

THE JUMPING PLANT-LICE OF OHIO (Homoptera: Chermidae)

JOHN S. CALDWELL

The Herbert Osborn collection and the Ohio Biological Survey collection served as a basis for this work representing an accumulation of data for thirty-six years according to labeled specimens. This data with the records of species occurring in the surrounding states and a fair knowledge of host plants along with intensive collecting in recent years should uncover most species likely to be found within the state. Although there are species not recorded for Ohio that may appear here it is believed that there are sufficient data present to warrant this publication. Records of species by county are very incomplete but this fact should serve as a stimulus for the amateur collector to get out into the field and add to our knowledge of this very interesting family.

ACKNOWLEDGMENTS

Systematic work on the Chermidae was begun as a project for the Ohio Biological Survey under the direction of Professor Herbert Osborn. Compilation and presentation of data as found in this bulletin will be presented as a dissertation under the supervision of Dr. Dwight M. DeLong. The writer is indebted to both men for helpful criticism and valuable suggestions. To Dr. J. N. Knull, Dr. R. H. Davidson, Mr. G. W. Colville, and many other friends the writer is likewise indebted for assistance in collecting, locating material, and literary work. Sincere thanks is due Mr. P. W. Oman, who has given very valuable assistance by comparing much Ohio material with material in the National Museum.

INTRODUCTION

The members of the family *Chermidae* commonly called jumping plant-lice or psyllids have been described by various writers as resembling miniature cicadas. They may roughly be distinguished from related families of Homoptera by their long antennae, usually clear wings held rather vertical, and hind legs adapted for jumping. Individuals are found abundantly during certain seasons on their

respective host plants. The family is relatively small but it presents a very interesting group for study because of widely diversified habits. Some forms are typical gall makers, others are free living with but one host plant, while some apparently have alternate hosts. The young or nymphs would scarcely be recognized as immature chermids. The body is usually oval in outline and much flattened dorso-ventrally. Many species produce an abundance of wax and honey-dew making the nymph quite conspicuous. Often the nymphs are present in such large numbers that the honey-dew drips from the trees. Such conditions have been produced by the pear psyllid and the blue-beech psyllid.

TECHNIQUE

The bulk of material was gathered by beating and sweeping vegetation during the warmer months. Winter collecting was carried on by beating evergreens and searching under bark, leaves, etc. Some odd records were secured by rearing immature stages.

Adults were mounted on cardboard points and the genitalia of both sexes dissected off, cleared in potassium hydroxide, and placed in glycerine. This method proved quite satisfactory permitting the detailed study of the basic diagnostic characters, the genitalia, and at the same time preserving the gross body structures, proportions, and colors. Genitalia were conveniently studied in H-ion cups with magnifications up to 120X; for higher magnifications they were placed in temporary glycerine mounts on slides.

Some immature forms were cleared in KOH, the internal body contents pressed out through a puncture in the derm (cleaned), and then placed in glycerine in H-ion cups or temporarily on slides. Others were cleared, cleaned, run up through alcohol, and permanently mounted in diaphane.

Drawings of gross body structure in all cases were made with a camera lucida and are proportional. Genitalia, wings, and nymphs were drawn with the aid of a projection microscope and are respectively proportional. Enlargements showing structural detail of specific structures or parts were drawn with the aid of a camera lucida using 440X in all cases.

In most cases figures of the head, or head and thorax, and wings are presented. These characters were of value when studying specimens under lower magnifications and often were sufficient for placement of a species; however, for reliable determination the prepared genitalia were studied under higher magnification with special value being placed on the form, comparative size, and rela-

tive proportions of the proctiger, forceps, and genital plate in the male. In addition to these the oedeagus was found to be distinctive in most species. In the female the relative length of the valves, their form and proportions were found to be reliable taxonomic characters. Often the female genitalia were found to be more distinctive than those of the male.

Drawings of the entire nymphs are presented in considerable detail. General form and structure was found to be of value for division into subfamilies and in a few instances generic. For specific determination the presence or absence of setae, spurs, and spines, and their location, type, and form were valuable. Probably the one most distinctive feature used for determination of nymphs was the location of the anal opening along with the location, structure, and form of the surrounding structures such as the circum-anal ring, spines, spurs, and setae.

All keys and descriptions, including generic, are drawn from material as found in Ohio and are designed only for this state. The specific descriptions and figures should permit placement of species when used outside of Ohio. Specific keys are arranged as simply as possible and do not necessarily follow phylogenetic arrangement.

Three species not recorded for Ohio are included in footnotes in their respective ranking. From ecological and biological evidence we may assume that these three species may occur in Ohio.

ECONOMIC ASPECT

Probably most species of chermids are an important factor in the environment of their respective host plants but only those which live on plants that are of direct value to man and those that are potentially of such nature are considered economic.

The most important economic species of chermid in Ohio is the pear psyllid, *Psyllia pyricola* (Förster). The leaves of the pear trees are stunted and discolored by the feeding of both adults and nymphs. The nymphs secrete enormous quantities of honey-dew making an ideal condition for fungi to grow on the leaves and fruit. In such a situation the fruit fails to develop and the trees are injured for future crops. The actual losses in Ohio are known only by the individual growers and are evidently not reported. According to Mr. J. S. Houser there are only two cases on record at the Ohio Agricultural Experiment Station. A third severe infestation is remembered by both Mr. Houser and Professor Herbert Osborn.

The Experiment Station reports working on the boxwood psyllid, *Psyllia buxi* (Linn.), in the Spring Grove Cemetery, Cincinnati,

Ohio, May, 1931. "At that time the psyllid was quite abundant on several species of boxwood."

The blackberry psyllid, *Phylloplecta tripunctata* (Fitch), while not an important economic species remains a potential menace to commercial growers in southern Ohio where heavy infestations occur on wild blackberry.

If the persimmon should be considered an economic tree in Ohio as it is in some other states, the persimmon chermid *Phylloplecta diospyri* (Ashm.) will definitely be an economic species.

Several inquiries have come to the Entomology Department at Ohio State University regarding control measures for the hackberry psyllids, mainly *Pachypsylla c.-mamma* Riley and *Pachypsylla c.-vesiculum* Crawford. Severe infestations of either or both species are not uncommon and the resulting distorted and discolored leaves make an unsightly tree. In situations where hackberry trees are in close proximity to dwellings *c.-vesiculum* often become a nuisance during late fall by swarming in large numbers into houses.

NATURAL ENEMIES

A rather impressive list of chermid parasites is given by Waterson (23) considering that very little work of this sort has been done on the chermids. It seems that the quiescent nature and the usually exposed position of the nymphs would subject them to rather frequent attacks by parasites and predators.

Both the egg and the first nymphal stage of *Phylloplecta salicis* (Mally) and *Psyllia albagenta* n. sp. are successfully attacked by a small red mite. The immature stages and the adult of the hemipterous predator *Triphleps insubidiosus* Say feed on all stages of *Aphalara persicaria* n. sp., *Phylloplecta salicis* (Mally), *Psyllia albagenta* n. sp., and the egg and adult stage of *Aphalara flavida* n. sp. The lady-bird beetle *Coccinella novemnotata* Hbst. has been found feeding on the nymphs of the blackberry psyllid *Phylloplecta tripunctata* (Fitch). Spiders take great numbers of *Pachypsylla c.-vesiculum* Crawford when their webs are located in hackberry trees during early spring. Ants seem to attack any species of chermid confined to a plant.

The only known parasite common to the Ohio chermids is a Chalcid of the species *Psyllaephagus triocephalus* Howard very commonly reared from the last stage nymph of the persimmon chermid *Phylloplecta diospyri* (Ashmead). The percentage of parasitism runs very high during late summer. The immature stages of two different species of Hymenoptera have been found in the galls of

Pachypsylla c.-mamma Riley apparently feeding externally upon the chermids. No adult parasites have as yet been reared from the galls; however, adults of an undetermined species of Hymenoptera have been observed inserting their ovipositor into the galls of *P. c.-mamma*.

BIBLIOGRAPHY

The original reference is given and in a few cases the synonymy is traced. The bibliography includes for the most part work done since the publication of the Van Duzee catalogue of Hemiptera in 1917; however, previous work especially biologic in nature is also included. It is hoped that this is complete enough to serve as a working bibliography for the beginner. Crawford's monograph and the Van Duzee catalogue will be found to be indispensable aids.

OHIO RECORD

Family CHERMIDAE (Fall.)

This family is characterized by having the beak apparently arising from between or behind the fore coxae, the tarsi two-jointed, and the hind legs adapted for leaping. Further division into subfamilies is as follows:

KEY TO SUBFAMILIES OF CHERMIDAE

1. Frons not covered by genae 2
Frons covered by genae 3
- 2(1). Vertex flat, horizontal, with frons beneath in form of elongate sclerite
Liviinae
Vertex rounded downward in front, not horizontal, with frons visible from front as a distinct rounded sclerite.....*Pauropsyllinae*
- 3(1). Forewing with radius, medius, and cubitus branching from basal vein at a common point (No cubital petiole). Head appearing deeply cleft in front; genae not produced into cones.....*Cherminae*
Forewings with no cubital petiole. Head not deeply cleft in front; genae produced into cone-like processes.....*Triozinae*
Forewings with radius, medius, and cubitus not branching from a common point on basal vein (Cubital petiole present).....*Psyllinae*

Subfamily LIVIINAE Low

KEY TO GENERA OF SUBFAMILY LIVIINAE LOW

1. Eyes greatly flattened; cephalic portion of head thin; wings opaque, thickened*Livia*
Eyes prominent, not flattened; cephalic portion of head thickened; wings hyaline, thin; male proctiger with caudal lobes.....*Aphalara*

Genus *Livia* Latreille

Head scarcely deflexed, broadly joined to the thorax. Vertex rectanguloid in outline; cephalic portion thin. Eyes more or less flattened. Genal cones undeveloped. Frons inferior, visible as a long narrow sclerite lying between the genae cephalad to the clypeus. Anterior ocellus at terminal end of frons, not visible from above. Pronotum extending laterally nearly to coxae. Forewings rugose, thickened.

KEY TO SPECIES OF LIVIA LATREILLE

1. Forewings unicolorous, not maculated or banded..... 2
Forewings maculated or banded.....*coloradensis**
- 2(1). Large, 3.5 mm. or longer; forceps of male pyriform.....*vernalis*
Small, less than 3.5 mm. in length; forceps of male not pyriform..... 3
- 3(2). Eyes greatly flattened; proctiger of male large, almost twice the
length of forceps*opauqua*
Eyes slightly bulging; proctiger of male small, scarcely longer than
forceps*ohioensis*

Livia coloradensis Crawford Pl. 1, 2, 4

1914 *Livia coloradensis* Crawford, U. S. Natl. Mus. Bull. 85:20.

Length to tip of forewing 2.5-2.8 mm.; forewing 1.5-2 mm.

Color: Light to dark brown; cephalic portion of vertex with orange tinge; wings whitish, brown maculae on veins, brown band apically.

Head distinctly wider than prothorax. Vertex as long as width between eyes; cephalic portion scarcely indented at median line. Eyes somewhat rounded; post-ocular portion small.

Body short, robust. Wings rectanguloid, coriaceous, subhyaline, maculated; veins prominent, sinuate, with prominent brown maculae.

Genitalia: Male genital plate small, rounded. Forceps short, stout, with cephalic margins arcuate and caudal margins straight with a large shallow notch near apex giving a semi-hooked appearance in lateral aspect. Proctiger rectangular, relatively short.

Female genital segment moderately short, blunt; termination of dorsal valve blunt, not turned up as in following species.

Recorded from Ashtabula Co., VIII-6; Franklin Co., 1916; Ross Co., V-21; Hocking Co., VII-5-36 and VIII-5-36; and Pike Co., V-10-36.

The short vertex and variegated forewings readily set this species apart from other Ohio species.

* Species differing from *coloradensis* as follows: Vertex much longer than broad, deeply notched at cephalic end of median line; larger size, approximating 3.4 mm., *Livia maculipennis* Fitch.

Species differing from *coloradensis* by veins of forewings lacking brown maculae, *Livia marginata* Patch.

Finding this species only in marshy areas in the spring and only on conifers (*Pinus rigida* Mill. and *P. virginiana* Mill.) after mid-summer arouses the suspicion that it may have alternate hosts, breeding on some swamp plant and later seeking conifers for hibernation.

Livia vernalis Fitch Pl. 1, 2, 4

1851 *Livia vernalis* Fitch, Homop. N. Y. St. St. Cab., p. 64.

Length to tip of forewing 3.5-4.25 mm.; forewings 2.5-3 mm.

Color: Yellow-brown to brown, sometimes dull orange.

Head slightly broader than long, as broad as thorax. Cephalic margin of vertex thin, upturned, with a rather deep emargination at cephalic end of median line.

Vertex and thorax deeply pitted. Forewings twice as long as broad, ovate, coriaceous, opaque.

Genitalia: Male genital segment large. Forceps large, very broad at base, pyriform; in lateral aspect, cephalic margins deeply indented midway to apex, caudal margins arcuate, apices broadly truncate. Proctiger large, rectangular.

Female genital segment longer than rest of abdomen in dried specimens. Dorsal valve gently sinuate, tapered to acute gently upturned apex; caudal half of dorsum of dorsal valve appearing finely, evenly serrate in lateral aspect.

The large size of *vernalis* will usually separate it from the other species. Ohio records are as follows: Adams Co., X; Lawrence Co., VI; Hocking Co., May through November; Ross Co., IV-26 and V-21. The catches in May were made in marshy or swampy areas, those later in the season were made from conifers (*Pinus rigida* Mill., *P. virginiana* Mill., and *Juniperus virginiana* L.)

Livia opauqua n. sp. Pl. 1, 4

Length to tip of forewing 3. mm.; forewing 2. mm.

Color: Dark brown, appearing black, body and forewings concolorous.

Head slightly broader than long, as broad as prothorax. Vertex deeply emarginate at cephalic end of median line, sides subparallel. Eyes greatly flattened; post-ocular portion small.

Vertex and thorax coarsely punctate. Forewings coriaceous, extremely thick and opaque, ovate in form.

Genitalia: Male genital plate small, rounded. Forceps short, stout; in lateral aspect sides sub-parallel, tapered near tip to blunt apex. Proctiger almost twice as long as forceps.

Female unknown.

Described from an unique male specimen collected in a corn field in Lucas Co., Ohio, July 18, 1935 by R. T. Everly. This male holotype is in the writer's collection at Ohio State University.

Livia ohioensis n. sp. Pl. 1, 2, 4, 8

Length to tip of forewings 3.-3.25 mm.; forewings 2.-2.5 mm.

Color: Body brown with a decided orange tinge; forewings brown.

Head about as long as broad, slightly broader than prothorax. Vertex broadest at anterior margin of eyes; cephalic margin not raised. Second antennal segment prominently enlarged, not covered by vertex. Eyes slightly bulging.

Forewing ovate, shorter than in *vernalis*, coriaceous, thick; vein Cu_1 relatively short, scarcely arched.

Genitalia: Male genital segment small. Forceps small; caudal margins arcuate, cephalic margins constricted near base, then bulging mid-length and gently converging to a well-rounded apex in lateral aspect. Proctiger short, stout, slightly longer than forceps.

Female genital segment as long as rest of abdomen in dried specimens. Dorsal valve more sinuate than in *vernalis*; apex turned up more abruptly; serration possibly coarser and less even.

Described from a series of four male and nine female specimens bearing the label Hawkins, Summit Co., Ohio, VI-27-02. Male holotype, female allotype, and male and female paratypes are in the Herbert Osborn collection at Ohio State University.

In the same series with the aforementioned adults are two nymphs that appear to be in the fifth stage.

Fifth stage: Length 2.2 mm.; greatest width 1.5 mm.; of psylline form. Antennae seven segmented, reaching almost to base of forewing-pads; terminal segment equal to the combined length of first three. Wing-pads set well back from cephalic end of nymph. Dorsum apparently evenly, heavily chitinized, roughened and densely beset with scale-like areas that are frequently raised to form short spines or setae. Margins of wing-pads sparsely beset with moderately long stout setae.

