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A SYSTEMATIC TREATISE OF THE COCCIDAE

(SCALE INSECTS) OF BROOKINGS

COUNTY, SOUTH DAKOTA

BY

MERRILL E. RILEY

A thesis submitted to the faculty of South Dakota  
State College of Agriculture and Mechanic Arts in  
partial fulfillment of the requirements for the  
degree of Master of Science.

May, 1929.

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THE COCCIDAE OF BROOKINGS COUNTY,  
SOUTH DAKOTA.

INTRODUCTION

Up to the present time no systematic research work has been attempted in South Dakota in an effort to determine and record the species of Coccidae (scale insects) present in South Dakota. From time to time specimens of various species have been received by the Department of Entomology, but no systematic treatise of the species has yet been made on this group within the State.

It is the purpose of this paper to present in an introductory manner a systematic treatise of the scale insects of South Dakota, by making an intensive study of all species represented in Brookings County. It cannot be asserted that this paper is a complete treatise of all species present, but a thorough attempt was made to obtain specimens of all existing species. This treatise involves only the species now present, though at times other forms have been reported. Notes have been included giving the host plants, location, and abundance.

The utilization of literature proved very valuable in obtaining descriptions of both species and various characters used in the identification of species. Whenever ent-

isfactory descriptions were available, they were used in preference to creating new descriptions. The original description of species was always used when it was available, but in many cases descriptions by other authors were necessary.

The drawings included in this paper were made by the author. In preparing plates I, II, and III, drawings and explanations of previous authors were used freely, and in such cases credit was given to the author concerned. In all the drawings of the Diaspinæ, the left side shows the dorsal surface of the pygidium, while the ventral surface is shown on the right. In presenting the drawings of each species, the author attempted to give a general view of the pygidium (Diaspinæ) by studying the specimen under low power of the microscope, and as a supplement an oil emersion study was made of one side of the pygidium. The oil emersion study is represented by the drawing showing the greatest magnification. The correct proportions of the two magnifications were maintained in all the drawings. By means of the oil emersion the smallest details could be observed, even in the most minute specimens.

The bibliography given in connection with each species has been chosen with reference to availability of literature and recency of publication. An attempt was made to use both the earliest publications and the latest. In some cases it was even necessary to wait for publications such as was the

case of Phenacoccus roseipii T. & Chitt. In addition to the bibliography concerned with each species, another bibliography is included at the end of the paper, the purpose of which is to cite other literature aside from descriptive work.

Whenever descriptions or extracts were copied from other publications, due credit was given to the author, by inserting a reference number to that author which can be found in the bibliography.

In preparing the manuscript for publication, it was necessary to revise the text and to correct the errors in the original manuscript. The author is indebted to the following persons for their assistance in this regard: Mr. J. H. ... and Mr. ...

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#### METHOD OF STUDY

Since the characters used in the identification of the members of the family Coccidae are confined almost entirely to the females, most attention was given to the collection of females and rarely were male specimens obtained. Specimens were collected, preserved, and preparations were made which would afford satisfactory study of both whole mounts and microscopic slides.

In preparing the specimens for microscopic slides, it was necessary to remove the wax and clarify the bodies so that clear uniform structure could be obtained. The author found no difficulty with either fresh or dried material and often dried specimens were more satisfactory.

In preparing specimens for study special methods were found necessary, as compared with the general preparation of insects for study. The author has accepted the recommendations of many previous workers in making the preparations, and in addition, employed several additional steps which were found by the author to be advantageous.

For satisfactory presentation, the method of study was divided into three divisions: collection and preservation of material, the preparation of whole mounts, and the preparation of microscopic slides.

### Collection and Preservation of Material.

The trees found to be most productive of scale insects were those growing in open spaces, on the outskirts of woods and windbreaks, parks and meadows, sheltered hedgerows, sunny spots along hedges and windbreaks. Seldom did the collector find much material in dense growths of vegetation, though the author has found a large amount of Chionaspis pinnifolia in dense groves of spruce trees. In these circumstances, however, the specimens were confined to the outermost part of the trees. In practically all instances the specimens discussed in this paper were collected from isolated hosts.

The chief requisite for the collector is keen observation. The casual observer often overlooks some of the most common species and more frequently fails to discover the rarer specimens. The collector must become accustomed to observing closely, both the upper and lower surfaces of leaves (in many greenhouse forms, specimens were found only on the lower side of the leaves), the tips of branches as well as their bases, the axils of leaves, superficial growth which may be due to scale insects.

### Collecting.

For field work or collecting the only utensils neces-

sary were a sharp, strong-bladed knife, a good pair of pruning shears, a basket, botanist's vasculum, or some convenient container for carrying the specimens, a number of 1 lb. paper sacks, bottles or other suitable containers for the specimens, a number of small bottles for rare specimens or male scales, a notebook into which can be recorded all data concerned with the habitat of the insect such as abundance, host, where located on host, location of host plant, time of collection, apparent injury and any other remarks necessary.

It was found best to put only a single species from a given host into a single sack or bottle. When material was discovered it was cut into convenient lengths and placed carefully into its container. Upon the container was placed the name of the host plant and location, and also a collection number. The corresponding number was placed in the notebook after which the above information was recorded.

#### Preservation of Material.

After the material was collected, generally the specimens were not studied immediately but allowed to remain in storage for future use. Some care was exercised in storing this material in order to avoid injury to the specimens. The author found the following system to be satisfactory. The specimens when brought to the laboratory were placed in bottles of convenient size and stoppered with cotton. These

bottles were then placed on a shelf or preferably in a large drawer. The collection number was also placed on the bottle.

#### Preparation of Material for Study.

##### Mounts in "Situ".

When possible the specimens studied for this paper were prepared "in situ" for permanent mounts. Frequently, descriptions are partly based on scale characters, so it is quite important that "whole" specimens be preserved. Especially do these mounts prove valuable if rare or new species are discovered.

There are several methods in use for constructing these permanent mounts, but the one adopted by the author has proven to be very satisfactory. The method is as follows: First, obtain a thin sheet of celluloid and cut "slides" with about the same dimensions as the ordinary microscopic slides. It proved more satisfactory to cut the "slides" about 3/16 inch shorter than the ordinary slide. This was done so that the completed slide could be placed in an ordinary slide box. When the slides are cut obtain a roll of 1/2 inch black paper tape on one side of which is a glued surface. In preparing the specimens for the mounts, the material on which the specimens were attached were split into as thin sections as possible. If the specimens were on leaves this was not necessary.

In assembling the mount, first two celluloid slides were placed face to face and a strip of paper pasted along one edge. This was permitted to dry, then the specimen was placed between the slides and a strip of paper was pasted around the other three edges. The mount was now complete and the specimens were studied through the celluloid slides.

Microscopic Preparations.

The most important and the most difficult specimens to prepare were those for microscopic study. It is because of poorly prepared specimens that many errors have been made in descriptions and naming of new species. When specimens are properly prepared the minute structures, such as gland openings, spines, and plates should be very distinct.

In recent years considerable investigation has been carried on to perfect efficient methods of staining and mounting Cecoid specimens. Some of the most efficient results can be obtained by following any of the methods recommended by Gage (3), McCallivray (6), or Kingsbury and Johanneen (5). The author followed the recommendations of Kingsbury and Johanneen and F. Howard Gage, with some modifications.

Simplicity and brevity should be observed in any system followed in mounting the specimens. If too many "steps" are introduced into the procedure some injury to the specimens is sure to follow and likewise specimens may become lost.

The author has endeavored to follow a plan, which though somewhat longer than some others, is brief and does not entail too many steps. In almost every case specimens were obtained which showed clearly defined characters.

Materials Used.

The following list of material was found by the author to be essential to the production of clear permanent mounts.

1. Potassium Hydroxide (K O H), (Potash), (10%)

Composition

10 grams K O H

90 cc. distilled H<sub>2</sub>O

2. Glacial acetic acid (70-80%)

3. Acid fuchsine or sauerfuchsine stain

Composition

Acid fuchsine,  $\frac{1}{2}$  gram

10 percent Hydrochloric acid, 25 cc.

Distilled water, 300 cc.

4. Acid alcohol

100 cc. 70% alcohol

Few drops of Con. H C L

5. Carbo-xylene

50 parts xylene merck

50 parts carbolic acid

6. Alcohol

70%

95%



W01

Absolute

7. Pipet - one for each solution.
8. Microscopic slides and cover slips.
10. Balsam and Xylol.
11. Sufficient supply of small stender dishes.

#### Procedure.

There were six distinct steps involved in the preparation and mounting of the specimens: (1) removing the specimens from the scale or wax covering when present; (2) clarification or treating them so that they would be clear or reasonably transparent; (3) removing the solvent solution or washing; (4) staining and destaining; (5) removing the water or dehydration; (6) clearing and mounting the specimens.

In the Diaspinae, it was necessary to separate the bodies of the insects from its scale or wax-like covering. The material was placed on a white card under the binocular microscope and by means of a pair of sharp dissecting needles the dried or living bodies were carefully removed from the scale. By moistening the tip of the needles the bodies could be made to adhere to the instrument and in this way easily transferred to the crucible containing K O H. Always a sufficient number of specimens were removed and placed in the solution to allow for injury and loss of specimens. In-

variably many of the specimens became injured or "lost" but by using many to start with, a sufficient number of satisfactory mounts were obtained.

The removal of the pigmentation and fatty substance, or clarification was performed in two ways. First, specimens were placed in the cold K O H and allowed to remain for several days. This method did not prove very satisfactory because of the time required and generally the specimens were poorly cleared. This plan was abandoned and the following was used entirely. The specimens were placed in the 10% K O H solution and heated to a temperature slightly under boiling. Many authors describe this process as "boiling" the specimens. The author, as well as previous workers (4, 10) discovered that "boiling" invariably results in poor mounts. When specimens are boiled, at least violently, the resulting mounts were always purplish in color instead of a bright red. On the other hand when specimens were only allowed to simmer and permitted to remain at this temperature until clear there was no injury due to overheating and the resulting mounts took the red color instead of purple. The time required to clear the specimens varied considerably with different species. For instance, the body of Aspidiotus ancylus was sufficiently cleared at the end of 5-7 minutes, while some of the Coccineae required 15-20 minutes. In several cases it was

necessary to puncture the insects with a sharp needle in order to remove the eggs and body contents. This was necessary only when fresh specimens were used. Specimens were removed before they were entirely clear or else trouble was encountered in transferring them from one solution to another, especially before they were stained.

The K O H solution containing the specimens was then transferred to a stender dish. By allowing light to pass under the dish or by placing a white card under the dish, the specimens were often quite visible and could be easily removed with forceps or brush to the next solution. In many cases the specimens were so small and clear before staining that they could not be seen definitely even under the binocular microscope. By placing a small piece of gauze in the tip of a pipet, the solution was sucked up into the pipet and the specimens remained in the dish. This plan proved to be so satisfactory that it was used in the preparation of most of the mounts.

A small amount of 70% glacial acetic acid was then added to the stender dish containing the material. Only a few minutes were allowed for the glacial acetic acid to neutralize the K O H. The purpose of the acetic acid was to neutralize the K O H in order to remove all trace of alkalinity. The presence of alkaline tends to make the col-

26420

or of the mounts fade after a time (3, 142).

The glacial acetic acid was then removed and distilled  $H_2O$  was poured into the dish, and allowed to remain several minutes. This wash was repeated as many times as it seemed necessary, but if the specimens were few and difficult to obtain, only one wash was used. The specimens were then subjected to the acid fuchsin stain and allowed to remain in the stain 15 minutes or for a longer period of time with some forms. No harm was done by allowing the specimens to remain in the stain indefinitely.

The excess stain was washed from the specimens with distilled water until the specimens could be seen clearly in the dish. Several washes were necessary, but care had to be taken that the specimens were not injured. The specimens were easily seen after being stained and in most cases the specimens were then transferred from one solution to the next by means of forceps. This was easily performed under the binocular microscope.

In most cases the specimens were overstained, but by leaving them in the acid alcohol, destaining was easily accomplished. This was done under the microscope so that the various structures could be studied until the desired intensity was obtained. This step was introduced after the 70% alcohol dehydration step was completed.

Dehydration was next performed. The specimens were sub-

jected to first 50%, then 70% (destain here), 90%, and finally absolute alcohol. Only a few minutes were allowed for each wash.

