

(*C. pepo*) cut lengthwise to show nectary. Fig. 4. New White Gem Water Melon with perfect flowers. Figs. 5 and 6. Long warted; fig. 5, one flower cut lengthwise to show nectary, the other shows an opening near base. All natural size. Drawn by Charlotte M. King, and pollen grains drawn by L. H. P.

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## PSYLLIDÆ FOUND AT AMES.

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BY C. W. MALLY.

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While studying Hackberry Psyllidæ last year, several other interesting species were found. This led to a general study of the family as represented in this locality. It was the original intention to give a general account of the anatomy and life history, with descriptions of new species. However, only the latter part is given at this time.

One important fact has been brought out again during this study, and that is that in order to generalize in regard to any group of insects, we should have a good representation of the species. Many statements that would be true for a small representation may need to be considerably changed in order to include other nearly related forms, which may not only show valuable structural characters, but in their life history present phases of development having an important bearing on other facts at hand.

Another thing of importance is to know, so far as possible, what has been done. To show this in the present instance, the best way will be to give a list of the American species already described. Dr. C. V. Riley, in Proc. Biol. Soc. Wash., v. 2, p. 67, gave a list and the synonymy up to that time. Since then quite a number of new species have been described and so many new facts brought to light that it seems best to present them altogether, showing clearly the synonymy, the species since recorded, and for the benefit of those interested in the Iowa fauna, indicate the species found here.\*

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\*NOTE.—The following list was prepared in connection with a bibliography of the family. The most important paper in this connection is the one by Dr. C. V. Riley just mentioned, and the synonymy is the same as there recorded. The names of the species recorded since that list was published were taken, as far as possible, from the articles in which they were first mentioned. Inaccuracies were avoided as much as possible. If it proves to be of value to other investigators and induces them to publish their observations on this family, it will have served its purpose.



Beginning with genus *Livia*, we find the described species to be as follows:

## FAMILY PSYLLIDÆ.

## I. SUB-FAMILY LIVIINÆ.

1. *Livia vernalis*, Fitch. (Ames, Ia.)  
*Diraphia femoralis*, Fitch.  
*Diraphia calamorum*, Fitch.
2. *Livia maculipennis*, Fitch. (Ames, Ia.)  
*Diraphia maculipennis*, Fitch.

## II. SUB-FAMILY APHALARINÆ.

3. *Aphalara ilicis*, Ashm.  
*Psylla ilicis*, Ashm.
4. *Aphalara calthea*, Linn.<sup>1</sup> (Ames, Ia.)

## III. SUB-FAMILY PSYLLINÆ.

5. *Calophya rhois*, Glover.<sup>2</sup>
6. *Calophya vitripennis*, Riley.
7. *Calophya nigripennis*, Riley.
8. *Calophya flavida*, Riley.
9. *Psylla arctica*, Walker.  
*Aphalara arctica*, Walker.
10. *Psylla quadrilineata*, Fitch.\* (Ames, Ia.)
11. *Psylla carpini*, Fitch. (Ames, Ia.)
12. *Psylla annulata*, Fitch. (Ames, Ia.)
13. *Psylla pyricola*, Forster.<sup>3</sup>  
*Psylla pyri*, Harris, Fitch, Glover, etc.  
*Psylla pyrisuga*, Bernard.
14. *Psylla buxi*.
15. *Pachypsylla venusta*, O. S.  
*Psylla venusta*, O. S.  
*Pachypsylla celtidis-grandis*, Riley.

\*The specimens in collections marked *Psylla quadrilineata*, Fitch, agree perfectly with the specimens of *Aphalara polygoni* found here. So it must be the same as the European species mentioned, or else we have not seen a specimen of the real *Psylla quadrilineata*, Fitch.

<sup>1</sup>Mentioned in bulletin 102 of Mich. Ag. Exp. Sta. as being injurious to celery.

<sup>2</sup>In a foot note of Dr. Riley's article, Proc. Biol. Soc. Wash., v. 2, p. 67, he substitutes the name of *nigripennis* for *rhois*. In his next paper, "Psyllidæ of the United States," Proc. A. A. A. S., v. 32, p. 319, *Calophya nigripennis* is included as a new species. I conclude that the old name, *Calophya rhois* Glover, is retained and another species, *Calophya nigripennis* Riley, added as shown above.

<sup>3</sup>*Psylla pyricola* Forster has been carefully studied by Mr. M. V. Slingerland, of Ithaca, N. Y., and the results given in bulletin 44 of the Cornell Exp. Sta. He found it to be dimorphic, and designated the summer form as *Psylla pyricola pyricola*, and the winter form as *Psylla pyricola stimulans*.



16. *Pachypsylla celtidis-mamma*, Riley. (Ames, Ia.)  
*Psylla celtidis-mamma*, Riley.
17. *Pachypsylla* (Blastophysa). *celtidis-gemma*, Riley,  
(Ames, Ia.).
18. *Pachypsylla celtidis-cucurbita*, Riley.
19. *Pachypsylla celtidis-pubescens*, Riley.
20. *Pachypsylla celtidis-asteriscus*, Riley. (Ames, Ia.).
21. *Pachypsylla celtidis-umbilicus*, Riley.
22. *Pachypsylla celtidis-vesiculum*, Riley. (Ames, Ia.).
23. *Pachypsylla celtidis-inteneris*, Mally. (Ames, Ia.).<sup>4</sup>

## IV. SUB-FAMILY TRIOZINÆ.

24. *Trioza tripunctata*, Fitch.  
*Psylla tripunctata*, Fitch<sup>5</sup>.  
*Psylla rubi*, Walsh and Riley.
25. *Trioza diospyri*, Ashm.  
*Psylla diospyri*, Ashm.
26. *Trioza magnoliæ*, Ashm.  
*Psylla magnoliæ*, Ashm.
27. *Trioza sanguinosa*, Riley.
28. *Trioza sonchi*, Riley.
29. *Trioza pyrifoliæ*, Forbes<sup>6</sup>.
30. *Ceropsylla sideroxyli*, Riley.
31. *Rhinopsylla schwarzeii*, Riley.