Tarsi with a pair of claws but no pulvillus. Derm on ventral side of abdomen similar to that of dorsum except that areas of heavier chitinization are visible.

Anal opening borne on apex of abdomen, with a long setae present laterally on each side. (The structure corresponding to the circum-anal ring could not be traced around the anus.) An oval shaped band of small circular pores surrounding a raised area is present apically and ventrally on each side of the anal opening.

Genus *Aphalara* Förster

Head scarcely deflexed. Vertex broader than long, notched at cephalic end of median line; cephalic margin thick, gently rounded. Genae gently swollen. Frons visible between genae. Clypeus pyriform, visible from front. Eyes bulging. Antennae ten segmented. Thorax arched; lateral termination of pronotum knob-like; pleurites small; pleural suture extending to center of lateral termination of pronotum. Forewings rounded apically, hyaline, sometimes

fumate or maculated; pterostigma absent. Male proctiger with long lobes extending caudad to forceps.

KEY TO SPECIES OF APHALARA FÖRSTER

1. Clypeus much elongated, cylindrical *persicaria*
Clypeus not elongate but round or pyriform 2
- 2(1). Wings distinctly maculated or banded 3
Wings clear, not maculated or banded 4
- 3(2). Wings whitish with prominent brown maculae *east*
Wings clear with brown band subapically *fascipennis*
- 4(2). Small, not over 2.5 mm. in length, slender light colored species. Dorsal valve of female genital segment rather straight, apex not upturned. Male genital plate very large and broad in lateral aspect; forceps very broad apically, over one-half as broad as exposed length *minuta*
Large, over 2.5 mm. in length, more robust, deeply colored species 5
- 5(4). Dorsal valve of female genital segment relatively straight with rather abruptly upturned apex. Forceps of male with caudal margins appearing straight to slightly concave *veaziei*
Dorsal valve of female sinuate or if appearing straight apex not upturned. Male forceps with caudal margins distinctly sinuate or convex in lateral aspect 6
- 6(5). Female genital segment with apex of ventral valve distinctly notched. Forceps of male with apical half abruptly bent cephalad *furcata*
Ventral valve of female not notched. Forceps of male with apical portion proceeding gently cephalad 7
- 7(6). Female with dorsum of dorsal valve much lowered from anal pore and proceeding straight to apex. Forceps of male with caudal margins gently convex in lateral aspect *fumida*
Female with dorsum of dorsal valve sinuate, apex rounded. Male forceps with caudal margins sinuate *flavida*

Aphalara persicaria Caldwell Pl. 1, 2, 4, 8

1937 *Aphalara persicaria* Caldwell, Ann. Ent. Soc. Amer., p. 565.

Length to tip of forewing 2.5-3.25 mm.; forewing 2.-2.6 mm.

Color: General color red-brown to orange; vertex lighter brown; prescutum with four more or less distinct light yellow stripes; abdomen dark brown, usually variegated; legs dusky yellow.

Vertex three-fourths as long as broad; lateral margins highly ridged along eyes, less ridged along caudal edge; foveal impressions appearing deep.

Pronotum almost as wide as head; thorax broad, gently arched, finely punctate. Forewings twice as long as broad, hyaline, sometimes with a suggestion of fumation in apical portion; marginal termination of all veins dark; usually a decided black spot present at termination of Cu_1 , more so in male than female.

Genitalia: Male genital plate small. Forceps short; sides subparallel in lateral aspect; anterior-mesal process short, subrectangular, removed from apex of forceps. Lobes of proctiger as long as plate, broad basally, narrowed beyond ventral hook to narrow apices. Apical portion of oedeagus "s"-shaped.

Female genital segment short. Dorsal valve sinuate caudad to anal opening; apex narrowed suddenly near tip to nose-like apex. Ventral valve almost equilateral-triangular in lateral aspect. Circum-anal ring of wax-pores extending caudally apron-like on dorsum of dorsal valve to mid-length of valve.

This is a rather abundant species breeding on small lady's thumb (*Persicaria persicaria* L.) from late June to September in Ohio. Recorded only from Auglaize, Maumee, Ross, Fairfield, and Pickaway counties.

Egg: Length .27 mm.; width .1 mm. Broadly rounded basally, tapered to a rather acute apex. Small spur present basally set well out from center of base toward side.

First stage: Length .5 mm. Antennae appearing two segmented. Entire derm membranous. Tibio-tarsal joint absent; tarsi with claws and pulvillus. Circum-anal ring circular in form.

Second stage: Length .8 mm. Antennae definitely two segmented; basal segment rounded; terminal segment longer but stubby. Wing-pads present. No setae other than terminal sensory setae visible on legs. Circum-anal ring as in following stages.

Third stage: Length 1. mm. Similar to second stage except that wing-pads are larger with marginal setae visible; setae other than sensory setae visible on legs.

Fourth stage: Length 1.3 mm. Resembling the fifth stage except that tibio-tarsal articulation is lacking and that the antennae are two segmented.

Fifth stage: Length 1.8 mm. Antennae seven segmented; terminal segment equal to the combined length of the three basal segments; four sensoria present on terminal segment. Chitinized plates of dorsum beset with small spines; setae present on plates with longer setae located along margins of wing-pads and abdomen.

Apices of tibiae extending well beyond margins of wing-pads; pulvilli are sub-circular pads. Ventral side of abdomen with heavily chitinized plates contacting each other along margins and extending across entire abdomen; all plates beset with spines similar to dorsal plates; long setae present on apical plate.

Anal opening set in from apex of abdomen. Circum-anal ring extremely large, semicircular; outer ring composed of slit-like pores with a ring of smaller pores set just off their inner ends; inner ring set well in from outer, composed of large oval pores.

Biologic: The position that male and female assume during mating is apparently characteristic of most species of chermids according to published data and observations. Both sexes face in the same general direction with their bodies forming a very acute angle when viewed from dorsal aspect. The abdomens of each are curved toward each other with the male's having the greatest curve and proceeding somewhat beneath the female's. The male genital segment appears to be applied in such manner that the forceps

assume an almost inverted posture from normal position. In this species copulation lasts up to fifteen minutes and is sometimes repeated at short intervals.

One female was observed to oviposit within 24 hours after copulation. In nature the eggs are laid in curled or unfolded leaves of small lady's thumb (*Persicaria persicaria* L.). Occasionally eggs are laid on the under side of normal leaves in depressions and along larger veins, anywhere in number from one to eight in a row. Most eggs appear to lie on their sides with an occasional egg appearing half set up on its broadly rounded base. The eggs are fastened to the leaf by a short spur penetrating the leaf tissue.

The eggs hatch in from five to eight days (August) and the nymphs seek the shelter of a curled leaf or the space between two contacting leaves if they are not hatched in such a place. (Because of this seclusive habit the duration of each separate stadium was not determined.) The total nymphal period varies from 20-28 days, probably largely dependent on temperature. Within the curled leaves the nymphs secrete large amounts of honey-dew and wax and pass through the first four ecdyses. The fifth or last ecdysis occurs on the outside. Generations overlap and as nearly as could be determined there are at least three generations in Ohio. The method of overwintering is not known.

Aphalara easta n. sp. Pl. 1, 2, 4

Length to tip of forewing 3.-3.25 mm.; forewing 2.5-2.7 mm.

Color: Appearing greenish-yellow; scutellum with several faint whitish stripes; forewing appearing white with brown maculae. Head little over twice as broad as long, narrower than thorax. Vertex two-thirds as long as broad, rather flat; notch at cephalic end of median line shallow. Antennae as long as width of head.

Thorax broad, strongly arched. Forewing almost two and a half times as long as broad, whitish, semi-opaque; numerous brown maculae distributed over entire surface, more densely apically; membrane appearing celled.

Genitalia: Male genital plate small. Forceps with cephalic margins greatly bulged for apical half thence broadly rounded apically to slightly raised apex; caudal margins relatively straight in lateral aspect. Proctiger long; lobes much longer than genital plate.

Female genital segment as long as rest of abdomen. Dorsal valve straight, very gently turned up apically.

Male holotype collected by Dr. D. M. DeLong, VI-15-17, North East, Pa.; female allotype and one female paratype collected by J. S. Hine, VI-30-04, Akron, Ohio. Twelve male and twenty-four female paratypes from North East, Hartstown, and Speechville, Pa.,

collected by J. N. Knull and D. M. DeLong during June. One female paratype from Columbus, Ohio, VII-8-28, no collector label present.

Holotype male, and male and female paratypes are in the DeLong collection, and female allotype and two female paratypes are in the Ohio Biological Survey collection at Ohio State University.

***Aphalara fascipennis* Patch Pl. 3, 4, 5**

1912 *Aphalara fascipennis* Patch, Me. Agr. Exp. Sta. Bull. 202:217.

Length to tip of forewing 3.5-4. mm.; forewing 3.-3.5 mm.

Color: Green to brownish yellow; thorax variegated with light brown patches.

Head two and a half times as broad as long. Vertex two-thirds as long as broad, flat, scarcely notched at cephalic end of median line; foveae shallow.

Thorax large, broad, rather arched. Forewing broad, less than twice as long as broad, hyaline with a brown band subapically, usually with brown blotches at termination of veins.

Genitalia: Male genital plate higher than long, roughly triangular in lateral aspect. Forceps long; basal portion enlarged within plate; sides subparallel; cephalic margins flaring near end to broadly rounded apices giving a spatulate appearance in lateral aspect. Lobes of proctiger longer than plate; caudal two-thirds narrow; apices broadly rounded.

Female genital segment longer than rest of abdomen in dried specimens. Dorsum of dorsal valve gently sinuate; apex rounded. Ventral valve slightly shorter than dorsal; apex rounded; stout, dense setae present on apical portion.

Taken in Hocking Co., V-7-34, and Champaign Co., VI-7-36, from swamp vegetation.

***Aphalara minuta* n.sp. Pl. 1, 2, 5, 8**

Length to tip of forewing 2.-2.5 mm.; forewing 1.5-2. mm.

Color: Uniformly light yellow with a suggestion of green in some specimens; forewing very light.

Head over twice as broad as long, broader than the widest part of thorax. Vertex two-thirds as long as broad; notch at cephalic end of median line rather sharp; foveal impressions scarcely visible in most specimens. Eyes very prominent. Antennae longer than width of head.

Thorax not broad, moderately arched. Forewing two and a half times as long as broad, hyaline; Cu_1 long; gently arched, making first marginal cell relatively long and broad.

Genitalia: Male genital plate much longer than high, somewhat semi-rhomboidal in lateral aspect. Forceps short; apical half twice as broad as basal half, gently bent cephalad; apices very broad, rounded; anterior-mesal process short, stout. Lobes of proctiger greatly narrowed on ventral margins for apical half.

Female genital segment as long as rest of abdomen in dried specimens. Dorsum of dorsal valve slightly sinuate, sometimes straight; apex not acutely

pointed, not turned up. Ventral valve stout, appearing acutely pointed in lateral aspect.

Described from a large series of specimens from Fulton Co., Hocking Co., Licking Co., and Pickaway Co., Ohio, from May through July; from Allenhurst, Charter Oak, Cresco, Hartstown, North East and Presque, Pa., during June and July; and from Decatur, Ill., VI-12-35. Male holotype, female allotype, and male and female paratypes collected in Pickaway Co., Ohio, V-30-36 by the writer are deposited in his collection. Male and female paratypes are in the DeLong collection, Herbert Osborn collection, and Ohio Biological Survey collection at Ohio State University, and the Illinois Natural History Survey collection at Urbana, Illinois.

Host: Nymphs and adults from a species of goldenrod (*Solidago* sp.).

Fourth stage: Length 1.5 mm. Antennae two segmented. A trilobed projection of derm present on cephalic margin of head next to base of each antenna. Tibio-tarsal articulation lacking. Except for forementioned characteristics resembling fifth stage.

Fifth stage: Length from 1.7 mm. to 2.1 mm. Antennae three segmented; in some specimens the terminal segment appears to be divided into six smaller segments. Chitinized plates of dorsum densely and minutely roughened by small circular areas; these small areas bear small setae on the wing-pads. Each wing-pad with a large marginal seta set just cephalad to apex; very small thin setae are present along rest of margin. Long marginal setae are present on abdomen for more than caudal half.

Apex of tibiae reaching well beyond margins of wing-pads. Pulvilli are sub-circular in ventral aspect. Ventral side of abdomen membranous except for apical plate, a plate around each spiracle, and five pair plates along median. Derm of abdomen beset with minute circular scale-like areas with a few long setae present. These small circular areas enlarge near apex of abdomen to form definite scale-like pieces.

Anal opening set in from apex of abdomen. Outer circum-anal ring composed of slit-like pores arranged narrowly elliptical; inner ring composed of irregular cell-like pores. A pair of setae-like structures present cephalad to center of anal opening and outside of circum-anal ring.

***Aphalara veaziei* Patch Pl. 1, 2, 5**

1911 *Aphalara veaziei* Patch, Me. Agr. Exp. Sta. Bull. 187:16.

Length to tip of forewing 2.5-3. mm.; forewing 2.-2.5 mm.

Color: General color green to yellow; dorsum marked with yellow; forewings flavous throughout.

Head not quite twice as broad as long, narrower than thorax. Vertex over half as long as broad, very flat; notch at cephalic end of median line rather broad; foveae very shallow. Antennae varying in length, at least as long as width of head.

Thorax broad, strongly arched. Forewing about two and a half times as

long as broad, broadly rounded apically. Veins yellow to orange; Cu_1 usually moderately arched.

Genitalia: Male genital plate a little longer than high in lateral aspect. Forceps shorter than height of plate; caudal margin appearing gently concave to straight in lateral aspect; cephalic margins greatly flared cephalad; apices appearing broad and rather flat. Lobes of proctiger narrowed similar to *minuta* but not so marked.

Female genital segment shorter than rest of abdomen, dorsum of dorsal valve slightly sinuate to straight; apex turned up, rather acute. Ventral valve short, stout.

Recorded from Ohio as follows: Ashtabula Co., VIII-6, Hocking Co., VII-15 and VIII-25, Lucas Co., VII-10, and Pickaway Co., VI-3 on goldenrod (*Solidago* sp.).

Aphalara furcata Caldwell Pl. 2, 5, 9

1936 *Aphalara furcata* Caldwell, Ohio Jl. Sci. 36:221.

Length to tip of forewing 2.5-3. mm.; forewing 2.-2.5 mm.

Color: Vertex yellow; thorax yellowish green; abdomen green.

Head over twice as broad as long, as wide as thorax. Vertex two-thirds as long as broad; notch at cephalic end of median line shallow; foveal impressions rather large, deep. Eyes very prominent. Antennae one and a half times as long as width of head.

Thorax not broad, moderately arched. Forewing slightly over twice as long as broad; longer in female than male; Cu_1 scarcely arched forming almost triangular marginal cell.

Genitalia: Male genital plate as long as high in lateral aspect. Forceps longer than height of proctiger; basal half straight, narrow; apical half curved cephalad, enlarged on cephalic margin. Lobes of proctiger longer than plate, narrow for full length; apices broadly rounded.

Female genital segment shorter than rest of abdomen. Ventral valve much shorter than dorsal; apex with a shallow notch.

Taken in Athens Co. and Hocking Co., Ohio, from July to September on goldenrod (*Solidago* sp.). Nymphs present VII-30-36, Hocking Co.

Fifth stage: Length 1.9 mm. Antennae three segmented; combined length of first two segments about half as long as third; four large, thick setae present in more or less of a row on third segment. Chitinized plates of dorsum appearing smooth, no setae visible. Wing-pads devoid of setae, margins finely roughened.

Legs short; apex of tibiae scarcely reaching to margin of wing-pads; fore tibiae with four setae present similar to type found on terminal segment of antennae; hind tibiae with six small, stout, black setae set in from apex. Ventral side of abdomen with chitinized plates densely beset with minute circular areas that become scale-like toward apex of abdomen; few setae present apically and around anal opening. Anal opening set in from apex of abdomen; outer circum-anal ring composed of slit-like pores arranged somewhat semi-elliptical; inner ring composed of circular pores.