The specimens were transferred to the carbol-xylene clearing solution and allowed to remain for a few minutes, after which they were transferred to slides. A drop of balsam was first placed on the slide and the specimens were placed directly into this drop of balsam. After the specimens were properly oriented a coverslip was carefully placed over the material. When material was abundant, several slides were made, and several specimens were placed on each slide. The slides were then placed on "slide boards" and laid aside to "dry".



EXPLANATION OF CHARACTERS USED IN

CLASSIFICATION OF COCCIDAE.

Because of the dissimilarity of this group of insects with other insects, certain characters which are common to this group only have become necessary for proper identification of its members. In the case of the Diaspidinae this dissimilarity is most pronounced. However, most of the characters are confined to the females and only seldom do characters of the male bear any importance.

In presenting a discussion of these characters, much use was made of descriptions by previous authors, but in many instances supplementary description was included by the author of this paper.

In discussing the characters of this group, the writer has attempted to consider only those characters which are not self-explanatory. To explain more clearly the characters used in classification of the members of the sub-family Diaspidinae and Coccinae, diagrammatic drawings were made, indicating the characters of specific value. In the case of the sub-family Dactylopiinae, no diagrammatic drawing was made since the individual specimen drawings show the distinguishing characters of that individual.

Scale.

"The term scale is applied to the pellicle that covers



the dorsal surface of all Diaspinae. It is composed in part of molted skins of exuviae. There is also a layer composed of secretion." (8, 1918: 430)

Pygidium.

In the sub-family Diaspinae, the abdomen of the adult female is terminated by a strongly chitinized unsegmented region which consists of four coalesced segments; this region is termed the pygidium. The application of this term is quite different from that used in descriptions of other insects where it refers only to the tergite of the last abdominal segment. Upon the pygidium are located practically all the morphological characters that are used in the classification of the sub-family Diaspinae. The following characters are those of greatest importance and are used consistently. These characters are represented in Plate I.

Lobes.—"The lobes (Fig. 8, C. H. B) are usually the most conspicuous of the appendages or characters of this segment. They appear to be inserted in a groove between the posterior edges of the dorsal and ventral surfaces of this segment. However, the lobes seem to be composed largely of the prolongation of the dorsal margin," and this fact is represented in all the species diagrams in this paper. (8, p. 432). The significance of this character in classification is based upon the number of pairs of lobes borne by the margins, the shape of the lobes, and whether or not

they are divided. The pairs of lobes are numbered, beginning with the pair at the end of the body (median lobe) and progressing laterad from this lobe.

Median Notch. - "The median notch is the area separating the median pair of lobes. Its value is not great as a distinguishing character, but frequently it is used in determining the depth of the inner margins of this pair of lobes. (Fig. 3, I.).

Marginal plates. - The plates are thin projections of the margin, usually long, flattened, and more or less notched or toothed. Sometimes they are hair-like or spine-like. They occur on the sides of the segments as well as between the lobes. Two distinct types of plates can be distinguished; in one they are broad and fringed, and in the other they are spine-like. These plates occur in variable numbers and variable appearances which make this character a quite valuable supplementary character. (Fig 1 & 2, II.)

Elongated chitinous thickenings. - In many species thickenings of the body wall occur near the prolongations of the lobes, but apparently distinct from them. They appear to be on the dorsal wall of all specimens studied. When specimens are stained these thickenings are very outstanding. The number, size and position of these thickenings afford good specific characters. (Fig. 1, T.)

Ventral thickenings. - On the ventral side of the seg-

ment corresponding with each lobe are thickened areas which appear to be definite structures. These thickenings do not correspond in any way with the above thickenings, but they frequently exhibit distinct characters. (Fig 3, J.)

Incisions with thickened edges. - In many species there are definite, clearly defined incisions in the ventral wall. In some the margins of these incisions are greatly thickened. The number of these incisions and the presence or absence of the thickenings afford specific characters.

Gland spines. - The gland spines are spine-like prolongations of the margin of the pygidium. The spines bear some resemblance to the plates but differ from them in being unbranched and spine-like. Within the spine may be seen the tubes of the glands which lead to the tips of the gland spines. (Fig. 3, A.)

Dorsal and ventral spines. - The spines are situated near the posterior margin of the segment. There are usually two, one on the dorsal surface and one on the ventral surface, associated with each of the lobes. The ventral spine generally appears to be slightly laterad of the dorsal spine. In the descriptions the lobes and spines are numbered beginning at the meson, the corresponding lobes of each side of the body bearing the same numbers. They are thus considered in pairs and in numbering the lobes and spines, the

numbers increase cephalad instead of caudad.

Ceratubae. - "In the Diapsinae and in some species of several other families, the terminal portion of the outlet of some of the wax-glands is an invaginated cuticular tube. The inner end of this tube is truncate, and in the Diapsinae bears a perforated knob. This invaginated cuticular tube is termed the ceratuba. The ceratubae vary greatly in length and shape. In some the tube is reduced to a fine thread-like tube and a bulb-like inner end. These are often called dorsal gland openings. (Fig. 1, Q.) Other ceratubae are found on and near the dorsal margin of the pygidium and are called marginal dorsal gland openings." (Fig 3, Q.) (S, 1925: 446).

Cerores. - "The various types of outlets of the wax glands in which the cuticula is not invaginated so as to form a ceratuba are termed cerores. The openings of cerores through the cuticula vary greatly in form. There are also variations in the grouping of the cerores. The most prominent cerores are those situated about the genital opening, and called genacerores." (S, 1925: 446). (Fig. 3, W, X, Q.) These glands also bear several other names such as circum-genital gland openings, spinnerets, tubular spinnerets, elongated pores, oval pores, circumgenital gland orifices, or wax ducts. The presence or absence of groups of genacerores,

the number of these groups when present, and the number in each group afford very definite and specific characters in classification.

Anal opening. - In the Diapsinae the caudal portion of the abdomen is strongly depressed and the anus is usually a circular opening located on the dorsal aspect. The position of the anus often affords a specific supplementary character.

Vaginal opening. - Near the center of the ventral surface of the pygidium is the vaginal opening, which is larger and represented in all the drawings of this segment.

#### Characters Concerned with the Sub-families

##### Coccinae and Dactylopiinae.

These two sub-families differ so remarkably from the Diapsinae that the characters for identification may be discussed most conveniently without reference to the Diapsinae. In these two groups no definite pygidium is formed by the coalescence of the last few segments, consequently characters from all parts of the body are necessary. In Plate II, all the important characters of the Coccinae are represented.

Anal ring. - In the weedy bugs, tortoise scales, and the lac insects, and in the nymphs of some others, the anus is surrounded by an elevated ring-like structure known as the anal ring. (Plate II, An. ring.)

Anal ring setae. - "The setae borne by the anal ring are known as anal ring setae, anal ring spines, or anal ring hairs. The number present may vary from two to thirty, but the usual number is six." (3, 38.) (Plate II, an. ring hairs.)

Anal lobes. - "In many Coccids, especially the mealy bugs, the caudal end of the body is terminated by a pair of lobes called the anal lobes. In some cases they are quite prominent and in others practically lacking. In certain species a more or less well defined chitinized area occurs on the ventral side of each anal lobe, usually extending in from the base of the anal lobe setae. In some species, these areas are sufficiently constant in shape and size to be extremely useful characters." (4, p. 22.)

Anal lobe setae. - "In some species these afford fairly good characters, which can be expressed best in terms of relative length to each other. Their value lies in the number present and how arranged." (4, p. 22.)

Anal cleft. - In many species such as are present in the sub-family Coccinae, the caudal portion of the body is incised or cleft. The cleft terminates at the region of the anus. The depth of this cleft and the absence or presence of it makes this a fairly important character. (Plate II)

Antennae. - "Almost ever since the study of the Coccidae began, the antennae have been relied upon to furnish both



genetic and specific criteria. The antennae are used quite extensively in determining the genera of the sub-family Dactyloclinae as well as with Coccinae. The value of the antennae as a distinguishing character is based upon the actual length of the antennae and the relative length of each segment. This comparison has generally been expressed by means of "antennal formulae", but these by no means are entirely satisfactory. Other attempts to express this comparison have been performed by means of graphs. The graphic method appears to be much more accurate." (4, p. 11.)

Body setae. - Each of the hair-like appendages borne by the cuticle is a seta. They are generally designated as hairs or spines although the hairs are entirely different in origin and structure from the latter. The position and number of setae frequently afford a good specific character. Care should be exercised to distinguish between setae and setae-like structures, including spines and spine-like structures. Spines are outgrowths of the cuticula that are not separated from it by a joint. Also they are produced by undifferentiated hypodermal cells. On the other hand, setae are produced from a differentiated hypodermal cell, called a trichogen. The setae arise from a cup-like cavity in the cuticula, by which character they can be recognized. Misapplication of this term is very frequent in papers on the Coccidae.

Cerarii. - These structures are regarded to be of the highest taxonomic value. Though they are not serviceable as group characters, they are very valuable for generic and specific differentiation.

"A typical cerarius consists of a pair of spines, generally spoken of as "cerarian spines", set closely together at the margin of the body and usually accompanied by a more or less distinct group of triangular pores and slender setae. This type, however, is subject to much modification. In some cases cerarian spines are quite large and stout and are readily distinguished from the body setae, while in others they are recognizable only by their paired characters and position. In some cases the grouped pores are very numerous, in others entirely lacking. In some species the cerarian spines are accompanied by a group of slender setae which are generally spoken of as "auxillary setae".

"The number of pairs of cerarii ranges from none to as many as 24. Within certain limits the number may be taken as of generic value although it is an indefinite character." (4, p. 23.)

Legs. - In many descriptions a considerable amount of attention has been given to the legs, their actual length and vestiture of hair being dealt with. These characters are very insignificant. The tarsal claw, however, affords a very

convenient generic character. In certain groups there is a minute "tooth" or "denticle" on the face of the claw which serves as a valuable key character. By itself this character is of minor importance, but in conjunction with other characters it is very useful.

Pores and ducts. - Though this character is very prominent and constantly referred to, very little specific investigation has been made of the wax glands.

The wax secreting glands are of several distinct types, each type discharging its products through the body wall by means of a different type of duct or pore. Certain types appear to be common to all Coccidae while others are more characteristic of groups. The types here discussed apply principally to the sub-families Coccinae and Dactylopiinae.

In plate III are shown some of the modifications which are characteristic of certain groups. "In all the Pseudococcidae forms the inner end of the basal portion of the duct is truncate and never reflexed into a cup." This is a character distinctive of this group. (Fig. 1, C.) "Two rather distinct types are commonly found in this group. In one of these the ducts are relatively large and the mouth is usually surrounded by a definite raised rim, while in the other the ducts are smaller and lack this rim."

"The glands which do not possess cylindrical ducts discharge their secretions through various types of dermal

pores. The dorsal pores of this group are of three distinct types, which are represented in Plate III, fig. E, F, G. One of these types is trilocular and more or less triangular in shape and is spoken of as the "triangular type". Pores of this type are present in all the species studied and occur for the most part on the dorsum and in connection with the cerarii."

"The pores of the other two types are circular. One of these is called the "quincuslocular type", which is not present in any of the species in this paper."

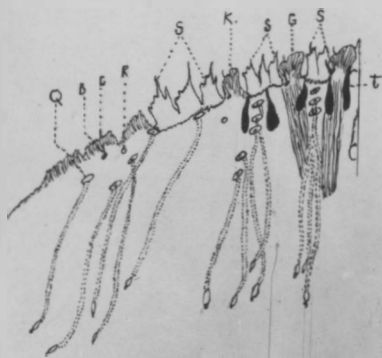
"The other type is spoken of as the "multilocular type", and occurs for the most part on the ventral side of the abdomen." (4, p. 23)

EXPLANATION OF CHARACTERS IN

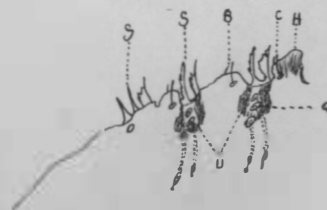
PLATE I.

- V.---Ventral side.
- D.---Dorsal side.
- A.---Gland spines.
- B.---Dorsal spines.
- C.---Ventral spines.
- D.---Marginal dorsal gland openings.
- E.---Outer lobule of second pair of lobes.
- F.---Inner lobule of second pair of lobes.
- G.---Second pair of lobes.
- H.---Median lobe.
- I.---Median notch.
- J.---Ventral thickenings.
- K.---Third lobe, cleft to form outer and inner lobule.
- L.---Vaginal opening.
- M.---Posterior group of circumgenital gland openings.
- N.---Anterior group of circumgenital gland openings.
- O.---Median group of circumgenital gland openings.
- P.---Anal opening.
- Q.---Groups of dorsal gland openings.
- R.---Micropore.
- S.---Marginal plates.
- T.---Elongated cutinous thickenings.
- U.---Incisions with thickened edges.

