultimate and penultimate, these being commonly more elongate and strengthened for use in defense against attack from the rear. The antennæ are relatively long and distinctly segmented. The anterior margin of the prosternum usually bears two or more pairs of teeth (prosternal teeth). Ocelli may be absent, may be one on each side, or may exist in a group of several to many. In our representatives a pair of spiracles always opens on each of the 3rd, 5th, 8th, 10th, 12th and 14th segments, while a pair may or may not open on the first. The coxæ of the last four (rarely five) pairs of legs in our forms bear a number of glands which open through pores arranged either in a single series or in several more or less irregular series. The genital segment of the female supports a pair of gonopods or genital forceps each of which ends in a claw which may be single or two or three lobed and bears at the base two or three pairs of conspicuous spines.

Key to Families of the LITHOBIOMORPHA.

a. Legs bearing only bristles, no true spines being present; a single ocellus on each side of the head; anal segment both in young and in adults with a pair of pores, the openings of the anal glands (anal pores); no males. Family *Henicopidae*.

aa. Legs bearing both bristles and stout spines; ocelli either absent or in a group of several to many on each side; no anal pores in adults; both males and females occurring. Family *Lithobiidae*.

Family *Henicopidae*.

Two genera of this family are represented in California. They are interesting, among other reasons, because, so far as known, their reproduction is exclusively parthenogenetic, no males ever having been recorded.

Key to Genera and Sub-families of the *Henicopidae*.

a. Tarsi of legs 1 to 13 undivided, those of the 14th and 15th pairs biarticulate; a pair of spiracles present on the first segment. Genus *Lamyctes* (sub. family Henicopinæ).

aa. Tarsi of all legs two-jointed; no spiracles present on the first segment. Genus *Zygethobius* (sub-family Zygetobinæ, new).

Genus *Lamyctes* Meinert.

Two species of this genus are known from the United States, one being recorded here for the first time, the other being common in the eastern part of the country and in Europe and being the type of the genus.

Lamyctes fulvicornis Meinert.

This is a small, slender, parallel-sided species from 7 to 10 pr., 11 mm. in length. The dorsum is yellowish brown in color; the head and prehensorial feet are darker, reddish, the head usually deeper in color anteriorly; the antennæ are yellowish red and darker at base than distally. The caudal margins of all the dorsal plates are straight or rounded, the angles of none being produced. The antennæ have from 24 to 29 (mostly 25) articles.

The author has taken this species in Oregon not far from the California border within which it doubtless occurs.

Lamyctes pinampus, sp. nov.

Very close to the preceding species; but manifestly more slender throughout. Among various points of difference the most conspicuous are in the anal legs which are decidedly more slender and relatively much longer. This may be seen in the accompanying figures, both of which were drawn by means of the camera lucida on the same scale of magnification.

This species was first taken by the author at Las Vegas, Nevada. In California it seems to be common at Claremont from which place specimens collected by C. H. Chen and A. Sugg have been studied.

Genus *Zygethobius* Chamberlin.

One species of this genus is thus far known.

Zygethobius dolichopus Chamberlin.

This species is considerably larger than the species of Lamyctes, measuring from 11.4 to 12.6 mm. in length. The body is manifestly attenuated from the 10th segment cephalad. It is mostly brown in color with the head distinctly darker, reddish to almost black; legs yellow, darkest distally; antennæ yellow to brown, darker proximally. The posterior angles of the 9th, 11th, and 13th dorsal plates are strongly produced. Antennæ with 39 or 40 articles.

Occurring widely in cool moist places in the Wahsatch and Uintah Mts. of Utah at elevations above 8,000 feet. In California it has been taken in the Sierras near Truckee (author).

Family *Lithobiidae*.

The spines borne upon the legs of the members of this family are important in the diagnosis of species. It is customary to enumerate those occurring on the ventral aspect of the first, penult and ultimate pairs, those found at the distal ends of the joints from trochanter to tibia inclusive being listed in order; thus, 1, 3, 3, 1, where trochanter bears one, prefemur 3, femur 3, and tibia 1. The number and arrangement of the ocelli is also of importance in the discrimination of species. It is advantageous to give the number of horizontal series in which the ocelli fall and to enumerate the number of ocelli in these series in order from above ventrad. There is commonly a large single ocellus a little caudad of the main group which is separately reckoned; e. g., 1 and 5, 5, 3, 2. The number of prosternal teeth on the two halves of the prosternum is indicated by the appropriate figures separated by a dash; e. g., 3—3, where the number of teeth on each side is three.

In making use of the keys in the present paper care must be taken to make sure that specimens are fully adult. Even the genera cannot always be ascertained from a study of immature specimens in the present state of our knowledge.

Four genera of this family are represented in California.