Aphalara fumida n. sp. Pl. 3, 5

Length to tip of forewing 2.7-3.2 mm.; forewing 2.-2.5 mm.

Color: Head, body, and legs uniformly straw-yellow; forewings often clouded to fumate.

Head about two and a half times as broad as long. Vertex over one-half times as long as broad; lateral margins pinched just cephalad to eyes; notch at cephalic end of median line broadly rounded; foveal impressions shallow. Eyes rather prominent. Antennae almost twice width of head.

Thorax broad, robust, rather strongly arched. Forewing twice as long as broad, broadly rounded apically; membrane appearing rugose, hyaline, sometimes fumate.

Genitalia: Male genital plate as high or higher than long in lateral aspect. Forceps slightly longer than height of proctiger; caudal margins gently, convexly rounded; apical half of cephalic margins gently expanded; apices rather flat. Lobes of proctiger longer than plate; dorsal margins sinuate; apices broadly rounded.

Female genital segment as long as rest of abdomen. Dorsum of dorsal valve much lower than anal opening and straight to apex; apex narrowly rounded; ventral margins of dorsal valve sloping gently downward from apex thence paralleling dorsal margins before curving ventrad to contact ventral valve. Ventral valve with lateral margins constricted apically producing a narrow apex in later aspect.

Described from a series of 60 specimens from Licking, Pickaway, and Vinton County in Ohio during May and June; from Charter Oak, Cresco, and North East, Pa., during June and July; and from Orono, Me., during June.

Male holotype from Licking Co., Ohio, V-30-34, collected by R. H. Davidson, female allotype from Pickaway Co., Ohio, VII-1-34, collected by the writer, are in his collection. Male and female paratypes are in the DeLong collection, Herbert Osborn collection, Ohio Biological Survey collection, and the writer's collection at Ohio State University.

Aphalara flavida n. sp. Pl. 1, 3, 5

Length to tip of forewing 2.5-3. mm.; forewing 2.-2.5 mm.

Color: Body usually uniformly light yellow, sometimes washed with pale green; eyes dark; legs yellow to white.

Head much broader than pronotum, as broad as widest part of thorax. Vertex one-half as long as broad, scarcely deflexed; scutum level. Forewing long, narrow, over two and a half times as long as broad, hyaline; apex not broadly rounded; Cu_1 rather long, scarcely arched making first marginal cell long and narrow; vein anomalies common.

Genitalia: Male genital plate small, length about equal to height in lateral aspect. Forceps longer than height of proctiger; caudal margins gently sinuate; cephalic margins straight for two-thirds length, thence slightly flared to broadly rounded apices. Proctiger short; lobes longer than plate.

Female genital segment as long as rest of abdomen. Dorsal valve much longer than ventral; apical half very narrow; dorsum sinuate; apex broadly rounded, gently turned up. Ventral valve rather slender.

Described from a series of 27 specimens collected in Athens, Clermont, Highland, Hocking, Lawrence, Licking, Ross, Vinton, and Washington County, Ohio, during May, June, and September; Orono, Me., during July and August; and Cheboygan Co., Michigan, in July.

Male holotype, female allotype, and paratypes from Athens Co., Ohio, IX-26-35, collected by A. Hart, are in the writer's collection. Paratypes are in the Herbert Osborn collection and the Ohio Biological Survey collection at Ohio State University.

Biologic: Females were observed ovipositing in the outside sepals of a species of goldenrod (*Solidago* sp.) during September in Hocking Co., Ohio. No nymphs were found and the eggs failed to hatch. The eggs were extremely long, .36 mm., well rounded basally, and tapered to an acute apex. The attachment of egg to sepal was accomplished through an off-center basal spur penetrating the plant tissue. The puncture was made in the plant tissue by the female holding its ovipositor perpendicular beneath its body and rocking its whole body back and forth sideways.

This species overwinters in the egg stage on the leaves of the dead goldenrod plant.

Subfamily PAUROPSYLLINAE Crawford

Genus *Calophya* Loew

Head short. Vertex roundedly convex in front, impressed discally. Genae produced into conical processes, usually short. Frons partly visible from front. Antennae short. Body robust; thorax arched, broad. Forewings ovate, more or less opaque; pterostigma present; first marginal cell much larger than second.

KEY TO SPECIES OF CALOPHYA LOEW

1. Yellow or light colored species found on smooth sumac. (*Rhus glabra* L.) *flavida*
Black or dark colored species found on mountain sumac. (*Rhus copallina* L.) *nigripennis*

Calophya flavida Schwarz Pl. 1, 3, 5

1904 *Calophya flavida* Schwarz, Proc. Ent. Soc., Washington 6:243.

Length to tip of forewing 2.-2.7 mm.; forewing 1.5-2. mm.

Color: Light yellow to orange.

Vertex almost twice as broad as long, deeply impressed discally. Genal cones longer than basal width, conical, stout, divergent.

Thorax smooth, strongly arched. Forewing semi-opaque, broadly rounded apically; pterostigma present.

Genitalia: Male forceps rather slender with sides relatively parallel; acute apices curved cephalad and inward. Proctiger very broad; both margins convex in lateral aspect; apex truncate.

Female genital segment very short. Ventral valve narrowed for apical fourth; ventral margins appearing sinuate in lateral aspect.

Specimens are on hand from Adams and Lawrence counties, collected in May from smooth sumac (*Rhus glabra* L.).

Calophya nigripennis Riley Pl. 1,3, 5, 7

1877 *Psylla rhois* Glover, Agr. Rpt. for 1876-77:33.

Length to tip of forewing 1.5-2.5 mm.; forewing 1.2-2. mm.

Color: Head shining black; genae light; thorax sulfur yellow to orange; forewings and abdomen light brown to black.

Head about as broad as thorax. Vertex twice as broad as long, very glossy. Genal cones about as long as basal width; apices varying from acute to broadly rounded.

Thorax broad, smooth, moderately arched. Forewings little less than two and a half times as long as broad, opaque to semi-opaque; first marginal cell twice size of second.

Genitalia: Male genital segment small. Forceps with sides relatively parallel, broader than in *flavida*; apices acute, curved cephalad and inward. Proctiger twice as long as broad; apex rounded.

Female genital segment short, thick. Dorsal valve heavier than in *flavida*; apical fourth of ventral valve not narrowed.

This species is very plentiful on mountain sumac during May in Ohio and should be found throughout the range of this plant. Present records include only Adams, Franklin, Hocking, Scioto, and Muskingum counties.

The eggs are laid during May or early June and nymphal development takes the entire summer. The last of fifth stage overwinters on the stems and leaves of the food plant and the adults emerge the following spring.

Fourth stage: Length .75 mm.; width .85 mm. General form sub-circular; entire body margined with closely set setae. General color mottled gray to black.

Derm of dorsum apparently evenly chitinized except for a small membranous area at base of abdomen. A series of large, paired, mammiform, wart-

like areas present for full length of dorsum with smaller, similar but single areas scattered over entire surface.

Legs apparently three segmented; tibio-tarsal articulation lacking. Setae few; each leg with a pair of claws, a median sensory seta, and a pulvillus; pulvillus broadly triangular in ventral aspect.

Anal opening set in from apex of abdomen; circum-anal ring composed of large oval pores with an inner ring of small circular pores. A large seta present laterally on each side of circum-anal ring with small setae present just cephalad to ring.

Subfamily CHERMINAE VanDuzee

Genus *Rhinopsylla* Riley

Head deeply cleft in front. Anterior ocellus in front. Frons covered by genae. Genae slightly swollen. Antennae long. Thorax scarcely arched. Forewings without pterostigma and cubital petiole.

Rhinopsylla dimorpha n. sp. Pl. 1, 3, 5

Length to tip of forewing 2.75-3.5 mm.; forewing 2.25-3. mm.

Color: Male solid black with the exception of antennal segments III, IV, and V; all tibiae; and ventral sclerites of abdomen which are light yellow.

Female with head and thorax red, a light spot in center of vertex and a wide light stripe the length of the thoracic dorsum. Antennal segments III, IV, and V white with the rest of antennae dark. Tibiae white. Abdomen black; genital segment yellow.

Both sexes with a prominent white, dusty band on dorsum of first two abdominal segments preceding genital segment.

Head deeply cleft in front, less than four times as broad as long, slightly narrower than thorax. Vertex with a deep impression on each side of median line. Frons covered by genae. Genae slightly swollen beneath antennal bases. Eyes conspicuous, directed forward. Antennae little less than length of body.

Thorax scarcely arched, narrowed slightly cephalad. Fore femora slightly enlarged. Hind coxae with forward as well as posteriorly directed spur. Hind tibiae with small spur at base; apex with one spine on outside and two within. Forewing slightly less than three times as long as broad, acute apically; marginal cells of equal size; a dark spot present between branches of cubitus, and medius, and between branches of medius.

Genitalia: Male genital segment very small. Forceps short, gently pyriform in lateral aspect; appearing pyriform in caudal aspect with apex truncate and a short spine-like process projecting laterally inward and one projecting laterally outward from apex. Proctiger longer than forceps, narrow basally and flared caudally and apically; truncate apically.

Female genital segment very short. Anal opening very large, extending half the length of dorsal valve. Dorsal valve thick; tip suddenly constricted ventrally to small blunt apex. Ventral valve shorter than dorsal, thick, triangular in lateral aspect.

Described from a series of 13 male and 3 female specimens collected by the writer on small lady's thumb (*P. persicaria* L.), July

Persicaria

1-36, in Pickaway Co., Ohio. Male holotype, female allotype, and paratypes are in the writer's collection. Paratypes are in the Ohio Biological Survey collection at Ohio State University.

Subfamily TRIOZINAE (Puton)

KEY TO GENERA OF SUBFAMILY TRIOZINAE (PUTON)

1. Hind tibiae without basal spur; hind coxae lacking anteriorly directed spur *Trioza*
Hind tibiae with basal spurs; anteriorly directed spur present on hind coxae, or appearing as such 2
2. Genal cones more or less divergent; thorax broader than width of head; hind coxae with distinct anteriorly directed spurs; hind tibiae with usually two apical spurs within. (Food plants various *Phyllopecta*
Genal cones usually closely appressed, usually long, slender; thorax narrower than width of head; hind coxae appearing to have anteriorly directed processes; hind tibiae with three apical spurs within. (Recorded only from pine) *Neotrioza*

Genus *Trioza* Förster

Head deflexed, narrower than thorax; vertex broader than long; genae developed into conical processes, acute to subacute apically; eyes large, bulging. Thorax strongly arched; pronotum short, descending cephalad, depressed below head and prescutum; prescutum about as long as broad, narrowed cephalad. Hind tibiae with no basal spur or spurs but with two or three black apical spurs within; hind coxae without anteriorly directed spur. Forewing hyaline to clear; radius, medius, and cubitus diverging from a common point on basal vein. (No cubital petiole.)

Trioza quadripunctata Crawford Pl. 2, 3, 5

1910 *Trioza quadripunctata* Crawford, Pomona JI. Ent. 2:233.

Length to tip of forewing 3.-3.5 mm.; forewing 2.5-3. mm.

Color: Head and thorax yellow; antennae black for more than apical half; abdomen green; legs sooty yellow, tarsal segments sometimes black.

Head twice as broad as long, narrower than thorax. Vertex over half as long as broad, bulging in front; foveal impressions appearing very deep. Genal cones slightly over half as long as vertex, rather acute apically.

Thorax moderately broad; pronotum vertical, depressed below prescutum. Forewing about two and a half times as long as broad; costal margin strongly arched; apex not broadly rounded; tendency toward a cubital petiole in some Ohio specimens; dark spot at apex of clavus, one between branches of cubitus, one between cubitus and medius, and one between branches of medius. Hind tibiae with three apical spines within.

Genitalia: Male genital plate rounded. Forceps as long as proctiger, broad at base, gradually narrowed to acute apex; apex curved inward and cephalad. Proctiger concave on cephalic margin, convex on caudal margin with a notch just before apex in lateral aspect.

Female genital segment shorter than rest of abdomen. Ventral valve equal in length to dorsal, apex appearing more broadly rounded in lateral aspect.

Specimens taken in Ohio from Franklin, Licking, Pickaway, and Richland Counties during June and July.

Genus *Phyllopecta** Riley

1884 *Phyllopecta*, Riley, Proc. Am. Assoc. Adv. Sci. 32:319.

1894 *Phyllopecta*, Mally, Proc. Iowa Acad. Sci. 2:154.

1913 *Phyllopecta*, Zacher, Ent. Mitteil. 2:148.

1915 *Megatrioza*, Crawford, Philippine J. Sci. (D) 10:254.

1919 *Megatrioza*, Crawford, Ibid. 15:192.

1920 *Triozza*, Crawford, Ent. News 31:70. (In part)

1926 *Phyllopecta*, Ferris, Canadian Ent. 58:16.

1932 *Phyllopecta*, Ferris and Klyver, Trans. N. Z. Inst. 63:37. (In part)

Head deflexed, narrower than thorax; vertex broader than long; genae developed into conical processes. Thorax usually strongly arched. Hind coxae with anteriorly directed spurs; hind tibiae armed with basal spurs, two to three apical spurs within. Forewings usually quite long with acute apices; radius, medius, and cubitus diverging from a common point on basal vein.

KEY TO SPECIES OF PHYLLOPECTA RILEY

1. Forewings marked apically along veins with brown.....*tripunctata*
Forewings clear, not marked apically along veins..... 2
2. Apex of hind tibiae with three black spurs within.....*diospyri*
Apex of hind tibiae with two black spurs within.....*salicis*

Phyllopecta tripunctata (Fitch) Pl. 3, 6, 9

1851 *Psylla tripunctata* Fitch, Homop. N. Y. St. Cab., p. 64.

Length to tip of forewing 4-4.5 mm.; forewing 3-3.5 mm.

Color: Head and thorax yellow brown; abdomen dark brown above, greenish beneath; legs dusky; forewings with brownish tinge.

Head narrower than thorax. Vertex two-thirds as long as broad, raised along median line; cephalic margin semi-circular; caudal margin slightly concave. Genal cones over half as long as vertex, stout, conical; apices broadly rounded; bases depressed below vertex. Antennae longer than width of head.

Thorax broad, arched. Hind coxae with well-developed anteriorly directed spurs; hind tibiae with two apical spurs within. Forewing about two and a half

* VanDuzee (17) considers *Phyllopecta* a nomen nudum. (See p. 792 under *Triozza*.)

times as long as broad; apex acute. Veins yellowish; marginal cells small; brown band for full length of cubitus and medius and for distal half of radius.

Genitalia: Male genital segment large. Forceps as long as proctiger, curved cephalad to acute apices. Proctiger with caudal lobes as long as plate, rounded distally in lateral aspect.

Female genital segment over half as long as rest of abdomen. Dorsal valve longer than ventral; apex rounded, gently turned up. Ventral valve narrow with acute apex in lateral aspect. Tip of ovipositor long, large, tapered evenly to acute apex.

This species is readily distinguished from other Ohio *Triozinae* by the color bands on the forewings. It has been taken in Adams, Hocking, Lawrence, and Ross Counties and should occur whenever blackberries and conifers are associated together.

Peterson (23) found that conifers are an essential host for overwintering. All breeding is done on blackberry during the warmer months. There is one generation a year.

Fifth stage: Length 2. mm.; width 1.5 mm.; broadly oval in form. General coloration light mottled with dark areas. Antennae appearing three segmented; terminal segment about four times as long as two basal segments together, sometimes appearing broken into six smaller segments.

Dorsum wrinkled and covered with small, round, flat areas that bear very minute setae on head, thorax, and wing-pads. Marginal setae present around entire body.

Apices of femora not nearly attaining margin of wing-pads. Pulvilli broad, triangular in ventral aspect. Ventral side of abdomen appearing segmented, beset with long setae. Anal opening near apex of abdomen. Circum-anal ring composed of slit-like pores bordered on outside with a great number of minute circular pores, on inside with indications of similar circular pores.