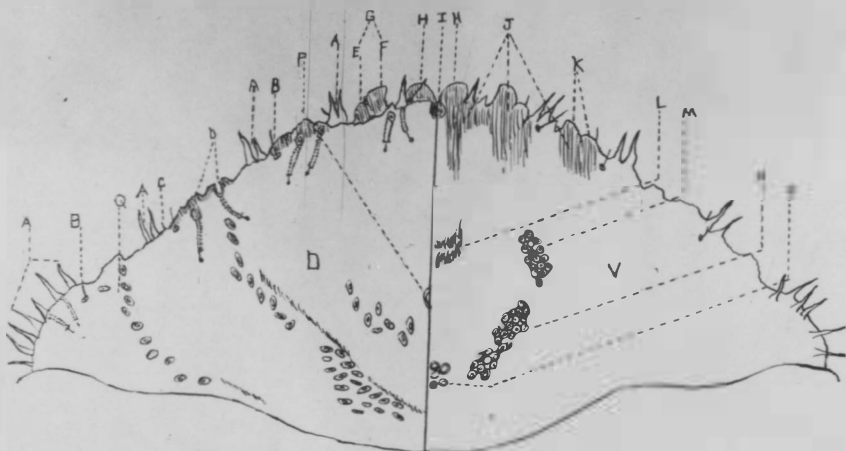
Plate-I.



1.



2.



3.

1. Pigdial fringe, *Chrysomphalus dictyospermi* Morgan. 2. Pigdial fringe, *Aspidiotus ancylus* Putnam. 3. Pigdium, *Chionaspis salicis-nigrae* Walsh.



Plate-II.

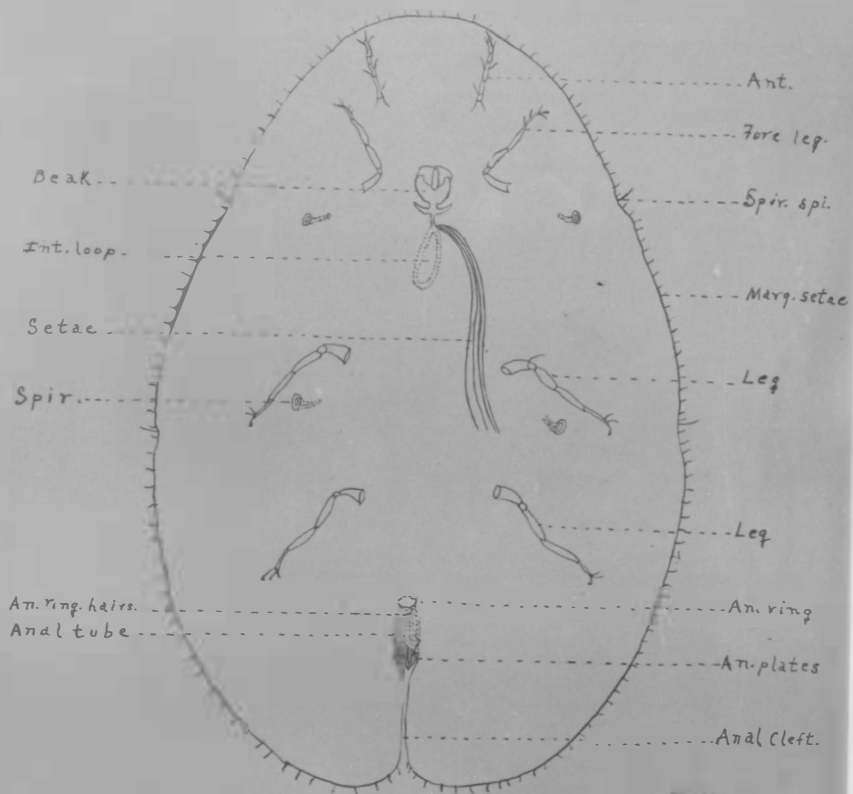


Diagram of *Coccus hesperidum* Linn.



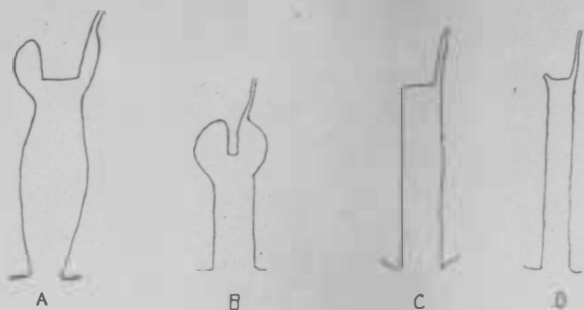


Fig. 1 — Diagrams of cylindrical ducts typical of: A. *Ericoccus*; B. *Kerres*; C. *Pseudococcus*; D. *Lecanium*. (After Ferris).

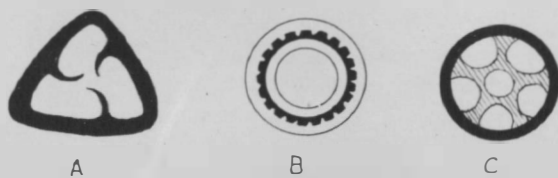


Fig. 2. — Derm pores of Pseudococcine forms:  
A. Triangular type. B. Multilocular type.  
C. Quingelocular type.

RECORD OF SPECIES COLLECTED IN BROOKINGS  
COUNTY, SOUTH DAKOTA.

*Phenacoccus gossypii* T. & Chl.

Habitat.-Greenhouse form.

Host.-Found only on *Bourgainvillea* vines.

Locality.-State College Greenhouse, April 29, 1928.

*Pseudococcus citri* Risso

Habitat.-Principally greenhouse in this locality.

Host.-Usually most abundant on *Coleus*, but abundant  
on *Vinca* vine and many other plants.

Locality.-State College Greenhouse, November 11, 1927.

*Pseudococcus maritimus* Ehrhorn

Habitat.-Found only in greenhouse.

Host.-Hibiscus vines.

Locality.-State College Greenhouse.

*Lecanium corni* Bouch

Habitat.-Outdoor form.

Host.-Found on white elm, American elm, boxelder, ash,  
maple, chokecherry. It is a very cosmopolitan  
species.

Locality.-Specimens for study were obtained principally  
from American Elm trees around the livestock  
pavilion of the State College, October 2,  
1927.

*Coccus hesperidius* Linn.

Habitat.-Indoor form.

Host.-Author collected specimens on Vines vine, but  
has been reported on other plants.

Locality.-State College Greenhouse, March 3, 1927.

*Scissotia hemispherica* Targ.

Habitat.-Greenhouse form.

Host.-Cycus.

Locality.-State College Greenhouse, November 15, 1927.

*Chrysomphalus aurantii* Mask.

Habitat.-Imported.

Host.-Found on grape fruit.

Locality.-Brookings, South Dakota, November 1, 1927.

*Chrysomphalus dictyospermi* Morgan

Habitat.-Greenhouse in this locality.

Host.-Werk of lemon plants.

Locality.-Brookings Greenhouse, Brookings, South Dakota,  
March 3, 1928.

*Aspidiotus hederæ* Vall.

Habitat.-Greenhouse in this locality.

Host.-Cycus.

Locality.-State College Greenhouse, November 15, 1927.

*Aspidiotus anoylus* Putnam

Habitat.-Outdoor form.

Host.-Found principally on aspen, but found also on  
birch, black locust, maple, and mountain ash.

Locality.-Specimens collected from aspen at 718-13th  
Street, Brookings, South Dakota, October 15,  
1927.

*Parlatoria pergandii* Comst.

Habitat.-Greenhouse form in this locality.

Host.-Collected on bark of lemon plants.

Locality.-Brookings Greenhouse, Brookings, South Dakota,  
March 3, 1928.

*Lepidosaphes gloverii* Packard

Habitat.-Imported.

Host.-Found on grape fruit.

Locality.-Brookings, South Dakota, December 1, 1927.

*Lepidosaphes backii* Newman

Habitat.-Imported.

Host.-Found on grape fruit.

Locality.-Brookings, South Dakota, December 1, 1927.

*Lepidosaphes ulmi* Linn.

Habitat.-Outdoor form.

Host.-Found on lilac, very abundant on apple, pear,  
and mountain ash.

Locality.-College Grove, Brookings, So. Dak., Oct. 8,  
1927.

*Chionaspis pinifolii* Fitch.

Habitat.-Outdoor form.

Host.-Found on Blue, Norway and Black Hills spruce.

Locality.-Campus, State College, Oct. 20, 1927.

*Chionaspis furfura* Fitch

Habitat.-Outdoor form.

Host.-Collected from apple, pear, plum and thornapple.

Locality.-College grove, Brookings, South Dakota,

October 8, 1927.

*Chionaspis salicis-nigrae* Walsh.

Habitat.-Outdoor form.

Host.-Willow.

Locality.-Three miles straight west of Brookings, along

the roadside, April 11, 1928.

*Eriopeltis coloradensis* Skll.

Habitat.-Outdoor form.

Host.-Found on wild wheat grass.

Locality.-Specimens received from J. R. Mathews at

Armore, South Dakota, December 1, 1927.

SYSTEMATIC TREATISE OF BROOKINGS COUNTY SPECIES

OF THE FAMILY COCCIDAE

Synopsis.

The Coccidae or scale insects belong to the order of insects known as the Homoptera, which may be identified by the following characters: "The winged members have four wings, except the family Coccidae which has only two, the wings are of the same thickness throughout and usually held at the sides while at rest. The mouthparts are formed for piercing and sucking; the beak arises from the hind part of the lower side of the head; the metamorphosis is gradual except in some highly specialized forms." (B, 1935: 304.)

This family is quite typical of the order but there are several exceptions to the above. In many respects this is a very anomalous group of insects, differing greatly even from closely allied forms in appearance, habits and metamorphosis. Not only do the members of this family appear very different from other insects, but there is a wonderful variety of forms within the family, and even the two sexes of the same species in the adult stage differ as much in appearance as insects belonging to different orders.

The more obvious characters in which the Coccidae agree and differ from other insects of the order Homoptera are as



follows: The males are winged in the adult state, but unlike other Homopterous insects, possess only a single pair of wings, the second pair being represented by "halters". The adult female is always wingless. The male in the adult state has no organs for procuring food, the mouthparts disappearing during the metamorphosis of the insect and a second pair of eyes appearing in their place. Also the tarsi are usually one-jointed, with a single claw, and the legs are often wanting. Female with the body either scale-like or gall-like in form, or grub-like and clothed with wax. The waxy covering may be in the form of powder, or large tufts or plates, of a continuous layer, or of a thin scale beneath which the insect lives.

Key to the Sub-families.

A. Caudal portion of abdomen of female termination in a chitinized compound segment, the pygidium. Anal orifice without setiferous ring.

B. Adult female very small, flat, antennae and legs wanting and possessing a distinct scaly covering composed of exuviae and secretions---

Diaspidinae.

AA. Pygidium wanting in the female. Female insects naked or covered by waxy, chitinous or cottony secretions.

B. Setiferous ring around anal orifice.

C. Caudal end of body with a more or less distinct cleft; anal opening covered by two more or less triangular plates-----

Coccinae.

CC. Caudal end of body without a cleft; anal plates wanting.

D. Limbs relatively short, body without waxy lamellae, though usually covered more or less by waxy or powdery secretions-----Dactyloinae.

SUB-FAMILY DACTYLOPTILINAE

Synopsis.

The adult females are active or stationary, naked or covered with either a mealy or waxy secretion, antennae and legs developed in all our species, but not long; anal lobes more or less developed; anal ring and anal ring setae present. The antennae are either well developed, rudimentary, or entirely absent; when present the last segment is usually larger than the penultimate. The antennae are present in all our forms. Only two genera are represented by our species.

Key to Genera.

- A. Antennae normally nine segmented; tarsus with a tooth beneath ----- Phenacoccus.
- AA. Antennae normally eight segmented (sometimes seven segmented); tarsus not toothed ----- Pseudococcus.

Genus Phenacoccus Skll.

Synopsis.

"Very similar to Pseudococcus but normally with nine segmented antennae; although sometimes eight segments; with a denticle on the inner face of the tarsal claw; with not less than 18 pairs of cerarii; without a continuous series

of chitinized areas about the margin of the body." (4, p. 65.)

Only a single member of this genus has been found in Brookings County.

