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SCALE INSECTS OF MISSOURI

A. H. HOLLINGER

Although Missouri was one of the first states to realize the importance of entomology, as was shown by the early appointment of C. V. Riley as State Entomologist, no careful systematic study of the family of scale insects was ever made. Such common species as the San Jose, oyster shell, scurfy and cherry scales have been studied and methods of control worked out. There occur in Missouri, however, many other species of scale insects about which little is known, so this investigation of the family as a whole was undertaken. Occasionally species considered of no economic importance may become pests when the proper conditions of climate, food plants, or freedom from parasites occur. That this is true is well shown by the history of the cottony cushion scale. This insect was imported into the United States from Australia, where it was never a very serious pest. However, it came here without its natural enemies, and the consequence was that it destroyed thousands of citrus trees and threatened the entire citrus industry of California for a time. Later its natural enemy, a lady beetle, was introduced and it soon placed the pest under control. One can never predict when an apparently non-economic species may become a serious pest, so it is important to find out as much as possible about all kinds of insects. A thorough knowledge of their distribution, life cycles, host plants, and their relative importance on each host, is important in working out methods of control.

It was for the purpose of extending our present knowledge of the scale insects of Missouri that the writer undertook this investigation. Two years of extensive collecting and careful laboratory work resulted in the finding of many known species as well as a number of undescribed species.

The writer desires to acknowledge the cooperation of E. R. Sasser, H. Morrison, M. P. Somes, W. H. Larrimer, Paul Evans, Eugenia McDaniel, R. H. Pettit, H. B. Parks and Leonard Hase-man.

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IMPORTANCE OF SCALE INSECTS

It seems scarcely necessary to emphasize the damage done by scale insects. Commercial fruit growers recognize certain species as being among the most injurious fruit tree pests. In many sections as much money is expended fighting San Jose scale and other destructive species as it costs to control all other fruit insects combined. Nurserymen and florists are acquainted also with their destructive work. Scale insects occur on practically all kinds of plants both wild and cultivated.

The mere mention of the San Jose scale brings to mind the accidental introduction of this Chinese insect into our country in the early seventies, with a resultant annual loss of millions of dollars to the deciduous fruit industry. The Missouri farmers and orchardists are certain to continue paying their portion of this immense toll unless they learn to recognize it and to destroy it in their orchards before it has had time to do serious damage.

The "red scale" in Florida and the "black scale" in California have killed thousands of citrus trees and have rendered much fruit unsalable. It is important therefore, that we recognize the destructive species of scale insects and that we know how to control them.

MEANS OF DISTRIBUTION OF SCALE INSECTS

Scale insects may be distributed in several ways, but it is only during the active crawling stage, that they are transferred from one position to another on the same tree or from one tree to another. Importations of nursery stock account for much of the world-wide distribution of many scale insects. Much legislation has been enacted purely against the entrance of these pests. Local distribution may occur through: (1) the activity or migration of the young; (2) the wind carrying the young considerable distances; (3) crawling on birds, insects and mammals and being transported to new regions; (4) infested uprooted trees, or broken branches being carried down streams.

PREVENTION AND CONTROL

Care should be taken by orchardists and others planting trees to see that they are absolutely free from scale infestation. This refers to the scions and buds used in grafting and budding as well as to the trees at time of transplanting. In all cases where there is danger of infestation it is well to insure freedom from scale insects by treating such trees or parts with a recognized scale treatment. Scale sprays or washes should be strong enough to kill the insects

but not so strong as to injure the trees. Fumigation with hydrocyanic acid gas may be used instead of washes. It is well to locate young orchards remote from old orchards or trees known to be infested with scales. Healthy trees are better able to withstand the attacks of scale insects than are sickly trees, so the use of pruning, cultivation, and fertilizers will aid a tree to resist such attacks.

In case scale insects have obtained a foothold in an orchard, some effective control measure is essential. Remedies for scales are generally well known to horticulturists. Spraying is the most effective method for controlling scale insects in the orchard. Within certain limited areas the process of fumigation with hydrocyanic acid gas may be satisfactory, and this method has proven of great value in the nursery business.

Of the sprays, commercial lime-sulphur solution diluted with a quantity of water, depending on its specific gravity, is generally considered the best*. The commercial material generally has a specific gravity of from 1.26 to 1.29. It should be diluted by adding seven to nine parts of water to one part of the concentrated solution. This is then called the dormant spray, indicating the necessity of application during the dormant season. Dry lime-sulphur under various trade names is now being pushed though most growers use the lime-sulphur solution. Certain miscible oils have also proven valuable as scale sprays. As a control measure for San Jose scale some of the miscible oils rank with lime-sulphur. On account of their higher price, however, they are less commonly used than the lime-sulphur solution. Coal oil emulsion is another spray solution that is of much value in combating scale insects especially those species which pass the winter in the egg stage. Lime-sulphur solution has not the penetrative power of oil sprays, so that in order for it to be effective against species which lay eggs, it should be applied just at the time of the hatching of the eggs.

No spray has been found for summer application that will do more than merely check the increase of the pests because of the danger of injury to the tree. Summer treatment is resorted to only when winter treatment has been neglected or has been insufficient. Five to ten per cent coal oil emulsion or whale oil soap solution may be used for summer applications on those trees and plants which resist foliage injury.

*See recent publications on lubricating oil emulsion.

CLASSIFICATION OF MISSOURI SCALE INSECTS

This large family of insects is subdivided into more or less distinct natural groups called sub-families. All species known to occur in Missouri have been placed under the following simple classification:

- A. Adult female always sedentary; completely covered by a secreted waxy scale in which the moulted skins (exuviae) are incorporated; anus not surrounded by hairs; ultimate segment with projecting or emarginate lobes, and with spines or fringed plates on the caudal margin ----- *Diaspinae*
- AA. Adult female not covered by a secreted waxy scale in which the moulted skins are incorporated;
 - B. Adult female with the abdominal extremity cleft; anus covered and protected by two more or less triangular, chitinous plates ----- *Coccinae*
 - BB. Adult female with the caudal extremity of abdomen not cleft; anus not covered by triangular plates.
 - C. Adult female without hair surrounding the anal ring; antennae with ten or eleven segments; a long, dense, cottony egg-sac secreted from the posterior ventral surface of the abdomen ----- *Monophlebinae*
 - CC. Adult female with the anus surrounded and protected by stout hairs.
 - D. Adult female more or less covered with heavy waxy lamellae; relatively long-legged; antennae normally eight segmented; marsupium present ----- *Ortheziinae*
 - DD. Adult female not covered with heavy waxy lamellae; heavy waxy Orthezia-like marginal lamellae rarely present, antennal segmentation variable; marsupium absent; legs not abnormally long ----- *Dactylopiinae*

The sub-family, *Diaspinae* is further separated into groups called genera, easily determined by the following structural key:

- A. Scale of female circular or nearly so, with exuviae central, sub-central or sub-marginal, but never marginal.
- B. Scale of male small, elongated, white and carinated. Medium lobes of female invaginated into apex of pygidium.
 - C. Dorsal gland pores in distinct curvilinear arrangement. Gland spines located in groups ----- *Aulacaspis*
 - CC. Dorsal gland pores with no distinct arrangement. Gland spines located singly ----- *Diaspis*
- BB. Scale of male small, oval, non-carinated, and of same color as female. Medium lobes of female not invaginated into apex of pygidium.
 - C. Pygidial margin completely and distinctly crenulate; second exuvia very large ----- *Parlatoria*
 - CC. Pygidial margin incompletely and not distinctly crenulate; exuviae very small.
 - D. Pygidium with many small circular gland pores scattered

- throughout. The caudal half; tubular wax ducts very short—no longer than a medium lobe; circumgenital gland pores absent -----*Targionia*
- DD. Pygidium with comparatively few gland pores; arranged in distinct rows; circumgenital gland pores generally present.
- E. Paraphyses (chitinous thickenings) much elongated -----
-----*Chrysomphalus*
- EE. Paraphyses short or absent -----*Aspidiotus*
- AA. Scale of female elongated with exuviae terminal.
- B. Scale of male smaller than scale of female, yet similar -----*Lepidosaphes*
- BB. Scale of male white and generally carinate; entirely different in appearance from scale of female.
- C. Median lobes together forming a dark colored semi-circle -----
-----*Hemichionaspis*
- CC. Median lobes not forming a semi-circle.
- D. Median lobes forming a distinct notch; more or less invaginated; serrate; strongly divergent -----*Phenacaspis*
- DD. Median lobes not forming a notch; generally projecting from margin of pygidium -----*Chionaspis*

Key to Genera

Considering these genera alphabetically, the key to the genus *Aspidiotus* follows:

- A. Scale light colored; exuviae naked; paraphyses absent.
- I. Tubular wax ducts elongate; length of each greater than five times its diameter; median lobes about three times as wide as the second pair; anal opening large -----*Aspidiotus cyanophylli* Sign.
- II. Tubular wax ducts short and stubby; length of each less than five times its diameter; median lobes but little wider than the second pair; anal opening relatively small --*Aspidiotus hederæ* Vall.
- AA. Exuviae covered with secretion; paraphyses present.
- B. Scale light colored; very convex; anal opening generally very large; second and third pairs of anal lobes rudimentary or wanting.
- I. Circumgenital gland pores present; anal opening moderately large; tubular wax ducts fairly numerous; a tubular wax duct opening between the median lobes ----*Aspidiotus lataniae* Sign.
- II. Circumgenital gland pores absent.
- (a) Anal opening very large; relatively few tubular wax ducts; no tubular wax ducts opening between median lobes; median lobes approximate; paraphyses sub equal. -----
-----*Aspidiotus camelliae* Sign.
- (b) Anal opening small; numerous tubular wax ducts; a tubular wax duct opening between median lobes; median lobes very large and separated; paraphyses unequal in size; paraphysis caudad of first incision large and clavate ----
-----*Aspidiotus ulmi* Johns.
- BB. Scale generally dark colored; flat to slightly convex; anal opening usually small; median lobes fairly well developed.
- I. Pygidium with two pairs of well developed lobes.

- (a) Second pair of lobes as long or longer than the median pair
-----*Aspidiotus comstocki* Johns.
- (b) Second pair of lobes shorter than the median lobes.
1. Groups of circumgenital gland pores absent; three stubby apically fringed plates cephalo-laterad of the second interlobular incision -----*Aspidiotus perniciosus* Comst.
2. Groups of circumgenital gland pores present.
- (a) Tubular wax ducts filamentous and capitate.
1. Anal opening very near the tip of pygidium; tubular wax ducts fairly numerous, one duct opening between the median lobes; plates simple; second pair of lobes notched on the outer margins -----
-----*Aspidiotus forbesi* Johns.
2. Anal opening near the cephalic ends of the ventral thickenings; tubular wax ducts very numerous, none opening between the median lobes; plates laterad of median and second pairs of lobes fringed; second pair of lobes broad, low, and unnotched ----
-----*Aspidiotus toxycrataegii* sp. n.
- (b) Tubular wax ducts cylindrical, rather long, and of the same diameter as the dorsal pores.
1. Anal opening very small; pygidium rather large; plates simple; median lobes deeply notched on the outer margins; second pair of lobes approximate to the median pair, notched on the outer margins; five groups of circumgenital gland pores present -----
-----*Aspidiotus juglans-regiae* Comst.
2. Anal opening rather large; plates fringed; median lobes deeply notched on both margins; second pair of lobes broad, tapering and unnotched; four groups of circumgenital gland pores present -----
-----*Aspidiotus townsendi* Ckll.
- II. Pygidium with well developed median lobes; second and third pairs of lobes rudimentary or lacking.
- (a) Tubular wax ducts of same diameter throughout.
1. Tubular wax ducts short; dorsal pores arranged in prominent, well defined rows; no dorsal pore opening near the margin between the fourth and fifth pairs of spines; apex of pygidium quite angular -----
-----*Aspidiotus osborni* New. & Ckll.
2. Tubular wax ducts relatively short; dorsal pores more obscure and not so definitely arranged in rows; dorsal pore generally near the margin between the fourth and fifth pairs of spines; apex of pygidium rounded and broad -----
-----*Aspidiotus ancylus* Putn.
- (b) Tubular wax ducts more or less filamentous and capitate; median lobes prominent and notched on both margins; plates fringed -----
-----*Aspidiotus wuae* Comst.

SPECIES OF ASPIDIOTUS

Aspidiotus ancylus Putnam.—Putnam's Scale.

This is one of the common scale insects having been identified from the following counties: Boone, Caldwell, Gentry, Jackson, Lawrence, McDonald, Pike, St. Louis, Stone and Wright. Its host plants in these counties are: sugar maple or hard maple, buckeye, pawpaw, river birch, blue beech or ironwood, pignut hickory, pecan, shellbark hickory, chestnut, hackberry, red bud, round-leaf dogwood, paniced dogwood, hawthorn, persimmon, honey locust, St. John's-wort, black walnut, bois d'arc or osage orange, sour gum, hop hornbean, sumac, willow, bladdernut, coral berry or Indian currant, linden or basswood, white linden and elm.

This species is sometimes mistaken for the San Jose scale and the cherry scale. It is distinguished from them by passing the winter as a half-grown female and in being less convex than the scales of these two species. It has but one generation a year.

Its distinguishing characters in addition to those given in the structural key are:

- (1) Top of scales dark brown to brick red.
- (2) Pygidial lobes converging and notched on outer margins at about one-third their length from apex.
- (3) Anal opening about twice its length from apex of lobes.
- (4) Limit of variation in number of circumgenital gland pores as follows: anterior medians (0 to 6); anterior laterals (3 to 17) posterior laterals (3 to 11).
- (5) One tubular wax duct opening between the median lobes.

**Aspidiotus camelliae* Sign.—The Greedy Scale.

This insect is a voracious pest in some parts of the United States, but is of minor importance here. It probably occurs in many greenhouses and has been intercepted on citrus fruits in this state.

Prominent characters other than those in the key are:

- (1) Top of scale dark brown or blackish.
- (2) Pygidial lobes distinctly converging; sharply notched on inner margin near apex; notched about midway of outer margin.
- (3) Anal opening very large and located less than its diameter from the apex of lobes.
- (4) Tubular wax ducts short, filamentous, captitate, unipistonnate.

*All asterisked species indicate exotic forms.

Aspidiotus comstocki Johns.—Comstock's Scale or Sugar Maple-Leaf Scale.

This insect is apparently confined to the leaves of the sugar maple, and occurs in Boone, Gentry and Jefferson counties. It causes the foliage to become spotted with yellow about the middle of July and persists until late summer often causing premature defoliation. Although it is strictly a leaf inhabiting insect, it has been observed on the leaf petiole and at the base of the petiole. The partly grown scales winter over under the bracts of the dormant buds.

Young crawling scales were observed June 15 and July 18, 1916. Egg laying occurred August 11. It appeared to have quite a variable seasonal history, but there is only one generation a year.

Its outstanding characters in addition to those already mentioned in the key are:

- (1) Top of scale light brownish to cream colored.
- (2) Median lobes notched on both margins near apex.
- (3) Second pair of lobes notched on both margins about midway their length.
- (4) Anal opening small; located about four times its diameter from apex of lobes.
- (5) Limit of variation of circumgenital gland pores as follows: anterior median (0 to 2); anterior laterals (3 to 7); posterior laterals (2 to 5).
- (6) Dorsal gland pores in fairly distinct rows.
- (7) Tubular wax ducts resembling those of *A. ancyclus* (Putnam) one opening between the median lobes.

***Aspidiotus cyanophylli** Sign.—Cyanophyllum Scale.

This insect occasionally proves injurious to plants in our greenhouses, having been found in Boone, Jackson and St. Louis counties, on umbrella plants. It was also intercepted on bananas on the Kansas City Market.

Characters featuring this coccid are:

- (1) Color of scale bright yellow.
- (2) Median lobes well separated; deeply notched on both margins at points about one-third their length from the apex.
- (3) Second pair of lobes each notched on both margins about midway their own length.
- (4) Anal opening large and located about three times its length from apex of lobes.

- (5) Limit of variation of circumgenital gland pores as follows: anterior median (0 to 1); anterior laterals (3 to 5); posterior laterals (3 to 5).
- (6) Dorsal gland pores relatively few.
- (7) Tubular wax ducts cylindrical; one opening between the median lobes.

***Aspidiotus forbesi* Johns.**—Cherry Scale or Forbes' Scale.

In the author's opinion, this pest is the most common scale met with in Missouri, for it occurs on a large range of plants, both horticultural and forest. It is very similar to the San Jose scale in several external characters, and undoubtedly has often been mistaken for that pest. However, it is not nearly as destructive as the San Jose scale, even though practically every bearing fruit tree in Missouri is more or less infested. It differs from the San Jose scale by (1) laying eggs, (2) passing the winter in partly mature stages of both sexes, male pupae being numerous, (3) only two generations a year in Missouri.

It has been identified from thirty-five counties in this state, Boone, Gentry, Grundy, Linn, Clinton, Jackson, Lafayette, Saline, Pettis, Audrain, Pike, Franklin, St. Louis, Jefferson, Iron, Wayne, Carter, Shannon, Oregon, Phelps, Laclede, Wright, Webster, Ozark, Douglas, Christian, Greene, Polk, Stone, Lawrence, Barry, McDonald, Jasper, Barton and Bates.

Its Missouri host plants are: shad bush, Siberian pea tree, Mississippi hackberry, common hackberry, hawthorn, blue ash, honey locust, holly, black walnut, hop hornbean, sycamore, Morello cherry, plum, bird cherry, peach, choke cherry, pear, apple, buckthorn, spiraea, lilac, basswood or linden, American elm, viburnum, wayfaring tree, high bush cranberry, paniced dogwood.

The author has observed many cases where this pest had killed small twigs or branches of its hosts, but rarely is a big tree seriously injured.

Its main additional characters are:

- (1) Center of scale bright orange.
- (2) Median lobes converging; deeply notched on their outer margin about midway their length.
- (3) Anal opening very small and about three times its diameter from apex of lobes.
- (4) Limits of variation of circumgenital gland pores as follows: anterior median (0 to 4); anterior laterals (2 to 9); posterior laterals (2 to 6).
- (5) Dorsal gland pores small; not prominent.

- (6) Tubular wax ducts short; unipistonate.

**Aspidiotus hederæ* Vall.—Oleander Scale; English Ivy Scale.

This scale is a pest of many greenhouse plants throughout this state, having been found in Boone, Buchanan, Gentry, Jackson, St. Louis, and Wright counties. Its list of host plants is very large but it has been collected from only a few hothouse plants in Missouri; asparagus, fern, cactus, lemon, oleander and various palms.

Some of its distinguishing characters are:

- (1) Center of scale straw colored.
- (2) Median lobes notched on inner margins near apex; notched on outer margin about one-third its length from apex.
- (3) Second pair of lobes notched on outer margins similar to median lobes.
- (4) Anal opening about four times its length from apex of lobes.
- (5) Limits of variation of circumgenital gland pores as follows; anterior median (0 to 1); anterior laterals (6 to 11); posterior laterals (5 to 11),
- (6) Dorsal gland pores fairly numerous and distinct.
- (7) A tubular wax duct opening between median lobes.
- (8) Marginal fringed plates numerous.

Aspidiotus juglans-regiæ Comst.—English-walnut Scale.

This coccid is a common pest of woodland trees and shrubbery, having been collected on box elder, sugar or hard maple, silver maple, buckeye, pignut hickory, hackberry, roundleaved dogwood, hawthorn, black ash, black walnut, sweet gum, Tartarian honeysuckle, osage orange or bois d'arc, hop hornbean, cottonwood, sumac, wild gooseberry, Indian currant or coral berry, basswood or linden, American elm and prickly ash. From this list it is clearly seen that it is not a fruit tree pest in Missouri as it is in some states, for the author has yet to find it on any of the fruits, with the exception of gooseberry.