Key to Genera of the *Lithobiidae*.

a. Coxal pores in several series are scattered. Genus *Bothropolys*.
aa. Coxal pores in a single series.
 b. Coxal pores borne upon the last four pairs of coxæ. Genus *Lithobius*
 bb. Coxal pores borne upon the last five pairs of coxæ. Genus *Pseudolithobius*.

Genus *Bothropolys* Wood.

The species of this genus known to occur in California may readily be separated by means of the following key:

Key to Species of *Bothropolys*.

a. Angles of the 9th, 11th and 13th dorsal plates produced (subgenus Allobothropolys Ver.). *B. xanti* Wood.
aa. Angles of none of the dorsal plates produced (subgenus Archilithobius Stuxberg). *B. monticola* Stuxberg.

Bothropolys xanti Wood.

This species is commonly 20 mm. and above in length, being one of the larger members of the Lithobiidæ of California. It is brown in general color above, the ultimate segments, head with prehensorial feet, and the legs commonly darker. There are 20 articles to the antennæ. The anal legs are long and slender. The claw of the female gonopoda is tripartite, the basal spines numbering 3—3.

B. xanti is common in southern California and along the coast and in the Coast Mts. north to San Francisco and possibly beyond. The author has specimens from San Bernardino County, Los Angeles, Santa Monica, Claremont (Pomona Coll. Collection), Santa Barbara and other southern points, and from Stanford, Monterey Co., etc.

Bothropolys monticola (Stuxberg).

Syn. *Lithobius californicus* Daday, 1889.

Cf. also sub *Lithobius pusio* Stuxberg in present paper.

B. monticola is on the average larger than the preceding species. It is darker in color. The dorsum commonly dark brown or mahogany; the head more reddish; legs yellowish the posterior pairs darker. Antennæ with mostly 20 articles but in some the number may be as large as 27 (variety). Gonopols as in the preceding form.

After examining material from many different localities, the author is convinced that Stuxberg based his description upon an individual only partly grown and that in enumerating the spines of the anal legs he included some more properly belonging to the dorsal side as would be natural in some individuals that have been studied, giving the formula 1, 4, 3, 1—1, 4, 3, 2 instead of 1, 3, 2, 1. The species in some features is variable and shows a tendency to dimorphism.

While *B. xanti,* as above indicated, prevails in Southern California and along the coast and in the Coast Mt., the present species replaces it in the Sierras and ranges northward into Oregon and Washington, where it is abundant.

Genus *Lithobius* Leach.

Two subgenera of this large genus, when considered in the prevalent manner, are known to occur in California. The following key will aid in the sparation of these subgenera and of the species known under each.

KEY TO SUBGENERA AND SPECIES OF *Lithobius.*

a. Angles of the 9th, 11th, and 13th dorsal plates produced (Subgenus Lithobius sens str).
  - b. Prosternal teeth 2—2; coxal pores circular.
    - c. None of the last pairs of coxæ armed laterally. Spines of anal legs 1—3—2—1, length 14—15 mm. *L. angelus* Chamberl.
    - cc. Last four pairs of coxæ armed both laterally and dorsally. Spines of anal legs 1—3—3—2; length up to 24 mm. *L. paucidens* Wood.
  - bb. Prosternal teeth 4—4 or more; coxal pores transverse.
    - c. Articles of antennæ 28—31; ocelli on each side about 30. *L. aztecus* H. S.
    - cc. Articles of antennæ 40 or more; ocelli on each side 16—21. *L. chumasanus* Chamberl.

aa. Angles of none of the dorsal plates produced (Subgenus *Metalithobius* nom. nov.)
  - b. Prosternal teeth 5—5; last coxæ ventrally armed. Coxal pores 2—3—3—2; spines of the first legs 1, 1, 1; length 12 mm. *L. pusio* Stuxberg.
  - bb. Prosternal teeth 2—2; none of the coxæ ventrally armed.
    - c. None of the posterior coxæ armed either laterally or dorsally.
      - d. Spines of anal legs 1, 2, 1, 0; coxal pores 1, 2, 2, 2; length 11 mm. *L. paradoxus* Stuxberg.
      - dd. Spines of anal legs 1, 3, 2, 0; coxal pores 3, 4, 4, 3; length 8 mm. *L. remex* Chamberl.
    - cc. Some of the posterior coxæ armed at least dorsally.
      - d. Length of body 15 mm.; width of body 2.5 mm.; 3rd and 4th joints of anal legs in male deeply furrowed above, the third with a rounded carina at distal end. *L. carinipes* Daday.
      - dd. Length of body 13 mm. or less; width well under 2 mm.; anal legs of male not modified as described under d.

e. None of coxæ laterally armed; claw of anal legs armed with one spine; claw of penultimate legs armed with two spines; claw of female gonopods bipartite.
L. Kochii Stuxberg.