Thus we see that we have now thirty-one species on record.

While studying the group last season, a number of species were found that heretofore had not been mentioned or described. One found very numerous on *Polygonum* agrees very well with the European species *Aphalara polygoni*. Another species found on Ash at Jamaica, Long Island, is apparently identical with the European species *Psylla unicolor*, also found on Ash<sup>7</sup>.

<sup>4</sup>This species was first mentioned by the author in Proc. Ia. Acad. Sci., (1898), vol. 1, part IV, p. 138.

<sup>5</sup>In an abstract of Dr. C. V. Riley's paper on "The Psyllidæ of the United States," *Phylloplecta tripunctata* is mentioned as occurring on the blackberry. This apparently is the same as *Trioza tripunctata* as mentioned in the list, except that a new genus has been designated. Not having seen the complete paper, however, I cannot say whether it is the same species or a new one which also infests the blackberry.

<sup>6</sup>This species was first mentioned and described by Prof. S. A. Forbes in the 14th Ill. Rept., (1884), p. 98.

<sup>7</sup>The specimens were sent to me by Mr. F. A. Sirrine, Entomologist in the N. Y. State Exp. Sta.



Other new species found are as follows:

PSYLLA NEGUNDINIS, sp. nov.

Found on box elder.

*Description of the adult.*—General color light green, sometimes tinged with yellow. Head, including the eyes, much wider than length of vertex; median line distinct; posterior margin concave, the part on either side of median line almost straight, meeting at an obtuse angle; lobes of vertex distinct, roundish, tips quite widely separated and between them is placed the anterior, bright yellow ocellus. Discoidal impressions large, deep, varying in shape, not distinctly limited. Near posterior end of median line there is usually a sharp constriction joining the impressions. Posterior ocelli are bright yellow, very prominent, located on roundish tubercles between discoidal impressions and inner angle of the eyes, and present a rather striking bead like appearance. Eyes very prominent, large, almost semiglobose, brownish, moderately granulated, inner angle distinct, roundish. Portion of head bearing the eyes very prominent, marked off from the rest of the head by a distinct constriction, thus bringing the eyes into greater prominence. Frontal cones large, color bluish-green (sometimes light green), visible from above, strongly diverging, equal in length to the vertex, furnished with numerous bristle-like hairs, slight constriction at middle, tips rounded. Antennæ light yellow, located centrally on either side between the anterior margin of the vertex, the eyes and the base of the frontal cones. First joint roundish, placed in a cup-like cavity with a sharply defined edge. Second joint about half as large as the first. The succeeding joints filiform, the last one slightly enlarged, black, terminal bristles nearly equal. Third joint the longest, the five succeeding ones nearly equal, the ninth and tenth shorter, being very little longer than the second. Tip of ninth slightly enlarged and sometimes darkened.

Pronotum small, of equal width throughout, two distinct lateral impressions on either side with a small ridge-like portion between them. In a fresh specimen we can usually distinguish four whitish spots as follows: Two comparatively large, roundish, dorsal ones separated by a faint median line of yellow, and a smaller one on either side about half way down to the lateral impressions.



Dorsulum well developed, usually tinged with yellow and has whitish markings.

Mesonotum of medium size, has two broad, yellow longitudinal bands on either side of median white line, which is broken in the middle, the ends somewhat triangular in shape and the points turned toward each other. Between the two bands on each side is a fine, curved, whitish line ending at the slight posterior angles of the dorsulum, and posteriorly at the whitish scutellum. Between the base of the anterior wings and the yellow bands, the mesonotum is more light colored.

The wings are transparent, characteristic for this genus, but present no special specific characters.

Ventrally the thorax is light green, sometimes tinged with bluish, sometimes tinged with yellowish. The legs are light colored, the tibiae and tarsi usually bluish green, distal end of posterior tibia and first tarsal joint with prominent black spines. Terminal claws and adhesive pads of second joint well developed.

Mouthparts inconspicuous, tip of terminal segments black.

Genital organs about same length as abdomen of female soon after transforming to adult, but as the developing ovaries gradually distend the abdomen, the ovipositor appears relatively shorter. The dorsal plate is longer than the ventral, although when closed their tips come near together. Anal opening large and prominent. From there on the dorsal plate descends rapidly, is almost straight, except the tip which is short, wedge-shaped, the angles rounded and slightly turned upward. Its margins are curved upward at tip, and at about one-third their length curve downward and meet the ventral plate which is large at base, of equal width to about its middle where it turns distinctly upward and tapers rapidly and evenly to a point. Some show a distinct concavity just beyond the turn. The basal portion of the upper margin distinctly curved upward.

The inner division of the egg sheath can be seen when the plates are slightly spread. The tip is chitinous, brownish, strongly curved upward and narrowing rapidly. The outer more transparent division is visible, flat, the apical angles broadly rounded.