Taylor's statement⁷² that "its occurrence upon walnut principally, will enable its recognition" is very misleading, for the author has collected it on walnut and butternut in only four instances. The scale insects common upon walnut in Missouri are: *A. ulmi* Johns; *A. ancyclus* Putn. and *Chionaspis furfura* Fitch. It has been found in Barry, Boone, Dunklin, Gentry, Jackson, Jasper, Pike, St. Louis and Wright counties.

There are probably three full generations a year, the partially mature female wintering over.

Its prominent characters are:

- (1) Scale of female very large, about 3 mm. in diameter.
- (2) Ventral scale distinctly noticeable.
- (3) Body of adult female distinctly segmented.
- (4) Anal opening located about four or five times its length from apex of lobes.
- (5) Limits of variation of circumgenital gland pores as follows: anterior median (0 to 9); anterior laterals (5 to 16); posterior laterals (4 to 13).
- (6) Dorsal gland pores numerous. Arranged in more or less definite rows.
- (7) Tubular wax ducts unipistonate; one or two openings between the median lobes.

**Aspidiotus lataniae* Sign.—Latania Scale.

This greenhouse species has been found in Boone, Jackson, Johnson and St. Louis counties and was collected from only eucalyptus, bay and yucca. It is reported infesting many other plants in greenhouses and in sub-tropical climates.

Its outstanding characters are:

- (1) Center of scale dark brown.
- (2) Median lobes broad, non-converging; notched on each margin near apex.
- (3) Anal opening located slightly more than its length from apex of lobes.
- (4) Limits of variation of circumgenital gland pores as follows: anterior median (0); anterior laterals (4 to 10); posterior laterals (3 to 8).
- (5) Tubular wax ducts long, filamentous, unipistonate, capitate; one opening between the median lobes.

Aspidiotus osborni New. & Ckll.—Osborn's Scale.

This species is very similar to *A. ancylus* Putn., both in external and microscopic characters. It is generally found on the smooth bark of the larger limbs and branches of several species of oak, and is often hidden by a thin layer of bark under which the young have crawled. They often occur along the under side of the branches quite scattered, never being massed like the Putnam's scale. It has been collected in Boone, Dunklin, Jackson and St. Louis counties.

Its main characters are:

- (1) Center of scale brownish.

- (2) Median lobes notched once or twice on the outer margin about midway their length.
- (3) Anal opening located about three or four times its length from the apex of lobes.
- (4) Limits of variation of circumgenital gland pores as follows: anterior median (0 to 2); anterior laterals (0 to 9); posterior laterals (0 to 6). (A lack of pores in the lateral and posterior groups is of rare occurrence).
- (5) Tubular wax ducts longer than in *A. ancylus* Putn.; unipistonate; one opening between the median lobes.

Aspidiotus perniciosus Comst.—San Jose Scale.

The San Jose scale has been the subject of so many publications that it is not the present author's intention to more than mention a few important economic and structural details. A number of excellent bulletins have been issued from this Station.

In this state our records show it occurring in at least 57 of the counties and in practically every section of Missouri. It has a wide variety of food plants but in Missouri it has been found on cottonwood, crab apple, plum, peach, pear, apple, currant, Japanese quince, grape, willow, lilac, elm, and osage orange. Some orchardists and others claim, that the inspection of nursery stock and spraying orchards will not control the pest since it is sometimes found on trees other than fruit trees. However, this insect is of rare occurrence upon any of its hosts in Missouri other than osage orange, currant, Japanese quince and fruit trees, so that any antagonistic feeling is unwarranted. In most cases scale on forest or shade trees are entirely different species and these are usually uninjurious to fruit trees.

It has been estimated that the progeny of a single gravid female scale could number over three billions at the end of the season under the most favorable conditions. It is little wonder, then, that so much damage can result from the feeding of this pest in such a short time as a year or two. It has three or four generations in Missouri.

Some characters featuring this scale are:

- (1) Center of scale nipped and lemon yellow.
- (2) Median lobes converging, notched on outer margin about midway the length.
- (3) Second pair of lobes similarly notched.
- (4) Anal opening located two or three times its diameter from apex of lobes.
- (5) Dorsal gland pores few and inconspicuous.
- (6) Tubular wax ducts filamentous; moderately long; capitate; unipistonate; one opening between the median lobes.

Aspidiotus townsendi Ckll.—Townsend's Scale.

In all probability, Missouri is the northern limit of this species, it being more strictly a southern insect. It has been collected in Boone County from the following plants: Box elder, ragweed, trumpet vine or trumpet creeper, bittersweet, panicled dogwood, American and purple euonymus, hop hornbean, oak, fragrant sumac, Virginia creeper, bladdernut and Indian currant or coral berry.

As a general thing, it attacks the leaves of its hosts in Missouri, although it has occasionally been collected from the petioles.

Some distinguishing characters are:

- (1) Scale sub-convex; brownish.
- (2) Center of scale chestnut brown.
- (3) Median lobes non-convergent; distinctly notched on both margins near the broadly rounded apex.
- (4) Anal opening about seven times size of a circumgenital gland pore; located about $2\frac{1}{2}$ times its length from the apices of the median lobes.
- (5) Limits of variation of circumgenital gland pores as follows: anterior median (0 to 3); anterior laterals (3 to 10); posterior laterals (3 to 9).
- (6) Dorsal gland pores numerous and conspicuous.
- (7) Tubular wax ducts capitate; unipistonate; one opening between the median lobes.

Aspidiotus toxycrataegii sp. n.

This new species of scale insect has been a manuscript species since the spring of 1917, although it was collected in 1915 and 1916 from Lawrence, Gentry, Jackson and Boone counties. It was found to be abundant under the exfoliating bark of hawthorn and osage orange or bois d'arc. The type locality is Lawrence County.

Its description appears here for the first time.

Scale of male: Darker than the scale of the female; small; oval; quite convex; exuvia sub-central.

Scale of female: Rather small, about 1 mm. to 1.5 mm. in diameter; circular to slightly elongate; moderately thick and tough; unweathered scales white with a grayish or brownish cast; moderately convex; exuviae central or sub-central; covered with a whitish secretion; orange-brown in color; ventral scale rather thick and white.

Adult female: Approximately circular; rather small; yellowish; *pygidium* chitinized with brown chitin; median lobes well developed; about as long as broad; inner margins separated by about two or three microns; parallel or slightly diverging; inner margins each

with a deep notch near the apex; apex well rounded; a deep notch about one-third the length of the lobe from the apex; second pair of lobes obscure and not well developed, being broad rounded or pointed prominences of the body margins between the inter-lobular incisions; third lobes more rudimentary than the second pair, being more pointed prominences. *Inter-lobular incisions* very wide; *paraphyses* present; those between the median lobes being slender, rod-like, and in-curved; a small bar of chitinization near the bases of the outer margins of the lobes and directly cephalad of the outer notch in the margins; inner paraphyses of the first inter-lobular incision the longer; paraphyses of the second inter-lobular incisions coalescing, and horseshoe-shaped; *plates* simple and fringed; two laterally fringed plates between the median and second and third lobes; three slender simple or slightly serrate plates laterad of the rudimentary third lobes; *spines* located as per figure; *anal opening* oval, and broadly rounded on each end; moderately large; width equal to about two and one-half and length equal to about two times the diameter of a circumgenital gland pore; located about three times its length from the apices of the median lobes; circumgenital gland pores arranged linearly in four groups: anterior median (0); anterior laterals (2 to 6); posterior laterals (1 to 3). *Dorsal pores* very numerous and arranged as follows: none between the median lobes; six or seven extending cephalad from the inter-lobular incision between the median and the second lobes; one opening in the body margin just laterad of the outer margin of the second lobe; seventeen to nineteen extending cephalad in an irregular double row from the inter-lobular incision between the second and the third lobes; twelve to fifteen in a more or less broken row laterad of this, extending cephalad from the bases of the three simple or serrate marginal plates; *tubular wax ducts* rather short, filamentous, bi-pistonate, and capitate; micropores, ventral pygidial setae, basal and ventral thickenings as in figure.

This species is apparently closely related to *A. wvae* Comst. but differs from it in the following:

- (1) Second pair of lobes much more developed than in *A. wvae*.
- (2) Anal opening located further from the apex of lobes than in *A. wvae*.
- (3) Tubular wax ducts bi-pistonate; while in *A. wvae* they are unipistonate and shorter.
- (4) Dorsal gland pores are larger and more numerous than in *A. wvae*.
- (5) Never a fifth group of circumgenital gland pores in this species, while usually one in *A. wvae*.

***Aspidiotus ulmi* Johns.—Corky-Bark *Aspidiotus*.**

The author has given this species the above common name because it seems to prefer the heavy bark of several of its host plants. It has been collected in Boone, Gentry and Jackson counties and from the following plants: buckeye, ragweed, trumpet vine, common catalpa, hackberry, panicled dogwood, American euonymus, Kentucky coffee tree, black walnut, butternut, heal-all, Virginia creeper, wafer ash, fragrant sumac, black locust, coral berry or Indian currant, basswood or linden, American elm, white vervain.

It will be noted that some of the above plants are annuals and perennials instead of shrubs or trees. This species seems to be the usual shield scale found on herbs in Missouri.

Some of the important characters are:

- (1) Scale very thick; center bright orange.
- (2) Median lobes deeply notched on both margins near the apex.
- (3) Anal opening located about five times its length from apex of lobes.
- (4) Dorsal gland pores very small and inconspicuous.
- (5) Numerous tubular wax ducts, long filamentous capitate and apparently non-pistonate; one opening between the median lobes.

***Aspidiotus uvae* Comst.—Grape Scale.**

This insect was discovered at St. Louis in 1875 where it was doing considerable damage to the vines in a neglected arbor or vineyard. It occurs on two-year-old canes and often is so abundant that the vine appears to have been white-washed. Grape and shellbark hickory are its hosts in Missouri and on the latter it occurs under the shaggy, exfoliating bark on the trunk. It has been collected in Platte, Pettis, Boone, Pike, St. Charles, St. Louis, Jefferson, Ste. Genevieve, Perry, Cape Girardeau, Jasper and Lawrence counties.

From material collected in early April in 1916 in Boone County all living insects had circumgenital gland pores. No living males were found nor were there any male pupae. Hundreds of small dead female scale insects were observed, thus emphasizing the following points: (1) the winter is passed as sexually mature females; (2) the males emerge in the fall and fertilize the female; (3) immature females are winter-killed. There is only one annual generation of this insect.

Other main characters of this species are:

- (1) Scale tan-colored; center yellow.
- (2) Median lobes non-converging; notched on inner margin near apex and on outer margin midway its length.

throughout the winter. It has been collected in the following counties: Barry, Boone, Cape Girardeau, Cooper, Greene, Jackson, Jasper, Lawrence, Pettis, St. Louis, Saline, Stoddard, Taney, and Wright.

Other featuring characters of this species are:

- (1) Male scale distinctly tri-carinated.
- (2) Female scale thin, with yellow to light brown center.
- (3) Outer margin of median lobes fused with body wall throughout the greater part of their length; inner margin serrate.
- (4) Limits of variation of circumgenital gland pores as follows: anterior median (8 to 32); anterior laterals (16 to 35); posterior laterals (10 to 36).
- (5) Dorsal gland pores in three rows (rarely in four); variable as follows:

Row number	1	2	3	4
Anterior group -----	0-3	0-4	4-5	4-8
Posterior group -----	0	0	3-6	4-8

THE GENUS *CHIONASPIS* SIGNORET

The species of this genus known to occur in Missouri may be separated by the following key:

- A. Dorsal gland pores very numerous and apparently without a definite grouped arrangement; lobes and lobules small, though distinct ----- *Chionaspis euonymi* Comst.
- AA. Dorsal gland pores generally not so numerous, and arranged in well defined rows and groups; lobes prominent -----
- B. Second row of dorsal gland pores absent, although rarely represented by the anterior group of one or two -----
- C. Median lobes distinctly notched on the lateral margins; inner margins fused for at least part of their length; elongate, clavate, chitinous thickening arising from between the bases of the median lobes ----- *Chionaspis americana* Johnson
- CC. Median lobes entire and rounded; inner margins approximate and parallel throughout their entire lengths; a broad, clavate, chitinous thickening arising from between the bases of the median lobes ----- *Chionaspis furfura* Fitch
- CCC. Median lobes not notched, but serrate; more or less pointed.
- D. Median lobes well separated between inner margins; apices more or less triangular; outer lobule or second pair of lobes rudimentary ----- *Chionaspis gleditsiae* Sanders
- DD. Median lobes not separated between the inner margins, but fused along their entire length; apices more or less reflexed cephalo-laterally; outer lobule or second pair of lobes well developed; reflexed, and serrate; third pair of lobes well developed, and similar to the second pair; paraphysis arising from between the bases of the median lobes broadly triangular; anterior group of fourth row of dorsal gland pores entirely absent ----- *Chionaspis acericola* sp. n.

- BB. Second row of dorsal gland pores present, or rarely lacking; represented by the anterior group -----
- C. Anterior group of second row of dorsal gland pores made up entirely or in large part of small circular pores; three pairs of well developed rounded, entire lobes -----
-----*Chionaspis salicis-nigrae* Welsh.
- CC. Anterior group of the second row of dorsal gland pores made up entirely of the regular type -----
- D. Median lobes fused for at least part of the length of the inner margins -----
- E. Median lobes rounded, entire, large and broad; a large broad elongate-oval paraphysis arising from between the bases of the median lobes -----*Chionaspis caryae* Cooley
- EE. Median lobes pointed and notched or serrate -----
- F. Median lobes notched; distinctly pointed, and very prominent; inner margin of each median lobe as long as the outer margin; second pair of lobes small, but each lobule distinctly notched; outer lobule well separated from the inner one -----*Chionaspis parkii* sp. n.
- FF. Median lobes serrate; unnotched; obscurely pointed; inner margin of each median lobe about one-third the length of the outer; second pair of lobes well developed, with unnotched, serrate lobules; the inner lobule much the larger; a bulb-shaped paraphysis arising from between the bases of the median lobes.
-----*Chionaspis sylvatica* Sanders.
- DD. Median lobes not fused along their inner margins -----
- E. Median lobes projecting well beyond the margin of the body; lobes and lobules long and serrate --*Chionaspis longiloba* Cooley
- EE. Median lobes retracted into the pygidium; divergent and forming a notch or crotch -----
- F. Median lobes small, and widely separated throughout their length by at least one-third of the breadth of each lobe; entire; anterior group of dorsal gland pores composed of small circular openings -----
-----*Chionaspis pinifoliae* Fitch
- FF. Median lobes large; widely separated only at the apices; very divergent; serrate lobes and lobules; dorsal gland pores all of the ordinary oval type --*Chionaspis platani* Cooley

***Chionaspis acericola* sp. n.—Maple *Chionaspis*.**

This is known only from Gentry County its type locality, and was collected on silver maple. It was found by H. B. Parks in the spring of 1916 and has been a manuscript species since 1917. However, the following is the first published description.

Scale of male: Small, slender, more or less oval; exuvia terminal, and light brown; color white; non-carinated to uni-carinated; about one-third the length of the female scale.

Scale of female: Moderate size; whitish; often partly covered with extraneous adhesive material; about 2 mm. long; more or less broadly pyriform to irregular in shape; flat and rather thin; exuviae relatively large, occupying one-fourth to one-third of the length of the scale; brownish and covered.

Adult female: *Pygidium* more or less broadly triangular in outline, with the lateral margins rounded; three pairs of well developed lobes present; median lobes fused together at their bases, but prominent, projecting and broad; inner margins strongly divergent, serrate; apices more or less reflexed; outer margins serrate; second pair of lobes cleft into two broad lobules, the inner ones the larger and more prominent, converging, pointed and crowded at the outer bases of median lobes; strongly serrate; outer lobules distinct, prominent, serrate, similar to inner lobules; third pair of lobes well developed; inner lobules similar to those of the second pair; outer lobules more or less rudimentary; a stout, more or less triangular paraphysis between the bases of the median lobes; slight, narrow *paraphyses* medio-laterad of the inner lobules of the second and third lobes; *gland spines* arranged as follows: 1, 1, 1, 1, 3 to 5; ordinary *marginal spines* as in figure; *anal opening* approximately circular, about centrally located in the pygidium; diameter about twice that of a circumgenital gland pore; *circumgenital gland pores* arranged as follows: Anterior median (7 to 9); anterior laterals (13 to 26) posterior laterals (14 to 26) dorsal gland pores few and arranged in two rows; the anterior group of the fourth row always absent; variable as follows:

Row number	1	2	3	4
Anterior group -----	0	0	0-2	0
Posterior group -----	0	0	1-2	2-4

Marginal gland pores arranged as follows: 1, 2, 2, 2; micropores, ventral pygidial setae, basal and ventral thickenings as in figure.

***Chionaspis americana* Johns.—Elm *Chionaspis*.**

This common elm scale is generally distributed having been found in practically every section, and from the following counties: Boone, Caldwell, Gentry, Greene, Hickory, Holt, Jackson, Jasper, Newton, Nodaway, St. Louis, Ste. Genevieve and Stoddard. In addition to the American elm which it prefers, the author has taken it on wafer ash and wild gooseberries. It has been reported as attacking apple trees, but has not been discovered an apple pest in this state.

It is of considerable economic importance because of the landscape value of the American elm. The leaves are often yellowed and destroyed by the male larvae infesting them in such large numbers and

occasionally a young tree and large branches will die from the attack of both sexes. From data obtained, it appears to be at least three-brooded in Missouri.

Other prominent characters of this species are:

- (1) Male scale distinctly tri-carinate.
- (2) Median lobes projecting; fused along most of their inner margins; apex rounded; with two notches on outer margin midway its length.
- (3) Inner lobule of second pair of lobes notched on outer margin midway its length.
- (4) Anal opening about central in pygidium.
- (5) Circumgenital gland pores with limits of variations as follows: anterior median (7 to 38); anterior lateral (8 to 42); posterior lateral (7 to 30).
- (6) Dorsal gland pores in two rows (rarely with a single one in the anterior group of the second row); variable as follows:

Row number	1	2	3	4
*Anterior group -----	0	0-1	1-7	1-9
			0x-10x	0x-16x
Posterior group -----	0	0	1-6	2-10

*Attention is called to small circular gland pores accompanying the regular ones and indicated herein by an "x".

Chionaspis caryae Cooley.—Hickory *Chionaspis*.

In some sections of this country this coccid has proven injurious to young hickory trees, malforming the branches and twigs. In Missouri however, no great damage has occurred to hickory from this pest. It has been collected in Boone and Scott counties and from the pignut hickory.

Its other outstanding characters are:

- (1) Male scale non-carinated to faintly uni-carinate.
- (2) Median lobes with inner margins fused for about half their length.
- (3) Second pair of lobes rounded and serrulate.
- (4) Anal opening decidedly cephalad of center.
- (5) Limits of variation of circumgenital gland pores as follows: anterior median (7 to 19); anterior laterals (9 to 29); posterior laterals (4 to 22).
- (6) Dorsal gland pores in three rows (rarely with a single gland in the posterior group of first row); variable as follows:

Row number	1	2	3	4
Anterior group -----	0	0-4	0-6	3-7
Posterior group -----	0-1	0	1-5	2-6

**Chionaspis euonymi* Comst.—Euonymus Scale.

This species occurs in Missouri both as a greenhouse and out-of-door pest. It has been collected in the open in Southwestern Missouri, in Mississippi County, on *Euonymus radicans*, and was found in a Jackson County greenhouse severely injuring *Euonymus Japonica*. Hedges and evergreen vines of euonymus plants are often killed by this insect.