Phyllopecta diospyri (Ashmead) Pl. 3, 5, 9

1881 *Psylla diospyri* Ashmead, Can. Ent. 13:222.

Length to tip of forewing 3.5-4.5 mm.; forewing 3.-4.5 mm.

Color: Shining black; middle and hind tibiae and tarsi, and antennae except tip light colored.

Head almost as broad as thorax. Vertex little less than twice as broad as long, almost vertical; deep, broad discal impression present on each half of vertex. Genal cones about half as long as vertex, closely appressed, broadly rounded apically, pubescent. Antennae longer than width of head.

Thorax strongly arched, sparsely covered with long pubescence; pronotum strongly descending. Legs long, densely pubescent; hind coxae with long anteriorly directed spur; hind tibiae with small basal spurs and three apical spurs within. Forewing very large, about two and a half times as long as broad.

Genitalia: Male genital plate rounded. Forceps as long as proctiger, gradually narrowed to acute apices which are flexed cephalad and inward. Proctiger with caudal lobes very arcuate, constricted apically on caudal margins.

Female genital segment shorter than rest of abdomen. Dorsum of dorsal valve straight; apical third gently elevated. Ventral valve rather heavy, shorter than dorsal, narrowed on dorsal margins for apical third; apex acute in lateral aspect.

Present records include Hocking and Pickaway Counties. Its distribution is dependent on the common persimmon (*Diospyros virginiana* L.). Careful collecting in the southern half of Ohio should produce this species.

Fifth stage: Length 2.2 mm.; width 1.3 mm.; elongate oval in form. Antennae three segmented; terminal segment about equal in length to fore tibiae.

Dorsum smooth, rather densely beset with minute, thick, setae. Marginal setae present around entire body.

Apex of femora not attaining margin of wing-pads. Ventral side of abdomen apparently evenly chitinized, a few long setae present; short setae present towards margins. Anal opening set close to apex of abdomen. Circum-anal ring extremely large, V-shaped; outer ring composed of slit-like pores; inner ring of small circular pores.

Phyllopecta salicis (Mally) Pl. 3, 6, 10

- 1895 *Trioza salicis* Mally, Proc. Iowa Acad. Sci. 2:161.
 1910 *Trioza nigra* Crawford, Pomona Jl. Ent. 2:232, 358.
 1910 *Trioza minuta* Crawford, Ibid., 2:232.
 1911 *Trioza assimilis* Crawford, Ibid., 2:233.
 1911 *Trioza minuta* and var. *similis* Crawford, Pomona Jl. Ent. 3:425, 427, 432, and 433.
 1911 *Trioza salicis* Crawford, Ibid., 3:426, 428, and 432.
 1911 *Trioza assimilis* Crawford, Ibid., 3:426, 429, and 438.
 1911 *Trioza nigra* Crawford, Ibid., 3:427, and 428.
 1911 *Trioza nigrilla* Crawford, Ibid. 3:503 (n. n. for *nigra* Crawford.)
 1911 *Trioza flori* Crawford, Ibid., 3:503 (n. n. for *assimilis* Crawford.)
 1912 *Trioza dubia* Patch, Me. Agr. Exp. Sta. Bull. 202:226.
 1912 *Trioza louisianae* Aulmann, Ent. Rundsch. 29:144. (n. n. for *nigra* Crawford.)
 1912 *Trioza pomonae* Aulmann, Ibid., 29:144. (n. n. for *assimilis* Crawford.)
 1913 *Trioza louisianae* Aulmann, Psyllid Cat., p. 48.
 1913 *Trioza pomonae* Aulmann, Ibid., p. 51.
 1913 *Trioza salicis* Aulmann, Ibid., p. 53.
 1914 *Trioza salicis* Crawford, U. S. Natl. Mus. Bull. 85:91.
 1916 *Trioza salicis* Van Duzee, Check List Hemip., p. 86.
 1917 *Trioza nigrilla* Van Duzee, Cat. Hemip., p. 796, No. 2870.

Length to tip of forewing 3.-3.5 mm.; forewing 2.7-3.2 mm.

Color: General color yellow-orange; light forms lack any black on head or body. Dark forms have vertex typically black though sometimes edged with orange; thoracic dorsum unmarked to strongly marked with black; abdomen varying from dark green to dark orange-black.

Head narrower than thorax though almost as broad in some specimens. Vertex over one-half as long as broad, rather flat; foveal impressions shallow.

Genal cones varying in length, at most a little less than length of vertex, divergent, usually with acute apices.

Thorax broad, strongly arched; pronotum almost concealed by head in dorsal aspect. Hind coxae with anteriorly directed spur, in some specimens these structures are more plate-like than spur-like; hind tibiae with basal spurs and two apical spurs within. Forewing about three times as long as broad, rather acute apically.

Genitalia: Male forceps slender, convergent, about as long as proctiger; apices curved cephalad, acutely pointed. Caudal lobes of proctiger with dorsal margins straight; caudal margins broadly rounded, narrowed mid-length thence sloping to base of proctiger.

Female genital segment very short. Dorsal valve longer than ventral; apex bluntly hooked in lateral aspect. Ventral valve very short, broad, notched cephalad to apex on dorsal margins.

Specimens collected from July to October are on hand from Athens, Franklin, Hancock, Pickaway, and Ross counties, Ohio.

It is of interest to note that there are two distinct color varieties of this species(?). The dark forms of both adult and nymph coincide with the description of Mally's *salicis*. The light forms devoid of any black on head, thorax, or abdomen fit into Crawford's description of *minuta*. The adults of the light form differ only from the dark forms in having the genal cones shorter with the apices more broadly rounded, and possibly are slightly larger in total body proportions. Other than color and possibly size, the genitalia of the two are alike; however, genitalia especially the male are very similar in our Ohio *Phyllopecta*. This leaves the possibility that these two forms may be distinct species. On the contrary the nymphs of both forms can only be distinguished by color which is unreliable, light-colored nymphs sometimes producing dark individuals. Nymphs marked with black or entirely black have never in the writer's experience produced light-colored adults. Nymphs of both forms have been reared on sandbar willow and other undetermined willows. (*Salix longifolia* Muhl. and *Salix* spp.). The habits and period of development of the two forms are apparently alike. Adults as collected in nature approximate equal numbers of both.

Egg: Length .24 mm. with a pedicel varying around .3 mm. in length. Spindle shaped when first laid with basal end rounding out as incubation progresses. Cream colored, darkening with age.

First stage: About .4 mm. in length. Light yellow; eye-spots red. Antennae very stout, appearing unsegmented. Head with a marked notch at median of cephalic margin. Marginal setae very few, only present on head and apically on abdomen. Legs short stout; tibio-tarsal articulation lacking.

Second stage: Length .6 mm., resembling first stage except that head and thorax and thoracic and abdominal conjunctives are visible; very small wing-pads present; marginal setae present around entire body.

Third stage: Length about 1. mm. Dark forms show indications of black along median of dorsum. Antennae definitely two segmented. Body regions distinct. Wing-pads large. Marginal setasetae dense around entire body.

Fourth stage: Length 1.5 mm. Antennae three segmented; terminal segment very long with concentric, constricted rings. Tibio-tarsal articulation apparent.

Fifth stage: Length 2.3 mm.; width 1.5 mm. Dark forms varying from irregular black band the length of dorsum to entirely black; light forms light yellow to hyaline. Antennae seven segmented; segments five or seven as long as combined length of first four.

Dorsum heavily chitinized, wrinkled, beset with minute setae. Continuous series of setasetae closely set around margin of body.

Legs short, very few setae present; pulvilli small, triangular in ventral aspect. Ventral side of abdomen less heavily chitinized, rough. Anal opening set well in from apex of abdomen. Circum-anal ring surrounded by fourteen small setae; outer ring composed of slit-like pores; inner ring irregular, composed of circular pores.

Biologic: Under natural conditions the eggs are placed singly at the base of a serration, either in the serration or on the upper leaf surface. They usually stand erect on their pedicels which vary from perpendicular to horizontal with the upper leaf surface. In unnatural overcrowded situations eggs may be placed without respect to serrations.

During oviposition the female may either stand on the leaf surface or on the edge of the leaf. Most of the time is spent attaching pedicel to the leaf, then the abdomen is slowly raised and with a slight pause in the upward movement the egg appears. This performance requires less than a minute. There has been no attempt to determine the number of eggs produced during the life of one female; however, one female deposited 20 eggs in two hours and 60 eggs in three days.

The eggs usually hatch in from eight to ten days (July and August). The newly hatched nymphs are quite active and crawl to the under side of the leaf or to another leaf before settling down to feed. The nymphs usually complete development on one leaf. Once in a while a nymph will remain on the upper surface of a leaf and complete development. The characteristic threads of wax projecting out from the margins of the body are quite prominent from the third stage to adult emergence. Honey-dew wrapped in wax is freely produced.

The first stage lasts from one to four days, the second stage from two to three days, the third stage from four to five days, the fourth stage from three to four days, and the fifth stage from five to

eight days. The total nymphal development ranges between fifteen and eighteen days with a few individuals going over twenty days.

The sex ratio of 60 reared adults approximated 1:1 with the females having a slight edge. Newly emerged adults attained their final coloration in from one to three days. Copulation was observed as early as the third day. Oviposition took place between three to five days after copulation.

Genus *Neotrioze* Crawford

Head broader than thorax. Genal cones usually long, slender, closely appressed for full length; apices acute. Thorax narrow; pronotum descending strongly cephalad, much depressed below head and prescutum. Hind coxae without true anterior projecting spurs. Hind tibiae with basal spurs, with three apical spurs within. (Recorded only from pine.)

KEY TO SPECIES OF NEOTRIOZE CRAWFORD

1. Genal cones longer than vertex; female genital segment with ventral valve styliform *immaculata*
Genal cones shorter than vertex; female genital segment with ventral valve narrowed evenly to apex..... *virginiana*

Neotrioze immaculata Crawford Pl. 3, 6

1910 *Trioze immaculata* Crawford, Pomona JI. Ent. 2:233.

Length to tip of forewing 3.-3.5 mm.; forewing 2.5-3. mm.

Color: Vertex black, sometimes outlined with red; thorax dark red with two more or less distinct black lines on dorsum; dorsum of abdomen black, under side slate colored.

Head as broad or broader than thorax. Vertex about one-half as long as broad; caudal margin concave; cephalic margin deeply emarginate at cephalic end of median line. Genal cones longer than vertex, slender, appressed full length. Antennae over twice width of head.

Thorax narrow, not strongly arched; pronotum strongly depressed, almost vertical. Hind tibiae with basal spurs; three spurs at apex within and one on outside. Forewing two and a half times as long as broad; apex rather acute; veins delicate.

Genitalia: Male genital plate very small. Forceps short, enlarged apically; apex broadly rounded. Proctiger about one-third longer than forceps; cephalic margin straight, caudal margin broadly convex in lateral aspect.

Female genital segment shorter than rest of abdomen. Ventral valve shorter than dorsal, apical third narrowed, styliform.

Adults taken during early May in Adams and Scioto counties from pitch pine (*Pinus rigida* Mill.).

Neotriozeella virginiana n. sp. Pl. 3, 6

Length to tip of forewing 3.5 mm.; forewing 3. mm.

Color: Very similar to *immaculata*. Vertex evenly dark; genal cones light colored.

Head as broad as thorax, strongly deflexed. Vertex almost two-thirds as long as broad. Genal cones shorter than vertex, slightly divergent, broad at base, subacute apically. Antennae about one and a half times as long as width of head; segment III almost as long as following three.

Thorax moderately broad; pronotum strongly depressed, vertical. Hind tibiae with basal spurs; apex with three spurs within and one on outside. Forewing twice as long as broad; apical portion rounded, slightly subacute. Veins prominent; cubital cell large.

Genitalia: Female genital segment shorter than rest of abdomen. Apical half of dorsal valve narrow, styliform; apex rounded. Ventral valve very broad, stout, narrowed evenly to apex in lateral aspect.

Male unknown.

Described from one female collected from scrub pine (*Pinus virginiana* Mill.) in Hocking Co., Ohio, V-17-36 by the writer. Female holotype is in the writer's collection at Ohio State University.

Subfamily PSYLLIINAE VanDuzee**KEY TO GENERA OF SUBFAMILY PSYLLIINAE VANDUZEE**

1. Robust species with quadrate vertex, short blunt genal cones, short thick antennae, and opaque to semi-opaque forewings. All species forming galls on hackberry (*Celtis*).....*Pachypsylla*
Slender species with rather triangular vertex, long rather pointed genal cones, usually long slender antennae, and hyaline to clear forewings. Food plants various.....*Psyllia**

Genus Pachypsylla Riley

Body robust, broad; pronotum and prescutum strongly arched. Vertex flat, practically rectangular, usually vertical. Genal cones small, divergent. Antennae short. Forewings thickened, colored; marginal cells rather long, narrow; pterostigma present.

KEY TO SPECIES OF PACHYPSYLLA RILEY

1. Large species, approximating 6 mm. to tip of forewing; forewing maculate apically*venusta*
Smaller species, less than 5 mm. to tip of forewing..... 2
- 2(1). Very robust species; vertex and thorax not pubescent; forewing uniformly darkened, at least for apical half..... 3
Slender species; vertex and thorax pubescent; forewing maculate or variegate at least for apical half..... 4

* Similar in shape and form to *Psyllia* except vertex not sharply defined on anterior margin but merged into genae. *Psyllopsis frazinicola* Förster. Host: *Juglans* and *Fraginus*

- 3(2). Forewing uniformly colored; veins straight.....*celtidis-gemma*.
Forewing with light marks along basal margins; medial veins sinuate.....*ungulata*
- 4(2). Seldom less than 3 mm. in length; oedeagus of male with apical hook; ventral valve of female genital segment evenly narrowed to apex.....*celtidis-mamma*.
Seldom more than 2.5 mm. in length; oedeagus of male with blunt apex; ventral valve of female genital segment suddenly narrowed ventrally for apical third.....*celtidis-vesiculum*

KEY TO GALLS

1. Galls formed on twigs or petioles..... 2
Galls formed on leaves 3
- 2(1). Very woody open gall, spherical in shape on twig or petiole.....*venusta*
Small gall formed from axillary bud on twig.....*c.-gemma*
Small gall formed under bark on twig.....*ungulata*
- 3(2). Mammiform gall on underside of leaf, concave on upper side (Galls very rarely on green twig).....*c.-mamma*
Blister-like gall visible on both sides of leaf.....*c.-vesiculum*

Pachypsylla venusta (Osten Sacken) Pl. 3, 6

1861 *Psylla venusta* Osten Sacken, Ent. Zeit in Stettin 22:422.

Length to tip of forewing 6.-6.5 mm.; forewing 5.-5.2 mm.

Color: Brown to greenish yellow, marked with red-brown stripes on dorsum of thorax.

Head twice as broad as long, broader than pronotum. Vertex vertical, large, rectangular, coarsely rugose. Genal cones small, divergent, covered with long pubescence. Antennae as long as width of head.

Thorax arched, very broad, finely punctate, pubescent. Forewing large, rhomboidal, with dark band or maculations apically.

Genitalia: Male genital segment very large. Forceps broad at base, gently tapered to rounded apices in lateral aspect. Proctiger extremely large; caudal margins bulging roundly; apex with a segment-like tip characteristic of all Ohio *Pachypsylla*.

Female genital segment as long as rest of abdomen. Caudal half of dorsal valve long, narrow, slightly arched; with acute abruptly curved-up apex in lateral aspect.

The only Ohio specimens on hand were reared from galls collected by A. Braun at Perintown, Ohio, February, 1934.

The galls are more or less spherical, about 1 cm. in diameter, polythalamous, and are formed on small twigs.

Pachypsylla celtidis-gemma Riley Pl. 3, 6, 10

1884 *Pachypsylla c.-gemma* Riley, Proc. Am. Assoc. Adv. Sci. 32:319.

Length to tip of forewing 3.-3.5 mm.; forewing 2.5-3. mm.