ee. Only the last two pairs of coxæ laterally armed.

f. Claw of gonopods of female entire. Anal legs of male not conspicuously modified; spines of anal legs 1, 3, 2, 1. *L. obesus* Stuxberg.

ff. Claw of female gonopods tripartite.

g. Claw of penultimate legs armed with but one spine or accessory claw.

h. Spines of anal legs 1, 3, 3, 1; spines of first legs 1, 2, 1; anal legs of male not specially modified.
L. sastianus Chamberl.

hh. Spines of anal legs 1, 3, 2, 0—1, 3, 2.

i. All tarsi distinctly biarticulate; fourth joint of anal legs in male produced into a conspicuous lobe at the dorso-mesal angle of proximal end.
L. clavigerens Chamberl.

ii. Tarsi of legs 1—13 undivided (Monotarsobius); anal legs in male not modified as under i.

j. Anal legs of male with the prefemur at distal end produced mesad as a lobe, above which the femur is excavated.
L. utahensis Chamberl.

jj. Anal legs of male not thus modified. *L. utahensis* var. *tiganus* var nov.

gg. Claw of penultimate legs armed with two spines.

h. Last three pairs of coxæ armed above; anal legs in male strongly modified. Spines of penultimate legs 1, 3, 3, 1; ocelli 12.
L. castellopes Chamberl.

hh. Last four pairs of coxæ armed above anal legs in male not conspicuously modified; spines of penultimate leg 1, 3, 3, 2; ocelli about 16.

i. Spines of anal legs 1, 3, 2, 1; articles of antennæ 20. *L. manni* sp. nov.

ii. Spines of anal legs 1, 3, 2, 0; articles of antennæ 21—23. *L. manni* var. *pia* var. nov.

eee. Last three pairs of coxæ laterally armed. Claw of penultimate legs armed with two spines; coxal pores 4, 5, 5, 4—4, 5, 5, 5. *L. pitophilus* Chamberl.

Lithobius paucidens Wood.

This is a large species quite readily recognized by the characters given in the key. Spines of 1st legs 2, 3, 2; of penult, 1, 3, 3, 2. Claw of the penult legs armed with two spines. Coxal pores 4, 3, 3, 3, to 6, 5, 5, 5. Articles of antennæ 29—34. Ocelli about 16 in four series (1—4, 4, 4, 4). Claw of gonopods of femal entire; basal spines 2—2 to 3—3. The femur in anal legs of male generally flattened dorsally and laterally extended for part of its length.

L. paucidens is evidently common in the southern part of the state, the author having collected numerous specimens at Los Angeles, Santa Monica, Laurel Canyon, San Bernardino, Santa Barbara, etc.

Lithobius angelus Chamberlin.

A species of medium size. General color reddish brown. Antennæ with 26—28 articles. Spines of 1st legs 1, 3, 1—1, 3, 2; of penult 1, 3, 3, 1, the claw armed with but one spine. Coxal pores 5, 5, 5 (6), 5. Claw of female gonopods tripartite.

Known only from Los Angeles (author).

Lithobius aztecus Humbert and Saussure.

Ferruginous. Length ad 23 mm. Prosternal teeth 6—6 to 7—7. Posterior legs longer than antennæ (ad 10 mm. and 8 mm. respectively).

A common Mexican species reported by Bollman from the state but not found by the author in any collections from the region. It is quite likely, however, that it occurs in the southern parts.

Lithobius chumasanus Chamberlin.

Adults are deep brown to mahogany in color, the legs being paler distally. Articles of antennæ 42—46. Coxal pores 7, 8, 8, 6—8, 8, 8, 7. Anal and penult legs each with spines 1, 3, 3, 1. Claw of penult legs armed with one spine. Claw of female gonopods bipartite or with a very small 3rd lobe on the inner side.

Santa Barbara (author).

Lithobius carinipes Daday.

Brown, the dorsum with a longitudinal fuscous stripe. Antennæ rather long, consisting of 22 articles. Ocelli 15 on each side. Prosternal teeth 2—2. Coxal pores 2, 3, 4, 3. Coxæ of ultimate legs laterally armed. Anal legs in male crassate, the third and fourth joints sulcate above, the sulcation of the third deeper and at end bearing a rounded carina. Claw of anal legs unarmed; spines 1, 3, 2, 0.

Female unknown.

Northern California (D. J. Vadona).

Lithobius pusio Stuxberg.

Head chestnut. Antennæ dark on mesal side. Feet and venter gray. Coxæ of last pairs of legs armed ventrally and also laterally. Antennæ short, the articles short and stout, the ultimate equalling the four preceding taken together. Ocelli on each side six in two series.