It attacks practically all parts of the plant above ground. The male scales seek the leaf blade where they sometimes are so abundant as to cover the leaf in a white mass, while the black female scales literally encrust the petioles and twigs.

Its other identifying characters are:

- (1) Male scale decidedly tri-carinate.
- (2) Female scale black to brownish-black.
- (3) Three pairs of well developed sub-equal lobes and lobules.
- (4) Median lobes rather pointed; entire or serrulate.
- (5) Anal opening decidedly cephalad of center.
- (6) Circumgenital gland pores with limits of variation as follows: anterior median (1 to 4); anterior laterals (3 to 9); posterior laterals (2 to 7).

Chionaspis furfura Fitch.—Scurfy Scale.

This insect, like the San Jose scale, is a pest quite familiar to the orchardists of this country. It is very well distributed over the State, having been found in the following counties: Gentry, Scott, Clark, Pike, Jackson, Cass, Saline, Boone, Warren, St. Louis, Jefferson, Miller, Crawford, Iron, Cape Girardeau, Carter, Texas, Wright, Webster, Polk, Lawrence, Jasper, Greene, McDonald, Barry and Stone. It is not alone a fruit pest, for some of our shrubs and shade trees are attacked. In Missouri the author has collected it from: hawthorn, Japanese quince, butternut, black walnut, plum, apple, buckthorn, American mountain ash, and American bladdernut.

The featuring characters of this pest are:

- (1) Male scale decidedly tri-carinate.
- (2) Female scale flat.
- (3) Inner lobule of second pair of lobes rounded; entire.
- (4) Anal opening located about central in pygidium.
- (5) Limits of variation of circumgenital gland pores as follows: anterior median (4 to 10); anterior laterals (8 to 34); posterior laterals (8 to 33).
- (6) Dorsal gland pores arranged in two rows (rarely one or two in the anterior group of the second row); variable as follows:

Row number	1	2	3	4
Anterior group -----	0	0-2	1-4	1-6
			0x-xx	0x-xx
Posterior group -----	0	0	1-5	1-6

Chionaspis gleditsiae Sanders.—Honey Locust Chionaspis.

This species of coccid seems to confine its attacks to the honey locust. It has been collected in Boone and Gentry counties. It attacks all parts of the exposed tree, from roots to leaflets, spines and seed pods. It is often found associated with *Phenacaspis spinicola* D. & M. from which it can scarcely be distinguished in the field.

The main characters of this insect are:

- (1) Scale of male faintly tri-carinate.
- (2) Second pair of lobes serrate.
- (3) Basal thickening between median lobes short, spear shaped.
- (4) Anal opening located about central in pygidium.
- (5) Circumgenital gland pores with limits of variation as follows: anterior median (4 to 16); anterior laterals (8 to 22); posterior laterals (4 to 17).
- (6) Dorsal gland pores arranged into two rows (rarely in the anterior group represented in the second row by one or two pores); variable as follows:

Row number	1	2	3	4
Anterior group -----	0	0-2	0-5	0-4
			0x-1x	x
Posterior group -----	0	0	1-6	

- (7) The anterior group of the fourth row is generally absent.
- (8) The anterior group of the third row is rarely absent.

Chionaspis longiloba Cooley.—Long-lobed Chionaspis.

Cottonwood and willow trees seem to be the only known hosts of this species which has been collected in Boone, Gentry, and Jackson counties. It can not be considered a very important pest, inasmuch as no great value is attached to either willow or cottonwood in this state.

Its outstanding characters are:

- (1) Male scale non-carinate.
- (2) Basal thickening cephalad of median lobes more or less heart-shaped.
- (3) Anal opening located about centrally in pygidium.
- (4) Limits of variation of circumgenital gland pores as follows: anterior median (8 to 21); anterior laterals (13 to 35); posterior laterals (9 to 24).
- (5) Dorsal gland pores in three rows with limits of variation as follows:

Row number	1	2	3	4
Anterior group -----	0	1-6	4-7	4-8
Posterior group -----	0	0	4-8	5-10

Chionaspis ortholobis Comst.—Straight-lobed Chionaspis.

While this species has been reported from Buchanan County, the author was unable to locate any material for study. Among its host plants are: willow, poplar, sycamore, honey locust, cottonwood and butternut.

From published records, the circumgenital gland pores number as follows: anterior median (10 to 25); anterior laterals (18 to 35); posterior laterals (16 to 24).

The dorsal gland pores number as follows:

Row number	1	2	3	4
Anterior group -----	0	4-7	7-9	9-11
Posterior group -----	0	0	5-8	5-9

Chionaspis parkii sp. n.—Sycamore Bark Chionaspis.

This new species occurs locally very abundant upon sycamore in Boone around Columbia, its type locality, and rather limited upon cottonwood in Gentry County. It infests the trunk and large limbs of the sycamore, but is found scatteringly over the smaller limbs and twigs of the cottonwood. The author names this species after H. B. Parks.

Scale of male: About 0.7 mm. long and 0.2 mm. wide; elongate; parallel-sided; moderately thin; slightly elevated and highest at the caudal end of the exuvia transparent or pale yellowish; about 0.28 mm. long and 0.2 mm. wide; ventral scale thick and white.

Scale of female: About 2 mm. long and from 1.5 mm. to 1 mm. wide; distinctly pyriform or broadened posteriorly; thin to moderately thick; tough; flat to slightly convex; whitish with often a yellowish or a brownish cast due to the adhesion of extraneous materials; exuviae dark brownish in scales over living insects, but pale yellowish-brown or entirely bleached in weathered scales; first exuvia 0.4 mm. long and 0.3 mm. wide; second exuvia 0.6 mm. long and 0.35 mm. wide; the first exuvia overlaps the second one about one-fourth its length; ventral scale thin and white.

Adult female: Moderately large; rather ovate; yellowish-brown to orange-brown when immature, but purplish at maturity due to the color of the ovules; *pygidium* heavily chitinized; somewhat ovoid with rounded lateral margins; apex rather pointed due to the large, well developed median lobes; median lobes prominent, projecting, decidedly serrate or notched four or five times, distinctly pointed, with

their bases fused for about one-half the length of the lobes; inner margins forming an angle of about 60 to 75 degrees; second pair of lobes rather small; inner lobule distinctly notched once or twice on the lateral margin, and more or less rounded or pointed; outer lobule pointed; apparently well separated from the inner lobule, and notched or serrate; third pair of lobes slightly smaller than the second pair; lobules broad and notched; each pair of lobes moderately separated from the other; *gland spines* relatively small and arranged as follows: 1, 1 to 2, 1 to 2, 1 to 2, 3 to 6; anal opening circular; diameter equal to about two and one-half times that of a circumgenital gland pore; located but slightly cephalad of the center; *circumgenital gland pores* arranged as follows, but often with the groups broken up into two arches as in the genus *Poliaspis*; variable as follows: anterior median (4 to 12); anterior laterals (9 to 38); posterior laterals (9 to 35). Dorsal gland pores arranged in two or three rows, variable as follows:

Row number	1	2	3	4
Anterior group -----	0	0-3	1-7	2-9
Posterior group -----	0	0	2-6	2-8

The marginal gland pores are arranged in groups, variable as follows: 1-2-2-1, 1-2-2-2, 1-2-1-2, 1-2-2-3.

Eggs: Reddish-purple; 245 mmm. long and 160 mmm. in diameter; from 20 to 40 eggs deposited; they occasionally give the scale a darkish appearance, as viewed externally, due to the dark purplish color showing through the scale.

Young: Flattish; purplish-red; broadly rounded on both ends; in the laboratory hatching February 6 from scales collected January 27, 1917; also hatching outdoors September 15, 1917.

***Chionaspis pinifoliae* Fitch.—Pine Leaf Scale.**

Injury to pine and spruce needles sometimes occurs due to this pest, which has been collected in the following counties: Nodaway, Gentry, Boone, St. Louis, Greene, Wright, Howell, and Cape Girardeau. It is at least two-brooded, and possibly a third one occurs here, but the broods are hard to distinguish on account of the hatching of the eggs over such a long period. Scales in all stages of development can be found throughout the summer.

Its distinguishing characters are:

- (1) Male scale distinctly tri-carinate.
- (2) End of female scale yellowish.
- (3) Median lobes well rounded.
- (4) Second pair of lobes well rounded.
- (5) Thickening between bases of median lobes "U"-shaped or horseshoe-shaped.

- (6) Anal opening located about central in pygidium.
- (7) Limits of variation of circumgenital gland pores as follows: anterior median (5 to 13); anterior laterals (12 to 24); posterior laterals (12 to 22).
- (8) Dorsal gland pores in three rows; variable as follows:
- | Row number | 1 | 2 | 3 | 4 |
|-----------------------|---|-----|-----|------|
| Anterior group ----- | 0 | 2-4 | 3-7 | 3-9 |
| Posterior group ----- | 0 | 0-1 | 3-7 | 5-10 |
- (9) The gland pores in the anterior groups of the fourth row are small and circular.

***Chionaspis platani* Cooley.—Sycamore Scale.**

Although this species has been found in only Boone and St. Louis counties, Missouri, and in Kansas it undoubtedly occurs elsewhere in the United States. Sycamore seems to be its only host in this country, although sumac is reported infested in Japan. While this insect does not kill its host, it often yellows the leaves which may fall prematurely. It infests practically all parts of the tree, from the base to the leaves, but prefers the small twigs, petioles and leaves.

Its distinguishing characters are:

- (1) Male scale non-carinate; exuvia pale brown.
- (2) End of female scale brown.
- (3) Second pair of lobes with inner lobule very well developed and extending nearly to tip of median lobes.
- (4) No apparent thickening between bases of median lobes.
- (5) Anal opening located about three-fifths the length of the pygidium from the tip of median lobes.
- (6) Limits of variation of circumgenital gland pores as follows: anterior median (6 to 16); anterior laterals (10 to 20); posterior laterals (8 to 16). (Occasionally a group of circumgenital gland pores occurs cephalad of the median group, similar to supra-mesal group in the genus *Poliaspis*.)
- (7) Limit of variation of dorsal gland pores as follows:

Row number	1	2	3	4
Anterior group -----	0	1-4	4-6	4-5
Posterior group -----	0	0	2-4	3-6

***Chionaspis salicis-nigrae* Walsh.—Willow Scale.**

This common scale insect is often quite a pest of willow and poplar trees, in particular, and has also been reported by some authors from several ornamental plants.

It is generally distributed over this country and has been collected in Boone, Gentry, St. Louis, and Wright counties in Missouri. It often

kills out large branches and decidedly devitalizes the infested tree. The winter is passed in the egg stage. Eggs are laid about the middle of September. The young emerge about the middle of June and adult males are recorded by July 1. There are at least two generations a year in this state.

Chickadees, nuthatches, and various other birds feed on the insects, sometimes cleaning out an infestation.

Its other prominent characters are:

- (1) Male scale obscurely tri-carinate.
- (2) Female scale very convex; upper end brown.
- (3) Anal opening located about two-thirds the length of the pygidium from the tip of median lobes.
- (4) Limit of variation of circumgenital gland pores as follows: anterior median (10 to 44); anterior laterals (17 to 68); posterior laterals (18 to 50).
- (5) Limit of variation of dorsal gland pores as follows:

Row number	1	2	3	4
Anterior group -----	0	0-8	4-10	4-15
		0x-18x	6x-16x	0x-23x
Posterior group -----	0-1	0-2	3-11	4-14

- (6) An almost constant character is the presence of one or two dorsal gland pores in the posterior group of the second row.

Chionaspis sylvatica Sanders.—Sour Gum Chionaspis.

In this state, this insect is restricted to the extreme southern part, having been found on the sour gum, in Stoddard County. It is found abundantly on the smaller twigs, but has not proven so far to be economically important.

Its additional outstanding characters are:

- (1) Male scale decidedly tri-carinate.
- (2) Anal opening located slightly supra-central in pygidium.
- (3) Limits of variation of circumgenital gland pores as follows: anterior median (5 to 13); anterior laterals (7 to 22); posterior laterals (7 to 18).
- (4) Limit of variation of dorsal gland pores as follows:

Row number	1	2	3	4
Anterior group -----	0	0-2	0-4	0-5
Posterior group -----	0	0	1-5	2-7

Note.—In the series of Missouri specimens, these pores occurred only in the third and fourth rows. Rarely were the anterior groups absent in the third row; those of the fourth row were often absent.

GENUS *CHRYSOMPHALUS* ASHMEAD

The scales of this genus resemble in general those of *Aspidiotus* Bouche.

The species found in Missouri can be separated by the following key:

- A. Anal opening remote from the apices of the median lobe, being about centrally located in the pygidium.
 - B. Apex of pygidium very narrow and pointed; margins of pygidium concave; paraphyses very long; four groups of circumgenital gland pores present -----*Chrysomphalus perseae* Comst.
 - BB. Apex of pygidium very broad and obscurely pointed; margins of pygidium straight or slightly convex; paraphyses clavate and broad; five groups of circumgenital gland pores present -----*Chrysomphalus obscurus* Comst.
- AA. Anal opening near the tip of the pygidium, being one-fourth or less of the length of the pygidium from its apex.
 - B. Circumgenital gland pores absent; dorsal tubular wax ducts not penetrating in the penultimate segment; paraphyses very long, clavate, and stout -----*Chrysomphalus tenebricosus* Comst.
 - BB. Groups of circumgenital gland pores present; dorsal tubular wax ducts extending into the penultimate segment; paraphyses elongate, but relatively short.
 - C. A tubular wax duct opening between the median lobes; plates cephalo-laterad of the third lobe, bifurcate and deeply fringed laterally; anal opening fairly large; tubular wax ducts of two types: (1) filamentous, capitate; (2) broad, cylindrical -----*Chrysomphalus aonidum* Linn.
 - CC. No tubular wax duct opening between the median lobes; plates cephalo-laterad of the third lobe deeply bifurcate, unfringed, and faintly serrate; anal opening small; tubular wax ducts of only one type, being long, narrow cylindrical tubes -----*Chrysomphalus dictyospermi* Morgan

**Chrysomphalus aonidum* Linn.—Florida Red Scale.

Although this species is an important pest in the citrus sections of the Southern United States, its attacks in Missouri are confined to greenhouses. At times it becomes so severe a pest of palms and other sub-tropical plants, as to render them unsalable.

Some of the plants attacked in Missouri greenhouses are: Japanese euonymus, cactus, English ivy, eucalyptus, oleander, orange, palms, rubber and sago palm. It has been collected in greenhouses in Boone, Jackson, St. Louis and Wright counties.

Its other main characters are:

- (1) Scale of female blackish, with reddish center.
- (2) Median lobes notched on each margin.
- (3) Second pair of lobes similarly notched, although sometimes bi-notched on outer margin.

- (4) Third pair of lobes notched once on the inner and multi-notched on the outer margin.
- (5) Lobes all widely separated.
- (6) Clavate thickenings about as long as diameter of anal opening.
- (7) Plates prominent, numerous and fringed.
- (8) Anal opening about two or three times diameter of a circumgenital gland pore and located about twice its diameter from the apices of median lobes.
- (9) Limit of variation of circumgenital gland pores as follows: anterior median (0 to 2); anterior laterals (4 to 9); posterior laterals (3 to 5).
- (10) Dorsal gland pores very numerous (100 or more).

***Chrysomphalus dictyospermi** Morgan.—Morgan's Scale.

This greenhouse scale is quite cosmopolitan in tropical and subtropical regions, and attacks many plants, although it is one of the less important pests in Missouri greenhouses.

The important characters of this insect are:

- (1) Scale of female flat and light colored.
- (2) Median lobes well rounded; deeply notched on outer margin about one-third the distance from the apices.
- (3) Second pair of lobes notched about midway of outer margin.
- (4) Third pair of lobes notched once or twice on outer margins.
- (5) Lobes all well separated.
- (6) Prominent fringed plates between the lobes, and bifurcate ones laterad of third lobes.
- (7) Anal opening rather small, and located about four times its diameter from the apices of median lobes.
- (8) Limit of variation of circumgenital gland pores as follows: anterior median (0 to 1); anterior lateral (2 to 5); posterior lateral (2 to 3.)
- (9) Dorsal gland pores fairly numerous but not conspicuous.
- (10) No tubular wax duct opening between the median lobes.
- (11) Tubular wax ducts unipistonate and cylindrical.

Chrysomphalus obscurus Comst.—Obscure Scale.

This common indigenous coccid is one of the largest of the *Diaspinae* and mainly attacks oak, pecan, and chestnut. It rarely kills the tree, although large branches may succumb to its attack. The winter is passed as partly grown male and female insects, and pupae were observed in Boone County April 12, 1916. Eggs were observed Sep-

tember 15, 1916. This species has been collected in Boone, Gentry, Jackson, Jefferson, Perry, and St. Louis counties.

The distinguishing characters are:

- (1) Scale of female very large, slightly convex, slate-gray.
- (2) Exuviae brownish black to jet black.
- (3) Median lobes prominent, projecting, but broad and short; notched midway the outer margin.
- (4) Second and third pair of lobes notched several times on outer margin.
- (5) Paraphyses clavate and stout.
- (6) Anal opening slightly smaller than a circumgenital gland pore as follows: anterior median (0 to 9); anterior laterals (0 to 15); posterior laterals (1 to 9).
- (7) Dorsal gland pores small and numerous.
- (8) Tubular wax ducts filamentous, long, captitate, unipistonate.

***Chrysomphalus perseae Comst.—Red-bay Scale.**

This species was collected from the skins of banana fruits on a Kansas City Market. It is of only secondary importance in Missouri. Eggs and young were observed April 21, 1916.

The prominent characters are:

- (1) Scale of female fawn to reddish brown.
- (2) Exuviae jet black.
- (3) Median lobes entire, and more or less circular, though broader than long.
- (4). Second pair of lobes notched midway the outer margins.
- (5) Anal opening rather large; located about three-fifths the length of the pygidium from it apex.
- (6) Limit of variation of circumgenital gland pores as follows: anterior median (0); anterior laterals (6 to 12); posterior laterals (5 to 8).
- (7) Gland pores very small, but abundant.
- (8) Tubular wax ducts very long, filamentous, capitata, unipistonate.

Chrysomphalus tenebricosus Comst.—Gloomy Scale.

This species has been collected in Missouri in Cape Girardeau, Dunklin, Scott, Stoddard, and Mississippi counties where it occurs injuriously on red maple, cottonwood, and American elm. It over-winters as an adult female.

The outstanding characters are:

- (1) Scale of female very convex, with distinct white nipple.

- (2) Four pairs of well developed lobes, all of which are notched on the outer margin.
3. Anal opening very small; located about four times its length from apices of lobes.
- (4) Dorsal gland pores minute, obscure, though numerous.
- (5) Tubular wax ducts long, filamentous, and decidedly variable at their bases.

GENUS DIASPIS COSTI

This group includes species in which the female has a circular scale with the exuviae sub-central or central. The scale of the male is like that of the *Chionaspis* and *Aulacaspis* groups.

***Diaspis boisduvalli** Sign.—Boisduvall's Scale.

This species often severely injures palms and other hothouse plants.

Its distinguishing characters are:

- (1) Scale of female very thin, flat, translucent, grayish to fawn colored.
- (2) Exuvia yellowish.
- (3) Median lobes retracted within pygidium, but well separated at inner base, inner margin serrate.
- (4) Anal opening large, located about four times its diameter from the apices of median lobes.
- (5) Limit of variation of circumgenital gland pores as follows: anterior median (6 to 16); anterior laterals (12 to 29); posterior laterals (10 to 21).
- (6) Dorsal gland pores numerous and apparently promiscuously arranged in caudal third of pygidium.