Color: Head dark brown; thorax dirty yellow to brown; forewing uniformly dark brown.

Head almost three times as broad as long yet narrower than thorax. Vertex much broader than long, slightly bulging. Genal cones short, divergent, rounded apically. Frons partly visible. Antennae as long as width of head.

Thorax smooth, glossy, broad, rather flat. Forewing unicolorous, rhomboidal, coriaceous, rounded apically.

Genitalia: Male genital segment relatively small. Forceps broadened at base; sides subparallel, tapered toward tip to blunt, rounded apex in lateral aspect. Proctiger short, typical.

Female genital segment superficially similar to *c.-mamma* (the following species) except proportionally shorter.

This common species is readily separated from the other pachypsyllids by the short vertex, uniform coloration of forewing, and absence of pubescence. Adults are usually found in May and sometimes in June in central Ohio. The nymphs are present in galls throughout the remainder of the summer and the following winter. Recorded from Franklin, Green, Pickaway, Ross and Sandusky counties.

The gall is an enlargement and deformation of the axillary bud. It is polythalamous with two being the usual number of nymphs within; however, some writers have observed as many as eight.

Fifth stage: Length 2.8 mm. Head short, broad; wing-pads small; abdomen very large, elongate, ovate.

Possessing slender, straight setae set in scattered groups and scattered over head and thorax with very few on fore wing-pads. Legs densely beset with short, stout, setae closely appressed to surface; a few long setae present projecting out from surface. Dorsum and venter of abdomen with long, slender setae.

Legs with trochanter; sub-apical, semi-circular ring of black spines on inside of hind tibiae composed of usually ten to twelve spines; tarsi bearing a pair of claws, a small median claw-like piece just dorsad to claws, and a pulvillus.

Apical spur on abdomen short, with well-rounded apical notch; at immediate base dorsally a trilobed spur present; at immediate base laterally four to five spurs present on either side; removed cephalad from apical cluster two groups of five spurs each present, second group cephalad from first with individual spurs more or less aligned laterally; removed laterally and circling apical cluster on ventral side of abdomen a continuous series of small spurs present, usually fourteen in number. All spurs small in proportion to size of nymph. Anal opening at apex of abdomen ventrad to base of apical spur.

Pachypsylla unguata n. sp. Pl. 4, 10

Length to tip of forewing 3.7-3.9 mm.; forewing 3.1 mm.

Color: General appearance black; vertex, pronotum, caudal edge of prescutum, a median and a pair of lateral stripes on scutum yellow-grey; rest of body dark brown to black except abdominal segments edged with red and

a series of three to four raised tubercle-like small bumps along margins of mesothoracic pleura white in color. Forewing uniformly dark brown to black with the exception of hyaline or lightly fumed area along basal margins.

Vertex rectangular, two-thirds as long as broad, slightly convex. Clypeus not visible around anterior ocellus. Genal cones as long as broad, slightly pubescent on broad apices. Antennae slightly longer than width of head.

Forewing about two and a half times as long as broad, rhomboidal; medial veins sinuate; pterostigma rather short.

Genitalia: Male genital segment relatively small. Forceps similar to *c.-gemma* in shape yet are more slender.

Female genital segment long; dorsal valve styliform for apical half; ventral valve suddenly narrowed for apical third in lateral aspect.

Described from a series of six specimens reared from galls on a hackberry in Pickaway Co., Ohio in March, 1937. All types are in the writer's collection at Ohio State University.

This species is easily recognized by the sinuate medial veins in the forewing.

The galls are located on the last year's twigs under the bark appearing as small raised bumps. The location may be anywhere on the twig, but there seems to be a slight preference for location at the base of a bud.

Fifth stage: Length 2.4-2.6 mm.; width 1.5-1.7 mm. Typical pachypsyllid in form. Antennae ten segmented. Body covered with few spines or setae. Legs composed of coxa, trochanter, femur, tibia, and a tarsus with two segments*; terminal segment bearing a pair of claws, a small median claw-like piece, and a pulvillus.

Apical spur on abdomen elongate with anal opening near apex of spur; at immediate base dorsally a small bilobed spur present; at immediate base laterally three large spurs present on either side; slightly removed cephalad from apical cluster a group of five spurs more or less arranged in a V; further removed from apex a more or less continuous series of small spurs present circling apical cluster.

Laterally and somewhat dorsally on abdomen cephalad to apical spurs is a group of wax pores composed of five to eight ocular pores.

Pachypsylla celtidis-mamma Riley Pl. 3, 6, 10

1876 *Pachypsylla c.-mamma* Riley, Johnson's Universal Encyclopedia 2:415.

Length to tip of forewing 3.5-4.5 mm.; forewing 3.-4. mm.

Color: Vertex light yellowish brown; thorax red-brown to black, often marked longitudinally with light stripes; abdomen dark.

Head over twice as broad as long. Vertex three-fourths as long as broad, flat, slightly convergent from eyes to genae. Genal cones lighter than vertex, short, slightly divergent, tipped with long pubescence. Antennae about as long as width of head.

Thorax strongly arched, as broad as head, pubescent. Forewing ellipti-

* In some nymphs this tarsal joint seems to be articulate, while in others it is quite apparent but does not seem to be articulate.

cal, about two and a half times as long as broad, whitish, densely maculated with a usually less maculate band subapically; pterostigma large; veins with a double row of setae.

Genitalia: Male genital plate rather large. Forceps short, stout, tapered apically to blunt apex in lateral aspect. Proctiger symmetrically enlarged apically. Oedeagus with thick, hooked apex.

Dorsal valve of female genital segment long, straight, styliform. Ventral valve narrowed evenly to apex.

This very common species is found abundantly in early May on the common hackberry (*Celtis occidentalis* L.). The mammiform galls are a common sight on the leaves during the entire summer. In late September and early October the adults emerge and almost immediately leave the tree to go into hibernation. The species should be found throughout the range of the hackberry, but it is present in the collections from only Franklin, Green, Pickaway, and Ross counties.

The galls are typically mammiform and vary from glabrous to quite pubescent. Under crowded conditions they may be deformed into various shapes, sizes, and colors. As many as 52 have been found on one leaf. Double and triple galls are not uncommon, however, single galls containing two or more individuals in the same cell are extremely rare. Galls have been found on twigs when the twigs were yet green. The nymphs develop in a dish-like cavity near the upper end of the gall. When maturity is reached the nymphs escape through a rough slit-like break in the upper surface. This break or hole is made with the heavy spurs on the caudal end of the nymph.

Fifth stage: Length varying around 4. mm. Antennae appearing ten segmented; small terminal segment may not be a distinct segment. Head small; wing-pads very small; abdomen very large.

Short, stout, closely set, curved setae present ventrally on head to base of antennae, dorsally on head extending onto thorax and narrowed from base of fore wing-pads to center of thorax; fore wing-pads with same type of setae scattered over dorsal surface.

Legs densely beset with short, stout, straight setae closely appressed to surface; a few long, slender setae present projecting outwards from ventral side of femora and outer side of tibiae and tarsi. Long slender setae present on dorsum and venter of abdomen.

Legs with a trochanter; extremity of hind tibiae with a pair of black spines within, further removed from apex is a semi-circle of usually ten black spines; all tarsi bearing a pair of claws and a small median spur-like piece; pulvillus a rectangular to sub-circular pad.

Apical fifth of abdomen heavily chitinized on dorsum and venter. Anal opening set at ventral base of apical spur. Apex of abdomen with spur arrangement and number as follows: apical spur with a pair of spurs at dorsal base, a pair of large spurs at each side laterally; two groups of three spurs

each set triangularly with first group set cephalad to pair at dorsal base of apical spur and second group set just cephalad to first group, each triad arranged so apex of triad is caudad and aligned with apical spur; some specimens bears a small solitary spur aligned and cephalad to second triad; removed laterally and slightly ventrally from large lateral spurs are three to four small spurs.

Laterally and somewhat dorsally on abdomen cephalad to apical spur are two groups of wax pores composed of usually seven ocular pores.

Pachypsylla-celtidis-vesiculum Crawford Pl. 3, 6, 10

1884 *Pachypsylla c.-vesiculum* Riley, Am. Assoc. Adv. Sci. 30:319 (Name only)
1890 *Pachypsylla c.-vesiculum* Riley, in Packard, 5th Rept. U. S. Ent. Comm., p. 618 (gall).

1892 *Pachypsylla c.-vesiculum* Beutenmuller, Am. Mus. Natl. Hist. p. 275. (gall)

1904 *Pachypsylla c.-vesiculum* Beutenmuller, Am. Mus. Jl., 4:120. (gall)

1906 *Pachypsylla c.-vesiculum* Jarvis, 37th Rept. Ent. Soc. Ont., p. 65. (gall)

1910 *Pachypsylla c.-vesiculum* Smith, Cat. Ins. N. J. ed. 3:109. (listed)

1913 *Pachypsylla c.-vesiculum* Crawford, U. N. Natl. Mus. Bull. 85:112. (desc. and figs.)

1917 *Pachypsylla c.-vesiculum* Van Duzee, Cat. Hemip., p. 801, No. 2889. (listed)

Length to tip of forewing 2.-2.5 mm.; forewing 1.-1.5 mm.

Color: Very similar to *c.-mamma*; forewings often less maculate.

Structurally similar to *c.-mamma* except body less robust; genitalia distinctly different.

Genitalia: Male genital plate rounded. Forceps short, not stout. Proctiger similar but less heavy than in *c.-mamma*. Oedeagus gently swollen apically, not hooked.

Female genital segment as long as rest of abdomen. Dorsal valve straight. Ventral valve suddenly narrowed on ventral margins for apical third producing a styliform apex in lateral aspect.

Probably the most abundant species of Ohio pachypsyllids. Its range and occurrence closely coincides with *c.-mamma*, often galls of both are present on the same leaf. County records include Athens, Coshocton, Franklin, Green, Knox, Pickaway, and Ross counties.

The monogamous galls are located along the large veins, often as many as 200 to a single leaf. The gall is raised blister-like on the upper leaf surface with a small depression in the center. On the under side of the leaf in the early stages of development the gall is usually sunken with a raised nipple in the center of the circular area. This sunken area rises as nymphal development proceeds within until it is definitely raised similar to the upper surface except that the raised nipple remains in the center. The mature nymph effects its escape through a slit-like hole in the side of the upper blister.

Egg: Usually about 1.4 mm in length; broadly rounded basally, tapered apically to apex; appearing smooth, white.

First stage: Length .17 mm. Body appearing sub-circular in dorsal aspect. Antennae appearing unsegmented; two terminal setae as long or longer than antennae. Legs appearing three segmented; pulvilli present, short but very broadly triangular in ventral aspect.

Second stage: Length .4 mm. Body elongate; thoracic-abdominal conjunctive visible. Antennae three segmented, about as long as fore femora. Apical spur present on abdomen, appearing short and bifid or double. Wing-pads very small buds.

Third stage: Length .78 mm. Antennae six segmented, rather stubby. Wing-pads with caudal margins perpendicular to body in dorsal aspect. Apical spur on abdomen elongate; apex notched.

Fourth stage: Length 1.4 mm. Antennae six segmented, elongate. Wing-pads developed similar to fifth stage. Coxal-trochanter conjunctive present. Apical spur on abdomen elongate with well-rounded apex.

Fifth stage: Very similar to fifth stage of *c.-mamima* but differing as follows: Length 1.7 mm. Sub-apical, semi-circular ring of black spines on inside of hind tibiae composed of six to eight spines. Extreme lateral-ventral spur groups on abdominal apex composed of one to two spurs. Wax pores located more laterally, fewer in number and individually less ocular.

Biologic: Soon after the hackberry trees begin to leaf the adult chermids emerge from hibernation in large numbers and feed on the new leaves. Copulation takes place on the leaves and soon afterwards oviposition begins. Eggs are laid on the under side of newly developed leaves and in unfolded leaf clumps. Strangely enough very few eggs have been observed on the upper leaf surface; however, all nymphs sink into this surface to form galls.

Incubation is completed in about twelve days. Three days later the nymphs are sunk in slight depressions along the principle veins in the upper leaf surface. Approximately eight to twelve days after hatching the nymphs are sunk out of sight and the hole in the leaf has begun to close over them. The first stage approximates 34 days, the second 24 days, the third 24 days, the fourth 29 days, and the fifth 25 to 35 days making a total nymphal period of around 136 days.

Emergence takes place either while the leaf is on the tree or after the leaf has fallen. Almost immediately after emergence the adults leave the leaf and seek hibernation quarters.

Genus *Psyllia* Geoffroy

Head as broad or broader than thorax, deflexed. Genae developed into conical processes, depressed from plane of vertex. Frons

sometimes slightly visible around cephalic ocellus. Thorax broad, arched; pronotum usually strongly descending. Hind tibiae usually with a spur at base. Forewings hyaline to clear, broadly rounded apices; medius and cubitus with a distinct petiole; pterostigma present; veins with setae.

KEY TO SPECIES OF *PSYLLIA* GEOFFROY

1. Female genital segment shorter than rest of abdomen. Male genital segment small; length of forceps not exceeding height of genital plate in lateral aspect 2
 Female genital segment as long or longer than rest of abdomen. Male genital segment large; length of forceps greater than height of genital plate in lateral aspect. 5
- 2(1). Small species, usually less than 3.5 mm. to tip of forewing. Male forceps appearing short, stout in lateral aspect. 3
 Large species, usually more than 3.5 to tip of forewing. Male forceps appearing slender, enlarged basally in lateral aspect. 4
- 3(2). Species appearing dark; black spot present at tip of clavus. Female with dorsum of dorsal valve relatively straight. Proctiger and forceps of male appearing very stout in lateral aspect (Found on pear) *pyricola*
 Species appearing light. Female with dorsum of dorsal valve definitely sinuate. Proctiger and forceps of male appearing less stout but short in lateral aspect. (Found on willow) *albigena*
- 4(2). Antennae ringed with black at joints. Male forceps rather suddenly narrowed for apical half on inner margins in caudal aspect. Contour of ventral valve of female not smooth. (Found on maple.) *annulata*
 Antennae not ringed with black, but plain yellow. Forceps of male evenly, gradually narrowed to apices in caudal aspect. Contour of ventral valve of female smooth. (Found on box-elder) *negundinis*
- 5(1). Length of male genital plate equal to length of forceps. Inner-apical margins of both valves of female genitalia beset with bulb-shaped nodules. (Found on box-wood) *buxi*
 Length of male forceps greatly exceeding length of genital plate. Female genitalia without bulb-shaped nodules. 6
- 6(5). Genal cones seldom longer than vertex; apices blunt. Female genital segment with dorsal valve acutely pointed. Proctiger of male evenly tapered from base to apex in lateral aspect. (Found on blue-beech) *carpinicola*
 Genal cones very long; apices acute. Dorsal valve of female genital segment with rounded apex. Proctiger of male with basal two-thirds greatly enlarged in lateral aspect (host unknown) *diloncha*

Psyllia pyricola (Förster) Pl. 6

1848 *Psylla pyricola* Förster, Verh. Natw. Press. Rheinl. 5:77.

Length to tip of forewing 1.2-3.5 mm.; forewing .75-2.5 mm.

Color: Vertex brown; body brown to black; scutum with four narrow longitudinal light stripes.

Head over twice as broad as long. Vertex two-thirds as long as broad, perpendicular, deeply emarginate at front of median line; foveal impressions deep. Genae greatly depressed from plane of vertex, divergent, sparsely pubescent; apices rather acute. Antennae longer than width of head.

Thorax strongly arched; pronotum practically perpendicular. Very small spur present at base of hind tibiae. Forewing hyaline, sometimes fumed in apical cells; conspicuous black spot present at tip of clavus; pterostigma relatively large.

Genitalia: Male genital plate small, rounded. Forceps short, tapered evenly to rather blunt apices in lateral aspect. Proctiger about twice length of forceps though appearing less.

Female genital segment short. Dorsum of dorsal valve straight.