The ventral plate is about two-thirds as long as dorsal one. Their tips coming so closely together is due to the fact that the base of the upper plate is farther forward than the base of the



lower. The ovipositor is furnished with numerous, long, conspicuous hairs.

In the male the lower plate is smaller than usual, little longer than the preceding ventral segment, tapers slightly to base of claspers, roundish ventrally, posteriorly deeply concave for reception of base of claspers, dorsal margins short, nearly straight. Claspers long, inclined forward when at rest, furnished with numerous short bristly hairs, curved laterally so as to include an egg-shaped space with the point downward, tips sharply pointed, brownish black, apparently chitinous, and touching each other. Dorsal plate same height as claspers, wide at base, has no horizontal, backwardly projecting prolongations as in the genus *aphalara*, tapers gradually to the tip, has a distinct curve in the middle, causing the tip to bend toward the claspers. Viewed posteriorly it is oval in outline, the curves corresponding to the curves in the claspers, whose closed tips fit neatly into the dorsal plate.

Penis usually distinctly visible between the claspers, its height to the geniculation a little more than one-half the height of the claspers.

*Pupa*.—Anterior margin of head broadly convex and bearing six or more bristles. Compound eyes dark, prominent. Paired ocelli distinct; anterior one hidden from above. Antennæ long, reach to middle of wing-pads, and have the usual ten segments as follows: Two enlarged basal joints and five succeeding ones distinctly separated, the eighth, ninth and tenth not so distinct, only being indicated by constrictions. The tip is black, terminal bristles distinct, of equal length. The first joint is short, thick and very roundish. The second is shorter, more cylindrical and much smaller in diameter than the first. Joints about three to seven, about equal in length and width, the fifth, however, being slightly shorter than the others; all have one or two visible bristles at their distal end.

Prothorax distinct and as broad as head with the eyes. Femur of first pair of legs projects about half its length beyond prothorax; tibia shorter than femur; first tarsal joint not clearly separated from tibia, only indicated by a slight constriction.

Mesothorax strong and robust, wider than head or prothorax. Wing-pads robust, outer margin convex, furnished with numerous hairs, tip broadly rounded and reaching back to second abdominal segment. Posterior wing-pads smaller, front part overlapped by anterior pads; tip and posterior



margin projecting beyond the anterior pads, broadly rounded; anterior margin more nearly straight, being shaped like costal of wing in the adult.

Abdomen widest at segments three and four, narrowing anteriorly to the first. Posteriorly it is broadly rounded. Segments one to five present short, sparse, marginal wax hairs or bristles, while the three terminal joints have numerous long wax hairs which become more numerous toward tip of abdomen. Anus reniform, with the notch turned backward.

The ventral surface usually a little lighter colored than the dorsal. Clypeus is prominent and of a more yellowish color. Mouth-parts distinct, first joint received by sternal lobes; the second short, quadrangular; the third or distal one longer, conical, tip black, and sometimes turned forward. Hind legs as yet not specially developed. All the coxæ are quite well defined, trochanters usually distinct.

*Brief History.*—This species was first noticed at Ames by Mr. F. A. Sirrine during the spring of 1893. The larvæ were found feeding in the opening buds and at the base of quite young leaves. Since then the life history has been traced in detail and some of the more important facts will be given.

The eggs are deposited in autumn just as soon as the leaves begin to fall. They are inserted closely around the edge of the buds, but are attached to the twig, so in case the bud is broken off the eggs still remain in place. They hatch in early spring, enter the opening buds and feed by sucking the juices from the young tissue. When the leaves are large and have a long petiole, the young larva may be found anywhere on the under side of the leaf, on the petiole, or more preferably at the axil of the leaf, with head downward, *i. e.* toward the stem, and crowded as far down as possible for protection. In this position they may be observed for hours, sitting very quietly, only moving the abdomen laterally or vertically occasionally so as to remove the white mass of excreta and the cottony wax secretion. They pass through five stages<sup>8</sup> and emerge as adults about the middle of May or the first of June. The adults live on the trees during the summer months, feeding on the plant juices, pairing, and maturing the eggs till autumn. When the leaves begin to fall and expose the buds the female begins

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<sup>8</sup>European authors record only four larval stages. With specimens of this species, and also of *Aphatara polygoni*, five stages were recorded. The stage that was most difficult to observe was the one from the hatching of the larva up to the first moult. After that the stages were more easily watched.



depositing the little white glistening eggs around the edges of the buds, and their life cycle is complete.

The egg when first deposited, during October, is of a glistening white color, largest at posterior end, *i. e.* the end having the stem or handle, which is roundish, and blends by a gentle curve with the side opposite the stem. This side is strongly convex in the posterior half, but the curve becomes more gradual as we approach the apex or cephalic end, which lies just across an ideal line extending longitudinally through the center of the egg. At the origin of the stem the egg is slightly bulged. Following the stem the egg is slightly concave, bending toward the opposite convex side of the egg. Then toward the anterior end it again becomes convex and blends with the opposite side to form the tip, which is acutely rounded and has a slight transparent appendage which, in some cases, is indistinct.

After the egg has been deposited for some time it turns yellow, probably due to the gradual development of the larva. As a whole it is not as transparent as with certain other species, but still the segmentation can be seen to some extent. Although they are deposited in the fall they do not hatch till in the spring when the buds begin to open.

The young larvæ present the usual appearance, but are marked with black while the older ones are light green.

PSYLLA AMORPHÆ. sp. nov.