*Phenacoccus gossypii* Townsend & Gull.

(Plate IV)

1896. *Phenacoccus gossypii* T. & Gull. Jpn. N. Y. Ent. Soc.  
VI: 170 (original description).

1898. *Phenacoccus helianthi* var. *Gossypii* Gull. Check  
List Suppl., 391.

1903. *Phenacoccus gossypii pallidus* Gull. Am. Mag. Nat.  
Hist. IX: 167.

1918. *Phenacoccus colemani* Schroder. Ferris, California  
Species of Weedy Bugs, Leland Stanford Junior Uni-  
versity Publications, Uni. Series, p. 57.

1928. *Phenacoccus gossypii* T. & Gull. Myere Monthly Bull.  
Cal. Dep. Ag. XVII, No. 6: 365.

Following is the original description by Townsend &  
Gull.:

Egg sac.—Egg sac lime white; length, 5 to 6½ mm.; width,  
2 to 2½ mm.; parallel-sided, more widened, larger and stout-  
er than in *helianthi*, and the body of female not apparent at  
one end, the sac wholly covering the body. Boiling in  
caustic soda does not stain the liquid.

Female.-- Length of body, 3 mm. Approximate antennal formula 2 (39) (145678). The antennae and legs are practically the same as in *helianthi*. The digitules of the claw are distinct, rather slender, well knobbed, and extending beyond the end of the claw about  $\frac{1}{2}$  the length of the latter. Antennae and legs pale brown.

Following is the redescription by Myers:

Habit.--In life the species is of a somewhat blue-gray color covered with a thin, powdery secretion, with the lateral waxy tassels very short and the caudal tassels scarcely more than one-fourth the length of the body. Upon irritation a gray, watery fluid is ejected from the dorsal ostioles. Egg-sac is firm and very uniform in size, reaching more than a quarter of an inch in length.

Morphological Characteristics.--With the common characters of the genus *Phenacoccus*, that is, with typical eighteen pairs of cerarii, nine segmented antennae and a tooth on the claw.

Cerarii all with very few pores, and with but two cerarian setae except the first three pairs which may have from two to four and the anal lobe pair which may have two or three larger and two or more smaller setae. All the cerarian setae, while varying in size are of the characteristic somewhat spear-head shape. Dorsal body setae relatively few,

small and inconspicuous of much the same shape as the cerarian setae but more slender. Ventral body setae all slender. Anal lobes but slightly prominent, bearing the usual long anal lobe seta and in addition on the ventral side two smaller setae, entirely without chitinized areas.

Tubular ducts all quite small, of two sizes, the smaller confined to the ventral side, the larger occurring both dorsally and ventrally, neither very abundant, all with a very slightly elevated collar about the mouth. Trilocular pores generally distributed over the body, being slightly more abundant on the dorsal side and showing but a slight concentration about the cerarii. Quinquelocular pores of the type shown in Plate III, fig. 3, c, and present in some abundance on the ventral side of the body only, being especially numerous in the thoracic region and entirely lacking on the last abdominal segment. Multilocular pores having the general appearance shown in Plate III, fig. 2, b, from which the ovisac undoubtedly originates, are abundant on the ventral side of the last six abdominal segments especially in the region of the vaginal opening. They occur also on the dorsum of all abdominal segments anterior to the anal lobe segment and very sparingly on the dorsum of the thorax as well.

Anal ring with no specially distinctive characters except for the presence about it of numerous extremely minute



fleshy tubercles, dorsal setioles inconspicuous.

Hosts.-Specimens were taken in abundance from Bougainvillea vines in the State College Greenhouse at Brookings, South Dakota, April 29, 1928. It was found on this plant exclusively.

Genus Pseudococcus Westwood.

Synopsis.

"Coccidae normally with 7 to 8 segmented antennae (in the female); without a tooth or denticle on the inner face of the tarsal claw, with not more than 17 pairs of cerarii and sometimes with not more than 5 distinct pairs." (4, p. 34)

Only two members of this genus have been found in Brookings County.

Key to Species.

- A. With a narrow, chitinized bar on the ventral side of anal lobes; pores of the anal cerarii scattered; body setae distinct-----citri.
- AA. Chitinized area unlike the above, chitinized area surrounding the anal lobe cerarii, pores of the anal cerarii arranged in a crowded circular group; body setae short, inconspicuous-----maritimus.

*Pseudococcus citri* Risso.

(Plate V.)

1813. *Orthesia citri* Risso. Essai, Hist. Nat. des Oranges.  
1881. *Dactylopius destructor* Comst. Comstock, Rep. U. S.  
D. A. (1880): 343.  
1909. *Pseudococcus citri* Risso. Sanders, Jour. Econ. Ent.  
3: 432.  
1915. *Pseudococcus citri* Risso. Dietz & Morrison, Uacc.  
Ind., Rep. Ind. State Ent., 8: 266.  
1918. *Pseudococcus citri* Risso. Ferris, Cal. Species of  
Mealy Bugs, Leland Stan. Junior Uni. Pub. Ent.  
Series, p. 39.

The following description is from Comstock:

Adult female.—Length, 3.5 mm. to 4 mm., width, 2 mm.

Color dull brownish-yellow, somewhat darker than with  
*P. longifilis* (now called *P. adonidis*); legs and antennae  
concolorous with body. The lateral appendages (seventeen on  
each side) are short and inconspicuous and are subequal in  
length. Upon the surface of the body the powdery secretion  
is very slight. In spite of the small size of the filaments,  
the spinnerets and the supporting hairs are as numerous and  
as prominent, or nearly so, as in *P. longifilis*; those upon  
the anal lobes being especially long. Antennae eight-jointed

joint 8 is the longest and is twice as long as the next in length, joint 3. After 3, joints 2 and 7, subequal, then 5 and 6, joint 4 being the shortest. The tarsi are a little more than half the length of the tibiae; claws strong.

Eggs.—Length, .25 mm.; shape rather long, ellipsoidal; color light straw yellow.

Young larva.—Rather brighter colored than the egg.

Antennae six-jointed with the female, with the same relative proportions as in *D. adonidis* (now called *P. adonidis*).

Tarsi considerably longer than the tibiae. The lower lip is large, conical, and reaches almost to the posterior coxae.

Male.—Length .67 mm. p. expanse of wings, 2.5 mm. Color light olive brown, legs concolorous with body; antennae reddish; eyes dark red; bands darker brown than the general color; anterior edge of mesoscutum and posterior edge of scutellum darker brown. Body rather small and delicate compared with size of the wings; head small, with almost no hair; antennae ten-jointed; joints 3 and 10 longest and equal; joints 2, 6, 7, 8 and 9 nearly equal and considerably shorter than 3 and 10; joints 3 and 4 subequal and a trifle shorter than the following joints. The lateral ocelli are each just laterad of the center of the eyes, and not at its posterior border. (This, however, is a character which will not hold with specimens long mounted.) Prothorax short, legs sparsely covered with hairs; tarsal digitules extremely delicate,

and the button is very difficult to distinguish; we have been unable to discover a trace of the pair belonging to the claw.

Hosts.—This species is the common mealy bug of the greenhouse. It is distributed all over the State, and often becomes a serious pest. It is usually the worst on Coleus, though it affects a large list of host plants. The specimens used for study were collected from Coleus plants on November 11, 1937.

*Pseudococcus maritimus* Ehrhorn.

(Plate VI.)

1930. *Dactylopius maritimus* Ehrhorn. Can. Ent. 32: 316.

1909. *Pseudococcus obscurus* Essig. Pomona, Cal. Jn. Ent. 1: 43.

1917. *Pseudococcus omnivorus* Hollinger. Ann. Ent. Soc. Am. 10: 371, fig. 31.

1916. *Pseudococcus maritimus* Ehrhorn. Calif. Sp. of Mealy Bugs, Lel. Stan. Jr. Uni. Pub., Uni. Series p. 48.

Following is a copy of the original description by Ehrhorn:

Adult Female.—Elongate, oval, about 2 mm. long and 1 mm. broad, flattish, slightly covered with secretion. Colour of body, reddish-brown. Margin beset with stout, short,

white filaments, which grow longer caudad. Caudal setae about  $\frac{1}{2}$  length of body. Legs and antennae are same colour as body. Eggs orange-yellow. Egg sac well developed and has the appearance of Pulvinaria caecillicola, but smaller--about 5 mm. long and 2 mm. broad.

Young larvae light orange-yellow.

When boiled in KOH, females turn liquid purple and afterwards become colourless. Body thickly beset with long slender spines and many round glands. Each segment has a group of spinnerets on its margin, in the centre of which are two short, stout conical spines. Antennae 8-jointed, quite hairy. Joint 8 always longest, and joint 4 generally shortest, although joint 6 sometimes is shorter than 4; again, joints 4 and 6 are sometimes equal.

Legs quite hairy, well developed, long and slender. Trochanter with long stout spine. Femur about as long as tibia. Tarsus about a third as long as tibia. Claw short and stout. Digitules fine knobbed hairs. Caudal lobes prominent, with moderately long setae and two very stout conical spines. Anal ring large, with 8 very long stout hairs.

Hosts.--Specimens of this species were found frequently on Hibiscus vines in the College Greenhouse at Brookings. At times it became very abundant. Specimens were collected April 28, 1928.

Sub-family COCCINAE

Synopsis.

This sub-family includes usually large forms, varying in shape from circular to oval and being flat or convex. The dorsum is usually very chitinous, though it is sometimes soft. In the females the posterior extremity of the body is always cleft, and with a pair of anal plates closing the anal orifice above. Anal ring bears eight to ten hairs. The margin of the body usually has a well defined fringe of hairs or spines, and the stigmatic clefts show modified spines.

Key to Genera.

- A. Adult female secreting a white cottony ovisac in which the eggs are deposited. Female completely or almost completely covered by the sac of cottony or felted secretion-----Eriopeltis.
- AA. Adult female not secreting a white cottony ovisac; eggs deposited beneath the body of the female.
  - B. Middle spiracular spines when present, less than twice as long as the others; outdoor forms-----Lecanium.
  - BB. Middle spiracular spine at least twice as long as the outer ones; greenhouse species.
    - C. Body only slightly convex, oval or elongate-



oval; derm with small scattered pores----

Coccus.

33. Body convex, usually nearly hemispherical;  
derm closely crowded with large circular  
or oval pores-----Saisettia.

Genus Eriopeltis.

Synopsis.

"The adult female of this genus is characterized by the formation of a cottony sac almost completely surrounding the individual, in which the eggs are deposited. The legs and antennae are very short and rudimentary or atrophied. Signoret describes the female as possessing six-jointed antennae, but in many specimens, the normal number is seven." (9, p. 23.) Only a single species was found in Brookings County.

Eriopeltis coloradensis Ckll.

(Plate VII.)

1905. Eriopeltis coloradensis Ckll. Cockerell, Canadian Entomologist, XXVII: 136.

1913. Eriopeltis coloradensis Ckll. Swenk, Neb. Ent. Bull. 1: 95.

Following is the original description:

Female.--"Dark brown (colourless after boiling in liquor potassae), forming a pure white ovisac 10 to 13 mm. long, of the form usual in the genus, compact, without any conspicuous filaments extending from its surface; antennae and legs very minute; antennae 8-jointed, joints 1 and 3 large but variable, 2 always very short, more than twice as broad as long, 4 to 7 all broader than long, 8 with several bristles; skin with truncate glandular spines as in E. festucae, but they are not nearly so numerous, and seem generally shorter, anal plates much longer than broad. Length of mounted female about 6 mm., breadth about 3."

Remarks.--This species may be confused with E. festucae, but differs from the latter in having 8-jointed antennae, usually found on the stems though often found on the leaves, and the truncate spines are not so numerous, there being about one-half as many, and are more numerous at the ends of the body. These spines also seem to be shorter than in E. festucae.

Hosts.--This species is abundant on wild wheat grass in the southwest part of the State. This is also reported as being found in abundance in Nebraska, Kansas and Colorado.

Genus Lecanium Burmeister.

Synopsis.

"The species in this genus are usually large forms,

naked, somewhat convex, usually oval, though sometimes circular; legs and antennae fairly well developed; middle spiracular spine less than twice as long as the outer two; anal ring with eight hairs; hypogigial setae wanting." (10, p. 191). Only one species was found in the locality.

*Lecanium corni* Bouche.

(Plate VIII)

1909. *Lecanium corni* Bouche, Sanders, Jour. Econ. Ent., 2: 443.