Reported abundant enough to have caused damage around Cleveland, Waterville, and Willoughby, Ohio, and is known to occur in Franklin, and Hocking counties.

According to Slingerland (96) the adults that have passed through hibernation begin to lay their eggs about the middle of April in old leaf scars around the terminal buds and in cracks in the bark of pear trees. The eggs hatch in from eleven to thirty days depending on temperature conditions. The nymphs mature in about twenty days making a cycle from egg to adult in about a month. There are four generations a year in New York state. Similar conditions should be found in Ohio.

The over-wintering adults are a little larger and darker than the summer forms and there is more contrast to the colors.

Psyllia albagenta n. sp. Pl. 2, 4, 6, 11

Length to tip of forewing 2.5-3.5 mm.; forewing 2.-2.3 mm.

Color: Genal cones light gray to white; vertex light orange to yellow; pronotum dark gray; prescutum and scutum orange; abdomen green; legs sooty white; forewings appearing white; sometimes whole body covered with a white dust.

Head over twice as broad as long. Vertex almost two-thirds as long as broad; dorsal margin cave; depressed discally. Genal cones as long as vertex at median line, divergent; apices not broadly rounded; bases moderately depressed below plane of vertex.

Thorax strongly arched; pronotum and prescutum strongly descending. Forewing almost two and a half times as long as broad, hyaline; pterostigma rather broad and long.

Genitalia: Male genital plate small. Forceps short, moderately stout. Proctiger one and a half times longer than forceps. Oedeagus swollen and hooked apically.

Female genital segment shorter than rest of abdomen. Dorsum of dorsal valve sinuate; apical fourth straight, narrow; apex broadly rounded. Ventral valve short, stout.

Described from a series of twelve specimens taken in Pickaway Co., Ohio, in July and August; six specimens reared from the egg on sandbar willow (*Salix longifolia* Muhl.); one female taken in Pickaway Co., Ohio, III-25-35; and one female from Akron, Ohio, VIII-13-28.

Male holotype and female allotype reared in Pickaway Co., Ohio, VII-1-36 by the writer are in his collection. Male and female paratypes are in the Ohio Biological Survey collection and the writer's collection at Ohio State University, and in the National Museum collection at Washington, D. C.

Egg: Length .3 mm.; width .14 mm.; broadly rounded basally, gently narrowed apically; short thread present apically on some eggs. Cream colored when laid but changing to yellow-brown in about 36 hours.

First stage: Usually .34 mm. in length. Deep yellow in color; eye-spots red; abdomen with a tinge of red. Head much elongated cephalad to eye-spots, broadly rounded. Antennae short, stubby, apparently not segmented. Wing-pads absent. Legs short, stout; tibio-tarsal articulation lacking. Long setae present posteriorly on abdomen. Derm apparently membranous throughout.

Second stage: Length .52 mm. Antennae definitely two segmented. Wing-pads present, very small. Tibio-tarsal joint lacking; pulvilli visible. Areas of heavy chitinization visible on abdomen.

Third stage: Length .74 mm. Head shortened cephalad to eyes. Eyes proportionally larger. Antennae appearing three segmented, reaching almost to tip of fore wing-pads; tip of terminal segment black. Long setae present on wing-pads. Tibiae present. Derm with chitinized plates present that are carried through the following stages.

Fourth stage: Length 1.3 mm. Antennae appearing five segmented. Middle and hind legs, and chitinous cap on posterior of abdomen black. Resembling fifth stage except for size and segmentation of antennae.

Fifth stage: Length 2. mm. Antennae reaching about two-thirds distance to tip of fore wing-pads, nine segmented; three terminal segments imbricate.

Derm of dorsum with heavy chitinization as follows: a pair of large ocular plates, wing-pads, small thoracic plates, five small abdominal plates, and an apical plate covering about caudal half of abdomen. The wing-pads, apical plate and two marginal plates of the ventral side of the abdomen beset with stout, stylet-form setae. Extremely long capitate setae present on margins of wing-pads and margins of apical third of abdomen.

Pulvilli large, triangular in ventral aspect; semi-lanceolate in lateral aspect. Circum-anal ring removed from apex of abdomen; composed of a single ring of slit-like pores, some specimens appear to have an inner ring of very minute circular pores closely appressed to the outer ring. (The location and structure of the circum-anal ring is not typically *Psylline* in this species.)

Biologic: The eggs are laid singly on the margins of the leaf in the serrations, the long axis of the egg paralleling the edge of the leaf. Most eggs are placed in the basal half of the leaf except in the

terminal leaves where they are placed in all the serrations. Actual oviposition requires less than a minute; however, the female spends considerable time selecting a favorable spot for the act. One female deposited 31 eggs in 24 hours.

Seven to twelve days are required for the eggs to hatch. The nymphs normally crawl down the leaf to the twig and up the twig to the axes of the terminal leaves where they feed and remain hidden except for ecdyses which takes place out on the leaf away from the twig. In feeding, the proboscis seems to be inserted into the twig at the base of the leaf rather than into the petiole. Very little free wax is produced, but honey-dew enclosed in wax balls is freely produced. When large numbers of nymphs are present in the terminal of one twig the immediate leaves turn yellow and growth of the terminal ceases.

The first stadium lasts from one to two days, the second from three to five days, the third five days, the fourth four to five days, and the fifth seven to ten days. One individual required 32 days to complete the last stadium (the month of September and the first two days of October). Adult emergence took place two days after the food plant was moved into a warm rather humid green-house. This case may be a clue to the method of over-wintering or possibly a way of nature assuring late adults for hibernation.

The foregoing data are based on the following results: Of 62 eggs laid by a lone female all but three hatched; from the 59 nymphs 12 were preserved for study, 9 developed into adults and 3 of these escaped, and the rest fell prey to natural enemies. The nymphal period of five specimens ranged between 23 and 27 days; one specimen took 48 days.

Psyllia annulata (Fitch) Pl. 2, 4, 7

1851 *Psylla annulata* Fitch, Homop. N. Y. St. Cab., p. 64.

Length to tip of forewing 3.5-4.2 mm.; forewing 3.-3.7 mm.

Color: Head light yellow; eyes black; thorax straw yellow; abdomen usually yellow but sometimes green; legs yellow; antennae yellow, joints annulated with black, apical third usually black.

Head as broad or broader than thorax. Vertex over twice as broad as long. Eyes appearing stalked. Genal cones as long as vertex, divergent; apices acute to subacute. Antennae about two and a half times as long as width of head.

Thorax not strongly arched; pronotum rather descending. Forewings large, clear; pterostigma large. Legs large; spur present at base of hind tibiae.

Genitalia: Male genital plate not large. Forceps slender, clavate basally in lateral aspect; inner margins gently constricted and curved convergently for apical half in caudal aspect. Proctiger long, slender.

Female genital segment very short. Dorsum of dorsal valve relatively straight. Contour of ventral valve not smooth.

Specimens from only Adams and Richland counties. Occurs on sugar maple (*Acer saccharum* Marsh.) and should be found where this tree occurs in Ohio.

Psyllia negundinis (Mally) Pl. 2, 7

1894 *Psylla negundinis* Mally, Proc. Iowa Acad. Sci. 2:155.

Evidently a closely related species to *annulata* but differing as follows: Ohio specimens more green than yellow. Antennae without dark rings yet black apically. Eyes on some specimens not quite so stalked; genae heavier distally. Male genital plate larger, more rounded. Forceps stouter in lateral aspect; in caudal aspect appearing stouter and tapering evenly from bases to apices. Female genital segment very similar though possibly larger, contour of ventral valve smooth in lateral aspect.

This species breeds on box elder (*Negundo* spp.). It probably should be found wherever box elder occurs but is as yet only recorded from Highland and Hocking counties in Ohio.

Psyllia buxi (Linnaeus) Pl. 7

1758 *Chermes buxi* Linnaeus, Syst. Nat., edn. 10, I, p. 454.

Length to tip of forewing 4.-4.2 mm.; forewing 3.2-3.5 mm.

Color: General color light green; scutum yellow-brown; forewings yellowish; female genital segment brown.

Head about two and a half times as broad as long. Vertex a little more than twice as broad as long, gently arcuate on dorsal margin, impressed on each side of median line. Genal cones pubescent, divergent, broadly rounded apically, about one-sixth shorter than length of vertex at median line. Antennae approximately one and a half times longer than width of head.

Thorax broad, strongly arched. Forewings less than two and a half times as long as broad; Cu_1 greatly arched; pterostigma not apparent.

Genitalia: Male genital plate longer than high in lateral aspect. Forceps a little shorter than proctiger, gently hemiclavate, caudal margins relatively straight, apices rounded in lateral aspect; inner-projecting apical tooth somewhat detached from body of forcep.

Female genital segment as long as rest of abdomen. Dorsum of dorsal valve slightly arched. Both dorsal and ventral valves beset for about apical half on opposing margins with small, tubercle-like setae.

Although this species has been officially reported from Cincinnati since 1931 as occurring on box-wood there are no Ohio specimens available for study. The description is based on one male from Europe, Lichtenstein, and one female from Essex County, N. J., VIII, both courtesy of Mr. P. W. Oman, U. S. National Museum.

Psyllia carpinicola (Crawford)* Pl. 2, 4, 7, 11

1851 *Psylla carpini* Fitch, Homop. N. Y. St. Cab., p. 64.

1914 *Psylla carpinicola* Crawford, U. S. Natl. Mus. Bull. 85:151.

1914 *Psylla cephalica* Crawford, Ibid., 85:151-152.

1917 *Psyllia carpinicola* Van Duzee, Cat. Hemip., p. 809, No. 2931.

1917 *Psyllia cephalica* Van Duzee, Ibid., p. 809, No. 2932.

Length to tip of forewing 3.5-4.5 mm.; forewing 3.-3.7 mm.

Head very broad, three times as broad as long, degree of deflexion varying. Vertex less than twice as broad as long; usually impressed discally. Genal cones varying in length, from shorter than vertex at median line to slightly longer; varying in degree of divergence and acuteness of apices. Antennae two and a half times as long as width of head.

Thorax broad. Forewing clear to tinged with yellow; Cu_1 varying in amount of arch.

Genitalia: Forceps of male very long; gently expanded subapically, caudal margin more so than cephalic; evenly and gently lunate in caudal aspect. Proctiger long, slightly tapered from base to truncate apex in lateral aspect.

Female genital segment longer than rest of abdomen. Dorsal valve much longer than ventral; caudal half slender, gently elevated; tip rounded upward to form acute, slightly raised apex; apical portion beset with short, stout setae. Dorsal margins of ventral valve narrowed ventrad in apical third forming a slender, acute apex in lateral aspect.

This is a very common species in Ohio being found from early May through September on blue-beech (*Carpinus caroliniana* Walt.). It is present in collections from Adams, Champaign, Delaware, Franklin, Green, Hocking, Knox, and Licking counties.

Fifth stage: Length 2.7 mm.; width 1.6 mm. Antennae nine segmented with last three segments imbricate.

Derm of dorsum sparsely beset with moderately long setae and densely beset with minute, stout setae (or spines?). Areas of heavier chitization not apparent on head and thorax; abdomen with a large chitin plate apically.

Ventral side with an area at base of antennae densely beset with small, slender setae; longer setae present on abdomen. Legs long; apex of fore and middle femora at least attaining margin of wing-pads; tarsi bearing a pair of claws and pulvillus; pulvillus broadly attached, triangular in ventral aspect.

Anal opening on apex of abdomen. Circum-anal ring composed of a single ring of slit-like pores surrounded by a band of numerous, small, circular pores; band broad, gradually narrowed medially on ventral side of abdomen and rather abruptly and broadly discontinuous medially on dorsal side of abdomen with

* A detailed study of both male and female genitalia of a large series of specimens representing both of Crawford's species namely *carpinicola* and *cephalica*, has revealed not one single consistent difference. On the other hand body structure, noticeably general build, coloration, length and form of genal cones, degree of arch in vein Cu_1 present a wide range of variation such that when arranged in a natural series, typical *carpinicola* is represented at one end and typical *cephalica* at the other. There is a possibility that these two are very closely related species; but due to the fact that the genitalia appear to be identical, that both species are recorded from *Carpinus*, and that body structures of each vary within range of the other species it does not seem logical to separate this group into two species with the present data.

The writer was able to study both species as arranged by Crawford. These specimens presented a wide range of variation and might well have been placed in either group.

three pair of setae arranged in paired series in dorsal break. Two long slender setae present on ventral side of abdomen somewhat laterad to band and extending beyond apex of abdomen.

Psyllia diloncha n. sp. Pl. 2, 4, 7

Length to tip of forewing 3.5-4. mm.; forewing 3.-3.2 mm.

Color: Yellow washed with pale green; scutum green; antennae dark yellow ringed with dark brown at joints, apical portion black.

Head strongly deflexed. Vertex practically perpendicular, less than twice as broad as long; dorsal margin concave; foveae rather deep. Genal cones large, divergent, acutely pointed, longer than length of vertex at median line; bases scarcely depressed below vertex. Antennae over twice width of head.

Thorax broad, arched; pronotum strongly descending; prescutum gently descending. Long spur present at base of hind tibiae. Forewing about twice as long as broad, clear; Cu_1 not strongly arched; pterostigma very small.

Genitalia: Forceps of male almost as long as proctiger; sides subparallel in lateral aspect; apices subacute. Proctiger broad basally; caudal margin suddenly narrowed for apical third in lateral aspect.

Female genital segment longer than rest of abdomen in relaxed specimen. Dorsum of dorsal valve very gently sinuate; apex broadly rounded, suggestion of being turned dorsad. Ventral valve rather evenly and gradually narrowed apically; apex appearing acute and hooked dorsad in lateral aspect.

Male holotype collected VI-24-34 by Professor Herbert Osborn in Fulton Co., Ohio. Female allotype with same data collected by Dr. D. M. Johnson. Both types are in the Ohio Biological Survey collection at Ohio State University.

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EXPLANATION OF PLATES

- PLATE I. Views of head of *Livia*, *Aphalara*, *Calophya*, and *Rhinopsylla*.
- PLATE II. Views of head of *Trioza*, *Neotriozella*, *Pachypsylla*, and *Psyllia*; and forewing of *Livia* and *Aphalara*.
- PLATE III. Forewings of *Aphalara*, *Calophya*, *Rhinopsylla*, *Trioza*, *Phylloplecta*, *Neotriozella*, and *Pachypsylla*.
- PLATE IV. Forewing of *Pachypsylla* and *Psyllia*; views of male and female genitalia of *Livia* and *Aphalara*.
- PLATE V. Views of male and female genitalia of *Aphalara*, *Calophya*, *Rhinopsylla*, *Trioza*, and *Phylloplecta*.
- PLATE VI. Views of male and female genitalia of *Phylloplecta*, *Neotriozella*, *Pachypsylla*, and *Psyllia*.
- PLATE VII. Views of male and female genitalia of *Psyllia*; immature stage of *Calophya*.
- PLATE VIII. Immature stages of *Livia* and *Aphalara*.
- PLATE IX. Immature stages of *Aphalara* and *Phylloplecta*.
- PLATE X. Immature stages of *Phylloplecta* and *Pachypsylla*.
- PLATE XI. Immature stages of *Psyllia*.