Found on *Amorpha fruticosa*.

*Description.*—General color light green, marked with yellowish bands, especially on the mesothorax. On the dorsulum we find two bands usually united in front but diverging posteriorly; on the mesonotum are four long yellow bands separated by smaller bluish-green ones. Head, including the eyes, much broader than long; posterior margin concave; dorsal cavities large, round, comparatively deep, well defined. Sometimes slightly tinged with yellowish, and surrounding surface of a lighter green color. Lobes of vertex distinct, rounded, slightly diverging. Frontal cones very short, broadly rounded, distant, and furnished with a large bristle and numerous small ones. Antennæ reach to base of first pair of wings; first joint larger than second, third the longest of all, succeeding ones of equal length; the tenth somewhat enlarged; first three light colored, the tips of the rest darker, being most intense on the fourth,



sixth and eighth; ninth and tenth black, and end with two equal terminal bristles. Eyes prominent, brownish, the margins somewhat lighter colored; ocelli reddish, placed as usual. Mouth-parts not clearly visible, the last joint black. Legs light green or yellowish, first and second tarsi brown or black, the third tarsi lighter; anterior tibia with a brown tinge, which is less distinct on the second, and usually hardly visible on the third. Posterior tibia and first tarsal joint have distinct black spines on the distal end; on first and second pair these spines are of same color as the legs, and therefore quite invisible. Terminal claws and adhesive disk well developed. Pronotum short, with three distinct lateral impressions, and a fourth sometimes indicated. Mesothorax moderately developed, marked as stated above. Wings transparent, project to one-third their length beyond tip of abdomen, veins whitish, petiolus cubitii half as long as discoidal portion of subcosta; radius straight, except a slight curve near distal end, almost parallel with stigmal portion of the costa. First cubitus straight, or but slightly curved toward clavus; second cubitus distinctly curved toward radius, and about three times as long as preceding. First furcal curved toward second, about one-third as long, and meets anal margin at only a slight angle. Second furcal strongly curved toward the third, and meets anal margin quite obliquely. Third furcal shorter than the second, almost straight, but in some cases showing a slight double curve. Fourth furcal slightly curved toward radius. First marginal cell wider than the second, but not so long as measured by first and third furcals. Cubital cell long and narrow; discoidal cell still longer and sides nearly parallel, being widest at furcation of second cubitus; radial cell narrow. Pterostigma distinct. Claval suture joins anal margin at union of first furcal. Anal cell distinct. Metasternal processes distinct, diverging, blue-green. First visible ventral abdominal segment longer and more strongly developed than usual, blue-green in the center; remaining abdominal segments smaller, light green. Ovipositor of female of medium size, furnished with numerous long hairs; dorsal and ventral plates pointed as usual; points of inner division of egg-sheath project beyond tips of the outer plates, are chitinous, slightly enlarged, arrow shaped, sharp at tips. Outer division of egg-sheath prominent, the tips standing out horizontally as lateral projections.



In the male the ventral plate is rounded, deeply lobed posteriorly. Dorsal plate longer than the claspers whose rounded bases are received in the lobed portion of the ventral plate, then constricted above this and again enlarged, roundish, having a distinct inward curve posteriorly and a similar one dorsally, thus making the upper posterior corners quite prominent and roundish. The upper anterior corners extend forward as roundish lobes which reach over half way to the dorsal plate and have numerous strong, slightly curved, spine-like projections. Their dorsal edges are sharp, turned inward, black, and apparently chitinous.

This species was first noticed June 17, 1894, on *Amorpha fruticosa*. At this time it was in the adult stage and depositing eggs very abundantly on the under side of the leaves, especially near the ends of the branches where the leaflets were as yet quite closely clustered together. Although many eggs were deposited, for some reason only a few larvæ could be found. It was thought probable that some predaceous insect devoured the eggs; but careful observations failed to disclose any such insects. Egg parasites were also suspected, but could obtain no definite proof. This fact of sudden disappearance was also very noticeable in the *Hackberry Psyllidæ*. In the season of 1892 the latter were very abundant and numerous parasites were found. In 1893 they were very abundant, and the parasites somewhat more numerous. In 1894 the *Psyllidæ* were very scarce, many eggs having been deposited early in the spring, but very few galls formed. In this case the chalcids (probably *Encyrtus Pachypsyllæ*) were prominent factors. The history of the case as just stated is more in accord with the general record of parasitism. One fact that makes it easier to trace the parasites in galls is that they are enclosed by the gall, thus preventing their dropping from the leaves, as is probably the case with the non gall-forming species.

TRIOZA SALICIS, sp. nov.

Found on Willow, (*Salix* sp.)

*Description*.—General color orange yellow, somewhat lighter underneath, the abdomen in some cases is of a light green color ventrally.

Ground color of head yellow, somewhat lighter than the rest. Vertex, including the lobes and posterior part of head, which is only narrowly visible from above, black, shining. Eyes



prominent, black, shining, finely granulated. Ocelli close to inner angle of eye, of deep orange color, and imbedded in the somewhat lighter colored part of head. Just outside the ocelli there is a fine constriction, beyond which the yellow part of the head simply forms a light band between the black posterior part of the head and the eyes. In some cases this constriction is more distinct, giving the impression that the eye is placed dorsally on a lateral tubercle. Antennæ filiform, reaching about to base of second pair of wings; four basal segments light colored, except top of fourth which, with the remaining segments, is black. In some cases the fifth and sixth segments are also light colored, except the tip. The two basal joints enlarged as usual, third the longest of all, fourth, fifth, sixth and seventh joints about equal, eighth somewhat longer, ninth and tenth short, equal in length, and, including the tip of the eighth, somewhat enlarged. Terminal bristles small, nearly equal. Frontal cones prominent, moderately diverging, acutely pointed, furnished with hairs, black, tips sometimes whitish. Clypeus dark colored.