Various points in Stuxberg's description of this species indicate that his specimen was immature. Its validity is very doubtful. The description fits immature specimens of *B. monticola* in certain stages; and the author is convinced that it was such that Stuxberg had before him. However *pusio* is kept apart for the present in order that any vestige of doubt as to its standing may be removed.

The type was collected by Eisen near San Francisco.

Lithobius pitophilus Chamberlin.

Dorsum brown or chestnut. Antennæ rufous at tips. Spines of first legs 2, 3, 2; of penult 1, 3, 3, 2; of anal 1, 3, 2, 0. Prefemur of anal legs of male enlarged distad and the more distal joints inflated.

Truckee (author).

Lithobius obesus Stuxberg.

Antennæ short, consisting of 20 articles. Ocelli 10 or thereabouts in three series. Coxal pores 2, 3, 3, 3—3, 4, 4, 4. Spines of 1st legs 1, 2, 1; of anal 1, 3, 2, 1. Antennæ rather longer than anal legs Anal legs a little crassate in both sexes.

Sausalito (G. Eisen), Claremont and Catalina Is. (Baker), Stanford (Mann), Monterey, Los Angeles, Laurel Canyon, San Bernardino (author).

Lithobius clavigerens Chamberlin.

Body, antennæ and last pairs of legs brown; other legs yellow. Spines of first leg 1, 3, 2; of penult 1, 3, 3, 1, the claw armed with one spine; of anal legs 1, 3, 2, 0, the claw unarmed.

Pacific Grove and Laurel Canyon (Los Angeles Co.), (author); Claremont and Catalina Is. (Baker).

Lithobius castellopes Chamberlin.

Brown, the legs and antennæ yellowish. Spines of 1st legs 1, 3, 2—2, 3, 2; of penult 1, 3, 3, 1, the claw with two accessory spines; of anal 1, 3, 2, 0, the claw unarmed.

Shasta Springs (author).

Lithobius manni, sp. nov.

Greyish brown, the caudal margins of dorsal plates darkened; head brown, paler over frontal region; legs yellow or whitish, the last pairs darker. Ocelli mostly about sixteen, arranged in four series 1—5, 5, 3, 2. Spines of first legs 1, 3, 1; of penult 1, 3, 3, 2; the claw armed with two spines; of anal 1, 3, 2, 1, the claw unarmed. Antennæ short, the articles 20. Last two coxæ armed laterally with a minute spine. Coxal pores 2, 3, 3, 2. Claw of gonopods bipartite, or a third lobe minute.

Stanford. (W. M. Mann).

Lithobius manni var. *pia* var. nov.

Similar to the preceding in general; but all specimens examined from the type locality differ in having several more articles to the antennæ (21—23), in having the spining of the anal legs uniformly 1, 3, 2, 0, and in a few minor points. The ocelli in one specimen ranged thus, 1—4, 5, 4, 2. Coxal pores 3, 4, 4, 3. Lateral spines of 14th coxæ much smaller than those of the 15th.

Monterey (author).

Lithobius paradoxus Stuxberg.

Brown, head and antennæ darker; ventral plates and legs, especially the caudal ones paler. Spines of first legs 1, 2, 1. Claw of penult legs with one accessory spine. Claw of anal legs unarmed. Antennæ about half the length of the body. Ocelli 8 in two series. Anal legs of male crassate.

San Pedro (G. Eisen). Probably based on a young specimen.

Lithobius remex Chamberlin.

Brown; legs paler. Ocelli on each side 6 in two series, deeply pigmented. Spines of first legs 1, 2, 1; of anal legs 1, 3, 2, 0, the claw unarmed. Anal legs in male flattened sublaterally, the plane of compression becoming nearly horizontal distad.

Shasta Springs (author).

Lithobius kochii Stuxberg.

Testaceous brown. Antennæ short, but little more than one-third the length of the body. Ocelli about 9, arranged in three series. Coxal pores 2, 3, 3, 3. Spines of first legs 0, 1, 1. Anal legs short, about equalling the antennæ in length, in male not crassate. Claw of anal legs armed with a single claw.

Sausalito (G. Eisen); Pacific Grove (author); Claremont (Baker; Pomona Coll.).

Lithobius sastianus Chamberlin.

Dorsally brown, the major scuta darker along the caudal margins; antennæ paler distad. Ocelli 12 in three series. Spines of first legs 1, 2, 1; of penult 1, 3, 3, 1, the claw with one spine. Coxal pores very small, 2, 2, 3, 3—3, 3, 4, 3.

Lithobius utahensis Chamberlin.

Yellow to brown, the legs and antennæ paler. Antennæ and anal legs about equal in length (2.5 to 3 mm.). Spines of first legs 1, 2, 1—2, 3, 2; of penult 1, 3, 3, 1—1, 3, 3, 2. Coxal pores 2, 2, 2, 2—2, 3, 3, 3. Length 7.5—11 mm. Rarely the anal legs of male lack the excavation on femur indicated in the key.