1916. *Lecanium corni* Bouche, Dietz & Morrison, Conn. of Ind., Ind. State Ent. Rep., 9: 256.

1917. *Lecanium corni* Bouche. Lawson, Conn. of Kans., Kans. Uni. Bull., 16, No. 1: 194.

The following description is by Dietz & Morrison:

Adult female.--Largest diameter ranging from 3.5 to 6 mm.; shape circular to oval, strongly convex, old female dark brown, the margins showing a heavier chitinization than the dorsum; dorsum nearly smooth, but the surface strongly wrinkled near the margins; the wrinkles mostly parallel to the body margins; antennae fairly well developed, normally seven-segmented; legs fairly well developed; dermopores usually of two sizes, some apparently double or multiple, arranged in more or less definite but very irregular

rows radiating from center to margin; this is less pronounced in some specimens; also with a closely set elongate group of pores running cephalad from the anal plates; marginal spines rather short and stout, spiracular spines rather slender, the median not twice as long as the outer ones; anal plates broad; each plate a little less than twice as long as broad; caudo-lateral margin typically slightly longer than the cephalo-lateral; with four fringed setae arranged in two pairs, with two subapical and four apical setae on each plate; anal ring with eight hairs, two smaller than the others.

Hosts.--This Lecanium is by far the most common one in the state. It seems to be well distributed all over the state, and seems hardly to have any restriction as to its host plants. It is most abundant always on white elm, though red elm is not far behind. It is very common also on soft maple. The specimens used for study were collected from American elm, on October 2, 1927.

Genus Coccus Linn.

Synopsis.

"In this genus the body of the adult female is naked, body at least slightly convex; anal cleft of medium length; legs and antennae fairly well developed; middle spiracular

spines at least twice as long as the outer ones; derm with small scattered pores." (10, p. 193.) One representative of this genus was found in the greenhouses of this locality.

*Coccus hesperidius* Linn.

(Plate IX.)

1758. *Coccus hesperidius* Linn. Syst. Nat. Ed. 1 (1758):

455.

1881. *Lecanium hesperidius* Linn. Comstock, Rep. U. S. D.

A. (1880): 358.

1909. *Coccus hesperidius* Linn. Sanders, Jour. Econ. Ent.

2: 436.

1917. *Coccus hesperidius* Linn. Lawson, Cocc. Kans., Kans

Univ. Bull., 18, No. 1: 196.

The following description is a copy of Fero's:

Adult female.--Oval, broader posteriorly, and slightly convex; dorsal cuticle yellowish brown, darker towards the center, with occasionally clear areas, each of which contains a very small dot, and there are a few small setae on the dorsal surface; length, 3 to 4 mm.; width, 2 mm. The antenna is long and slender and has seven segments, with the fourth longest. Anal plate slightly more than twice as long as broad, with the caudo-lateral margin one-fifth longer than its cephalo-lateral; both the lateral extremity and the



and the apex are rounded; cephalic end of the crease between the dorsal portion of the plates terminated in a V-shaped mark; there are two subapical and four apical setae on each plate, apical setae situated as follows: two adjacent and directly on the apex; one on the outer lateral margin and projects at a right angle; and one on the inner lateral margin near the apex; four fringe setae arranged in groups of two, with the lateral seta of each group one-fourth longer than the mesal seta; median spiracular seta almost three times as long as the first, first and third short and conical; marginal setae short and hairlike and occasionally bifurcated at apex. It is viviparous and only a small portion of the body wall becomes concave when the young are born.

Host.—This scale is reported throughout the state on numerous plants. The author collected specimens from Vinca vines in the State College Greenhouse at Brookings, South Dakota on March 3, 1928. It does not appear to be very abundant.

Genus Saisettia Deplanches.

Synopsis.

"The chief difference between this and the preceding genus lies in the shape, size and distribution of derm pores. In this genus the scales are more convex, usually hemispher-



ical and the derm is quite crowded with large, circular, oval pores." (10, p. 200.) Only a single species was found present in this locality.

*Saisettia hemispherica* Targ.

(Plate X.)

1886. *Lecanium hemispherica* Targ. Studi Sul. Coco.  
(1867): 26.  
1881. *Lecanium hemispherica* Targ. Comstock.  
1889. *Saisettia hemispherica* Targ. Cockerell, Pr. Acad.  
of Nat. Sci. Ph. (1889): 270.  
1909. *Saisettia hemispherica* Targ. Sanders, Jour. of Econ.  
Ent., 2: 459.  
1917. *Saisettia hemispherica* Targ. Lawson, Coco. Kans.,  
Kans. Uni. Bull. 18, No. 1: 203.

Following is the description by Thro:

Adult female.—Shape elliptical, dorsum very convex; dorsal cuticle light or dark brown, and densely alveolate, although not to such an extent as in oleae; length, 3 to 4 mm.; width, 3 mm. Antenna usually has seven segments, but it may have eight, with setae on all; first segment has one long and two short setae, and the third segment is the longest. Anal plate nearly twice as long as broad, with its cephalo-lateral margin four-fifths as long as its caudo-lateral, and the lateral extremity of the plate is angulate and the apex rounded; on each plate there are a discal seta,

four subapical setae, and three apical setae with the one on the inner, lateral margin longest, discal seta occasionally fringed at the apex; there are eight fringe setae arranged in groups of four, with one in each group three times as long as the first, and the first and third are long and conical; long marginal setae serrated at the ends and the shorter ones acuminate; many unicellular glands opening on to the ventral surface; when eggs are laid the entire ventral body wall becomes concave.

Remarks.--We find the caudo-lateral margin of the anal plates fully as long as the cephalo-lateral.

Hosts.--This species does not appear to be very abundant, but several species were collected by the author from *Cycus* on November 15, 1927.

Sub-family DIASPINAE

Synopsis.

This sub-family is at once separated from the others by the possession of a distinct scaly covering by the adult female, which is composed of cast larval skins and secreted matter. The terminal segments of the abdomen are united into a chitinized compound segment, the pygidium; the anal orifice lacks the setiferous ring, and the antennae and legs are wanting.

Key to Genera.

A. Scale of female circular to oval with central, sub-central, or submarginal exuviae.

B. Scale of male usually resembling scale of female in color and texture; only slightly elongated.

C. Only one exuvia present.

D. Much elongated chitinous processes extending anteriorly from bases of lobes

-----Chrysomphalus.

EE. Chitinous processes smaller and shorter or wanting-----Aspidiotus.

FF. Scale of male elongated, not carinated; scale of female with two distinct exuviae--Parlatoria.

AA. Scale of female elongated with exuviae at one extremity.

B. Scale of male similar to scale of female, smaller.

C. Scale of female plain, convex, or flattened ----- Leptodesaphes.

CC. Scale of female plain, with very large exuviae ----- Parlataria.

EB. Scale of male elongate, white and usually carinated; scale of female white ----- Chionaspis.

Genus Chrysomphalus Ashmead

Synopsis.

"The members of this genus usually have large, dark scales with covered exuviae; margin of pygidium without incisions; plates strongly branched; chitinous processes extending cephalad from base of lobes, quite long." (10, p. 208.) Two representatives were found in this county.

Key to Species.

A. Circumgenital gland openings wanting ----- aurantii.

AA. Circumgenital gland openings present ----- dictyosperm.

Chrysomphalus aurantii Mark

(Plate XI.)

1827. Aspidiotus aurantii Mark. N. Y. Trans. 11: 129.

1891. *Aspidiotus aurantii* Mark. Comstock, Rep. U. S. D. A.

(1890): 293.

1916. *Chrysomphalus aurantii* Mark. Lawson, Conn. Kans.,

Kans. Uni. Bull., 18, No. 1: 216.

The following is the original description:

Scale of female.—Really dirty white, but seeming yellowish brown from the color of the insect beneath; sometimes dark brown; circular, flat, diameter,  $1/11$  in.

Scale of male.—Much smaller, rather oval.

Female.—Adult female yellow, becoming brown at last; peg-top shaped, but the abdominal segment is comparatively so small and is so much overlapped by the others that the insect looks almost globular; length, about  $1/15$  inch. Abdomen ending in six lobes (of which the two median are the largest), and several scaly hairs. No groups of spinnerets.

Male.—Adult male very small, brown or yellow in color. The antennae have ten joints; the two first joints are very small, round and smooth; the third, fourth, fifth and sixth equal in length; the seventh, eighth and ninth half as long; the tenth somewhat shorter still, and pointed. All the last eight joints show numerous hairs. The thorax is short and thick, the thoracic band occupying more than one-half the width; the abdomen short, the double spike of same length. The wings are oval, about as long as the body. The legs are hairy, femora thick, tibiae longer, thicker at the end next



the tarsus than at the other end; tarsi broad at the top tapering gradually down to the usual single claw. The hairs on the femora are much fewer than those on the tibiae and tarsi.

Hosts.—This species was found on imported grape fruit at Brookings, South Dakota, on November 1, 1927.

*Chrysomphalus dictyospermi* Morgan.

(Plate XII.)

1889. *Aspidictus dictyospermi* Morg. Ent Mag. 25: 363.

1894. *Aspidictus dictyospermi* Morg. Cockerell, Can. Ent.

26: 128.

1897. *Aspidictus dictyospermi* Morg. Cockerell, U. S. D. A.

Bull. 6: 23.

1904. *Chrysomphalus dictyospermi* Morg. Sanders, Cocc.

Ohio, Pr. Ohio Acad. Sci., IV, sp. papers No. 8: 71.

1916. *Chrysomphalus dictyospermi* Morg. Dietz & Morrison,

Cocc. of Ind., Ind. State Ent. Rep. 8: 310.

1917. *Chrysomphalus dictyospermi* Morg. Lawson, Coccidae

Kans., Kans. Uni. Bull., 16, No. 1: 260.

The following is the description by Dietz & Morrison:

Scale of female.—Diameter about 1.5 mm; very light brown or grayish, flat, thin; exuviae central, nipplelike, covered by a secretion, nearly the same color as the rest of



the scale; ventral scale thin, whitish, not well developed.

Scale of male.-Similar to that of female, but more elongate and smaller.

Female.-Rather small, strongly projecting; with three pairs of well developed lobes, the outer margins of each deeply and distinctly notched; with long club-shaped chitinous thickenings running cephalad from the posterior margin of the pygidium as follows; one from both the inner and outer margin of each median lobe, one large one from the inner margin of the second lobe, one from laterad of the outer margin of the second lobe, and one from the inner margin of the third lobe, the largest of these being the second and third as located above; with fairly strongly branched plates, somewhat less prominent than the lobes, as follows: two between the median lobes, one between the first and second lobes, typically three, sometimes two between the second and third lobes, and three basally broad, apically slender plates, with serrate margins laterad of third lobes; anal opening about three times its diameter from the median lobes; circumgenital gland openings in four groups, anterior laterals 3-4, posterior laterals 2-3; dorsal gland openings in three rows, the first between median and second lobes, of 2, second between second and third lobes of 4-7, and third outside of third lobes, of 4-6.

Hosts.-Specimens were found on the bark of lemon plants

associated with *Parlatoria pergandii*, in the Brookings Greenhouse, on March 3, 1928.

Genus Aspidiotus Bouche.

Synopsis.

Scale of female.--Circular or nearly so, with the exuviae at or near the center.

Scale of male.--Somewhat elongated, smaller, exuviae nearer the margin usually, but in general, similar to scale of female.

Female.--The body of the female generally resembles the shape of the scale. The segmentation is usually distinct; color most frequently yellowish. The pygidium has from one to three pairs of well-developed lobes, the mesal lobes being almost invariably the largest and notched either on both sides or simply the outer margin. Chitinous processes, when present, not as well developed as in *Chrysomphalus*. Incisions may or may not be chitinized; plates usually present and assuming various degrees of development and simple or branched; anal opening nearer to apex than to base of pygidium; dorsal gland openings not conspicuous; circumgenital gland openings not conspicuous; circumgenital gland orifices absent or in four or five groups, few in number; micropores usually present. Only two species were found in this county. (10, 216.)

Key to Species.

- A. Female pygidium with three pairs of lobes; third lobe well developed; median and second lobes about same size-----hederas.
- AA. Female pygidium with less than three pairs of lobes; second and third pairs of lobes rudimentary or wanting-----angulus.

Aspidiotus hederas Vall.

(Plate XIII.)