Mouth-parts not prominent, terminal segment and tip of second black. Thorax prominent, convex. Pronotum short, comparatively small, orange yellow; dorsulum same color as prothorax, but in some cases the posterior part tinged with black; widens posteriorly till it almost equals width of head and eyes; mesonotum orange yellow with central portion black. Sides of the thorax sometimes with black markings, the most prominent of which is a curved one opposite the metasternal spines, and another one in front of this. Dorsally the posterior part of the metathorax\* is marked with four longitudinal black lines.

Legs light colored, tibiæ and torsi of first and second somewhat darker, smoky; posterior tibiæ and tarsi nearly the same color as the femora, slightly darkened in some cases. Posterior tibiæ with strong black spines. The tibial spines in the others light colored.

Wings comparatively long, extending over half their length beyond the tip of the abdomen. Pterostigma wanting, *i. e.*, no enlargement at union of subcosta and costa. Discoidal portion of subcosta more than one-third as long as basal portion. Basal part of radius straight, the distal part curved slightly toward

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\*NOTE.—This part of the metathorax probably corresponds to the dorsal part of the first abdominal segment, which, according to Witlaczil, has coalesced with the metathorax.



costa, which it joins about two-thirds the distance from pterostigma to tip of wing. First cubitus only slightly curved toward costal margin, the second strongly curved. First furcal short, almost straight, and meets the anal margin at a slight angle about one-fourth the distance from tip of clavus to tip of wing. Second furcal a little over three times as long as the first, strongly curved towards costal margin, and meets anal margin very obliquely. Third and fourth furcals straight, third almost parallel to the first, fourth about one-half longer than the third, and meets the marginal vein just at tip or a very short distance in front of it. Usually, however, the tip is acutely rounded and may be said to be between third and fourth furcals. The costal margin is in the form of a gentle curve from base to tip, only the curve becoming slightly stronger in the distal half. Anal margin almost straight from base of anal cell to first furcal. Tip of clavus distinct. On anal margin near center of first marginal, cubital, and second marginal cells is a darker, somewhat triangular spot as in *Trioza tripunctota*, only not so distinct. Greatest width of wing at union of first furcal with the anal margin. Wings, as a whole, very transparent, all the nerves very distinct, light colored, slightly tinged with yellow. Posterior wings very delicate, costal margin shaped as usual; deeply curved at tip of clavus, broadly rounded at end of second furcal, strongly ascending from them to tip, which is comparatively rounded and between the two longitudinal veins; nerves all quite indistinct. The hind wings are more whitish than the first pair. (This appearance is probably due to a fine whitish pubescens.)

Abdomen a little shorter than the thorax, dorsal portion of the segments dark, sides and ventral portion usually light green. Ovipositor very short, hardly as long as preceding ventral segment, roundish, furnished with numerous hairs. Dorsal plate the largest, its tip black.

In the male the genital organs small and difficult to examine. The claspers exceed the ventral plate in length, curve toward each other, are slender, acute at tip, and furnished with numerous hairs.

Some important variations in color, not previously given, must be noticed, especially the markings of the head. We can arrange a gradual series of specimens so that the head will be darker and darker until almost jet black. The same is true of the antennæ, all being black except the basal joints and part of



the fourth, but in some cases the fifth and sixth are also light colored except the distal part. The dark colors of the thorax and legs are also liable to vary. On the abdomen, in some cases, the black markings could be traced slightly below the pleurum, being most noticeable in the males, which are usually a little smaller and darker than the females.

The intensity of these markings may be due largely to the length of time from their issuing as adult and their being killed. The older the more intense are their color markings. Still this cannot be taken as an invariable rule. Some specimens seem to have their colors more intense than others, although they are of the same age. This same fact of color variation is also noticed in the larvæ. Some are more intense than others, and the marks somewhat differently arranged. The life history has not been traced carefully enough, as yet, to say whether the darkest larvæ produce the darkest adults, or whether this larval variation has any effect on the markings of the adult.

The first specimens were taken by Mr. E. D. Ball in August, 1894. The adults and the larvæ could be collected from that time on till the leaves fell in November. They are quite inconspicuous, because their coloration blends very nicely with that of the leaves and twigs, thus bringing out very nicely the subject of protective resemblance. This is very noticeable throughout the family.

*Larva.*—The young larvæ are thin, flat, scale-like, very closely applied to the surface of the leaf; wing-pads blend with general form of body, making a quite regular oval outline. Head broad; front margin gently rounded, distinctly lobed, terminates in gently rounded angles in front of the eyes, and furnished with a conspicuous fringe of wax-hairs. Antennæ comparatively small, in first or second stages reaching only about half way to anterior margin. Eyes of usual shape, deep orange yellow. The wing-pads usually extend forward to the eyes, but sometimes reach the slightly indicated lateral angles of anterior margin of head. They gradually diverge posteriorly, and the first pair extends slightly beyond the posterior coxæ, but do not reach the posterior margin of the metathorax. The second pair are much smaller, extend over half their width back of first pair, and reach to the second or third abdominal segment. Abdomen broadly oval in outline, segments distinctly indicated. Anal opening larger than usual, conspicuous. The



pseudovitellus is not as regular as in other species, especially *Aphalora polygona*, often being broken up into a number of parts, and these parts on each side more unequal than usual. Legs well developed, quite distinct from above, but ordinarily only the tarsi projecting beyond the wing-pads.