GENUS HEMICHIONASPIS COCKERELL

This group is similar in characters to the *Chionaspis*s, but differs in the shape that the approximate median lobes make—a semi-circle.

***Hemichionaspis aspidistrae** Sign.—Aspidistra Scale.

This hothouse species occasionally does considerable damage to various ferns and other sub-tropical plants, and is known locally as the "white scale".

The prominent characters are:

- (1) Scale of male white, tri-carinate.
- (2) Scale of female reddish brown to light brown.
- (3) Median lobes approximate, forming a serrate semi-circle.
- (4) Anal opening about centrally located in pygidium and fairly large.

- (5) Limit of variation of circumgenital gland pores as follows: anterior median (5 to 15); anterior laterals (14 to 30); posterior laterals (15 to 26).
- (6) Dorsal gland pores arranged only in two rows with only the posterior groups.

Row number	1	2	3	4
Anterior group -----	0	0	0	0
Posterior group -----	0	0	1-5	2-5

GENUS LEPIDOSAPHES SHIMER

The scales of the female are long, narrow, more or less curved, convex, and dark-colored, with the exuviae cephalo-terminal. The scale of the male is quite similar to that of the female.

Those species of this genus found in Missouri may be separated by the following synoptic key:

- A. Median group of circumgenital gland pores rarely with less than nine or ten; an omnivorous feeder, but rare upon citrus plants
-----*Lepidosaphes ulmi* Linn.
- AA. Median group of circumgenital gland pores rarely with more than six or seven; normally a citrus pest.
- B. Scale of female very long and narrow; circumgenital gland pores moderately abundant -----*Lepidosaphes gloverii* Pack.
- BB. Scale of female relatively broad; circumgenital gland pores moderately abundant -----*Lepidosaphes beckii* Newman.

**Lepidosaphes beckii* Newman.—Purple Scale.

This scale is one of the worst citrus pests, and causes immense damage to the industry in Florida and California. In greenhouses it often destroys ornamentals.

The distinguishing characters are:

- (1) Scale of female, convex, grayish brown to purplish.
- (2) Limits of variation of circumgenital gland pores as follows: anterior median (3 to 8); anterior laterals (8 to 18); posterior laterals (7 to 11).
- (3) Dorsal gland pores of two types: The marginal ones, similar to those in *Chionaspis*, and the grouped small, circular ones similar to those in *Chionaspis pinifoliae* and *C. salicis-nigrae*.

**Lepidosaphes gloverii* Pack.—Glover's Scale.

This coccid is not as injurious as the previous species, and may readily be distinguished from it by the long slender scaly covering of the female which is generally thinner and more variable in color.

The circumgenital gland openings are less numerous than in the preceding species, the median group having from two to four.

Lepidosaphes ulmi Linn.—Oystershell Scale.

The oystershell scale is very common in Missouri having been collected in Worth, Gentry, DeKalb, Clark, Pike, Jackson, Lafayette, Pettis, Benton, Boone, St. Charles, St. Louis, Jefferson, Cape Girardeau, Oregon, Howell, Ozark, Texas, Wright, Webster, Greene, Lawrence, and McDonald counties. Its Missouri host plants include: box elder, cottonwood, plum, pear, apple, brambles, willow, lilac and *Buxus*.

Young scales were hatching on May 8, 1915, in Boone County. By May 15, they had their scales well started. Also on September 10 young were making scales in Gentry County.

The distinguishing characters are:

- (1) Scale of female grayish to chestnut brown, convex.
- (2) Limits of variation of circumgenital gland pores: anterior median (6 to 18); anterior laterals (10 to 24); posterior laterals (9 to 22).
- (3) Dorsal gland pores of three types: Two semi-circular rows of minute glands along the anterior boundary of the pygidium and just posterior of this boundary along a line parallel to it.

GENUS PARLATORIA TARGIONI

Generic characters: Scale of female narrow at base then suddenly enlarging; second exuvia very large; pygidium very crenulate and with large plates along the margin.

The four species found in Missouri are sub-tropical forms.

- A. Pygidium with three pair of lobes; anal opening large -----
-----*Parlatoria proteus* Curtis.
- AA. Pygidium with four pairs of lobes, the fourth pair being pointed and more or less triangular in shape.
 - B. Fourth lobes short, broad, and notched; the three pairs of lobes sub-equal -----*Parlatoria pergandei* Comst.
 - BB. Fourth lobes long and tapering.
- C. Median lobes larger than the others and distinctly pointed caudad of the notches; anal opening large; five groups of circumgenital gland pores generally present -----*Parlatoria theae* Ckll.
- CC. Median lobes no larger than the second or third pairs; median lobes distinctly rounded caudad of the notches; anal opening very small; four groups of circumgenital gland pores present -----*Parlatoria ziziphus* Lucas

***Parlatoria pergandii** Comst.—Chaff Scale.

Although occasionally a pest in greenhouses, this insect is noted more for its effect on citrus trees. In Missouri it was collected on *Buxus* plants.

Its distinguishing characters are:

- (1) Scale of female: flat, grayish.
- (2) Anal opening small, located two-fifths the length of the pygidium from the apex.
- (3) Limit of variation of circumgenital gland pores as follows: anterior median (0); anterior laterals (4 to 10); posterior laterals (4 to 10).
- (4) Dorsal gland pores similar to those in Chionaspids and quite numerous.

****Parlatoria proteus* Curtis.—Curtis' Scale.**

This species also is of little importance to greenhouse men.

Distinguishing characters are:

- (1) Scale of female: brownish-yellow to translucent.
- (2) Anal opening rather large and located about five times its diameter from the apices of the lobes.
- (3) Limit of variation of circumgenital gland pores as follows: anterior median (0); anterior laterals (5 to 10); posterior laterals (4 to 6).
- (4) Dorsal gland pores relatively few.

****Parlatoria theae* Ckll.—Green *Parlatoria*.**

This species has heretofore been intercepted on nursery stock only in California and New York. It was taken in Missouri on imported Japanese flowering cherry.

Its distinguishing characters are:

- (1) Scale of female flattish, white to grayish with the exuviae greenish black.
- (2) Adult female bluish green.
- (3) Anal opening located about six times its diameter from the apex of the pygidium.
- (4) Limits of variation of circumgenital gland pores as follows: anterior median (0 to 1); anterior laterals (4 to 9); posterior lateral laterals (7 to 17).
- (5) Dorsal gland pores numerous.

****Parlatoria ziziphus* Lucas.—Lemon Scale.**

This coccid is sometimes taken on citrus fruit imported from Italy, although it is also reported on sub-tropical plants other than citrus.

Its distinguishing characters are:

- (1) Scale of female brownish with very large jet black exuviae.
- (2) Anal opening very small and located about centrally in the pygidium.

- (3) Limit of variation of circumgenital gland pores as follows: anterior median (0 to 1); anterior laterals (4 to 9); posterior laterals (8 to 12).
- (4) Dorsal gland pores numerous.

GENUS PHENACASPIS COOLEY & COCKERELL

Generic character: adult female with median lobes forming a distinct notch on median line; margin of lobes serrate.

The scales of this genus are indistinguishable from those of the genus *Chionaspis* and only one species has been taken in Missouri.

Phenacaspis spinicola D. & M.

This scale of honey-locust is found generally associated with *Chionaspis gleditsiae* Sanders but more frequently attacks the leaf petioles, leaves, fine stems and thorns than it does the main body of the tree, where the other species is generally found.

It has been taken only in Boone County.

Its distinguishing characters are:

- (1) Scale of male: tri-carinate.
- (2) Median lobes serrate and forming a distinct notch between them.
- (3) Inner lobule of second pair of lobes as tall as median lobes.
- (4) Third pair of lobes rudimentary.
- (5) Paraphysis more or less crescentric.
- (6) Anal opening located eight times its diameter from the apex of the lobes.
- (7) Limits of variation of circumgenital gland pores as follows: anterior median (5 to 12); anterior laterals (10 to 18); posterior laterals (0 to 12).
- (8) Dorsal gland pores always in three rows: variable as follows:

Row number	1	2	3	4
Anterior group -----	0	1-3	2-5	1-4
Posterior group -----	0	0	2-7	4-8

GENUS TARGIONIA SIGNORET

Generic characters: Circumgenital gland pores absent; dorsal gland pores very numerous; tubular wax ducts short, filamentous capitate, bi-pistonate.

Although two species of this genus have been identified from Missouri, it is a question whether or not both are identical.

Targionia dearnessii Ckll.

This species has been reported from Atchison, Jefferson, Cape

Girardeau, Wright, Greene, Lawrence, and Taney counties, feeding on *Ceanothus americanus*, *C. ovatus*, and *Symphoricarpos orbiculatus*. This insect as well as the following has the peculiar habit of attacking plants in small areas only, although its host plants abound all around.

Targionia helianthi Parrott.

So similar is this insect to the previous, that differentiation is scarcely possible. It has been collected only in Boone County and from herbaceous plants: *Ambrosia artemisiifolia*, *Ambrosia trifida*, *Aster multiflorus*, *Helianthus divaricatus*, wild lettuce, golden rod, red clover and *prunella vulgaris*.

Some main characters are:

- (1) Scale of male creamy-buff.
- (2) Scale of female very convex; creamy white.
- (3) Exuviae golden.
- (4) Median lobes well developed, approximate, and "shouldered" on outer margins near their tips.
- (5) Plates between lobes short, bifurcate, obscure.
- (6) Heavy chitinous bars near middle of pygidium.

SOFT SCALES

The so-called "Soft Scales" include the four sub-families, *Monophlebinae*, *Orthesiinae*, *Dactylopiinae*, and *Coccinae*. The various genera will be considered alphabetically and not in relation to each other.

GENUS COCCUS LINN. (COCCINAE)

Generic characters: Adult female slightly convex, ovoid; anal ring with eight hairs; derm alevolate; pores small and scattered; median spiracular spine over twice as long as outer ones; antennae and legs well developed; eggs laid beneath the body of the female; pair of triangular dorsal anal plates.

The two Missouri species are exotic and may be separated as follows:

A. Antennae eight segmented; the third longest -----*Coccus elongatus* Sign.

AA. Antennae seven segmented; third and fourth segments sub-equal
-----*Coccus hesperidum* Linn.

**Coccus elongatus* Sign.—Elongate Soft Scale.

This coccid is found only in greenhouses in this latitude and has many host plants, most of which are sub-tropical or tropical. It does not rank among the serious pests of Missouri floriculture.

The distinguishing characters of this species are:

- (1) Each anal plate about as broad as long; apex rather angular.

- (2) Fringe setae in two groups of four each.
- (3) Sub-apical setae in two groups of four each.
- (4) Apical setae in two groups of three each.
- (5) One discal seta on each plate.

**Coccus hesperidum* Linn.

This species has long been known to science, being one of the first of the *Coccidae* to be studied and described. It lives only in greenhouses in this latitude although it is found out of doors in some of the Gulf states. Its food plants as recorded in literature number upward of 75, most of which are sub-tropical or tropical.

It is a rather serious pest and does damage in two ways: (1) weakening the plant by sucking the sap; (2) by excreting honey dew upon which black-fungi grow, thus producing unsightly and unsalable plants or fruits.

The distinguishing characters of this species are:

- (1) Each anal plate one-half as broad as long; apex rounded.
- (2) A characteristic "V"-shaped mark formed by the cephalic ends of the median side of each anal plate.
- (3) Four fringe setae arranged in two groups of two.
- (4) Two sub-apical setae on each plate.
- (5) Four apical setae on each plate.

GENUS *ERIOCOCCUS* TARG. (DACTYLOPIINAE)

Generic characters: Adult female enclosed in a felt-like sack soon after fecundation and before oviposition; a small opening in the end of the sac for the escape of the young; antennae seven segmented; anal ring with eight stout hairs.

Two native species occurring in Missouri are separated as follows:

- A. Adult female deep reddish-purple; occurring on trees or shrubs ----
 -----*Eriococcus borealis* Ckll.
- AA. Adult female straw colored; striped longtitudinally with two gray-
 ish blue bands; occurring on herbaceous plants -----
 -----*Eriococcus missouri* sp. n.

Eriococcus borealis Ckll.

This species is of rather common occurrence locally on hackberry at least in Boone County. It has also been found on buckeye.

The distinguishing characters are:

- (1) Adult female: reddish purple; two to three millimeters long.
- (2) Antennae seven segmented; the fifth and sixth the shortest.
- (3) Anal lobe spine about three times the length of the anal ring hairs.
- (4) Boiled in KOH the body turns blood red.

Eriococcus missouri sp. n.

Young: About 0.25 mm. long and 0.1 mm. wide; ovoid, but broader at the anterior end and tapering to the posterior end; deep purplish-red; legs and antennae paler in color; two long anal filaments about one-half the length of the body; derm with about 40 short, curved spines; eyes blackish; a short, white tuft of waxy filaments between the anal lobes.

Immature female: About 2 mm. long and 1 mm. wide; ovoid and narrowing at the anal end, but rounded at the cephalic end; ground color cream to grayish-white; dorsum longitudinally marked with five distinct stripes, the median and the two laterals being of the ground color while the two remaining stripes laterad of the median stripe are dark grayish blue; these two stripes are the largest and somewhat mottled due to the ground color breaking through; the lateral and median stripes are about the same width throughout their length, and converge at their extremities, thus making the bluish stripes widest through the middle of the dorsum, and converging at their extremities; derm coarsely covered with long, stout, grayish-white waxy hairs or spines, arranged as follows: those on the median stripe recurving on each other; those laterad of the median stripe curving toward their respective margins; body contents turn deep reddish-brown color in hot 10% KOH; a narrow, snow-white tube extending between the anal lobes.

Immature female mounted: 1.8 mm. long and 0.9 mm. wide; legs, antennae, spines and mouth parts straw colored; derm thickly beset with short body spines varying in length from 21 mmm. to 62 mmm. long, and from 9 mmm. to 21 mmm. in diameter; circular gland pores the same as in the preceding species; also with several short hairs and some long ones; antennae seven segmented; leg measurements (in mmm.) as follows:

	<i>Trochanter and Femur</i>	<i>Tibia</i>	<i>Tarsus</i>
Prothoracic leg	200 x 65	126 x 35	126 x 29
	232 x 77	132 x 38	
Mesothoracic leg	212 x 65	132 x 32	132 x 29
	235 x 77	144 x 38	138 x 29
Metathoracic leg	283 x 65	141 x 35	138 x 26
	253 x 74	163 x 38	150 x 29

Tibial spines vary from 29 mmm. to 38 mmm. long; trochanteral spines vary from 75 mmm. to 100 mmm. long; anal lobes prominent and bearing three body spines in addition to the hair arising from its distal

end; this anal lobe hair 279 mmm. long, which is about twice the length of the hairs of the anal ring.

Adult ovisac: 3 mm. long and 1 mm. wide; white and matted; felt-like; numerous long, white, filaments projecting from the sides and top.

Mature female: 2.8 mm. long and 1.3 mm. wide; straw colored; derm with pores similar to those in the preceding species; antennae seven-segmented; legs fairly well developed, with measurements (in mmm.) as follows:

	<i>Trochanter and Femur</i>	<i>Tibia</i>	<i>Tarsus</i>
Prothoracic leg	185 x 59	103 x 35	118 x 29
	215 x 80	118 x 41	129 x 29
Mesothoracic leg	191 x 59	118 x 35	123 x 26
	215 x 74	126 x 41	135 x 29
Metathoracic leg	200 x 65	123 x 35	135 x 29
	223 x 71	132 x 41	131 x 32

Tibial spines vary from 24 mmm. to 44 mmm.; trochanteral spines vary from 53 mmm. to 80 mmm.; tarsi in all cases longer than the tibia and bear about the ratio 2:3 to the length of the trochanter plus the femur; the femur is about one-third as wide as long; body spines vary from 21 mmm. to 62 mmm. long and are 8 mmm. to 24 mmm. in diameter; the seta or hair on each anal lobe about twice the length of those of the anal ring, being 225 mmm. in the former, and 105 mmm. in the latter.

Remarks: On September 25, 1916, felted coverings had formed over caged specimens. The insects had crawled from their host plant and had formed their sacs on the sides of the earthen crocks in which *Ambrosia trifida* was growing; sacs completely covering the bodies, and broader in proportion to their lengths than occurs in most species of this genus. The sacs had not formed on all, but the bodies were quite plump, and the ventral surfaces were sprinkled with fine, white powder especially noticeable in the abdominal region. The general shape of the body just previous to the formation of the sac is more or less convex on the dorsum, and with the ventrum quite conspicuously keel-shaped. The females are not early enclosed in a felted sac; they become covered only when full grown, for they were studied on their food plant almost continuously from August 23, when the young females were collected. At that time they were 2 mm. long and 1 mm. wide. When the sacs were opened on October 10, 1916, they were found to be filled with small, oval-elliptical, fawn-colored eggs.

GENUS *EUCALYMNATUS* CKLL. (COCCINAE)

This genus was withdrawn from the genus *Lecanium* Burn. on account of these characters:

Adult female: Flat, a fringe of marginal hairs; derm hard and with large tessellations on plates.

One species occurs in Missouri and only in greenhouses.

**Eucalymnatus tessellatus* Sign.—The Tessellate Scale.

This exotic species is of but secondary importance in Missouri floriculture, and is only occasionally met with.

Its distinguishing characters are:

- (1) Adult female; antennae eight-segmented; the third the longest.
- (2) Each anal plate twice as long as broad.
- (3) Fringe setae in two groups of two each.
- (4) Three sub-apical setae on each plate.
- (5) Three apical setae on each plate.

GENUS *EXAERETOPUS* NEWST. (COCCINAE)

This genus was established in 1894 by Newstead. In correspondence with Morrison, he states: "According to Lindlinger, 'Die Schildlause, Cocciden', Stuttgart, 1912, the type of this genus, *E. formiceticola* Newst., is the same thing as *Luzulaspis luzulae* (Dufour)." So that if Lindlinger is right, it is possible that the above species will have to be changed to *Luzulaspis* Ckll., or some other name, as *Exaeretopus* Newst. will become a synonym of *Luzulaspis* Ckll.

The characters of this genus are:

Adult female: Mouth parts present; spiracles absent on the abdominal segments; naked; anal ring fringed with hairs or setae; extremity of abdomen cleft; anal opening closed by a pair of triangular dorsal plates; at least the anterior tarsi two-segmented.

Only one species of this genus has been found in Missouri. Its synoptic characters are as follows:

- A. Tarsi two-segmented; antennae eight-segmented; segments all short and robust; derm with many ducts ending in long whip-like lashes; body with a discontinuous fringe of marginal spines --

-----*Exaeretopus boonei* sp. n.

Exaeretopus (? *Luzulaspis*) *boonei* sp. n.