1829. Chermes hederas Vall. Mem. Acad. Dijon. 30.
1881. Aspidiotus nerii Bouche. Comstock, Rep. U. S. C. A. (1880): 301.
1894. Aspidiotus hederas Vall. Cockerell, Ent. News, 5: 211.
1894. Aspidiotus hederas Vall. Sanders, Conn. Ohio, Pr. Ohio Acad. Sci., IV: sp. papers No. 8: 63.
1913. Aspidiotus hederas Vall. Dietz & Morrison, Conn. of Ind., Ind. State Ent. Rep., 8: 288.
1917. Aspidiotus hederas Vall. Lawson, Conn. of Kans., Kans. Uni. Bull., 16: No. 1, 233.

The following is the description of Dietz & Morrison:

Scale of female.--Diameter, 1 to 2 mm.; approximately

circular, varying to ovate, often irregular, flat or slightly convex; color very dull pale yellow, often whitish in well protected specimens; thin, somewhat transparent, extrinsic central, yellow, covered in newly molted adult females but usually bare in older specimens.

Scale of male.--Form variable, usually ovate; white; extrinsic apparently central, usually naked and some shade of orange yellow.

Female.--Broadly rounded, small; with three pairs of well-developed lobes, the median the largest, the second pair somewhat smaller, the third small and slender, the median notched on both inner and outer sides, the inner notch nearer to the apex; second lobes indistinctly notched on the outer sides, as are also the third, which are almost pointed at tip; no incisions or chitinous thickenings present; with two plates between the median lobes, two between the median and second lobes, all these apically branched, with three between second and third lobes, with four to six laterad of third lobe, all these both apically and laterally branched; anal opening circular, about three times its diameter from the apex of the pygidium; circumgenital gland openings in four groups, anterior laterals 7-10, posterior laterals 8-10; marginal gland openings rather large, giving the margin a rather crenulated appearance and arranged as follows: one between the median lobes, one between the median and

and second lobes; two between the second and third lobes, the inner one ento-caudad to the outer, two beyond the third lobes; dorsal pores arranged in three or four indistinct rows.

Remarks.-In our forms the anterior lateral groups of circumgenital gland orifices are somewhat larger than those described above; the spines are well developed, those on the ventral surface situated laterad of the corresponding dorsal spines, which are placed as follows: one on each of the three lobes, one at one-third, and one at two-thirds of distance to penultimate segment. Micropores as in figure.

Hosts.-This scale appears to be very common in the greenhouses of the state. It was found on palms and several *Cycus* plants on November 15, 1937.

*Aspidiotus ancyclus* Putnam.

(Plate XIV.)

1877. *Diaspis ancyclus* Putnam. Transactions of the Iowa State Hort. Soc., 12: 321.  
1881. *Aspidiotus ancyclus* Putnam. Comstock, Rep. U. S. D. A. (1880): 292.  
1889. *Aspidiotus ancyclus* Putnam. Hunter, Kans. Uni. Quart. 8: 4.  
1904. *Aspidiotus ancyclus* Putnam. Sanders, Cocc. Ohio. Pr. Ohio Acad. Sci., IV, op. papers No. 2: 27.



1916. *Aspidiotus ancylus* Putnam. Dietz & Morrison, Conn.  
Ind. State Ent. Rep., 8: 303.

Scale of female.-Circular, 1 to 1.5 mm. diameter.

Brick red exuviae covered by gray film of excretion; remainder of scale dark gray, or almost black, except light gray margin. A very delicate, white ventral scale is present. Show a tendency to gather in clusters several deep.

Scale of male.-Elongated, and smaller than female scale; or same color as female scale. Length, 1 to 1.5 mm; width .5 to .6 mm.

Female.- (The following description is from Sander's.) Only the median pair of lobes well developed, somewhat separated with mesal margins. Parallel; notched on lateral margin about one-third of the distance from subtruncate apex, and frequently notched near apex on mesal margin. Second lobes rudimentary, truncate, not extending beyond margin of segment. First interlobular incision rather wide and shallow, with variable chitinous processes, usually straight, the inner the larger. Second interlobular incision similar; inner chitinous processes usually larger than the outer. Sometimes a very small incision laterad of second incision. Small chitinous process at inner base of each median lobe. There are two plates, usually furcated, caudad of each incision and occasionally a third plate.



The spines on the ventral surface are shorter than the dorsal spines, and situated at the base of the lateral margin of the median lobes, and the rudimentary second and third lobes. The spines of the dorsal surface are slightly mesad of the corresponding ventral ones; the fourth being about two-thirds of the distance from the median lobes to the penultimate segment. Between the third and fourth pairs of spines there are three or four irregular spinelike extensions of the margin of the segment. Four or five groups of circumgenital gland orifices are present; median group 5-6 (rarely more than three); anterior lateral, 5-14; posterior lateral, 4-8. Rows of dorsal pores sometimes quite prominent.

Remarks.-In our specimens we find that generally the mesal margins of the median lobes are somewhat converging. The lateral notch is very pronounced but the median notch is nearly absent.

Usually the dorsal pores are quite prominent, due to their large size and numbers.

In the majority of our specimens the median group of circumgenital gland orifices are only 1 to 3 in number. In many they appear to be absent.

Host.-This species is one of the commonest scales in the state. The writer has found it abundantly on aspen, mountain ash, birch, black locust, and less commonly on buckthorn, maple, hackberry, hawthorn, and gooseberry.

Specimens were collected from aspen on October 15, 1937.

Genus Parlatoria Targ.

Description. - (Niets & Morrison).

Scale of female.-Circular to oval, whitish or grayish, exuviae marginal.

Scale of male.-Small, elongate, slender, sides nearly parallel, light gray, exuvia terminal at the cephalic end.

Body of female.-Approximately circular, color variable, usually light purple, pygidium not produced beyond the body outline; with broad more or less distinctly toothed plates on each margin of some of the abdominal segments anterior to the pygidium; pygidium with many large, toothed plates along the whole margin.

Pygidium of female.-With three pairs of well developed lobes, the fourth somewhat developed, projecting from the margin of the pygidium, all more or less distinctly notched, at least at the outer side, median distinctly separated; without incisions or chitinous thickenings; plates large, broad, deeply serrate, apically, almost branched, with a pair between the median lobes and between each median and second lobe, and three between the second and third lobes and the base of the pygidium; anal opening small, somewhat nearer the apex than base of pygidium; circumgenital glands openings present, a few in number, arranged in four groups;

marginal gland openings present, one between median lobes, one between median and second, one between second and third, one just beyond third, one just before rudimentary fourth and two near base of pygidium; dorsal gland openings present, scattered, not arranged in distinct rows.

Only one species was found in this county.

*Parlatoria pergandii* Comst.

(Plate IV.)

1881. *Parlatoria pergandii* Comst. Comstock, Rep. U. S.

D. A. (1880): 327.

1904. *Parlatoria pergandii* Comst. Sanders, Conc. of Ohio,

Pr. Ohio Acad. Sci., IV. sp. papers No. 8: 75.

1917. *Parlatoria pergandii* Comst. Lawson, Conc. Kans.,

Kans. Uni. Bull. 18; No. 1: 248.

Following is the original description:

Scale of female.-The scale of the female varies in form; sometimes it is nearly circular in outline, with the exuviae upon one side; usually, however, it is somewhat elongated, with the exuviae at one end; color of scale dirty gray; the first skin is naked; the second is covered with a very thin film of secretion, and occupies about one-third of the length of the scale; length of scale, 1.5 mm.

Scale of male.-The scale of the male is long and narrow;

the larval skin is at the anterior end, and occupies a little more than one-third the length of the scale; the lateral margins of the scale are prominent; the central part is not carinated and is very seldom higher than the sides; usually, and especially with old scale, after the adult has emerged the central part is depressed, giving that part of the scale posterior to the larval skin the form of a gutter.

Female.-The female is nearly as broad as long, and varies greatly in color; some specimens are almost entirely white, with only the end of the body slightly yellow; others are entirely yellow, and some are purplish with the posterior end of the body yellow; eyes black. The last segment presents the following characters:

There are only four groups of spinnerets, each usually consisting of eight or nine; but the number in each group varies from four to ten.

There are three pairs of well-developed lobes; each lobe is widest near the middle tapering anteriorly, and suddenly narrowed posteriorly. There is a fourth rudimentary lobe on each side about midway between the third lobe and the penultimate segment; this lobe is irregularly rounded and produced into a papilla at its distal extremity; there is a similar lobe on the penultimate segment, cephalad of the posterior plate of that segment. Connecting the bases of the lobes are crescent-shaped thickenings of the body

wall, which are in reality the thickened margins of elongated pores placed at right angles to the median line of the body. There is one of these pores in each of the following places: between median lobes; between median and second lobes; between second and third lobes; and there are two between third and fourth lobes; also two between fourth lobes and penultimate segment.

There are two plates between the median lobes; two between first and second lobes; and three between second and third lobes. These are similar in shape, and in each case extend caudad as far as the tips of the lobes. Each plate is oblong, with the sides parallel and the distal extremity fringed. Between the third and fourth lobes are three plates varying in shape from the form just described to palmate; the middle member of this group is usually as large as the other two combined. The three plates cephalad of the fourth lobe are usually palmate. The three segments preceding the last usually have five or six plates, each, on each lateral margin; these plates are rounded and produced into a single papilla at the distal extremity. The fourth segment preceding the last often bears one or two plates also.

Each lobe bears a spine on its dorsal surface; that of the fourth lobe is situated near the center of the lobe;



each of the others is near the lateral margin of the base of the lobe. The spines on the ventral surface (except the first, which is obsolete) are longer and more conspicuous; the second, third, and fourth are each situated dorsad of the lateral margin of the first plate, laterad of the second, third and fourth lobes, respectively. Each of the three segments preceding the last bears a conspicuous spine near the middle of each lateral margin.

Egg.--The eggs and young larvae are purplish. Twenty-seven eggs were observed under one scale; but in another instance the abdomen of a female was more than half filled by five eggs.

Male.--The male is purplish in color, with the disk of the thorax nearly colorless, with the exception of some irregular purplish spots, and the sutures, which are brownish; the eyes are large and very dark.

Hosts.--This species was collected from the bark of lemon plants in the Brookings Greenhouse, Brookings, South Dakota on March 3, 1928. Only a few specimens were found.

Genus Lepidosaphes Shiner.

Description. -- (Diets & Morrison).

Scale of female.--Elongate, slender, more or less distinctly broadened behind, some shade of brown, exuviae terminal at cephalic end.



Scale of male.- Similar to that of female, but smaller and with a hingelike construction on posterior third.

Body of female.-Elongate, broadened posteriorly, pyriform; color ranging from pale yellowish white in L. beckii to pale purple with yellow pygidium in L. gloverii; body distinctly segmented, each of the last two to four abdominal segments bearing a group of from 3 to 5 prominent gland spines on each margin and one or more setae among these; dorsal pores small, oval, numerous and scattered.

Pygidium of female.-With two pairs of well developed lobes, the median large and broad, strongly projecting from the apex of the pygidium, widely separated and with a pair of gland spines between these, second pair of lobes cleft to form two lobules, the inner the larger, no incisions or chitinous thickenings present; gland spines arranged as follows on each side of the median line: two between median lobes, 2, 2, 2, 2, anal opening small, relatively very close to base of pygidium; circumgenital openings numerous, arranged in five groups; marginal gland openings present, arranged as follows on each side of the median line: 1, 2, 2, 1; dorsal gland openings present, arranged in 2 to 3 rows; ventral thickenings present.

Three species were found present in this county.

Key to Species.

A. Penultimate segment of body with two or three plates on each side-----gloverii.

AA. Penultimate segment of body with 4 or more plates on each side.

B. Median lobes not distinctly notched on each side; apex triangular; outer lobule of second lobe slightly smaller than inner-----beckii.

BB. Median lobes distinctly notched on each side, apex broadly rounded; outer lobule of second lobe much smaller than inner-----ulmi.

Lepidosaphes gloverii Packard

(Plate XVI.)

1889. *Coccus gloverii* Packard. Guide to Study of Ins.

Nd. I.; 537.

1891. *Mytilaspis gloverii* Packard. Comstock, Rep. U. S.

D. A. (1889): 323.

1904. *Lepidosaphes gloverii* Packard. Sanders, Cocc. Ohio,

Pr. Ohio Acad. Sci., IV: sp. papers No. 8: 74.

1917. *Lepidosaphes gloverii* Packard. Lawson, Cocc. of

Kans., Kans. Uni. Bull. 18, No. 1: 255.

The following is the description of Dietz & Morrison:

Scale of female.—Quite similar to that of L. beckii.

but more slender and usually more variable in color; the ventral scale completely separated into two halves along the median line.

Scale of male.-Similar to that of L. beckii, but more slender.