Abundant in Utah and among the author's notes recorded from Cal. In. Cal., however, it occurs chiefly as the following variety.

Lithobius utahensis var. *tiganus* var. nov.

Differing from the species apparently in never having the anal legs of male modified as described for that form. Specimens from Pacific Grove, etc., agree as follows: Last two coxæ laterally armed. Spines of first legs 1, 3, 2; of penult 1, 3, 3, 2, the claw armed with a single spine; of anal 1, 3, 2, 9, the claw unarmed. Ocelli 5—7 in two series. Coxal pores 3, 4, 3, 3—3, 4, 4, 3, small.

Pacific Grove; Santa Barbara, etc. (author).

SOME MOTHS FROM CLAREMONT, CALIFORNIA
WITH NOTES ON CERTAIN ALLIED SPECIES

BY HARRISON G. DYAR.
U. S. NATIONAL MUSEUM, WASHINGTON, D. C.

Among a collection of "Micros" made by Mr. C. W. Metz at Claremont, for the purposes of a faunal synopsis, were certain smaller moths of higher families. The material was sent to Mr. August Busck by Prof. C. F. Baker, and those not belonging to the Tineid families were turned over to me. I make mention also in this connection of specimens from Claremont, formerly sent to me by Prof. Baker, as well as certain species from other localities that are allied to these.

Family NOCTUIDAE.

Pleonectyptera cumulalis, new species.

Ground color of wings dull ocherous, powdered with brown; lines marked at their inceptions on costa by dark spots, pale, the inner line straight, edged outwardly by dark shading; reniform dark filled, contrasted, yet not strongly so; outer line incurved below cell, pale, defined by the powderings; subterminal line flexuous, pale, marked with a dark submaculate border within. Hind wings brown-powdered, showing an outer dark shaded line. Expanse, 21—24 mm.

Three specimens, Claremont, Cal., (C. F. Baker, No. 3102); Argus Mts., Cal., (Koebele).

Type, No. 13447, U. S. National Museum.

This appears to be the species misidentified by Smith as *P. finitima* Smith (Trans. Am. Ent. Soc., xxxiii, 377, 1907), which therefore requires a new name. The types of *finitima* are identical with *tonalis* Smith of the paper cited, the name *fiinitima* having precedence.

Family GEOMETRIDAE.

Eois microphysa Hulst.

A single specimen collected by Mr. Metz appears to belong to this rare species, described from the Panamint Valley. The specimen is much rubbed, so that a positive identification cannot be made.

Family PYRALIDAE.
Subfamily PYRAUSTINAE.

Loxostege similalis Guenée.

Two specimens. These are unusually dark in color.

Evergestis napacalis Hulst.

Seven specimens. Also several other specimens from Prof. Baker.

Nomophila noctuella Den. and Schiff.

One specimen of this world-wide species.

Metasia argalis Fernald.

One specimen, agreeing well with Fernald's type from the Argus Mts. Both are females. The species strongly resembles *Diasemia elegantalis* Warren, of which I have three males. In *elegantalis* the hind wings are nearly immaculate, in *argalis* they are marked with two wavy brown lines, but these may be sexual differences. I do not perceive any other specific characters between them. Warren's name has precedence in case the species prove to be identical.

Pyrausta cinerosa Grt. and Rob.

Ninteen specimens. All are of the dark *cinerosa* form, no true *laticlavia* being present. I have, however, some of the true *laticlavia* from Claremont, formerly received from Prof. Baker.

Cornifrons thalialis Walk.

One specimen.

Lineodes integra Zeller.

Fourteen specimens. This species would seem to be remarkably common in Claremont; but as it feeds upon potatoes (among other plants) its abundance may be due to the proximity of gardens.

Subfamily CHRYSAUGINAE.

Acallis griphalis Hulst.

One female specimen. This female is like males before me, and proves that the specimen referred here by me as the female (Proc. Ent. Soc. Wash.. x, 96, 1908) is really specifically distinct. I therefore describe it as follows:

Acallis centralis, new species.

Dull purplish red; forewings with two illy defined orchraceous lines, the inner curved from before middle of costa to basal third of inner margin, the outer from beyond middle of costa to outer third of inner margin, slightly angled downward in its lower third. Hind wings silky whitish, shading to purplish at apex and in a narrow line along outer margin. Expanse, 26 mm.

One female, Williams, Arizona, July 10 (H. S. Barber).

Type, No. 13445, U. S. National Museum.

The species of *Acallis* have veins 4 and 5 of forewings stalked. A single specimen before me, apparently of *A. griphalis* Hulst, has these veins completely coincident. It might, therefore, be placed in another genus, but it resembles *griphalis* so closely, that I consider it for the present as an instance of variation in venation. The specimen is from Mesilla, New Mexico, (C. N. Ainslie).