Adult female: 3.2 mm. long and 3 mm. wide; derm with innumerable, small circular gland pores, 5 mmm. in diameter; near the body margin are many short, rod-shaped ducts with whip-like lashes which are as long as 30 mmm. also obscurely pitted or alveolated with small irregular to circular pores, 15 mmm. in diameter; antennae eight-

segmented; legs extraordinary for female coccids. Prothoracic legs well inside the prothoracic spiracles, between them and the mouth parts; the coxa well developed and cone shaped; the trochanter small and obscurely triangular and fitting close upon the femur, two-fifths as wide as the length of the trochanter plus the femur; tibia about as long as the femur plus the trochanter; the tarsi distinctly two-segmented the distal segment being the longer of the two by about one-half its length. The tarsal claw as long as the first tarsal joint or the segment next to the tibia. Mesothoracic leg with coxa well developed; trochanter obscure; the trochanter plus the femur about twice as long as wide, and about the length of the tibia, but at least twice as broad as the tibia; the tibia club-shaped the larger end being nearly as wide as the femur and joins to the tarsi; the tarsi nearly as long as the tibia and are about as wide as the distal end of the tibia, and with the middle margins slightly concave; tarsal claw long, curved and pointed. Metathoracic leg with the coxa as in the other legs; the trochanter plus the femur not so long as the tibia, but about the same length as the tarsi; the tarsi apparently two or three jointed, but the segments very obscure, being mere indications that the number of joints in this tarsus is rather indefinite. Spiracles very characteristic, with tops shaped like the apothecia of *Sclerotinia fructigena* (Pers.) Schroet., the brown-rot fungus of stone fruits; each one 125 mmm. by 50 mmm. at the top or cup, add with a stalk portion about 90 mmm. long and 30 mmm. in diameter. Marginal fringe of about 290 stout body spines, varying in size from 30 mmm. to 45 mmm. in length and from 9 mmm. to 10 mmm. in diameter, the shorter ones being found only in the regions of the spiracles, and four in number on either side of the body; this marginal fringe ends at the caudal end of the anal incision about 815 mmm. from the anterior end of the anal orifice and 550 mmm. from the caudal extremity of the anal plates; spines in the position of the spiracular spines arranged as follows: a series of long marginal spines then one short one, then a long one, then another short one, and then a series of long marginal spines; the spines are from 25 mmm. to 35 mmm. apart, generally the greater distance. Anal plates broad and triangular in form, but somewhat irregular on the margins; the inner side about 200 mmm. long, and irregular in outline; cephalo-lateral margins from 130 to 175 mmm. long; caudo-lateral margin rounded and about 175 mmm. long, chocolate brown in color; the combined width of the plates is about 265 mmm.; each anal plate with four fringe setae.

Remarks: This interesting species was collected on *Ulmus spp.* near McBaine, Missouri, and due to its close external re-

semblance to certain species of *Lecanium*, the insect was not discovered until slide mounts had been made. The writer places this species in the genus *Exaeretopus* Newst. due to the fact that it has the tarsi of the prothoracic legs two-segmented.

GENUS ICERYA SIGN. (MONOPHLEBINAE)

Generic characters: Adult female, without mouth parts; forming a long ovisac under the caudal end of the body similar to *Pulvinaria*, Tarq.; antennae eleven-segmented. Only one species is known from Missouri and is rare in greenhouses.

**Icerya purchasi* Mask.—Cottony Cushiony Scale.

This species has long been the object of much interest in the citrus regions of this country for unless checked it soon kills the trees or branches. It has numerous hosts and a wide distribution.

Its distinguishing characters are:

- (1) Adult female pinkish or yellowish-red to slate or dark purple gray; with a margin of dull orange, and with tufts of short black bristles.
- (2) Ovisac ribbed or fluted longitudinally; yellowish white.
- (3) Antennae eleven-segmented.

GENUS KERMES BOITARD (DACTYLOPIINAE)

Species of this genus have been known for ages, a valuable dye having been made from their dry bodies. They resemble to a great extent, galls on oaks. The adult females are globular; antennae rudimentary, anal lobes absent. The male and the young resemble others of this sub-family.

The two species definitely known to occur here can be separated as follows:

- A. Adult female, conically convex; marked with distinct transverse, reddish brown bands -----*Kermes andrei* King.
- AA. Adult female globularly convex; ochreous; with small black spots and minute black specks; pale transverse bands parallel to the rows of black spots -----*Kermes galliformis* Riley.

Kermes andrei King.

This species has been collected in Boone, Gentry, and Ripley counties on White Oak. It occurs singly upon the smaller branches and its red-brown colors and conical shape easily identify it.

Kermes galliformis Riley.

This is the most common species of *Kermes* found here and often occurs in groups of several closely crowded specimens around a fork in a small branch. It is very likely that specimens, included by me

within this species, will later on prove to be other species of *Kermes*. This insect is globular and specked with minute black spots. It has been taken in Boone, Jefferson, and St. Francois counties on several species of oak.

GENUS *LECANIODIASPIS* TARG. (DACTYLOPIINAE)

Generic characters: Adult female: mouth-parts present; spiracles absent on abdomen; enclosed in a leathery, waxy test; legs absent; body glands dumbbell-shaped or like a figure 8; spiracular spines blunt; five pairs of cribiform plates or perforated discs on the dorsum; a chitinous arch above, but apparently below the anal ring; a dense chitinous, quadrangular plate on inner margin of each anal lobe, the two plates confluent above the anal cleft; margin of test arising from the bark.

Only one species of this genus is known from Missouri and has been found only in Boone County.

Lecaniodiaspis pruinosa Hunter.

Hunter's original description leads one to infer that the antennae of adult females are eight-segmented, and in correspondence he stated: "While most of our specimens have eight-segmented antennae, yet many are nine-segmented, and some even seven-segmented." The author has found that sexually mature females have nine-segmented antennae, while younger staged females—even though inclosed in a test—had seven- or eight-segmented ones. Conclusions are that Hunter's description is of an immature form. Consequently the following description may be considered complete for the species.

Eggs: Russet-brown; oval-elliptical; pointed at one end; found in large numbers under the leathery or waxy tests on September 15, 1916; laid beneath the body of the female, and entirely enclosed in the test; about 440 μ m. long and 315 μ m. in diameter. Xylol turns them from brown to greenish yellow. Winter over as eggs.

Male test: 1.5 mm. long and 1 mm. or slightly less in width; yellowish brown; uni-carinate; segmentation distinct; posterior third of the dorsum fitted with a circular flap-shaped lid for the easy emergence of the adult male.

Adult male: Purplish abdomen; legs and antennae brownish; ventral thorax and penis brownish; halteres translucent; head purplish; wings whitish and apparently tessellated; antennae ten-segmented.

Nearly mature female: Orange-brown; with powder white

exudation down the dorsum and along the articulation of the segments.

Test of adult female: 3 mm. to 3.5 mm. wide and 4 mm. long; flat to quite convex, depending on the age, being flatter and broader when nearly full grown than when fully mature; color of test ranging from snow white through grayish, and from ochreous and yellow-brown through chocolate brown to blackish brown, depending upon conditions; several of the colors found on the same tree and even on the same branch; test over living females with a noticeable prominent median carina, and with nine transverse ridges sloping to the margins, these ridges corresponding to the body segments; margins of test generally slightly scalloped, with the bottom of the scallop corresponding with the middle of the segment and the ends of the scallops at the articulation of the segments; these scallops not noticeable in old weathered specimens, nor are the transverse ridges apparent; margins of test arising from the surface of the bark, and not noticeably elevated as in *Solenococcus parrotti* Hunter.

Adult female: About 3 mm. long and 2 mm. wide; oval-elliptical. Derm thickly beset with rod-shaped glands and with "V"-shaped gland pores; also with numerous circular pores in the anal region; about 100 wax powder pores on each side of the body extending from the spiracles laterad; antennae distinctly nine-segmented; spiracle more or less curved and with a bean-shaped disc; five pairs of circular, cribriform plates along the dorsum of the abdomen. Marginal spines absent. Spiracular spines rather short, clavate, and with slightly curved apices and arranged as follows: a pair on either margin laterad of the anterior spiracle; a single one cephalo-laterad of the posterior spiracle and another caudo-laterad of the posterior spiracle. Anal lobes but slightly produced, each bearing one hair about as long as those of the anal ring or the length of the anal plate, and about five other short hairs; anal ring with ten hairs; anal plate more or less triangular in form but continuous on their cephalic margin by a narrow bridge or band; with two quite stout spines on the caudo-median line and a smaller one near the inner edge; also three minute setae near the cephalo-lateral angle.

The writer has taken this species from the following hosts: box elder, sugar maple, buckeye, Mississippi and common hackberry, moonseed, weeping mulberry, red and white mulberry, ironwood or hop hornbean, sumac, basswood, white linden, American elm and viburnum.

GENUS *LACANIUM* BURMEISTER (COCCINAE)

While there are several distinct species occurring in Missouri,

this genus has not been carefully worked as yet. One species of economic importance is the terrapin scale.

Lecanium nigrofasciatum Perg.

Insects of this species may be identified especially well in the winter, for they cluster along a small branch, are hemispherical, and are mottled with red over a black ground color. This scale has been definitely identified from both peach and sugar maple, and has been collected in Boone, Jasper, Pulaski, Pike, St. Charles, St. Louis, Jefferson, Perry, and Cape Girardeau counties.

Important distinguishing characters are:

- (1) Dorsum of adult with from 19 to 90 tubercles extending cephalad from the anal plates.
- (2) Median spiracular spine more than twice as long as the outer ones.
- (3) Each anal plate about three-fifths as wide as long, and outer margins about equal in length.
- (4) Fringe setae in two groups of two.
- (5) Three apical setae on each plate.

GENUS ORTHEZIA BOSCH. (ORTHEZIINAE)

Generic characters of this group are: adult females with eight- or nine-segmented antennae; no digitules or claws; anal ring with six hairs; spiracles present on all abdominal segments; covered with waxy lamellae forming a marsupium at caudal end; active throughout life.

The two species occurring in Missouri are separated as follows:

- A. Body of adult female dark green; part of body devoid of waxy lamellae -----*Orthezia insignis* Dougl.
- B. Body of adult female dark brown, entirely covered by heavy waxy lamellae -----*Orthezia solidaginis* Sanders.

**Orthezia insignis* Dougl.—Greenhouse *Orthezia*.

This greenhouse species occasionally overruns many kinds of plants and destroys their value. In Missouri it has been found in greenhouses on *Coleus* and *Lantana*.

Its important characters are mentioned under the discussion of this genus.

***Orthezia solidaginis* Sanders.**

This species is quite prolific and more or less local in distribution. It generally attacks the sub-terminal leaves on their under sides. Besides its recorded hosts, the writer has collected it from

ragweed, great ragweed, blue aster, many-flowered aster, beggar tick, aster-like boltonia, great Western fireweed, daisy fleabane, trumpet weed, white snakeroot, woodland sunflower, Jerusalem artichoke, Jewell weed, monkey flower, Bradburry's monarda, cone flower, broad-leaved goldenrod, showey goldenrod, American germander and red clover. It has been collected only in Boone County.

Its general characters are considered in the discussion of the generic characters.

GENUS PHENACOCCLUS CKLL. (DACTYLOPIINAE)

Generic characters: Adult female: mouth parts present; abdominal spiracles absent, naked or covered with mealy secretion; anal ring of six hairs; legs present; antennae of nine segments; tarsal claws double-toothed.

The species of this genus in Missouri may be identified from this key:

- A. Cerarical spines short and spearhead-shaped and numerous; color of female deep maroon; orthezia-like waxy lamellae surrounding basal margin of the body ----- *Phenacoccus regnillohi* sp. n
- AA. Cerarical spines not spearhead-shaped, but slender -----
- B. Anal lobe with two large, elongate, cylindrical ducts each opening through an elevated prominence; two cerarical spines present in each cerarus of the ultimate segment; body slate-gray -----
----- *Phenacoccus stachyos* Ehrk.
- BB. Anal lobes without elongate, cylindrical ducts; -----
- C. Cerarical spines very long; three such spines in each cerarus of the ultimate segment; body canary yellow -----
----- *Phenacoccus celtisifoliae* sp. n.
- CC. Cerarical spines very short; five scattered cerarical spines in each cerarus of the ultimate segment; body of adult female very large ----- *Phenacoccus grandicarpus* sp. n.

Phenacoccus celtisifoliae sp. n.

This species was collected on the lower surface of hackberry leaves along the Hinkson creek south of Columbia, Boone County, Missouri.

Adult female: 2.3 mm long and 1.5 mm. wide; light canary yellow; covered with a heavy, white, mealy powder; legs, antennae and mouth parts very pale brownish or yellowish; body margined with very short, white masses of waxy exudation, and a slight ridge of the same down the dorsum; boiled in 10% KOH, it turns yellowish and then reddish brown.

Mounted adult female: 2.3 mm. long and 1.5 mm. wide; derm with scattering ordinary body hairs and cylindrical body glands; eyes prominent and project bulb-like above the body surface; beak

situated between the two anterior coxae; legs and antennae well developed; the trochanter plus the femur is about equal to the tibia and about three times the length of the tarsus; the femur is about four times as long as wide; tibia about six times its width in length; the tarsus about three times as long as wide; cerarii distinct and with long (30 mmm.) conical setae of characteristic shape, being very slender; not differing greatly from the ordinary body hairs; conical setae of the cerarus type irregularly scattered over the derm, together with a scattering of the cerarical wax glands; cerarical spines in 36 groups with limits of variations as follows:

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Cerarical																		
spines	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
Group	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Cerarical																		
spines	3	4	4	3	2	3	4	3	2	3	3	2	2	2	2	2	3	3

Cerarii of the ultimate, penultimate, and the second-head group as shown in figures; spiracles characteristic, being sclerotinia-shaped on the outer extremity, and with a short neck which expands flask-shaped to a base nearly as broad as the cup, and quite thick; the first pair of spiracles occurring laterad and about medial between the coxae of the first two pair of legs; the second pair of spiracles on a line between the bases of the coxae of the last two pairs of legs, but lie much nearer the mesothoracic coxae than the metathoracic coxae; anal lobes but slightly developed, each bearing a hair 2.35 mmm. long and four other hairs of lengths varying from 0.50 mmm. to 1.15 mmm. in length; hairs of the anal ring about 1.35 mmm. long.

Phenacoccus grandicarpus sp. n.

This is the largest species of this group known to the writer. It was collected under the outer bark of *acer saccharum* in rough and partly healed-over places.

Adult female: When dead and dried, of a dark brown color; somewhat hemispherical, with distinct segmentation; derm covered with fine, white, curled, waxy secretion; especially abundant at the anterior portion of the body; ovisac white, not very compact, being loose and open; shriveled insect and the ovisac about 5 mm. long. When removed from the bark it leaves a thick, white powdery secretion to mark the position of its body. Turns dark greenish when boiled in 10% KOH.

Adult female mounted: 2.8 mm. long to 4.2 mm. long; from 1.8 mm. to 2.5 mm. wide; legs and antennae poorly developed in comparison to the size of the body; leg measurements (in mmm.) as follows:

	<i>Trochanter and femur</i>	<i>Tibia</i>	<i>Tarsus</i>
Prothoracic leg	173 x 53	103 x 25	74 x 21
	197 x 62	123 x 35	80 x 26
Mesothoracic leg	176 x 53	108 x 26	77 x 24
	206 x 62	129 x 32	88 x 29
Metathoracic leg	185 x 56	150 x 38	80 x 24
	215 x 68	176 x 47	82 x 29

tarsal claws 26 mmm. long; spiracles sclerotinia-shaped at their outer ends; derm with small scattered body spines, and also sparingly dotted with small, obscurely triangular gland pores, most numerous at the cephalic and the caudal ends and along the margins of the body; cerarii widely separated and not prominent; with from two to five conical spines in each group, and with very few accompanying triangular gland pores; conical cerarical spines very short and thin; arranged in 36 groups along the margins, as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
4	3	4	3	3	5	5	2	3	2	2	2	2	2	2	3	2	5
3	4	5	4	2	4	3	?	?	?	?	?	?	?	?	?	?	?

Hairs of the anal lobes about 150 mmm. long; those of the anal opening about 90 mmm. long.

Phenacoccus regnillohi sp. n.

This new species was collected a few inches above the base or crown of *Ostra virginiana*, south of Columbia, Boone County. It is noticeable in its habitat because of the maroon insect surrounded by the white waxy lamellae. There is no ovisac, the young hatching from eggs laid directly beneath the parent. Young were hatching August 12, 1916. This coccid was attended by the common black wood ants which sometimes build a carton over the females.

Young: Quite flat; ovoid; quite broad through the middle of the abdominal region; rounded at the anal extremity; narrower at the cephalic extremity than at the caudal end, and rounded cephalad; lemon yellow; legs pale brownish, antennae yellowish to translucent; derm dusted with fine whitish powder; anal lobes prominent and each bearing a seta about as long as the last segment of the antenna; antennae six segmented; caudal end of larva somewhat

scalloped on lateral margins; tarsi bearing long claws.

Adult female: Globular and kermes-like with diameters about equal, being 2 mm. in diameter; body flattened on the ventral surface; deep maroon to wine-colored; body at point of contact with the bark surrounded by a marginal fringe or layer of snowy-white powder, especially at the caudal end; a low, broad longitudinal median ridge most noticeable along the posterior half of the body but slightly apparent in the thoracic region; transverse depressions lead to the margins from this median ridge, indicating the segmentation; the white powder collects in abundance in these slight depressions; derm bearing many small gland pores which are about equidistant from each other and which secrete the waxy powder; at the anal opening a stout white, waxy tube which is broad at the distal end, and extending caudally as far as the outer margin of the white, waxy, orthezia-like lamellae; ventrum somewhat concave; distinctly segmented and sparingly dusted with white powder; when removed from the bark; the adults leave a noticeable, thin, white circular layer of secretion; when boiled in 10% KOH it retains maroon color until entirely bleached, and colors the solution faintly.

Adult female mounted: 2.5 mm. long and 2.7 mm. wide; derm bearing a few scattering hairs of the ordinary type, and also small scattering circular gland pores; cephalad of the anal opening are a few conical spines of the cerarus type, several small circular gland pores and several large gland pores of the circumgenital-type; legs and antennae relatively small; segments all bear a few small setae; leg measurements (in mmm.) as follows:

	<i>Trochanter and femur</i>	<i>Tibia</i>	<i>Tarsus</i>
Prothoracic leg	179 x 65 182 x 65	109 x 35 121 x 35	80 x 29 82 x 29
Mesothoracic leg	188 x 65 197 x 65	123 x 35 147 x 50	85 x 29 88 x 32
Metathoracic leg		153 x 50	

Tarsal claws vary from 21 mmm. to 24 mmm. long; the femur, tibia and tarsi about three times as long as wide; the trochanter plus the femur slightly over twice the length of the anterior coxae very near the mouth and well within and above the position of the anterior pair of spiracles; eyes just laterad and cephalad of the bases of the antennae; spiracles with characteristic shape, being about 75 mmm. long, and with both the top and the base expanded, being about 65 mmm. in diameter; posterior pair of spiracles between the

coxae of the last two pairs of legs, though slightly laterad of a line connecting the two coxae, and being slightly nearer the mesothoracic coxae than the metathoracic coxae; cerarii characteristic, due to the large number of conical spearhead-shaped spines in each group, and due to the few accompanying circular gland pores; conical cerarical spines varying from 18 mmm. to 24 mmm. long and from 3 mmm. to 6 mmm. in diameter; each cerarus on the ultimate segment with ten or eleven spines, and with but few gland pores which are circular and are not triangular as in the other species; conical spines occurring somewhat separated from the cerarii in many cases; cerarical spines numerous and arranged about as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
6	5	4	6	4	6	3	3	3	7	10	11	10	5	10	12	11	—
?	?	?	?	?	?	?	?	?	?	7	8	11	10	11	11	10	—

Anal lobes slightly developed, short and broadly rounded; anal hair being about 190 mmim. long; also bearing about ten shorter setae, about the same length as those of the anal opening, being about 100 mmm. to 110 mmm. long; also bearing the above mentioned cerarii.

Phenacoccus stachyos Ehrh.

Through correspondence and interchange of specimens with G. F. Furis, Leland Stanford University, California, I find that this species, described by me under the name *P. pettiti* is unmistakably Ehrhorn's species.