PLATE I

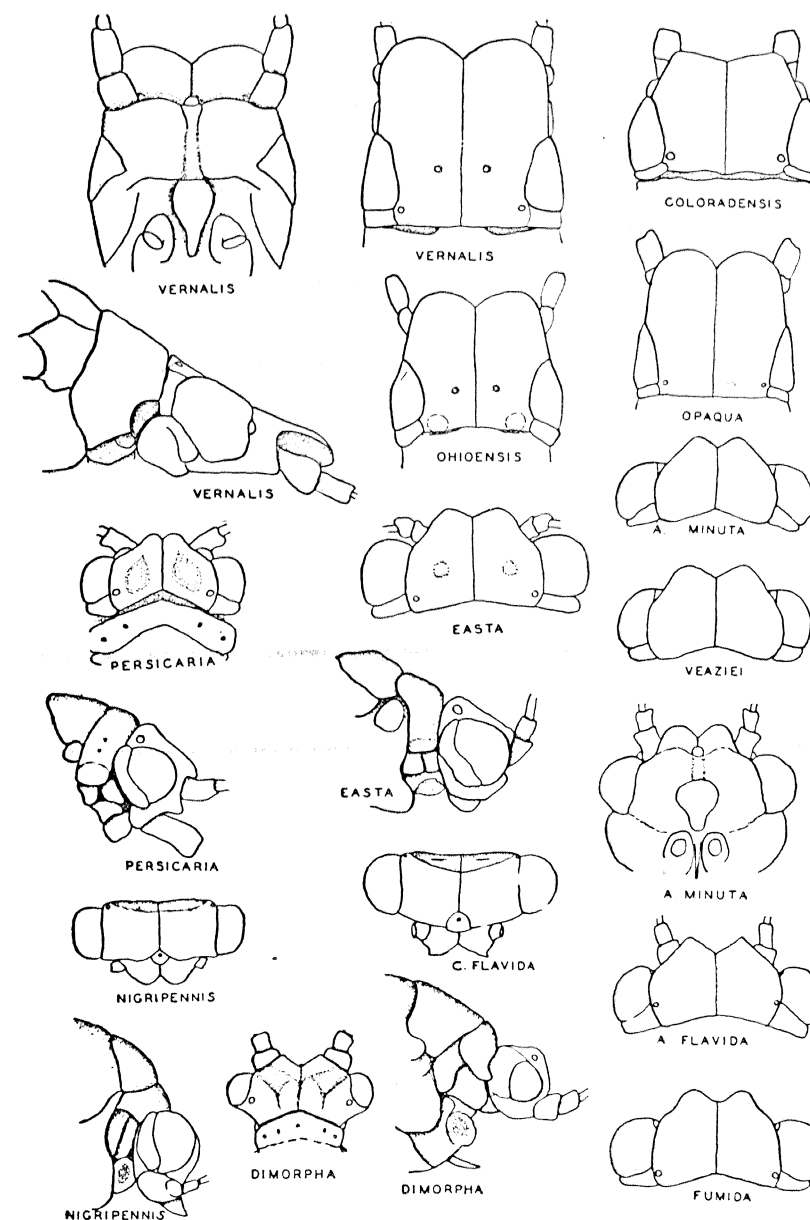


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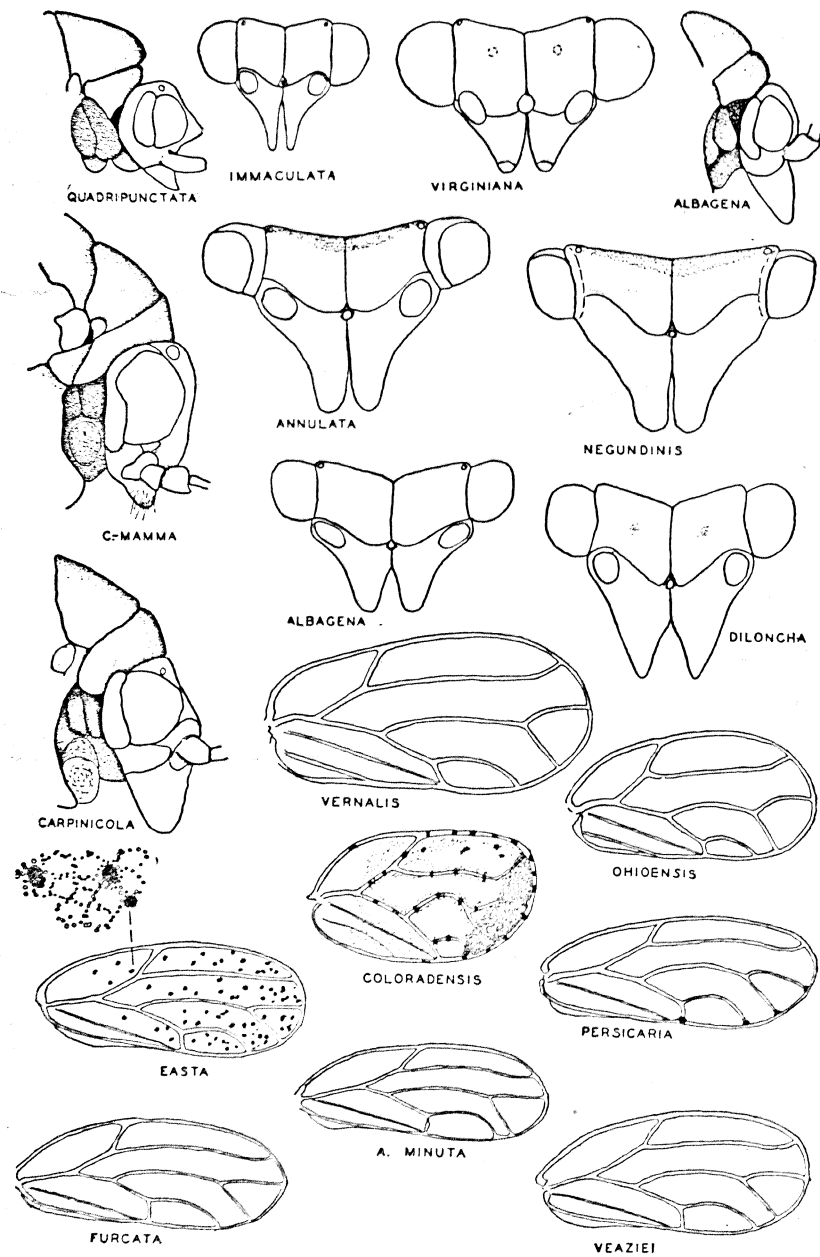


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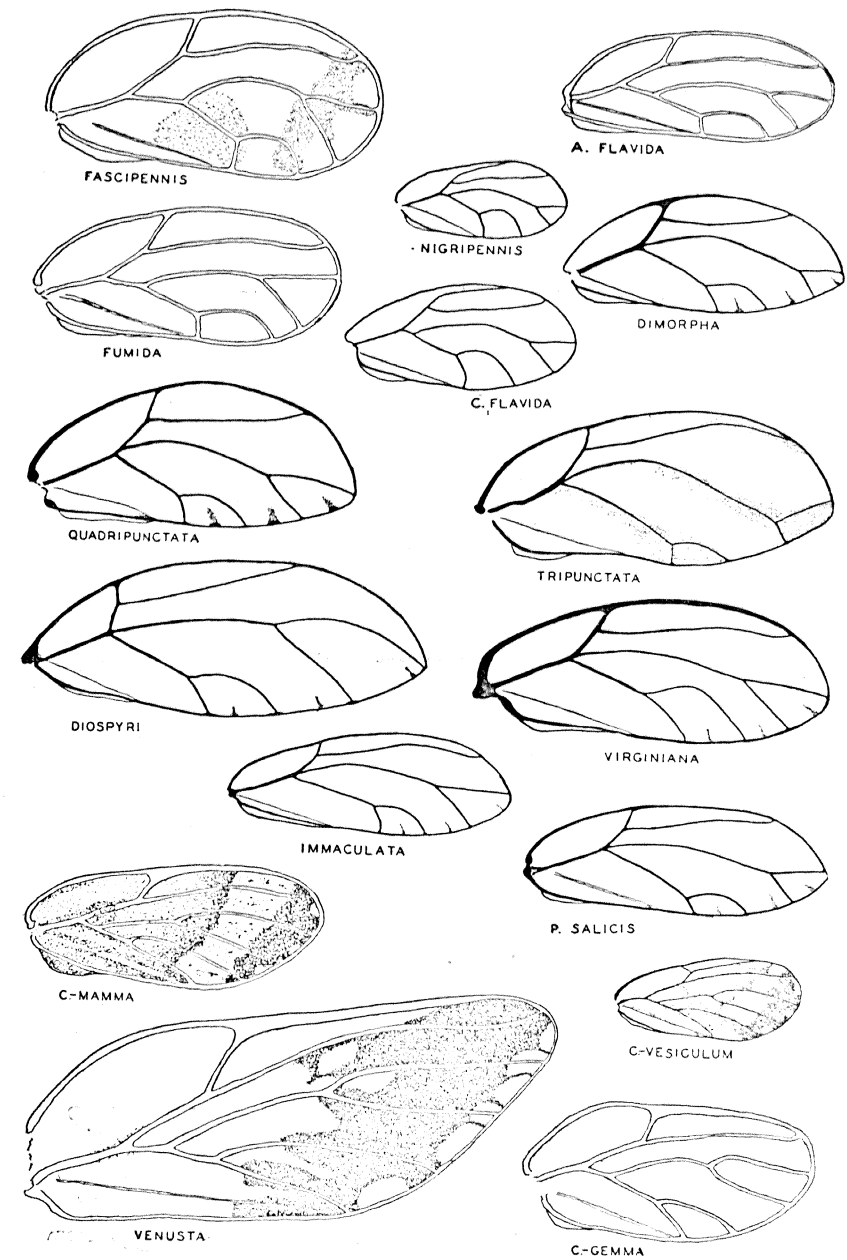


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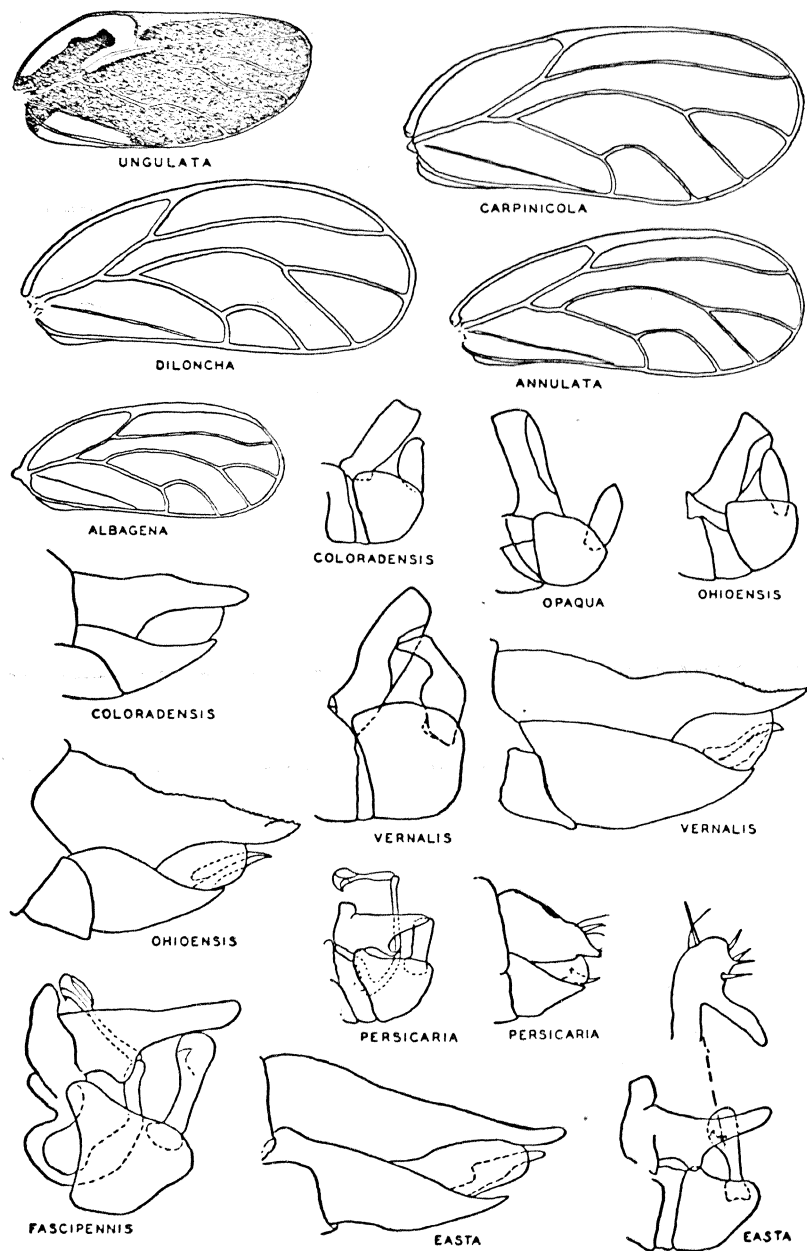


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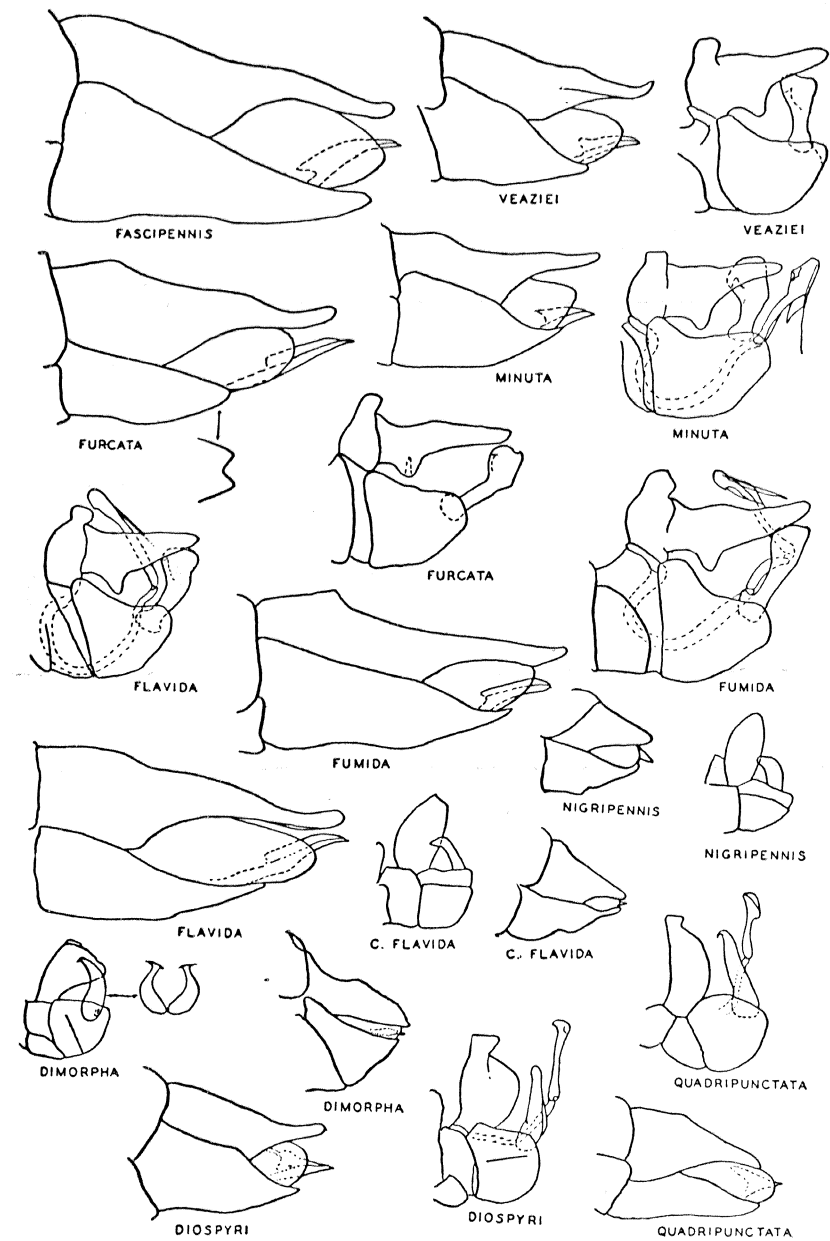