Pygidium of female.-Very similar to L. beckii, except for the following differences: median lobes more or less distinctly notched on both margins, not serrate, corresponding gland spines larger and more prominent than in L. beckii, with two to three on the margin of the penultimate segment; circumgenital gland openings less numerous in each group; inner group of dorsal gland openings much fewer, 2-4.

Hosts.-Specimens of this species were collected from grape fruit on December 1, 1937. It is common on imported fruits.

Lepidosaphes beckii Newnan

(Plate XVII.)

1869. Coccus beckii Newnan. The Entomologist, 4: 217.  
1887. Mytilaspis citricoli Packard. Comstock, Rep. U. S. D. A. (1880): 331.  
1904. Lepidosaphes beckii Newnan. Sanders, Cocc. Ohio, Fr. Ohio Acad. Sci., IV, sp papers No. 8: 73.  
1916. Lepidosaphes beckii Newm. Dietz & Morrison, Cocc. Ind., Ind. State Ent. Rep., 8: 280.  
1917. Lepidosaphes beckii Newm. Lawson, Cocc. of Kans., Kans. Uni. Bull. 18, No. 1: 193.

Scale of female.-Length about 3 mm.; elongate, slender, normally nearly straight, but often curved when crowded, broadened behind, only slightly convex, fairly dense, purplish brown in color; exuviae concolorous with or slightly paler than the scale, about 1 mm. long; ventral scale well developed, usually remaining attached to the dorsal scale, continuous, or with a narrow irregular open space along the median line.

Scale of male.-Length about 1.5 mm.; nearly straight, narrower and smaller than that of the female; color about the same or a little lighter; posterior third with an indistinct hinge.

Body of female.-Penultimate abdominal segment with four to five marginal gland spines on each margin.

Pygidium of female.-Medium in size, not very heavily chitinized; median lobes large, broad, strongly projecting, converging to form a triangular apex, crenulate; second lobes less prominent than median, distinctly cleft to form two lobules, the inner more prominent, third lobes somewhat developed, inner lobule notched slightly about the middle; no plates, gland spines arranged as follows: two between the median lobes, two between median and second, two between second and third, two beyond the third, and two more about half way between these and the base of the pygidium; anal opening circular, much nearer to base than to apex, circum-

genital gland openings arranged in five groups, median 5-7, anterior laterals 12-15, posterior laterals 8-11 in specimens examined; marginal gland openings as follows; one between median and second lobes, one just inside of third lobe, a pair on a slight prominence placed where the fourth lobe should be, one on a slight projection beyond the fifth pair of gland spines; the large elongate inner group of dorsal gland openings the most noticeable, ranging from 16 to 20; with thickenings of the pygidium extending cephalad from the first and second pair of lobes.

Hosts.—This species was often found associated with L. gloverii, on grape fruit. Specimens were collected on December 1, 1927.

*Lepidosaphes ulmi* Linn.

(Plate XVIII.)

1758. *Coccus ulmi* Linn. *Syst. Nat. Ed. 11.*, 458.  
1881. *Mytilaspis pomorum* Bouche. Comstock, *Rep. U. S. D. A.* (1880): 325.  
1904. *Lepidosaphes ulmi* Linn. Sanders, *Cocc. Ohio, Fr. Ohio Acad. Sci.*, IV, sp. papers No. 8: 74.  
1917. *Lepidosaphes ulmi* Linn. Lawson, *Cocc. of Kans.*, *Kans. Uni. Bull.*, 18, No. 1: 258.

The following is the description by Sanders:



Scale of female.--Long, 2.5 to 3 mm., more or less curved, gradually widened posteriorly; brown or dark brown, shining; thick in texture, with exuviae yellowish or yellowish brown.

Scale of male.--Similar in color to scale of female, but smaller. The posterior one-fourth of the scale bends upward like a hinge for exit of the male.

Female.--The median lobes are large, broader than long, with parallel margin, deeply notched on either side near the apex and rounded; the mesal much the larger. Third lobe rudimentary. Plates long, simple; two on each of the following places; between median lobes, between first and second and between second and third lobes; laterad of third lobe, and one about one-half way to penultimate segment. There is an elongated pore laterad of first lobe, two laterad of the third and fourth pairs of plates respectively, and one laterad of the fifth pair of plates. The spines on the dorsal surface are longer than the ventral spines and situated as follows: one at base of each margin of first lobe, one dorsad of incision of second and third lobes, respectively, and one between the fourth and fifth pair of plates. On the ventral surface there is a spine at the base of each margin of the median lobe, third spine at base of outer margin of outer lobule of second lobe, and the fourth and fifth

Male.--Elongated, broadened posteriorly, distinctly



spines between the fourth and fifth pairs of plates, respectively. There are four or five spines on the lateral lobules of the penultimate segment. Second row of dorsal pores (extending anteriorly from the third pair of plates) of about 13 small, round orifices, third row of about 10, fourth row (near margin) of about 8. Median group of circumgenital gland orifices, 12-15; anterior lateral and posterior lateral, 17-22 each.

Hosts.-This species has been taken on lilac, mountain ash, apple. Specimens were collected from lilac on October 8, 1937.

Genus Chionaspis.

Description. - (Cooley).

Scale of female.-Elongated, nearly parallel-sided, or plainly broadened posteriorly; more or less convex. Ventral scale developed only at the anterior end. Exuviae at the anterior extremity, the first one naked and lying partly on the second, which is more or less covered by secreted matter. Secreted portion of scale white; exuviae from colorless to orange yellow or brownish.

Scale of male.-Elongated; tricarinate, unicarinate or without carinae. Ventral scale complete, forming with the upper part, a complete tube.

Female.-Elongated, broadened posteriorly, distinctly

segmented. A more or less distinct group of small, nearly circular gland orifices on each side of the abdominal segments. These are much more distinct just in front of the pygidium than near the anterior extremity of the body. More or less distinct rows of oval gland orifices on the dorsal surface between the posterior segments. A group of gland spines on each side of each abdominal segment, more distinct near the pygidium than anteriorly.

Pygidium.--Two or three pairs of lobes present. Median lobes more or less semicircular in outline, their bases either close to each other, or touching for more or less of their length, serrate, notched or entire. Each lobe of the second and third pair composed of two lobules, of which the inner one is larger than the outer. Second pair always smaller than the first; third pair always smaller than the second. Gland spines usually simple, though sometimes forked at their tips and usually shortest nearest the median lobes; gradually increasing in size toward the anterior part of the pygidium. The spines are usually plainly visible, those on the dorsal larger than those on the ventral surface. First row of dorsal gland orifices absent; second row usually represented by the anterior group only, though in one species the posterior group only is present; third and fourth rows always present. Circumgenital gland orifices

always present and arranged in five groups.

Four species were found present in Brookings County.

Key to Species.

A. Inner margins of median lobes continuous for much of their length and sometimes apparently fused-----

americana.

AA. Inner margins of median lobes more divergent, at least near the tips.

B. Median lobes at most fused only at base, median notch wide and deep; space between first and second lobes about width of median lobe-----

pinifolia.

C. Second row of dorsal gland openings entirely absent; median lobes broadly rounding-----furfura.

CC. Only one group of second row of dorsal gland openings present; both the small circular and usual dorsal pores present-----salicis nigrae.

*Chionaspis americana* Johns

(Plate XIX.)

1936. *Chionaspis americana* Johns. Ent. News, 7: 140.

1899. *Chionaspis americana* Johns. Cooley, Spec. Bull.  
Mass. Exp. Sta. (1899): 41.
1904. *Chionaspis americana* Johns. Coccidae of Ohio, Pr.  
Ohio Acad. Sci., 4, Sp. Papers No. 8: 43.
1913. *Chionaspis americana* Johns. Dietz & Morrison,  
Coccidae of Ind., Rep. Ind. State Ent., 8: 284.
1917. *Chionaspis americana* Johns. Lawson, Coccidae of  
Kansas, Kans. Uni. Bull. XVIII, No. 1: 280.

The following is the description by Dietz & Morrison:

Scale of female.--Length, 2-3.2 mm.; normally uniformly broadened from the apex, widest beyond the middle, rather dense, color normally pure white but often obscured by dirt, particularly on specimens found in the larger cities; exuviae brown in color, often concealed by the grayish or blackish secretion, about one-half the total length of the scale; ventral scale rather thin and delicate, white.

Scale of male.--Length about 1 mm.; elongate, slender, sides subparallel, distinctly tricarinate, white, exuvia pale yellow, about two-fifths of the total length of the male.

Female.--Medium, outline broadly triangular, not heavily chitinized; with two pairs of well developed lobes, the third pair more or less distinctly developed, median lobes large, strongly projecting beyond the pygidial margin, inner margins parallel and very close together for much of their



length, sometimes partly fused, apex rounded, outer margin deeply and distinctly notched about its middle, second lobes deeply and distinctly cleft to form two lobules, the inner very much larger than the outer, pointing diagonally inwards and notched on its outer margin, third lobes incised to form two more or less distinct lobules; with an elongate club-shaped thickening running cephalad from between the median lobes; no plates, gland spines as follows: 1 on each side of the median lobes and 1-2 between the second and third lobes, 2 often branched at tip, beyond third lobes, then 2-4 and last near the base of the pygidium, a group of 4-7; anal opening circular closer to base than to apex of pygidium; circumgenital gland openings in 5 groups, as follows in specimens examined: median 18-30, anterior laterals 17-23, posterior laterals 20-24; marginal gland openings as 1 between median and second lobes, 1 near the inner margin of third lobe, the last about half way between the last two groups of gland spines; only the two outer rows of dorsal gland openings present, each of two groups, inner or third row with the posterior group 4-5, anterior group 4-6, the outer or fourth row with the posterior group 5-8, anterior group 3-5.

Remarks.-In most of our specimens the second and the third pairs of lobes were usually quite apparent. The third

pair, however, is quite reduced. Gland spines as follows: 1, 1, 2, 2-4, 5-6. Many of these are forked. Dorsal spines located as follows: 1 on each lobe, one between third and fourth groups of gland spines, and one with fifth group of gland spines.

Hosts.-This species is very common through the state on American Elm (*Ulmus americana*). At Brookings the young trees from 5-10 feet high showed the greatest infestation. Very little injury is done to the older trees, but many of the young trees are injured. Specimens were collected on October 10, 1927.

*Chionaspis pinifolii* Fitch

(Plate IX.)

1855. *Aspidiotus pinifolii* Fitch: Rep. Ins. N. Y. 2: 488.

1871. *Mytilaspis pinifolii* Fitch. Le Barron, Rep. Ins. of Ill. 1: 23.

1880. *Chionaspis pinifolii* Fitch. Comstock, Rep. U. S. D. A. 1880: 318.

1904. *Chionaspis pinifolii* Fitch. Sanders, Conn. of Ohio, Tr. Ohio Acad. Sci. IV, Sp. Papers No. 8: 49.

1917. *Chionaspis pinifolii* Fitch, Dietz & Morrison, Conn. of Ind., Ann. Rep. Ind. State Ent. 5: 255.

The following is the description of Dietz & Morrison:

Scale of female.-Length about 3 mm.; more elongate and



slender than the other species of Chionaspis; fairly dense, rather strongly convex, normally pure white in color, but often dirty white; ventral scale very thin and inconspicuous.

Scale of male.- length about 1 mm.; elongate, narrow, sides nearly parallel, but slightly broadened behind, tricarinate, white; exuvia pale yellow, about one-third the whole length of the scale.

Female.-Rather large, circular to oval, with three pairs of fairly well developed lobes, the median sunken in to the apex of the base, then gradually diverging, the apices rounded, not very broad, second lobes distinctly notched, forming two lobules, the inner larger and a little less prominent than the median lobes, third lobes distinct, the inner lobule broad and short; with an almost circular chitinous thickening, notched caudally, between the median lobes; gland spines arranged as follows: 1, 1, 1, 1, 1-3: anal opening distinctly nearer to the base than the apex of the pygidium, circular; circumgenital gland openings in five groups as follows in specimens examined: median 7-8, anterior laterals 14-18, posterior laterals 14-18; marginal gland openings as follows: 1, 3, 3, 3; dorsal gland openings in three rows, the first only wanting, second or inner two represented only by the anterior group of 3-4, third or middle row represented by two groups, the posterior of 4-7, anterior of 3-3 large openings, on 3-4 smaller ones cephalad

of the larger ones, outer or fourth row represented by two groups, the posterior of 7-8, anterior group of 4-7, smaller openings; micropores so far as observed shown in figure.