There is a distinct longitudinal dorsal black band extending the full length of the body. Its width is about equal to half the width of the head between the eyes. On the abdomen it expands somewhat, becoming rather oval in outline, contracting again a short distance before the tip of the abdomen, which is slightly tipped with black. In the middle of this band there is a distinct, clear, longitudinal line extending from the anterior lobe of the head to the first or second abdominal segment. In the full grown larva this line extends still farther back, reaching the fourth segment.

As the larvæ grow older, all the parts become more distinct. The antennæ project beyond the head, the longitudinal black band becomes somewhat irregular, but more intense in places; the head, thorax and wing-pads dark-colored, varying from smoky to brownish.

In the full grown larva the head and prothorax are closely united, about equal in length, half as long as broad, and together are subquadrate in outline. The mouth-parts are distinct, strongly held by the prosternal lobes, tip of last segment black. The antennæ project about half their length beyond anterior margin, but do not show the joints very plainly, as those in the club are simply indicated by constrictions as in the other species. Mesothorax and metathorax distinct, dark color quite intense and shows several light colored portions. (See plate xv, figure 8.)

The abdomen presents five large, usually roundish, light-colored spots on either side, the anterior the smallest and not so distinct. Between each one of these spots is a dark band extending inward and slightly forward toward median dorsal band. In some cases these little bands are rectangular, in others triangular with the points turned inward. When the bands between the marginal abdominal spots are rectangular, their inner ends are usually blended, thus forming a crescent-shaped band on either side of the median longitudinal band, leaving a light-colored space between them.

The color markings are somewhat variable, depending on the age of the larva and the length of time after moulting.



Closer study of their life-history will undoubtedly furnish accurate characters and markings for separating the different stages of development.

APHALARA EXILIS Web. and Mohr., var. RUMICIS, var. nov.

*Description.*—General color brown. Head uniformly light brown, the posterior margin obtusely angled. Eyes distinct, very dark brown or almost black; the part of the head on which they are placed is lighter colored and separated by a distinct suture. Front dark brown or blackish, clypeus somewhat lighter. The antennæ reach to the base of the upper wings or a little beyond; the two basal segments light brown, the six succeeding joints somewhat lighter colored or even light yellow, and the two terminal joints dark brown or black, forming a small compact club, the last being sometimes almost truncate; terminal bristles of equal length. The third joint is the longest, but comparatively not as long as in *Aphalara polygona*. Pronotum of almost equal width throughout, being slightly wider and convex in the middle, slightly inclined, and has two distinct cavities on either side. Anterior half dark brown or almost black, being darker than the adjoining parts of the head or mesothorax; the posterior half lighter. In some cases there are only light spots on the posterior half and from some points of view look like a white line between it and the mesothorax. Dorsulum uniformly light brown, surrounding sutures black. Mesonotum prominent, light brown, in some cases white. In others it has two large dark bands on either side of median dark line, all separated by longitudinal bands of lighter color which sometimes extend forward to the dorsulum. Sometimes the whitish bands predominate, giving the mesonotum a more whitish appearance, and extending forward in the dorsulum almost obscure the brown color. In some the two central whitish bands of the mesonotum extend back into the scutellum and give it a whitish appearance, only the fine brown central part being maintained, the two lateral ones only slightly indicated. The scutellum is usually brown, sometimes light brown or grayish.

The central portion of the metathorax is usually light brown; the lateral portions dark brown or black, bordered with a whitish line. Prosternum dark colored, mesosternum dark with a light border; metasternum brown; metasternal tubercles brown except the tips and a light spot near the base. The legs



are light colored; sometimes the second tarsal joint and the claws brownish; the femora slightly tinged with brownish, the posterior ones sometimes having a faint brownish band near the base.

The wings have the typical venation for *Aphalara*. The brownish markings are as follows: A black spot at the anal angle of the clavus; a slight one at the origin of the cubitus; three darker ones almost in a straight line across the wing, the anterior one near the middle of the descoidal portion of subcosta, the middle one a little beyond the center of the petiolus cubitii, and the third near the top of the clavus; a black spot on the pterostigma and the union of the radius and each of the four furcals with the marginal vein; a clouded spot surrounding the first furcal; an oblique somewhat irregular band extending from the end of the first marginal cell to near the end of the radial cell, being most dense in these two cells, and quite thin and scattered in the cubital and descoidal cells; at the end of third and fourth furcals is a clouded portion which is more or less dense across the second marginal cell. The oblique apical band varies as to continuity. In some cases it is broken up into three or four separate parts and more scattered. The abdomen is uniformly dark colored dorsally; the ovipositor light brown and the tip furnished with numerous radiating hairs. The lateral margins are light colored, being the same color as the pleurum in the distended abdomen. The anus usually shows a fine cottony substance which may or may not collect in the form of a little mass as in *Aphalara polygoni*, depending on when the specimen was taken, how mounted, and its condition before mounting. On the posterior margin of the first visible ventral segment is a distinct white band, widest in the middle where it is arched and nearly reaches the middle of the segment. The two succeeding ones are more uniformly colored, only being slightly lighter in the middle. The fourth is light colored, only having a dark portion between the light colored margin and the central portion, and extends backward under the ventral plate, thus giving the ovipositor the appearance of being retracted, only the distal half being visible from below. Usually there are fine white lines separating the abdominal segments. These represent the more distinct light colored tissue between the segments which in life are distended, giving the abdomen a plump appearance and showing the three divisions, tergite, pleurite and sternite. In the female, in



life, the white parts predominate, the brown parts appearing as distinct transverse bands, the last four of which are arranged in pairs, while the first is separate.