Another closely allied species is before me, which presents a somewhat similar peculiarity of venation, but in this case I think it is indicative of generic separation. It differs from *Acallis* in that veins 7 and 8 of hind wings are coincident. I separate it under the new name *Polloccia,* as the character seems constant and the species is superficially distinct from any of our Chrysauginæ.

Polloccia alticolalis, new species.

Straw color, irrorated with purplish; lines of the pale ground, defined by borders of dark purplish, placed mesially of the lines; a basal costal patch of dark purplish; inner line slightly projected, almost dislocated subcostally; outer line sharply angled subcostally, then roundedly excurved, becoming below parallel to inner line. Hind wings silky pale ochraceous. Expanse, 13 mm.

Two males, Skyland, Page Co., Virginia, July 31, 1900 (H. G. Dyar), Dublin, New Hampshire, June, 1909 (A. Busck).

Type, No. 13446, U. S. National Museum.

Subfamily CRAMBINAE.

Crambus leachellus Zinck.

Five specimens.

Ommatopteryx ocellea Haw.

One specimen.

Subfamily PHYCITINAE.

Epischnia boisduvaliella Guen.

One specimen.

Etiella schisticolor Zeller.

One specimen; also another formerly sent by Prof. Baker. Neither specimen is good enough in condition to show the presence of the discal dots, the character separating this form from the Eastern and European *zinckenella* Treits.; but I have others from California that do show them. This form occurs in California, Washington and Idaho. In specimens from Utah the discal dots are faint, while specimens from Colorado are unequivocally of the *zinckenella* form. The species has been bred from pods of Astragalus, and may prove injurious to beans or peas.

Vitula serratilineella Rag.

Two specimens.

Honora dotella, new species.

Costa broadly whitish-shaded to beyond cell; rest of forewing dark gray with vinous tint; a diffuse reddish ocher patch at base, a stain of the same color on lower edge of cell; inner line narrow, whitish, angled, followed by black; one discal dot only (the lower); outer line lost. Hind wing whitish, gray only on the fringe on upper part of wing. Expanse, 25 mm.

Two specimens, collected by Mr. Metz.

Type, No. 13448, U. S. National Museum.

Allied to *H. mellinella* Grt., but larger, the costal pale edge much wider, the orange beyond the inner line diffused. Differs from *subsciurella* Ragonot in the obsolescence of the outer line.

The following species is not from Claremont, but from a neighboring region and may appropriately be described here:

Zophodia stigmella, new species.

Reddish gray, lightened to nearly white at end of cell and outwardly along both sides of the veins; except on lower half of wing lined in black; a double black patch covering most of basal third of inner margin; costa shaded with black along the middle; a patch on lower edge of cell near middle; a black discal mark on lower angle of cell; no lines. Hind wing whitish, shading to gray at costa and narrowly along termen. Expanse, 28 mm.

One specimen, San Diego, California, May 8, 1909 (G. H. Field).

Type, No. 13449, U. S. National Museum.

Homoeosoma mucidellum Rag.

Twelve specimens. Only three of these are of the usual light-colored form. Most are dark, some nearly uniformly dark gray, with the markings nearly lost.

Ephestiodes gilvescentella Rag.

Thirty-one specimens of this common little species.

WEST COAST NEWS NOTES

[In this department we hope to give in most numbers of the Journal some idea of the doings and movements of western entomologists, notices of publications of interest to western students, notices of entomological meetings, etc. To this end, we hope that students or collectors will send in all items of entomological interest about themselves or others. Address: Mr. Fordyce Grinnell, Jr., 572 N. Marengo Ave., Pasadena, Calif.]

Dr. A. Fenyes, of Pasadena, has been elected a Fellow of the Entomological Society of London.

Dr. William Morton Wheeler, of Harvard University, the chief authority on ants in this country, is planning to spend a part of the winter in Southern California.

Prof. R. W. Doane, of Stanford University, is the author of a recent publication of Henry Holt & Co., called "Insects and Disease."

Dr. A. Fenyes is working on a Catalogue of the *Aleocharinae* of the World.

According to an interesting editorial in The Argonaut, San Francisco, of October 29, Prof. Woodworth of the University of California, has a book in press on eugenics, based on the life organization of the bee.

Messrs. Clemence and Coolidge, of Pasadena, have described a new Hesperid, a *Rhabdoides*, from Southern Arizona, related to *cellus,* Bdv.-Lec.

Mr. W. M. Davidson, a graduate of Stanford University, has been spending the fall months in Pasadena. Mr. Davidson has done considerable work on Californian *Aphididae,* and is now beginning the study and collection of the *Syrphidae.*

The late Alexander Agassiz did considerable entomological work in his younger years; he collected a lot of Lepidoptera in central and northern California, and his very first scientific paper was on the flight of Lepidoptera. An excellent sketch of his life is found in Popular Science Monthly for November.