Its food plants in Missouri are: sugar maple, hickory, hackberry, hop hornbean, poison ivy, ragweed, white ash, red bud, and Virginia creeper. It occurs in Jackson, Gentry, and Boone counties.

The characteristic dorsum from which hundreds of long thin glassy filaments project will distinguish this species in the field, while the projecting glands in the anal lobes will identify it under a microscope.

GENUS PSEUDOCOCCUS WESTWOOD (DACTYLOPIINAE)

Generic characters: same as for *Phenacoccus* with these exceptions: antennae seven- or eight-segmented in adult female: tarsal claws simple.

The species known to occur in the State may be separated by this key:

- A. True cerarical spines not present in the cerarii of the ultimate segment, being replaced by several very long hairs; adult female very large; body blood-red in color ----*Pseudococcus jessica* Hollinger
- AA. True cerarical spines present in the cerarii of the ultimate segment -----
- B. Conical spines in ultimate cerarii very slender -----
- C. Wax pores very numerous, and with several small circular pores interspersed -----*Pseudococcus trifolii* Forbes
- CC. Wax pores relatively few, and no small circular pores interspersed -----*Pseudococcus shaferi* sp. n.
- BB. Conical spines in the ultimate cerarii stout -----
- C. Conical spines of the ultimate cerarii relatively broad -----
- D. Conical spines of the ultimate cerarii very short and in pairs; each spine remote from the other; triangular wax pores relatively few -----*Pseudococcus nipae* Mask.
- DD. Conical spines of the ultimate cerarii not short, but very prominent, and approximate -----
- E. Wax pores very numerous; conical cerarical spines variable in size in the different cerarii ----*Pseudococcus maritimus* Ehrh.
- EE. Wax pores very few; conical cerarical spines all stout ----
-----*Pseudococcus pseudonipae* Ckll.
- CC. Conical spines of the ultimate cerarii relatively narrow -----
- D. Wax pores very numerous; cerarical spines of the ultimate cerarii large -----*Pseudococcus morrisonii* sp. n.
- DD. Wax pores but moderately numerous; conical spines of the ultimate cerarii relatively small -----
- E. Wax pores few and scattered; setae in the ultimate cerarii much shorter than the conical spines -----
-----*Pseudococcus mcdanieli* sp. n.
- EE. Wax pores relatively numerous; setae in the ultimate much longer than the conical spines --*Pseudococcus citri* Risso.

Pseudococcus citri Risso.

This cosmopolitan coccid is often decidedly injurious to greenhouse plants and care must be taken to keep plants free from it. Many men simply use a jet of hydrant water, forcing the bugs from the twigs and leaves. This gives good results if continued systematically, but there are generally enough left to start reinfestations.

Its distinguishing characters are:

- (1) Adult female: light yellow or brownish-yellow, covered with white wax.
- (2) Marginal wax filaments distinct, sub-equal, excepting those of the anal lobes, which are longer.
- (3) Normally two conical spines in each cerarus.
- (4) Spines of ultimate cerarii about five times as long as the basal width.

Pseudococcus mcdanieli sp. n.

This new species was collected most abundantly from the great ragweed, but has also been taken on *actinomeris alternifolia* and stinging nettle. It is of local distribution only and has been collected only in Boone County.

Ovisac: From 5 mm. to 6 mm. in diameter; always located on the lower surface of the leaves of its host plants, and generally at the juncture of two large veins.

Young: Pale lemon-yellow; 0.5 mm. long and 0.25 mm. wide; oval; eyes black; antennae six-segmented, the sixth segment always the longest, and as long as segments two, three, and four combined; the second segment slightly longer than the third, fourth or fifth, which are sub-equal; the first and second ones sub-equal.

Adult female: Scarcely concealed beneath the cottony, waxy, secreted material, generally not so deeply covered as to entirely hide the insect; the white, fluffy hairs extend around the mother for quite a depth; 2 mm. long and 1 mm. wide; orange-brown; segmentation easily distinguished on the dorsum by the regularly secreted bands of white, cottony wax, between which the body at the articulation of the segments can be seen; a heavy, white, secreted, waxy tube surrounding the anal opening; the operation of egg laying seems to be accomplished only with difficulty and much exertion; eggs pale yellow, and very numerous; when boiled in 10% KOH the body contents turn deep blood-red and tints the solution pinkish.

Adult female mounted: 2.1 mm. long and 1.4 mm. wide; derm with many circular gland pores which open into short, cylindrical ducts about 5 mmm. or 6 mmm. long, and about 2 mmm. or 3 mmm. in diameter; these glands most numerous laterad of the legs and spiracles and near the margins of the abdominal segments; derm colorless; antennae and mouth parts well developed; brownish-straw colored; antennae only seven-segmented; legs well developed, the extreme measurements in mmm. being:

	<i>Trochanter and femur</i>	<i>Tibia</i>	<i>Tarsus</i>
Prothoracic leg	179 x 53	109 x 29	71 x 24
Mesothoracic leg	185 x 53	112 x 29	74 x 24
	188 x 53	115 x 29	
Metathoracic leg	197 x 47	132 x 26	80 x 21
	200 x 53	132 x 32	80 x 26

Spiracles relatively narrow tubes with small discs ending on their outer extremities; circumgenital type of wax pores numerous in

the anal region; cerarii in 34 groups, each one normally containing two conical spines; obscurely triangular wax pores in each cerarus very few, and also occurring scattered over the derm; seta of each anal lobe and the setae of the anal opening about equal in length, being 153 mmm. long. The metathoracic coxae are but faintly and partially alveolate.

***Pseudococcus maritimus* Ehrh.**

Through correspondence and exchange of mounted specimens of this species with Mr. G. F. Ferris of Leland Stanford University, California, we now consider the species *Pseudococcus omniverse* Hollinger to be a synonym of Ehrhorn's species. About the only material difference existing between Missouri and California specimens, was the somewhat fewer cerarical waxy glands in the California mounts. It has been taken only in Boone County, Missouri, and usually associated with the small black wood ant.

Distinguishing characters are:

- (1) Eggs, golden brown (Egg laying Sept. 13, 1916).
- (2) Adult female, dark orange-brown to reddish-brown.
- (3) Slight lateral depression circumscribing the dorsum mesad of the margin.
- (4) Antennae eight-segmented.
- (5) Cerarical spines in 34 groups, with limits in each group as follows:

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Cerarical spines	3	3	2	2	2	3	2	2	1	2	2	1	1	2	2	1	2
Group	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Cerarical spines	3	5	4	3	2	3	2	2	2	2	2	2	2	2	2	2	2

- (6) Conical spines of ultimate cerarii about two and one-half to three times as long as broad.
- (7) Anal ring hairs and anal lobe hairs sub-equal.

Its food plants in Missouri are osage orange, mint, red mulberry, hop hornbean, smartweed, willow and linden.

***Pseudococcus morrisonii* sp. n.**

This species was found in two colonies on the same hickory in close proximity to each other. They were massed in a nearly closed callus which had been partially covered by a protecting carton built by the little black ants which were associated with them.

Adult female: Length 2.3 mm. to 2.4 mm.; width 2 mm. to 2.3

mm.; semi-globular in form; covered with a heavy, white, mealy, waxy secretion; finely pubescent with short hairs; body varnish brown in color; abdominal segments greatly telescoped and retracted, making the anal extremity truncate; margins slightly flattened, laterally, in some specimens but convexly rounded in others; slightly rubbed specimens present a banded appearance of white and brown; legs and antennae about the same color as the body; when boiled in 10% KOH the body contents turn a deep blood red or a maroon red and tint the liquid brownish.

Adult female mounted: Length 3 mm.; width 2.5 mm.; derm with numerous long and short body hairs, and also with scattering, small, obscurely triangular wax pores; legs and antennae rather small in comparison to the length of the body; antennae eight-segmented; leg measurements show about the following proportions: coxa as wide as the length of the tibia; trochanter plus the femur about the same length as the tarsus plus the tibia; tarsus about as long as the coxa and about twice its own width; femur about as wide as the length of the tarsus; the whole leg relatively short and thick; spiracles very short and broad-necked with a short expanding cap about 50 mmm. in diameter, and with a bulb-shaped base; spiracle, anterior coxa and cephalic portion of the mouth in line; anterior spiracles laterad and caudad of the anterior coxae being nearer to them than to the mesothoracic coxae; the posterior spiracle has about the same relation to the two posterior coxae that the anterior spiracle has to the first two coxae; beak long and two-segmented, and bearing a few short setae; cerarii present on each segment, although some of them near the middle of the body have long hairs in addition to or replacing the conical spines. Cerarii occurring in 34 groups, variable as follows:

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Cerarial																	
spines	3	2	1	2	2	1	1	2	1	1	2	2	2	2	3	2	1
Group	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Cerarial																	
spines	3	3	3	3	2	3	3	4	3	3	4	4	4	4	4	5	2

Conical spines on ultimate segment are 26 mmm. long and 7 mmm. in diameter; the posterior coxae are not alveolate.

***Pseudococcus nipae Mask.**

This beautiful exotic coccid resembles only one other form, that of *Pseudococcus pseudonipae* Ckll., but can readily be distinguished

from it by its yellow body. Various species of palms are its only host plants.

Distinguishing characters of adult female are:

- (1) Yellowish brown, with 24 cream or pink waxy lamellae around margin.
- (2) Dorsum with several conical waxy lamellae.
- (3) Antennae seven-segmented.
- (4) Conical spines occurring on body in addition to the cerarii.
- (5) Cerarus of ultimate segment with two small conical spines each about three times as long as their base, and separated.
- (6) Few accompanying gland pores in cerarii.
- (7) Marginal cerarii with two conical spines widely separated from each other.
- (8) Ejective glands present.

***Pseudococcus pseudonipae Ckll.**

This greenhouse species is similar to the preceding species, but is a cardinal color, instead of yellow-brown or amber. It is also found on palms.

Distinguishing characters of the adult female are: similar to *P. nipae* Mark. but with the following exceptions:

- (1) Body cardinal red.
- (2) Cerarical spines of ultimate segment approximate and large, each about three times as long as their base.

Pseudococcus shaferi sp. n.

The writer collected this new species in several places in Boone County and from the following host plants: great ragweed, white avens, wild lettuce, golden rod, and riverbank grape. Nowhere was it very abundant, being found singly in most places.

Eggs: Brownish; oval and with well rounded ends; observed hatching August 5, 1916.

Young: Pinkish-brown; fattish, and ovoid.

Adult female: Length 1.5 mm. to 1.8 mm.; width 0.7 mm. to 1.2 mm.; brownish; covered with a thin, whitish, powdery secretion; derm bearing numerous body hairs of the ordinary type; in the anal region with numerous gland pores of the circumgenital type, and also a few scattered spiracle-shaped, also many circular or obscurely triangular wax pores; antennae relatively short and thick; eight-segmented; legs, antennae and mouth parts well developed, table showing the extreme measurements of the leg segments (in mmm.):

	<i>Trochanter and femur</i>	<i>Tibia</i>	<i>Tarsus</i>
Prothoracic leg	200 x 62	147 x 32	77 x 29
	215 x 71	168 x 32	82 x 32
Mesothoracic leg	147 x 59	147 x 29	74 x 24
	229 x 71	182 x 35	85 x 29
Metathoracic leg	229 x 58	182 x 29	88 x 26
	258 x 71	212 x 35	91 x 29

The posterior coxae are partly alveolated; spiracles typically flask-shaped with a small, flat top 36 mmm. in diameter, and with a shank about 50 mmm. long and a swollen base about 22 mmm. in diameter; second pair of spiracles just laterad of the middle pair of coxae; anterior coxae arising about midway between the mouth parts and the anterior spiracles; body with short, cylindrical glands which have circular to obscurely triangular pores; cerarii obscure on all segments except the ultimate; conical spines very narrow, moderately long, and two in number; anal lobes moderately well developed, each bearing a long seta, varying from 118 mmm. to 175 mmm. long; also a shorter seta and several ordinary body hairs in addition to the two narrow, conical spines of the ultimate cerarii, and the accompanying scattered gland pores; setae of anal ring 118 mmm. or 120 mmm. long.

Pseudococcus trifolii Forbes.

This clover mealy bug has been reported from other states damaging the stand considerably. In Missouri it has been found in Gentry, Boone, and Wright counties but nowhere destructive. It is usually found at the roots of the clover plants, but occasionally crawls to the leaves. In addition to clover, it has been collected by the writer from the roots of dandelion.

The distinguishing characters of the adult female are:

- (1) Robust, nearly circular in diameter.
- (2) No waxy lamellae around margin.
- (3) Antennae seven-segmented.
- (4) Cerarical spines present *only* on the ultimate segment and two in number, rather slender, being about six times as long as broad.
- (5) Numerous gland pores in ultimate cerarii, some of the glands being circular and apparently without the sieve-like openings.
- (6) Anal ring hairs sub-equal to anal lobe hairs.
- (7) Posterior coxae decidedly alveolate.

The summer form—so-called by some writers—is not this species,

but undoubtedly *Pseudococcus maritimus* Ehrh. or other distinct species. In reality, this species of clover mealy bug is not a *Pseudococcus*, but is close or similar to a *Ripersia*.

GENUS PULVINARIA TARG. (COCCINAE)

Generic characters of adult females: mouth parts present; abdominal spiracles absent; naked or with a fluffy, cottony secretion; anal ring with eight hairs; extremity of abdomen cleft; anal opening closed by a pair of triangular dorsal plates; tarsi one-jointed producing an abundance of white, cottony secretion to form an ovisac at the caudal extremity, which tilts the body at quite an angle to the surface on which it feeds.

The two species of this genus which are known to occur in this State, may be distinguished by the characters given in the following synoptic key:

- A. Body of adult female naked: color dark-brown to black; third segment of the antennae less than 75 mmm. long; occurring on branches, never on leaves -----*Pulvinaria vitis* Ckll.
- AA. Body of adult female covered with fine fluffy hairs; ochreous to yellow-brown; third segment of the antennae longer than 75 mmm.; occurring on leaves, rarely on the twigs -----
-----*Pulvinaria amygdalit* Ckll.

Pulvinaria amygdalit Ckll.

This species has only been found locally in one place in Boone County, on and near a wild gooseberry bush in the shelter of a tall osage orange hedge. It was collected from the leaves of these annuals in addition to the wild gooseberry: lady's sorrel, pellitory, and phlox.

The distinguishing characters of the adult female are:

- (1) Ochreous or yellowish-brown, and covered with fine white waxy cottony like filaments.
- (2) Marginal spines simple, tri-fid or multi-serrate.
- (3) Two fringe setae on each plate.
- (4) Two discal setae, two sub-apical setae, three apical setae and one hypopygial seta on each plate.

Pulvinaria vitis Linn.—Cottony Maple Scale.

This common species is a rather conspicuous insect in late spring, because of its large size and due to the large variety of plants it attacks. In this State it has been collected in Jackson, Boone, Pike, St. Charles, St. Louis, Ste. Genevieve, Jefferson and Butler counties on 24 different host plants: box elder, Norway maple, silver maple, sugar maple, hackberry, paniced dogwood,

burning bush or euonymus, honey locust, black walnut, osage orange, ninebark, sycamore, Virginia creeper, smoke tree, sumac, willow, spireas, coralberry, elm and snowball.

The distinguishing characters of the adult female are:

- (1) Reddish-brown to black.
- (2) Body devoid of cottony filaments.
- (3) Marginal spines simple.
- (4) Spiracular spines with median one about three times length of the outer ones.
- (5) Two fringe setae, two sub-apical setae, and two apical setae on each plate.

GENUS SAISSETIA DEPLANCHES (COCCINAE)

Generic characters:

Adult female: Strongly convex; nearly hemispherical; mouth parts present; abdominal spiracles absent; anal ring fringed with eight hairs; dorsal triangular anal plates present; abdomen caudally cleft; derm closely crowded with large circular or oval gland pores; median spiracular spine more than twice as long as the outer ones.

The two species of *Saissetia* known to occur in Missouri may be separated by the following synoptic key:

- A. Antennae normally seven-segmented; dorsum without ridges; derm pores widely separated -----*Saissetia hemisphaerica* Targ.
 AA. Antennae normally eight-segmented; dorsum with two transverse and one longitudinal carinae, forming the letter "H"; derm pores approximate -----*Saissetia oleae* Bernard

**Saissetia hemisphaerica* Targ.—Hemispherical Scale.

This common greenhouse pest is sometimes numerous enough to damage its host plants severely. However, it is generally considered of secondary importance by the floriculturists of this State.

The distinguishing characters of the adult female are:

- (1) Very convex, light to dark brown.
- (2) Derm densely alveolate, but less compactly than in the following species.
- (3) Antenna seven-segmented.
- (4) Marginal spines either short and awl-shaped, or rather long, clavate and serrate.
- (5) Spiracular spines with the middle one about three times the length of the outer ones.
- (6) Anal plates with lateral angle pointed.
- (7) Four fringe setae, four sub-apical; three apical setae and one discal seta on each plate.

**Saissetia oleae* Bernard.—Black Scale.

This greenhouse scale insect is very pernicious in California and other warm climates where it lives outdoors. Its numerous host plants afford it a splendid opportunity to multiply rapidly and remain permanently located.

The distinguishing characters of the adult female are:

- (1) Very convex; dark brown, with three interesting carinae forming the letter "H".
- (2) Derm densely and conspicuously alveolate.
- (3) Antennae eight-segmented.
- (4) Marginal spines awl-shaped, bifurcate, tri-fid and multi-serrate; several short, marginal tubercle-like appendages.
- (5) Spiracular spines with the middle one four times the length of the others.
- (6) Anal plates with lateral angle well rounded.
- (7) Each plate with four fringe, four sub-apical, one discal and three apical setae.

GENUS *SOLENOCOCCUS* CKLL. (DACTYLOPIINAE)

The generic characters of the adult females are: Mouth parts present; abdominal spiracles absent; covered with a waxy, leathery test, in which no moulted skins are incorporated; anal ring fringed with eight hairs; abdominal extremity not cleft; no triangular dorsal plates present; apodous; antennae very rudimentary; anal lobes moderately developed; caudo-dorsum of abdomen with a double pair of cribiform plates cephalad of the anal ring and anal lobes; margin of the test not arising directly from the surface of the bark, but from a more or less keel-shaped ventral portion; spiracular and marginal spines absent.

Solenococcus parrottii Hunter.

Inasmuch as the original description deals only with the test, the following technical description may be considered as the original for all the stages.

This rare coccid has been collected in Boone County from sugar maple, buckeye, hackberry, hop hornbean, and elm, and generally occurs singly. It is attacked by parasites and also predacious enemies. The writer observed one rather heavy infestation that had been practically cleaned up by some bird. Each test had been pecked open and the eggs and adult female had been removed.

Since there is no published description of the adult female insect or the male test the following original technical description is given.

Eggs: Held together by strong fibers of waxy secretions; old unhatched infertile, shriveled eggs deep purplish black; observed October 15, 1916, infested by an oval inactive, shiny, blackish brown mite.

Young: Have legs.

Male test: Oval-elliptical; about 1.5 mm. long and 0.75 mm. wide; truncate at the caudal end and slightly tapering at the anterior end; dorsum flatish or slightly convex; with an obscure median ridge pinkish-carmine in color; dorsum forming an angle with the ventral surface, which is more or less keel-shaped; margins carmine; general color of the test reddish; ground color creamy or straw; segmentation distinct; with small pits at the articulation of the segments; caudo-dorsum with a flap-like arrangement, allowing easy emergence of the male; ventrum straw-colored; very often found in association with the male tests of *Lecaniodiaspis pruinose* (Hunter) but may be distinguished by the reddish color.