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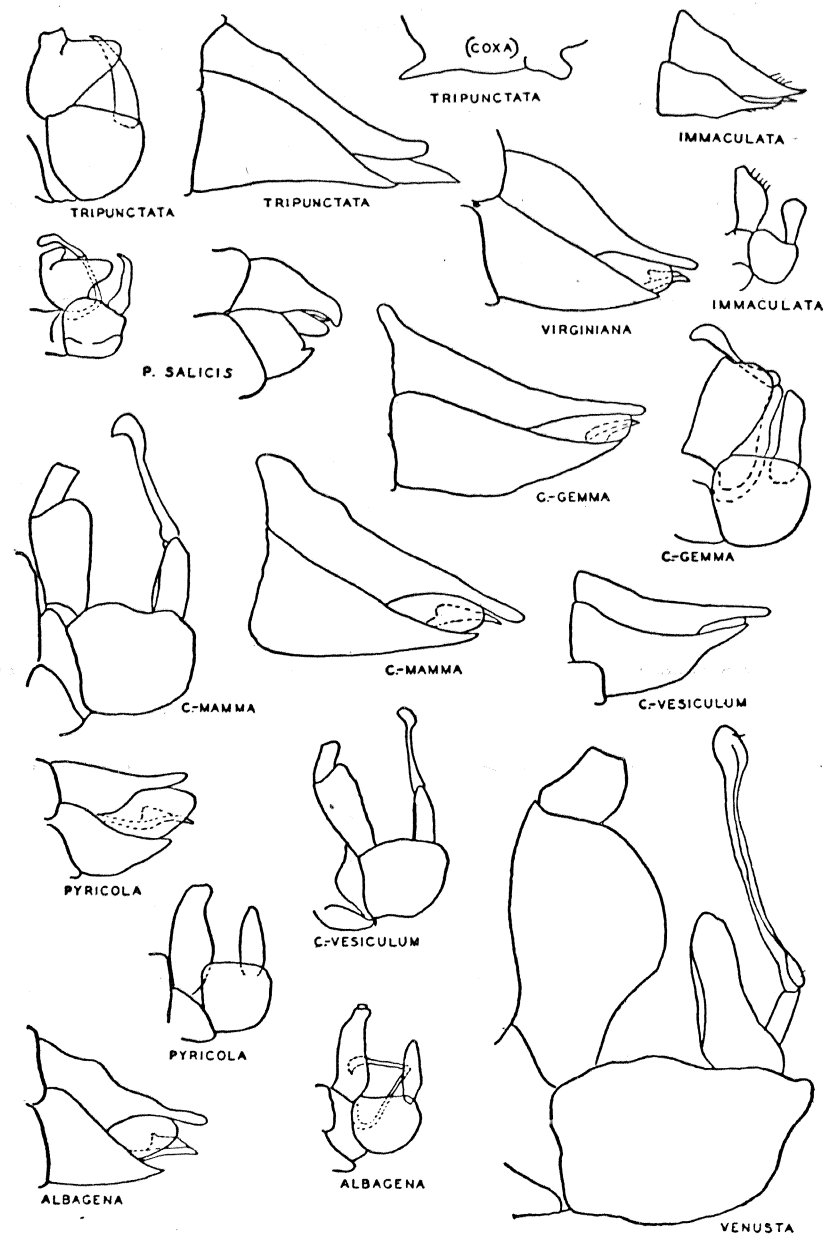


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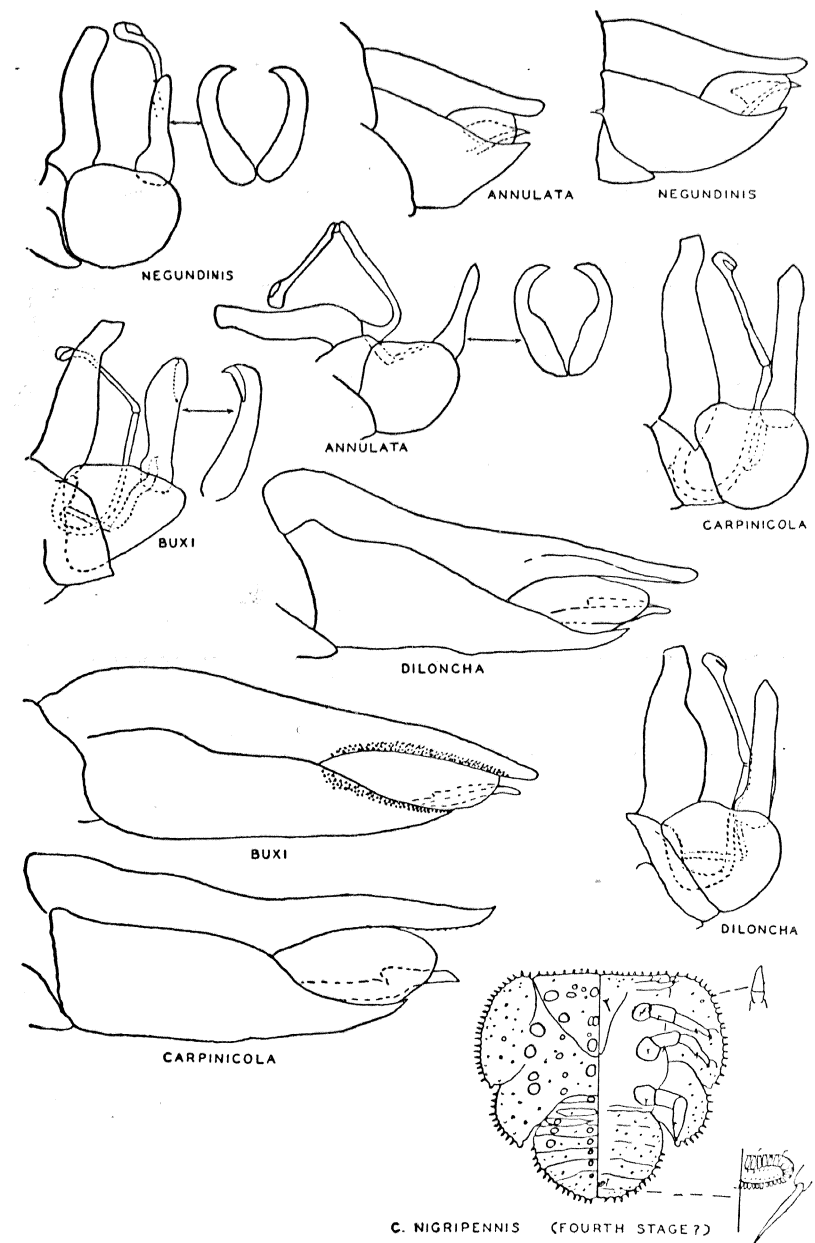


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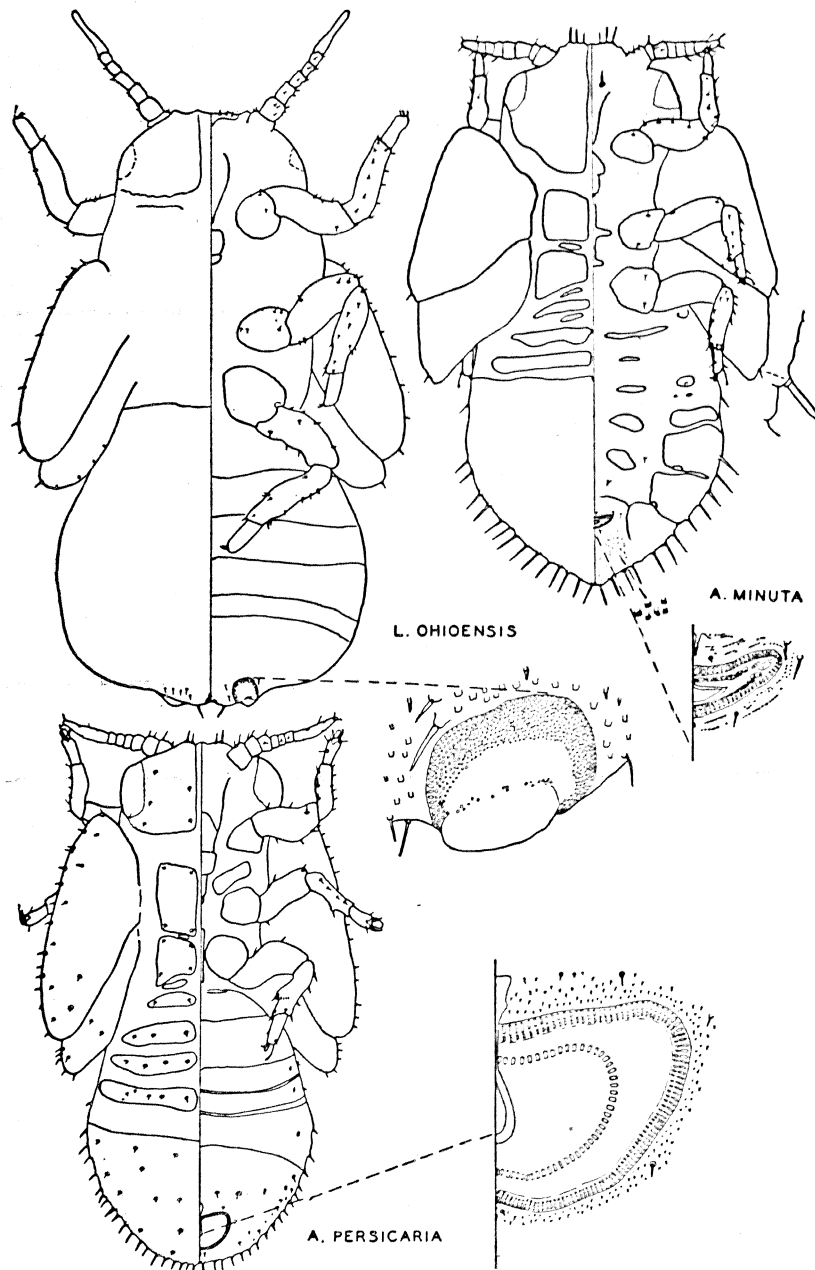


PLATE IX

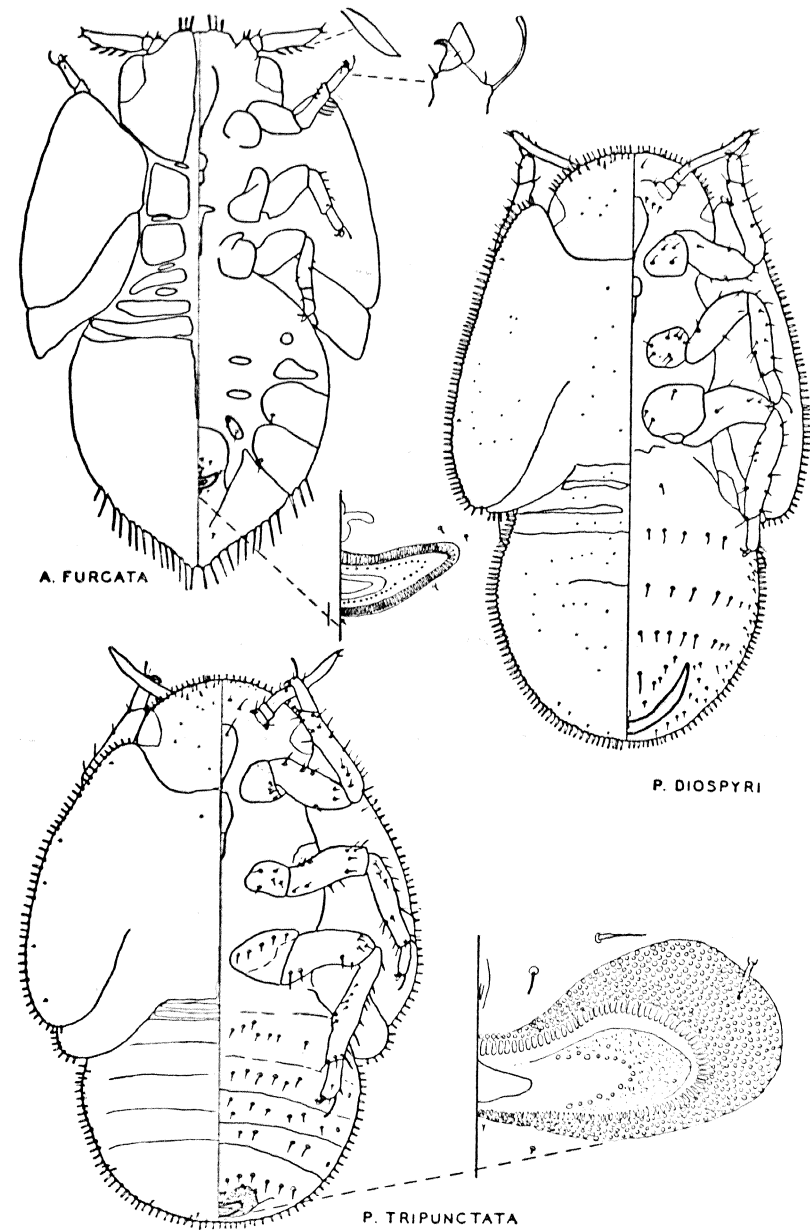


PLATE X

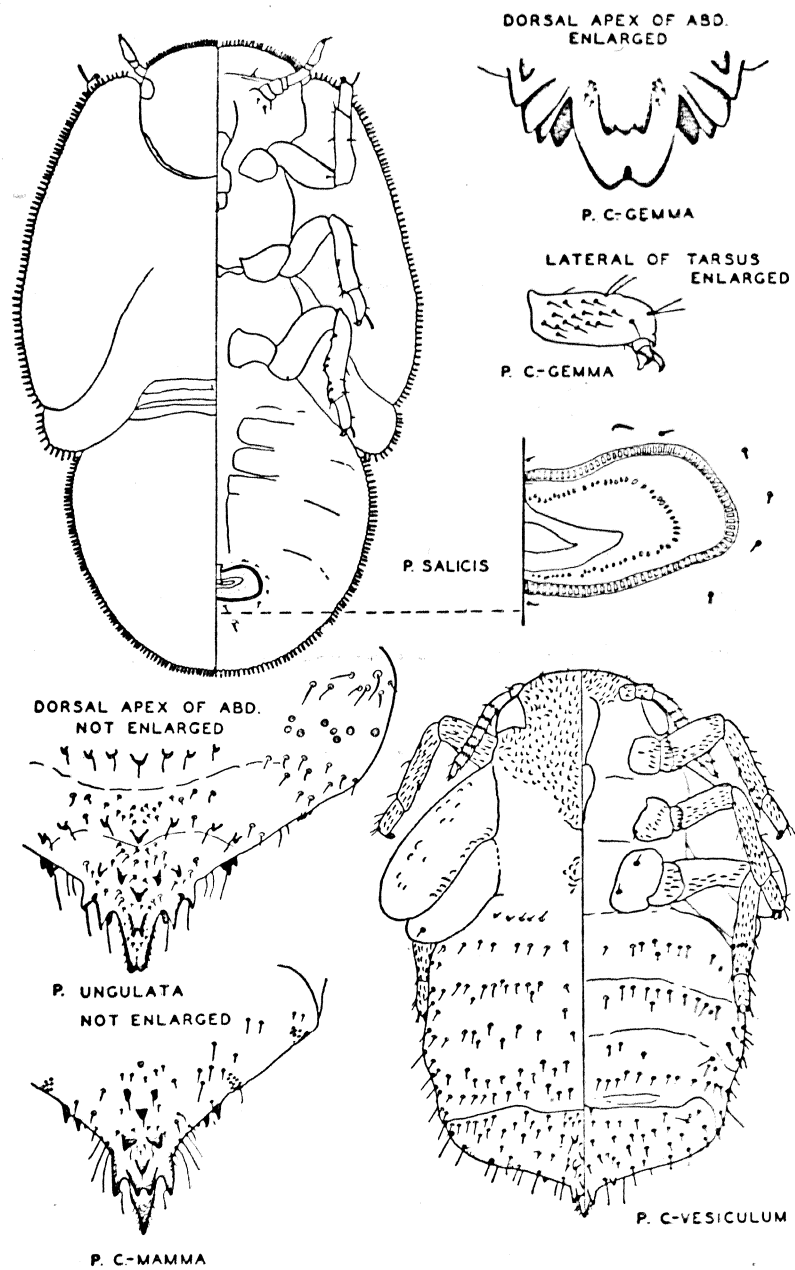


PLATE XI