Mr. J. R. Haskins has returned from a week's vacation at Gold Run, Arizona, where he turned up some interesting Lepidoptera. During the early summer he made an extended trip to the east, doing some collcting in Arizona and Mexico on the way.

Messrs. J. A. G. Rehn and Morgan Hebard were in Pasadena on September 25 and 26, taking a trip up Mt. Lowe. They collected about 10,000 Orthoptera during a two months' collecting trip along the coast.

Mr. E. A. McGregor, of Stanford University, stopped in Pasadena, the early part of September, on his way to Texas to help fight the Cotton-boll Weevil.

Mr. D. T. Fullaway, entomologist in the Hawaiian Experiment Station, has been spending the present semester in study at Stanford University, and also assisting in Course I, in Entomology.

The Southern California Academy of Sciences has received, by gift, the collection and library of the late Max Albright, of Soldiers' Home. The insects, mostly Coleoptera, are contained in about 70 boxes, and include some good Californian species.

A new experimental station is being established at Santa Ana, Orange County, under the direction of Prof. C. W. Woodworth.

Dr. L. O. Howard, U. S. Entomologist, visited various sections of Southern California during the last of September, stopping off at Pomona College.

"The United States government says that toads are worth $20 apiece to the farmer as they eat up flies, bugs and worms which destroy fruits and other farmers' crops. One toad is known to have caught 86 flies in ten minutes."—Pacific Rural Press, Oct. 29, 1910.

Gleanings in Bee Culture, issued twice monthly at Medina, Ohio, has an interesting department of short notes:—Beekeeping in Southern California, by Mrs. H. G. Acklin, of Glendora, Cal.

Mr. F. Grinnell, Jr., is editing a collection of biographies and selections of the Pioneer Naturalists of California, to be published in book form, probably in the spring.

The honey crop in the Imperial Valley is reported short this year, owing, it is said, to the fact that cotton-fields are taking the place of alfalfa-ranges.

The sessions of the University Farm at Davis, in the Sacramento Valley, are proving very instructive to the farmers of the region. A good force of lecturers and instructors are in charge, including the entomologists Professors W. T. Clarke and J. C. Bridwell.

Mr. E. W. Rust, of Whittier Pathological Laboratory, is engaged in the study of the life-histories of scale-insects.

The Catalogue, Entomologie, 1911, of Max Weg of Leipzig, Germany, No. 127, includes the library of Herr. Prof. G. Kraaz, Berlin; it consists of 4343 titles, and is very interesting to the bibliophile. Another recent catalogue is that of the New York Book Mart.

"Prof. W. T. Clarke, in charge of the farmers' institutes and university extension work in agriculture, will attend the meeting of the men interested in farmers' institute work which will be held in Washington. He will then return to the coast to take charge of a demonstration train."—San Francisco Call.. Nov. 2, 1910.

"Daniel William Coquillett knows more about insects harmful to vegetable growths than any other man, though he is only fifty-four years old. Since 1896 he has been honorary custodian of diptera in the United States National Museum at Washington, but before that he had done a large amount of effective work in the farms and in the orchards of Illinois and California. Grasshoppers, caterpillars, and the microscopic pests which injure fruit trees are his especial prey, and it was through his efforts that ladybirds were imported to exterminate the cottony-cushion scale dreaded by horticulturists."—The Argonaut, San Francisco, Oct. 15, 1910.

Early Geological Surveying in Kentucky, by H. Foster Bain. Mining and Scientific Press, San Francisco, Oct. 1, 1910, pp. 435-437. An account of the survey under N. S. Shaler, tells "the other half of the story," other than the "Dull documents," which "tell but half the story of geological survey life," which is hardly known to the "younger generation" F. G. Sanborn was the entomologist of the survey, and he and his net figure conspicuously in the well executed, humorous and suggestive cartoons of scenes. Any naturalist who has done field work away from towns and railroads will appreciate the article and cartoons. We "should know how the men we now admire as leaders got their start."

Prof. H. C. Fall, of Pasadena, is a member of the executive committee of the International Congress of Entomology.

Prof. C. A. Kofoid, of the University of California, is studying the blood-parasites of birds. This is of a technical and systematic character; but it may turn out to be of great practical value to medicine. Several of our dreaded diseases are caused by the transmission of the blood parasite, by means of insects, from the host to man.