Test of immature female: About 2.5 mm. long and 2 mm. wide; slightly obovate; moderately broad; dorsum tri-carinate; median carina composed of several small prominences, the three in the thoracic region being the largest; the other prominences are often barely present or indicated by spots of color; dorsal abdominal region depressed between the lateral carinae; the three lateral protuberances on either side of the thorax the largest; cream-colored with blotches of pinkish; several transverse ridges leading from the median carina; not always distinct; color varying from creamy to grayish or purplish with an occasional blotch of pinkish, and with pink always on the tips of the low protuberances; ventral portion of test keel-shaped, with the lateral margins elevated from the surface of the test by a distance equal to that between carinae.

Test of adult female: About 3 mm. to 4.5 mm. long and 2 mm. to 3 mm. wide quite convex being highest in the middle; dorsum elevated from the bark as in the immature stages; general color dark brown; rather obscure when on dark colored bark; median carina composed of seven tubercles or prominences circumscribing the body are 21 lateral projections, composing the lateral carinae; latero-medial row composed of six small elevations; minute creamy markings leading radially from each apex; each of the large lateral thoracic protuberances with a narrow pinkish stripe extending both dorsally and ventrally a distance equal to that between the fifth and sixth lateral protuberances; at the anal extremity a broad area at the end of which is a relatively large, oval or circular opening, through which the anal lobes may protrude.

Adult female: When dead, burnt-senna-brown; wrinkled; with a lateral ridge around the body; anal end pointed and triangular; truncated into the rest of the abdomen at a distance equal to about one-sixth of the length of the body from the anal end; segmentation distinct ventrally; located in the dorso-anterior end of the test.

Adult female mounted: About 3 mm. long and 2.5 mm. wide; derm with numerous figure "8" glands; cephalad of the triangular anal portion of the abdomen a double pair of cribiform plates, being the only ones present; antennae very rudimentary, stubby, and somewhat triangular; bearing eight or ten short hairs; legs absent; spiracles very narrow, with a rather small cup-shaped disc, and a flattened, one-sided base; spiracular powder pores rather numerous; spiracular and marginal spines absent; anal lobes moderately developed; each with a relatively short hair about as long as the breadth of the two lobes at their base; each lobe with two short conical spines and one or two ordinary hairs; anal plates combined rather triangular in shape, with the caudal margin deeply emarginate between the lobes; anal ring with eight hairs.

GENUS *TOUMEYELLA* CKLL. (COCCINAE).

Generic characters are:

Adult female: Body very convex; circular to oval; more or less globular; moderately chitinized; surface sometimes very rough and irregular; dorsum shiny with many white waxy rings on which may occur small black spots; legs very rudimentary or apparently absent; antennae rudimentary; six-segmented; anal ring with ten hairs.

Toumeyella liriodendri Gmel.

This large insect is generally found on the tulip tree and rarely on linden and magnolia. In Missouri it has been taken in Stoddard County. When a tree becomes badly infested, it is disgusting to look at because of the warty appearance presented by the large irregularly shaped scales.

Its distinguishing characters are:

- (1) Adult female large; very convex, irregular surface.
- (2) Antennae more or less rudimentary, indistinctly segmented.
- (3) Marginal spines small, stout, set in distinct chitinous thickenings.
- (4) Spiracular spines short, stout, sub-equal in length.
- (5) About 16 hypopygial setae.

- (6) One fringe seta, seven sub-apical setae and three apical setae on each anal plate.

GENUS TRIONYMUS BERG. (DACTYLOPIINAE)

Generic characters:

Adult female: With a long, parallel-sided body; antennae eight-segmented; stouter and shorter than in the other mealy bugs; eyes present; anal ring with six large bristles; mentum short; no projecting caudal lobes; legs present; abdominal spiracles absent; abdomen without posterior anal cleft; no dorsal triangular anal plates present.

The type species is *T. perissii* Sign. The main distinguishing characters of this genus which separates from other mealy bugs is the long, parallel-sided body.

Only one species of this genus is known to occur in Missouri, and its synoptic characters are as follows:

- A. Adult female elongate; antennae eight-segmented; anal lobes undeveloped; cerarii present only on the ultimate and the penultimate segments of the abdomen; cerarical spines of the ultimate cerarii broad and short -----*Trionymus americanus* Ckll.

Trionymus americanus Ckll.

Observations on this species by the writer lead to the conclusions that it is a grass coccid and not an arboreal species as reported by Bergande, although this and allied forms have the habit of ascending trees and other objects as hibernation places.

It has been collected in Boone County from several grasses: Panicum species, Kentucky blue grass, foxtail, and an unidentified flat-stemmed grass.

The distinguishing characters of this species are:

- (1) Eggs brownish purple imbedded in a loose, white, cottony ovisac between the leaf sheath and the stem. Egg laying observed October 16-19, 1916. Hatching observed October 16, 1916. Young are purplish; very active, with six segmented antennae. Partially grown female: olive-brown to purplish-brown, antennae seven-segmented; body sparsely covered with white powder and with long scattering waxy hairs. Adult female: purplish-brown; when boiled in 10% KOH, it turns purplish-red to blackish-purple.
- (2) Antennae eight-segmented.
- (3) Posterior coxae decidedly and distinctly alveolate.
- (4) Cerarii occurring only on ultimate and penultimate segments.

- (5) Conical spines in ultimate cerarus two in number and each about twice as long as broad at the base.
- (6) Numerous wax glands and long hairs in ultimate cerarii.

FIELD KEY TO THE COCCIDS FOUND OR KNOWN TO OCCUR IN MISSOURI

In order to facilitate the identification of the species, this key is given. It is hoped that students may be better able to recognize the various insects when they meet them afield. Nursery inspectors, floriculturists, fruit growers, and many others will find this key helpful in identifying scale insect pests.

- A. Neither male nor female insects forming waxy scales in which their moulted skins are incorporated; moderately large insects
----- NON-DIASPINEAE
- B. Exotic species infesting plants of greenhouses, observatories, etc.
- C. Adult female more or less naked -----
- D. Adult female secreting a waxy ovisac under the caudal end of her body ----- *Icenya purchasi* Mask.
- DD. Adult female not secreting an ovisac at all -----
- E. Body of adult female relatively flat -----
- F. Body of adult female very flat and distinctly tessellated
----- *Eucalymnatus tessellatus* Sign.
- FF. Body of adult female slightly convex but still relatively flat; non-tessellated ----- *Coccus*
- G. Body of female elongate ----- *Coccus elongatus* Sign.
- GG. Body of female relatively short ---- *Coccus herperidum* Linn.
- EE. Body of adult female very convex and hemispherical ----
----- SAISSETIA
- F. Dorsum ridged with one distinct longitudinal carina and two transverse carinae, forming an "H" -----
----- *Saissetia oleae* Bern.
- FF. Dorsum smooth and light colored -- *Saissetia hemisphaerica* Targ.
- CC. Adult female more or less covered with waxy secretion ----
- D. Adult female forming a distinct marsupium -- *Orthezia insignis* Dougl.
- DD. Adult female never with a marsupium ---- PSEUDOCOCCUS
- E. Adult females covered with distinct waxy *Orthezia*-like lamellae -----
- F. Body of female yellow ----- *Pseudococcus nipae* Mask.
- FF. Body of female crimson ----- *Pseudococcus pseudonipae* Ckll.
- EE. Adult females covered with fine powdery secretion and with a marginal fringe of short waxy spurs -----
- F. Waxy anal filaments short ----- *Pseudococcus citri* Risso.
- FF. Waxy anal filaments long ----- *Pseudococcus longispinus* Targ.
- BB. Species living out of doors in Missouri -----
- C. Adult female enclosed in a distinct leathery or cottony test ----
----- ERIOCOCCUS, LECANIODIASPIS, SOLENOCOCCUS
- D. Test more or less cottony and felt-like -----
- E. Occurring on trees ----- *Eriococcus borealis* Ckll.

- EE. Occurring on annuals or perennials --*Eriococcus Missouriii* Sp. n.
- DD. Test more or less firm, compact, and leathery -----
-----*LECANIODIASPIS*, *SOLENOCOCCUS*
- E. Test with margins arising from the surface of the host plants; edges not distinctly scalloped; male tests cream colored -----*Lecaniodiaspis celtidis* Ckll.
- EE. Test with margins arising from the surface of the host plant; base more or less keel-shaped; edges distinctly scalloped; male tests reddish ----*Solenococcus parrotii* Hunter
- CC. Female not enclosed in a leathery or cottony test -----
- D. Adult female with a distinct marsupium *Orthezia solidaginis* Sanders
- DD. Adult female never with a marsupium -----
- E. Female retaining its power of locomotion throughout its life ----*PHENACOCCLUS*, *PSEUDOCOCCUS*, and *TRIONYMIUS*
- F. Body of adult female relatively long --*Trionymus americana* Ckll.
- FF. Body of adult female relatively broad -----
-----*PHENACOCCLUS*, *PSEUDOCOCCUS*
- G. (N. B. The characters for "G" and "GG" are microscopic) Adult female with toothed tarsal claws; antennae normally nine segmented *PHENACOCCLUS*
- H. Adult female with a lateral fringe of more or less *Orthezia*-like lamellae; body deep maroon colored -----*Phenacoccus regmillohi* sp. n.
- HH. Adult female with no *Orthezia*-like lateral fringe
- I. Body of moderate size -----
- J. Body slate gray in color, and often with long, glassy secreted hairs ----*Phenacoccus stachyos* Ehrh.
- JJ. Body canary yellow in color, and no such hairs -----*Phenacoccus celtisifoliae* sp. n.
- II. Body of adult female very large -----
-----*Phenacoccus grandicarpus* sp. n.
- GG. Adult female without toothed tarsal claws; antennae normally eight or seven segmented *PSEUDOCOCCUS*
- H. Body of adult female very large and hemispherical; no marginal waxy fringe present -----
-----*Pseudococcus jessica* Holl.
- HH. Adult female of moderate size -----
- I. No marginal fringe present --*Pseudococcus morrisonii* sp. n.
- II. Marginal fringe present -----
- J. Adult female forming a nest of wooly, white waxy filaments which surrounds and covers her body and eggs ----*Pseudococcus mcdanieli* sp. n.
- JJ. Adult female not ovipositing in a nest of thick, white, wooly filaments -----
- K. Found normally feeding on trees and shrubs -----
-----*Pseudococcus maritimus* Ehrh.
- KK. Found normally feeding on annuals and perennials -----*Pseudococcus shaferi* sp. n.
- EE. Female losing its power of locomotion when adult -----
-----*LECANIS sensus latus*, *EXAERETOPUS*

- F. Adult female secreting a cottony egg sac under the caudal end of its body, and tilts the body at an angle
----- PULVINARIA
- G. Adult female normally large; egg sacs never occurring on leaves; body entirely naked -----*Pulvinaria vitis* Linn.
- GG. Adult female of moderate size; egg masses occurring normally on leaves; body more or less covered with fine cottony secretion -----*Pulvinaria pruni* Hunter
- FF. Adult females not secreting an egg sac -----
-----*LECANIA sensus latus*, EXAERETOPUS
- G. (N. B.) The genus *Lecanium* has not been worked up. (Characters at this point are microscopic.) Tarsi with two segments; body with numerous rod-shaped glands, a marginal fringe of spines -----
-----*Exaeretopus boonei* sp. n.
- AA. Both male and female insects forming distinct dorsal waxy shield-like scales which are separate from the insect beneath; about the size of an ordinary pinhead -----DIASPINAE
- B. Exotic species infesting plants of greenhouses or imported plants.
- C. Scale of female more or less circular -----ASPIDIOTUS,
----- AULACASPIS, CHRYSOMPHALUS, DIASPIS, PARLATORIA
- D. Male scale small, narrow, parallel-sided, white and carinated
-----AULACASPIS, DIASPIS
- E. Male scale generally covered with long, white wooly filaments of secretion; infesting palms, etc. *Diaspis boisduvalli* Sign.
- EE. Male scale not covered with long, white wooly filaments of secretion; rarely infesting palms; generally infesting imported fruit stocks -----*Aulacaspis pentagona* Targ.
- DD. Male scale small, oval, and non-carinated -----
-----ASPIDIOTUS, CHRYSOMPHALUS, PARLATORIA
- E. Female scale with the exuviae marginal -----
- F. General color of the scale of the female dark -----
- G. Exuviae of female scale dark green ----*Parlatoria theae* Ckll.
- GG. Exuviae of female scale black ----*Parlatoria zizyphus* Lucas
- FF. General color of the scale of the female light -----
- G. Scale of the female gray and approximately circular --
-----*Parlatoria pergandii* Comst.
- GG. Scale of the female brown and somewhat elongate
-----*Parlatoria proteus* Curt.
- EE. Scale of the female with the exuviae central or sub-central
-----ASPIDIOTUS, CHRYSOMPHALUS
- F. Scale of the female light colored -----
- G. Scale convex -----
- H. Scale very convex, moderately thick; exuviae nipple-like -----*Aspidiotus lataniae* Sign.
- HH. Not so convex, and relatively thin; exuviae not nipple-like -----*Aspidiotus camelliae* Sign.
- GG. Scale flat -----
- H. Scale exuviae naked and not nipple-like -----

- I. Color of scale brownish ----- *Aspidiotus cyanophyll* Sign.
 II. Color of scale whitish ----- *Aspidiotus hederæ* Vall.
 HH. Exuviae covered and nipple-like; color grayish or brownish ----- *Chrysomphalus dictyospermi* Morg.
 FF. Scale of the female dark colored -----
 G. Scale of female brown with black exuviae -----
 ----- *Chrysomphalus perseæ* Comst.
 GG. Scale of the female black with red exuviae -----
 ----- *Chrysomphalus aonidium* Linn.
 CC. Scale of the female elongate -----
 ----- CHIONASPIS, HEMICHIONASPIS, LEPIDOSAPHES
 D. Male scales normally brown or purplish-brown, non-carinate; female scales elongate and of the same color as the male scales ----- LEPIDOSAPHES
 E. Female scale very long and slender -- *Lepidosaphes gloverii* Pack.
 EE. Female scale relatively broad ----- *Lepidosaphes beckii* Newm.
 DD. Male scales always snow white, carinated and narrow; female scales blackish or brownish in color -----
 E. Occurring on leaves and twigs of *Euonymus* spp. -----
 ----- *Chionaspis euonymi* Comst.
 EE. Occurring on ferns, *Aspidistra*, etc. -----
 ----- *Hemichionaspis aspidistrae* Sign.
 BB. Scales found out of doors in Missouri -----
 C. Scale of female more or less circular -----
 ----- ASPIDIOTUS, AULACASPIS, CHRYSOMPHALUS, TARGIONIA
 D. Male scale small, narrow, parallel-sided, and carinated ----
 ----- *Aulacaspis rosæ* Bouche
 DD. Male scale small, oval, non-carinated -----
 E. Scale of female whitish -----
 F. Scale very convex -----
 G. Found on annuals and perennials ---- *Targionia helianthi* Parr
 GG. Found on trees and shrubs ----- *Targionia dearnessii* Ckll.
 FF. Scale flat or moderately convex -----
 G. Found scale flat and thin -----
 H. Scale fawn-colored -----
 I. Occurring on sugar maple leaves *Aspidiotus comstocki* Johns.
 II. Occurring on the trunks of trees, vines, etc. ----
 ----- *Aspidiotus wvæe* Comst.
 HH. Scale grayish or white; found on tree trunks, and branches ----- *Aspidiotus toxycrataegii* sp. n.
 GG. Scale moderately convex -----
 H. Scale thick and white ----- *Aspidiotus ulmi* Johns.
 HH. Scale thin and fawn-colored ---- *Aspidiotus townsendi* Ckll.
 EE. Scale of female normally darker -----
 F. Scale of female very convex, black and tough -----
 ----- *Chrysomphalus tenebricosus* Comst.
 FF. Scale of female flat or moderately convex -----
 G. Scale of female very large -----
 H. Exuviae blackish ----- *Chrysomphalus obscurus* Comst.
 HH. Exuviae brownish ----- *Aspidiotus juglans-regiæ* Comst.

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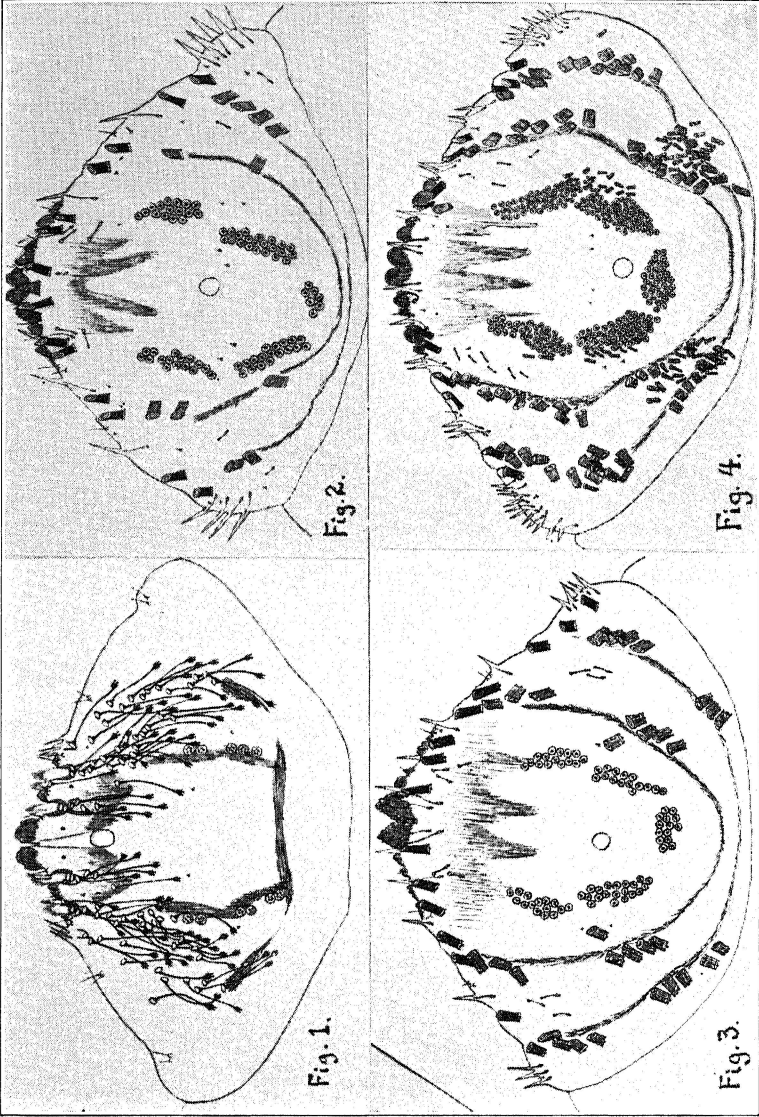


PLATE I.—(Fig. 1) Pygidium of *Aspidiotus torycrataeppii*, Hollinger. (2) Pygidium of *Chitonaspis aceranamani*, Hollinger. (3) Pygidium of *Chitonaspis farbii*, Hollinger. (4) Pygidium of *Chitonaspis salicis-nigrac*, Walsh.