The male differs from the female in that the brown spots are usually somewhat darker and the brownish tinge of the legs is more distinct. The lower genital plate is brownish at base, while the tip and upper margins are whitish. The claspers dark-colored, furnished with numerous hairs, somewhat enlarged toward the tip but narrowing acutely and the points slightly overreaching. They are equal in height to the dorsal plate, which is dark-colored. The horizontal, backwardly projecting portions of the dorsal plate are light-colored, hairy, and not reaching beyond the forceps as in *A. polygona*.

The pupa is smaller than in *A. polygona*, and can be easily distinguished by being much more elongated, the wing-pads narrower and their anterior angles more acute. The abdomen is comparatively more elongated and does not give so much the appearance of being drawn cephalad. The color-markings are virtually the same as in *A. polygona* and are as follows:

On the head, between the eyes, two brown spots separated by the whitish longitudinal band which extends to the fifth abdominal segment. Their inner and posterior borders are nearly straight, but the anterior and lateral ones roundish. Just back of these there are usually two small brown spots indicated. On each division of the thorax there are two squarish brown spots, and just back of each of these two smaller ones indicated. On each of the first four abdominal segments there is a short, transverse brown band on either side of the longitudinal line. Just back of those on the first segment two small ones are indicated. On the fifth the transverse brown band extends the entire breadth.

The last three segments are distinctly indicated, but not especially marked, being uniformly dark colored. The wing-pads are of a light brown color. The legs are light colored, the tarsæ more distinctly tinged with brownish. The antennæ are mainly light colored, a little darker at tip. Ventrally the general color of the pupa is more whitish, thus giving the legs a darker appearance than when compared with the darker dorsal surface. The clypeus is yellowish, the suture between it and the head indicated by a fine dark line. The prosternal lobes which receive the first joint of the rostrum are indicated by two very fine black lines. The second joint of the beak is



short, squarish, light colored, margined with black. The terminal joint is cone-shaped, tip and sides black, but central basal portion light colored. The ventral color of the abdomen is whitish, and the posterior margin of each segment indicated by two fine, short, black lines.

This species was first noticed about the latter part of August in the summer of 1894. It lives on the common dock, *Rumex altissimus*. It is most commonly found on the tips of the branches in autumn and causes them and their leaves to curl up into a rather compact ball. In a short time these take on a brown color and some of them soon die, only the stems remaining alive. These gnarled bunches are very characteristic and can be recognized as far as visible. They very much resemble the work of plant lice and very likely have been considered by some as such.

One important fact in its life history is the production of honey dew in connection with the white waxy secretion.

It was first studied as a new species and a description written for it under the name *Aphalara rumicis*. But since then careful comparison with the description of *Aphalara exilis* given by Flor in "Rhynchoten Livlands," Vol. II, p. 532, shows that the two forms are very nearly related, possibly the same species, the variations due probably to locality and host-plant. Yet the fact of such a difference in host-plant, when considered in connection with observations on other species in regard to this point, indicates that there is an essential difference. The difference in color-markings could be easily reconciled because they have been found quite variable in some species. The first tarsal joint in *Aphalara exilis* is stated to be as long as the second, and they together about half as long as their tibia. In the form at hand the first tarsal joint is about half as long as the second, and they together about one-third as long as their tibia. The ovipositor of the female of the present form is very similar to that of *A. polygoni*, but in the male genital organs the claspers and the horizontal backwardly projecting portions of the dorsal plate seem to be quite different, while in *A. exilis* they are given as almost identical, there being only a slight variation in the claspers. The form on *Rumex acetosella* has not been found here as yet, and until a careful comparative study of the life history of the two forms is recorded it is difficult to say just how the form on *Rumex altissimus* should be designated. At present it is thought best to consider it as a variety of *Aphalara exilis*.



## EXPLANATION OF PLATES\*.

## PLATE XV.

Figures 1, 2, 3.—Different stages of the larva of *Aphalara polygoni*, 3 representing the pupa.

Figures 4, 5, 6.—Different stages of the larva of *Aphalara exilis* var. *rumicis*, 6 representing the pupa; *a*, anterior lobes of head showing the wax-hairs; *b*, second tarsal joint showing claws and adhesive disk; *c*, part of the tip of the abdomen showing the wax-hairs.

Figure 7.—Young larva of *Trioza salicis*.

Figure 8.—Pupa of *Trioza salicis*; *d*, edge of wing-pad showing wax-hairs; *e*, tip of abdomen showing wax-hairs.

Figure 9.—Central nervous system of larva of *Psylla amorphae* (third or fourth stage); *c. b.*, central body; *m.*, mushroom-shaped body; *m. l.*, middle lobe; *o. m.*, outer medulary layer; *e. s.*, eye swelling; *c. e.*, compound eye; *at. l.*, antennal lobes; *f. l.*, frontal lobes; *æ.*, oesophagus; *s. g.*, sub-oesophageal ganglion; *s. s.* indicates the location of what Dr. E. Witlaczil designates as the sack containing the setæ; *th. g.*, thoracic ganglion showing four distinct parts, of which 1, 2 and 3 represent the ganglia for the three divisions of the thorax respectively, and 4 the ganglion from which arise the abdominal nerves.