The Oakland College of Medicine has a strong department of Tropical Medicine and Hygiene, under the direction of Dr. Creighton Wellman, with a well-equipped laboratory. There is one associate professor, two assistant professors and two assistants. There are seven regular courses, with lectures and laboratory work. "During the past year the students in this course (Course III) saw and studied cases of Amœbic Dysentery, Amœbic Appendicitis, Liver Abscess, Beri-Beri, Bubonic Plague, Cochin China Diarrhœa, Flagellate Diarrhœa, Endemic Hæmoptysis, Filariasis, Gangosa, Opiathorchiasis, Hookworm, Leprosy, Tertian, Quartan and Æstivo-Autumnal Malaria, Pellagra, various tropical intestinal worms, etc." Course V is divided into three sections:—Medical Protozoölogy, Medical Helminthology, and Medical Anthropology. The textbook in the department is: Manson's Tropical Diseases.

WEST COAST INSECT NOTES

(Every active entomologist is constantly encountering in the course of his work, isolated facts of the greatest interest concerning life histories, locality occurences, new points in anatomy, nomenclatorial corrections, and so on, that are of the greatest interest and value and should not be lost to entomological literature. We shall regularly devote some space to such notes and invite them from every quarter.

Plecoma near Pasadena.—A fresh but partially eaten specimen of *Plecoma* was found in a mountain cañon near Pasadena just after the rain of October. This is especially interesting, as only one other fragment of this rare beetle was found years ago in this region, and a species described from one specimen from the Cuyamaca mountains, by Prof. Rivers. The males of this genus have the habit of flying during or directly after the first heavy rain of the season; the females, on the other hand, being wingless, remain hidden a foot or more in the ground, where the males locate them. It is to be hoped that more specimens of this interesting beetle will be discovered. The present fragment was taken by a High School boy, and is in the collection of Prof. Fall.

Later note: Nineteen more specimens of this *Plecoma* were taken during a rain, about a week ago. They represent a new species, and Prof. Fall will describe it soon.—Fordyce Grinnell, Jr.

Harpyia cinerea Wlk. near Spadra, Cal.—Mr. C. H. Vary, Horticultural Inspector of Pomona, called our attention to the fact that large cottonwoods at Spadra were being entirely defoliated by a very peculiar notodontid larva. After some delay Profs. Cook and Baker visited the locality and found the larvæ pupating in immense numbers in the crevices of the bark on the main trunks, and also on fence posts and boards near by. Although occurring in great numbers the cocoons are difficult to find, being exactly the color of the bark, and set into cavities hollowed out by the larvæ. A large number of the cocoons placed in breeding boxes gave principally Tachinid parasites, so that it is not probable that the occurrence of the moth in so great numbers will be soon repeated.—C. F. Baker.

A Borer in the Castilloa Rubber Tree in Mexico.—Specimens of a Cerambycid borer (*Taeniotes suturalis* Thomson—determined by Wickham) were recently reared from a portion of the trunk of a rubber tree in the State of Chiapas in Mexico. The deeper incisions made in the tree for the purpose of tapping are often invaded by a fungus which causes a constantly enlarging decayed spot in the wood. These spots of dead wood invite, among other insects, this large conspicuous Cerambycid, which, extending its borings into the living wood, accomplishes immense damage to the rubber forests. The gallery made by this borer is fully one-third of an inch in diameter.—D. L. Crawford.

Tortrix citrana in Oranges.—We are now receiving at the Pomona College Biological Laboratory, as we have every year since 1894, oranges in which have burrowed the larvæ of this moth. Last season it did great damage in one part of this county. Although the burrow is small, it ruins the fruit. this pest may become as serious to the orange, as the codling moth—a near relative—is to the apple and pear. While *Tortrix citrana* has worked on the oranges in this county for twenty years, it has usually done but little harm. It is to be hoped that the serious mischief of last year will not be repeated.—A. J. Cook.

The Yellow vs. Red Scale.—*Chrysomphalus citrinus* has usually been regarded as of small importance among the scale pests of orange orchards. It was supposed that a chalcid parasite held it rigorously in check. However, in many sections at the present time, the yellow is hardly less harmful than the red scale. Repeatedly we have brought into the laboratory copious material from various very serious infestations of the yellow scale, without being able to rear from them a single specimen of any chalcid. Its parasite seems to "hold it in check" about as much as the *Scutellista* does the black scale—which is not at all. The yellow scale from present evidence, must be placed upon the list of our serious pests, and must be dealt with rigorously wherever its blighting presence becomes apparent.—A. J. Cook.

Volume 1 Number 1

Pomona Journal of Entomology

MARCH 1909

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PUBLISHED UNDER THE PATRONAGE OF
ONTARIO-CUCAMONGA CITRUS ASSOCIATION
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DEPARTMENT OF BIOLOGY OF POMONA COLLEGE
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JUNE 1909

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Pomona College Journal of Entomology

MARCH 1910

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PUBLISHED BY THE

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MAY 1910

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VOLUME TWO NUMBER THREE

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SEPTEMBER 1910

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