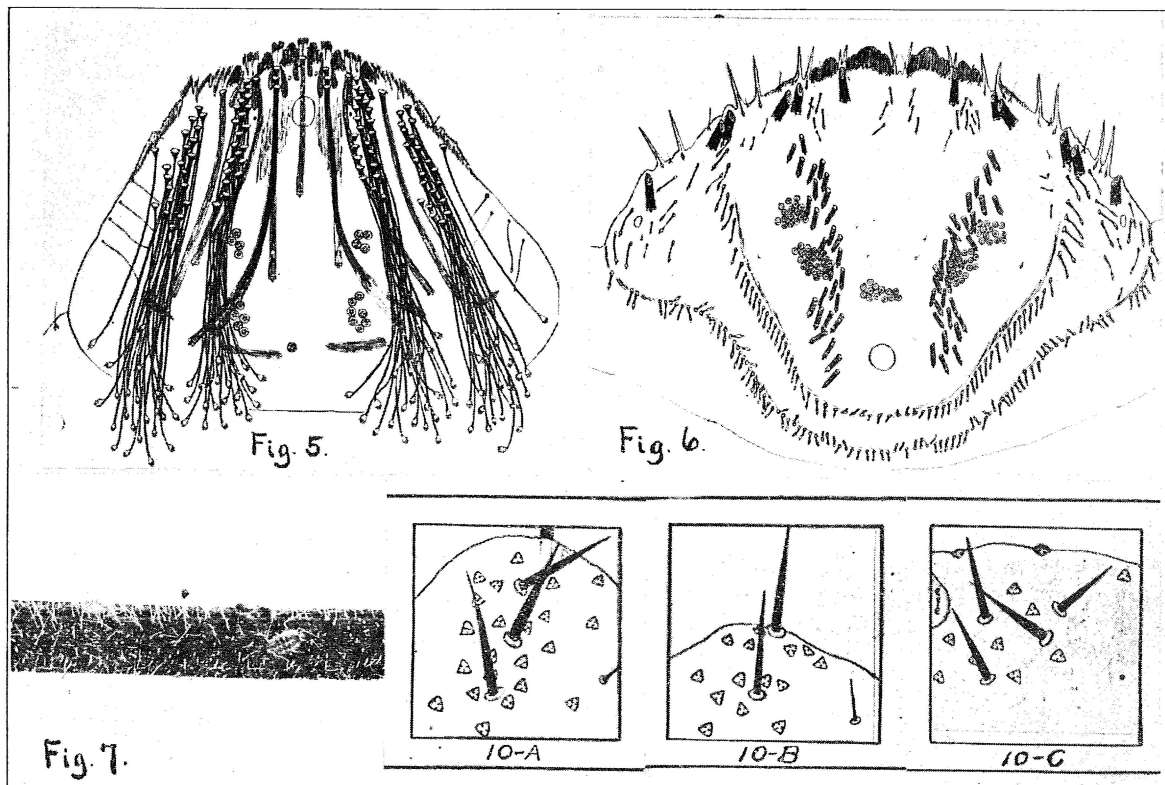


PLATE II.—(Fig. 5) Pygidium of *Chrysocephalus aonidum*, Linn. (6) Pygidium of *Lepidosaphes ulmi*, Linn. (7) *Eriococcus missouri*, Hollinger, nearly mature female on stem of *Ambrosia*. (10-A) Cerarus on ultimate segment of female *Phenacoccus celtisifoliae*, Hollinger. (10-B) Cerarus on penultimate segment of female of same species. (10-C) Second head cerarus of female of same.

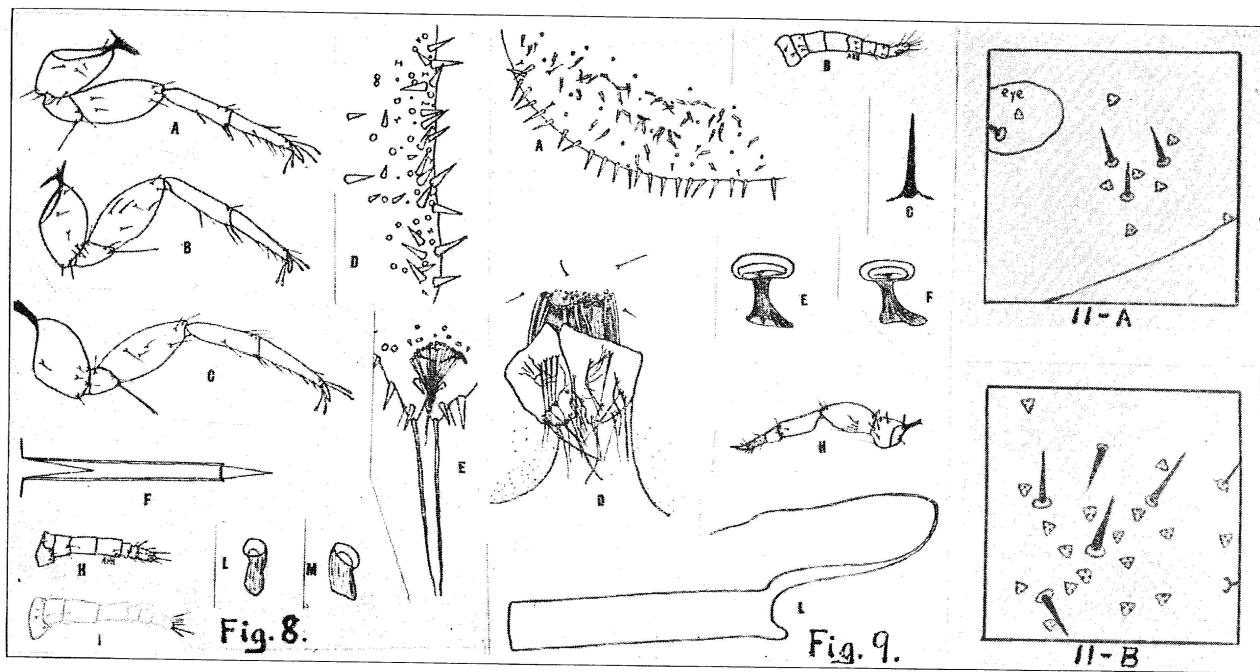


PLATE III.—(Fig. 8) *Ericoccus missouri*, Hollinger, legs and morphological drawing: A. Prothoracic leg of adult female. B. Mesothoracic leg of adult female. C. Metathoracic leg of adult female. D. Part of derm of adult female. E. Anal region of adult female. F. Glossy hair of adult female. H. Antenna of immature female. I. Antenna of adult female. L. Anterior spiracle of adult female. M. Posterior spiracle of adult female.

(Fig. 9) Morphology of *Exaeretopus boonci*, Hollinger: A. Portion of derm caudad of anal plates. B. Antenna of adult female. C. Marginal spine of adult female. D. Anal region of adult female. E. Anterior spiracle of adult female. F. Posterior spiracle of adult female. H. Prothoracic leg of adult female. L. Whip-lash gland from derm of adult female.

(11-A) Cerarus on ultimate segment of female *Phenacoccus grandicarpus*, Hollinger. (11-B) Cerarus on ultimate segment of female *Phenacoccus grandicarpus*, Hollinger.

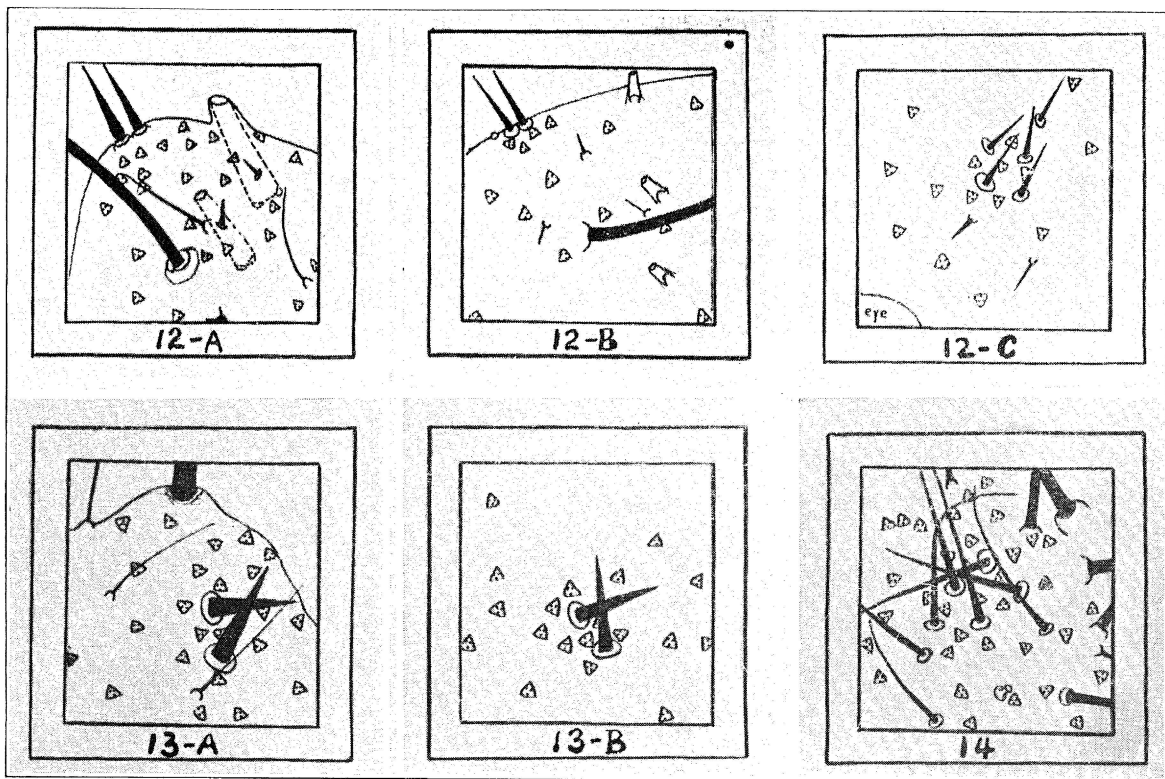


PLATE IV.—(12-A) Cerarus of ultimate segment of *Phenacoccus pettiti*, Hollinger. (12-B) Cerarus of penultimate segment of same. (12-C) Second head cerarus of adult of same. (13-A) Cerarus of ultimate segment of adult *Pseudococcus citri*, Risso. (13-B) Cerarus of penultimate segment of adult of same. (14) Ultimate Cerarus of *Pseudococcus jessica*, Hollinger.

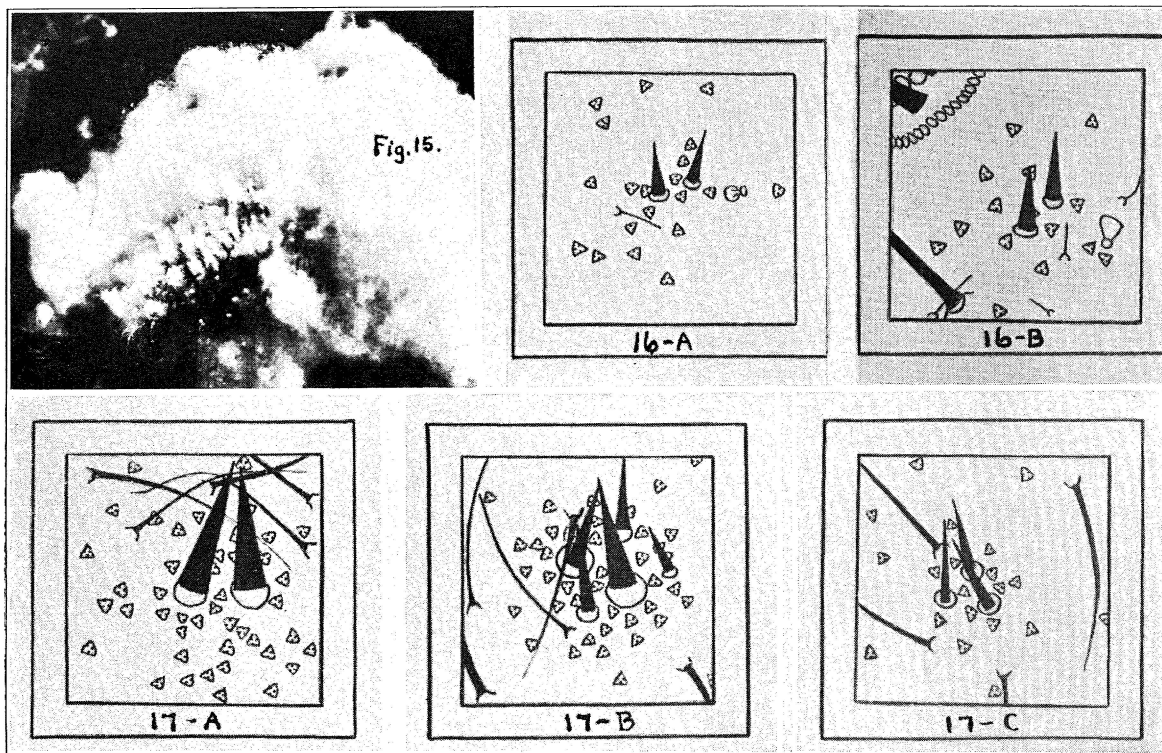


PLATE V.—(Fig. 15) *Pseudococcus mcdanieli*, Hollinger, on leaves of *Ambrosia trifida* (greatly enlarged). (16-A) Penultimate cerarus of *Pseudococcus mcdanieli*, Hollinger. (16-B) Ultimate cerarus of same. (17-A) Ultimate cerarus of *Pseudococcus morrisonii*, Hollinger. (17-B) Penultimate cerarus of same. (17-C) Second head cerarus of same.

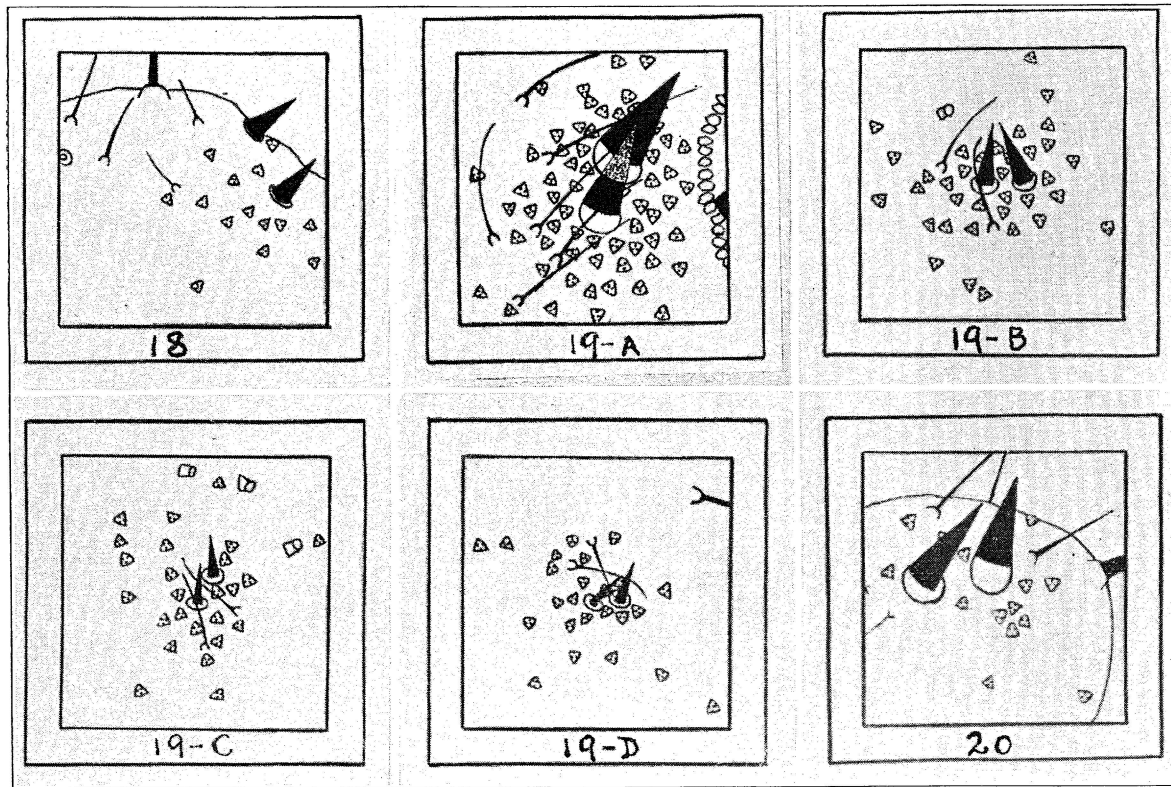


PLATE VI.—(18) Ultimate cerarus of *Pseudococcus nepae*, Mask. (19-A) Ultimate cerarus of *Pseudococcus omniverae*, Holtinger. (19-B) Penultimate cerarus of same. (19-C) Antepenultimate cerarus of same. (19-D) Cerarus on fourth segment from anal opening of same. (20) Ultimate cerarus of adult female of *Pseudococcus pseudonipae*, Ckll.

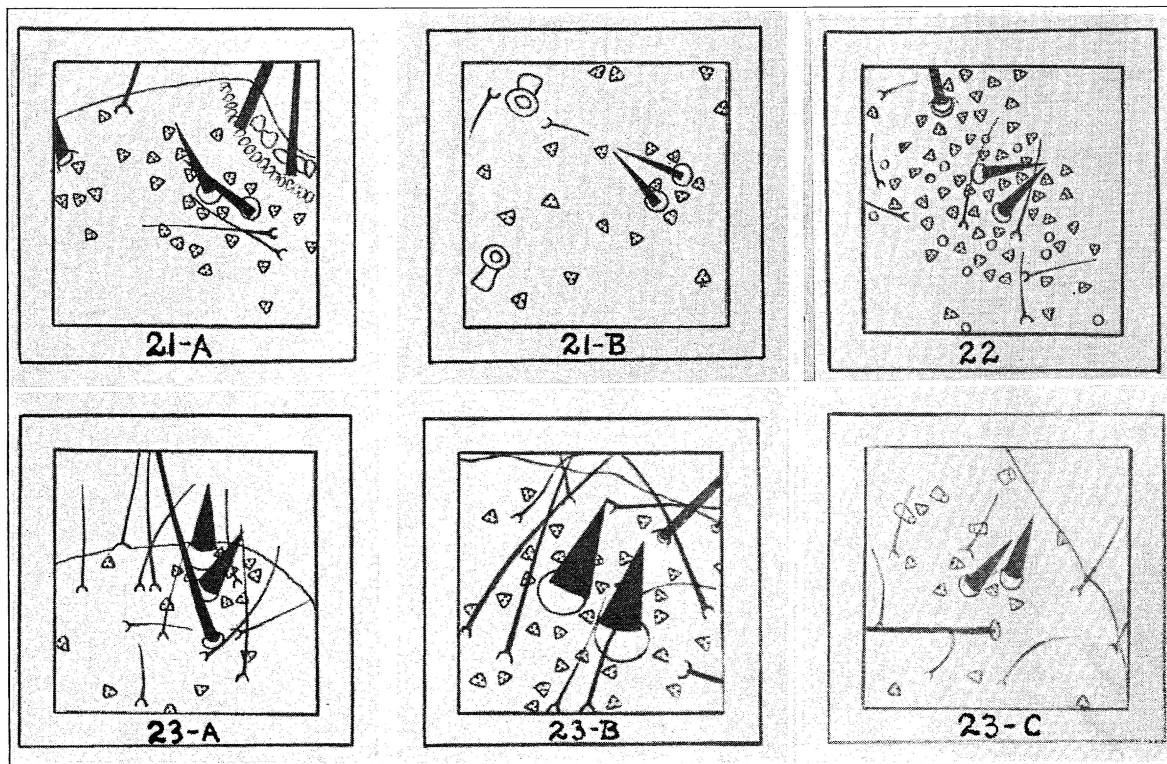


PLATE VII.—(21-A) Ultimate cerarus of *Pseudococcus shaveri*, Hollinger. (21-B) Penultimate cerarus of same. (22) Ultimate cerarus of *Pseudococcus trifolii*, Forbes. (23-A) Ultimate cerarus of immature female of *Trionymus americanus*, Ckll. (23-B) Ultimate cerarus of adult female of same. (23-C) Penultimate cerarus of adult female of same.