The drawing was made from a dorsal view of the larva named above. The parts named were determined by comparison with figures in Dr. E. Witlaczil's paper on "Die Anatomie der Psylliden," and the brief review of the same paper by Prof. G. Macloskie in Amer. Nat., Vol. XX, p. 283. Some of the parts were quite puzzling, especially the lobe between the middle lobe and the outer medulary layer. It is indicated in Dr. Witlaczil's paper, plate XXI, figs. 39 and 40, but apparently not named. Also the parts designated as antennal lobes and frontal lobes. It seems as though they would be more on the front part of the brain and not visible from above. But as the larva is so flat and all the parts of the head not so distinctly developed as in the adult, it is likely that these lobes are located backward and upward from what they are in the adult, thus bringing them more nearly into the same plane with the other lobes indicated, and making them visible from above. They may, however, indicate entirely different parts. Further research during the larval stages is necessary to determine that point.

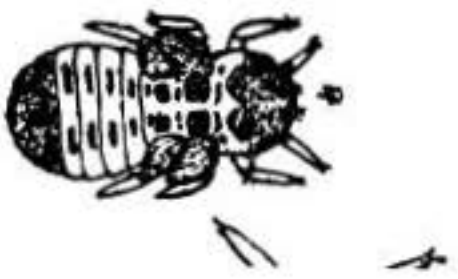
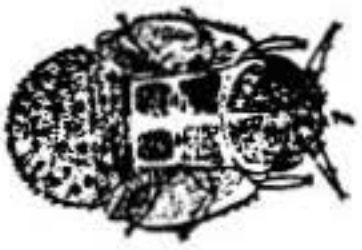
Figure 10.—Edge of abdomen of *Psylla amorphae*, showing the peculiar development of the marginal wax-hairs.

## PLATE XVI.

Figure 1.—Wings of *Psylla carpini*, Fitch. The veins of the front wings are usually designated as follows: *a*, basal portion of costa, which continues clear around the wing as a marginal vein; *b*, stigmal portion of costa; *c*, basal portion of the subcosta; *d*, discoidal portion of subcosta; *e*, radial portion of subcosta; *pt*, pterostigma; *r*, radius; *p. c.*, petiolus cubiti; *c<sub>1</sub>*, stem of

\*Miss Charlotte M. King did the pen work on the drawings. All the figures are much enlarged; the natural size of some of them being indicated by the lines at the side of the figure. Those in plate xv drawn from measurements, 7 and 8 being drawn on a little larger scale than the preceding, and 9 and 10 much more enlarged. Those on plates xvi and xvii are camera drawings.





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first fork, or first cubitus;  $c_2$ , stem of second fork, or second cubitus;  $r_1$ ,  $r_2$ ,  $f_3$ ,  $f_4$ , first, second, third and fourth furcal veins respectively; c. s., claval suture; cl., clavus.

The cells are designated as follows: 1, outer basal cell; 2, inner basal cell; 3, radial cell; 4, discoidal cell; 5, cubital cell; 6, first marginal cell; 7, second marginal cell; 8, anal angle.

The same letters that are applied to the front wings are also used for the corresponding parts of the hind wings.

In the venation of the hind wings notice: (1) That the radial portion of the subcosta is obsolete, thus leaving the outer basal cell and the radial cell unseparated and in the form of one long costal cell. (2) The basal portion of subcosta, discoidal portion of subcosta, and the radius form a continuous vein extending the full length of the wing. (3) The third furcal is obsolete, leaving the stem of second fork (second cubitus) and the fourth furcal as one continuous vein, and the second marginal cell in common with the cubital cell. Otherwise the venation seems to be virtually the same as in the front wings, except that the marginal vein becomes indistinct from the stigmal part on to the clavus.

The fine hair lines indicate the natural size of the wings.

Figure 2.—Wings of *Psylla negundinis*, n. sp. The venation is the same as usually found in the genus *Psylla*, and all the veins and cells correspond very closely to those of figure 1.

Figure 3.—Wings of *Psylla amorphæ* n. sp. Veins and cells named the same as in figure 1.

Figure 4.—Wings of *Psylla annulata*, Fitch. Veins and cells named as in figure 1.

#### PLATE XVII.

Figure 1.—Wings of *Trioza tripunctata* Fitch. Lettering the same as in figure 1, plate II. The same veins are represented except the petiolus cubiti which is wanting, thus causing the stem of the first fork (first cubitus) and the stem of the second fork (second cubitus) to arise from the same point. In the hind wings the part that would correspond to the petiolus cubiti is represented.

Figure 2.—Wings of *Trioza salicis* n. sp. Lettering same as preceding.

Figure 3.—Wings of *Aphalara polygoni*. Lettering the same as before. The petiolus cubiti is a little shorter than the discoidal portion of the subcosta, but the other structural characters unmistakably place it in the subfamily Aphalarinæ. The hind wings show an important difference in the fact that the veins marked  $c_1$  and  $c_2$  arise from different parts of the subcosta, and the part that in the other genera corresponds to the petiolus cubiti is wanting.

A very faint vein arising about half way between the two forks and extending to what corresponds to the pterostigma, is sometimes indicated and might be taken to represent the radial portion of the subcosta.

Figure 4.—Wings of *Aphalara exilis*, var. *rumicis*. Lettering same as before.