Remarks.-This species as represented by our forms varies only slightly from the description. The circumgenital gland orifices differ slightly from the description. The anterior and posterior lateral groups are fewer in number, there being at most not over 14, and an average of 12.

Hosts.-This species appears to limit itself to several species of spruces, though infrequently found on pine. It is particularly abundant on Blue, Norway and Black Hills spruce, all three species bearing outstanding infestation on the lower limbs of the trees. Many of the specimens collected contained parasites in the pupal stage. Specimens were collected October 23, 1937.

*Chionaspis furrura* Fitch

(Plate XXI.)

1856. *Aspidiotus furrura* Fitch. Third Rep. Ins. N. Y.: 353.

1916. *Chionaspis furrura* Fitch. Comstock, Cornell University Agr. Experiment Sta. Bull. 373: 464.

1904. *Chionaspis furrura* Fitch. Saunders, Coccidias of Ohio, Pr. Ohio Academy Sci. IV, Sp. Paper No. 8: 45.

1917. *Chionaspis furfura* Fitch. Lawson, Coccidae of  
Kansas, Kansas Uni. Biol. Ser. Bull. 14, no. 1: 256.  
1918. *Chionaspis furfura* Fitch. Dietz & Morrison, Coccidae  
of Ind., Eighth Rep. State Ent. Ind.: 373.  
1931. *Chionaspis furfura* Fitch. Gustafson, Rep. U. S. D.  
A. (1930): 315.  
1899. *Chionaspis furfura* Fitch. Cooley, Special Bull.  
Mass. Exp. Sta. 23.

The following description is by Cooley:

Scale of female.-Length, 2-3 mm. Decidedly broadened posteriorly, slightly convex, thin but not transparent; dirty white or snow white. Exuviae unusually small in proportion to the secreted part; 1 mm. long; yellowish brown. The first exuvia is often brushed off, leaving only the second, which is .7 mm. long.

Scale of male.-Length, .7 to .9 mm. Surface above rather rough in texture; distinctly tricarinate. Exuvia pale yellow, occupying about one-third the length of the scale.

Female.-Median and second pairs of lobes well developed; third pair rudimentary. Median lobes broad and short, entire, plainly striate, with oblique thickened bars at their bases. Second pair usually entire, striate; inner lobule larger than the outer, oblique and with the inner edge

thickened. Third pair serrate, striate, usually very short but sometimes very well developed. The gland spines are arranged as follows: 1, 1, 1, 1, 4-9. The one nearest to the median lobe on each side is very small and blunt, sometimes wanting. Second row or dorsal gland orifices absent; third row with 2 to 3 orifices in the anterior and 3 to 5 in the posterior group; fourth row with 2 to 3 orifices in the anterior and 2 to 4 in the posterior group. Median group of circumgenital gland orifices, 7-16; anterior laterals 22 to 32; posterior laterals, 16 to 32.

Remarks.-Median group of circumgenital gland orifices seldom over 7-10 in number. Posterior and anterior lateral groups normal. Marginal gland orifices as follows: 1, 3, 2, 2. Dorsal spines situated as follows: one on each of the three lobes, one about half way to the penultimate segment, and one a fifth from end of gland spines. Anterior group of fourth row of dorsal pores often wanting.

Host plants.-This is one of the most common species of the genus Chionaspis. Specimens have been taken on pear, apple, plum, and thornapple. It is especially abundant on pear and apple. Though it is abundant at times, only infrequently have we heard of any serious damage. Specimens were collected from apple and pear on October 8, 1927.

*Chionaspis salicis-nigrae* Walsh

(Plate XVII.)

1888. *Aspidiotus salicis-nigrae* Walsh. First Rep. Nox.  
Ins. Ill. (1888): 40.
1881. *Chionaspis salicis* Linn. Comstock, Rep. U. S. D. A.  
(1880): 320.
1899. *Chionaspis salicis-nigrae* Walsh. Cooley, Spec.  
Bull. Mass. Exp. Sta. (1899): 19.
1916. *Chionaspis salicis-nigrae* Walsh. Dietz & Morrison,  
Cocc. of Ind., Ann. Rep. State Ent. of Ind. 8: 272.
1917. *Chionaspis salicis-nigrae* Walsh. Lawson, Cocc. of  
Kans., Bull. of Unl. Kans. Bio. Ser. XVIII, No. 1:  
262.

The following is the description by Cooley:

Egg.-Oval, reddish purplish in color.

Scale of female.-Length, 2.8 to 4 mm.; moderately elongate, broadest near the middle, distinctly convex, white. Exuviae .8 to .9 mm. long; usually yellowish brown, but sometimes almost colorless.

Scale of male.-Length, 1 to 1.3 mm. Parallel-sided, or slightly broadened posteriorly, with the posterior extremity rounded; distinctly but feebly tricarinated. Exuvia brown or almost colorless, occupying about one-third the length of the scale.

Female.--Pygidium usually very broad in proportion to its length. Median lobes broad, short, rounded, entire or faintly serrate. Second and third pairs with the inner lobule larger than the outer, entire or faintly serrate. Third pair often almost obsolete. The gland spines are arranged as follows: 1, 1-2, 1-2, 1-2, 5-6. The dorsal gland orifices are often of two kinds in this species. Besides the usual groups of oval orifices there frequently occur smaller circular ones which are placed in groups. In such examples the anterior group of oval orifices is wholly or in part replaced by one of these groups, and anterior to each of the inner groups of oval orifices on the pygidium and abdominal segments is another group of circular orifices. Some specimens have the anterior group of the second row made up of both circular and oval orifices. The oval orifices are arranged as follows: third row with 5 to 9 orifices in the anterior and 5 to 8 in the posterior group; fourth row with 8 to 10 orifices in the anterior and 8 to 11 in the posterior group. Median group of circumgenital gland orifices, 31-36; anterior laterals, 31-35; posterior laterals, 38-32.

Remarks.--Marginal gland orifices as follows: 1, 2, 2, 2-3. Ventral spines smaller and lateral of corresponding dorsal spines, which are arranged as follows: one on each of



the three lobes, one about half way to the penultimate segment, and one at fifth group of gland spines. Microcores as in figures.

Hosts.--This species was taken on several species of willow, but always found in isolated patches. Specimens were collected on April 11, 1928.

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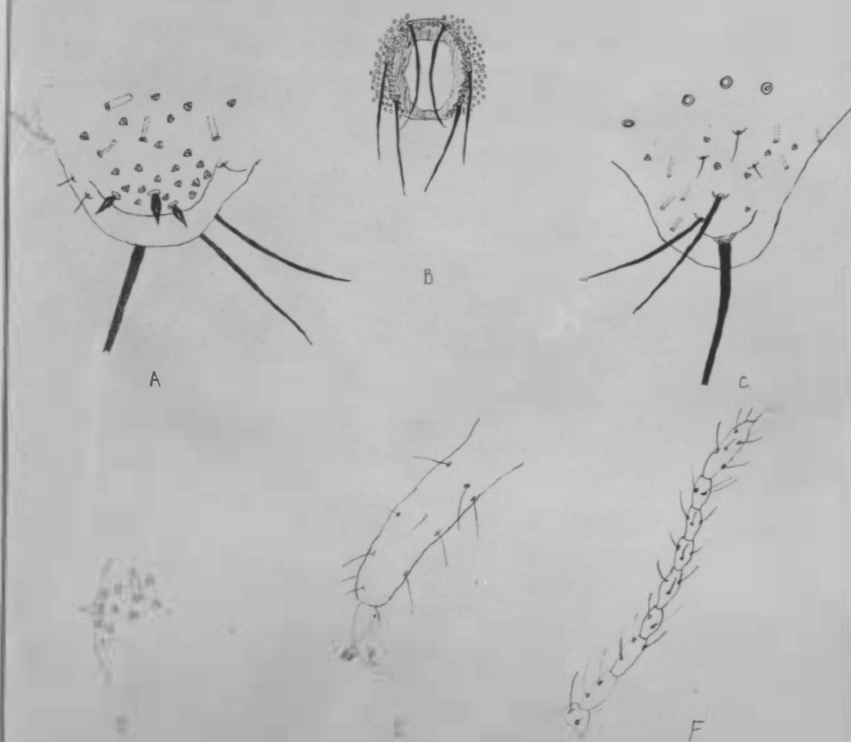
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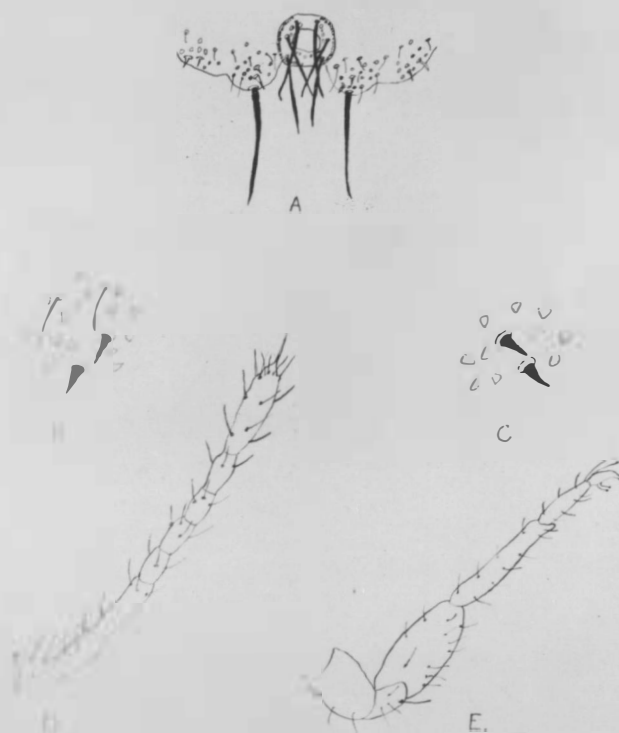
1918. The Coccidae of Kansas, Kans. Uni. Bull. 18,

No. 1.

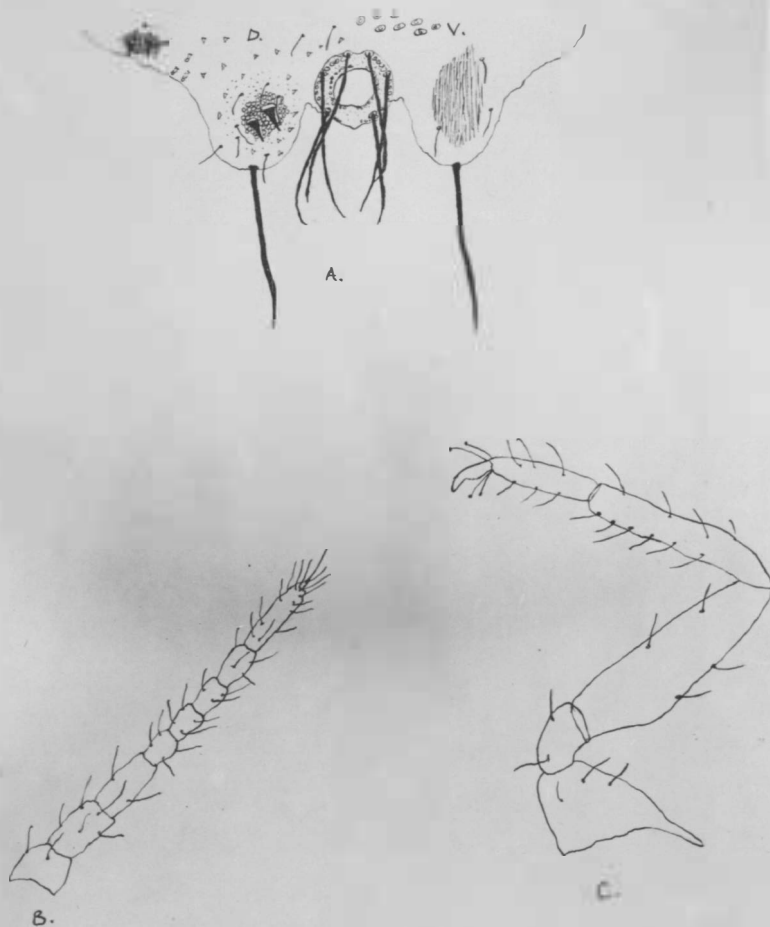
Plate-IV.



*Pleurocardia jessypii* T. and Chl. A. Anal lobe (dorsal view). B. Anal lobe (ventral view). C. Anal lobe (ventral view). D. Gynaeceum with two setae. E. Tarsus showing toothed claw. F. Antenna.



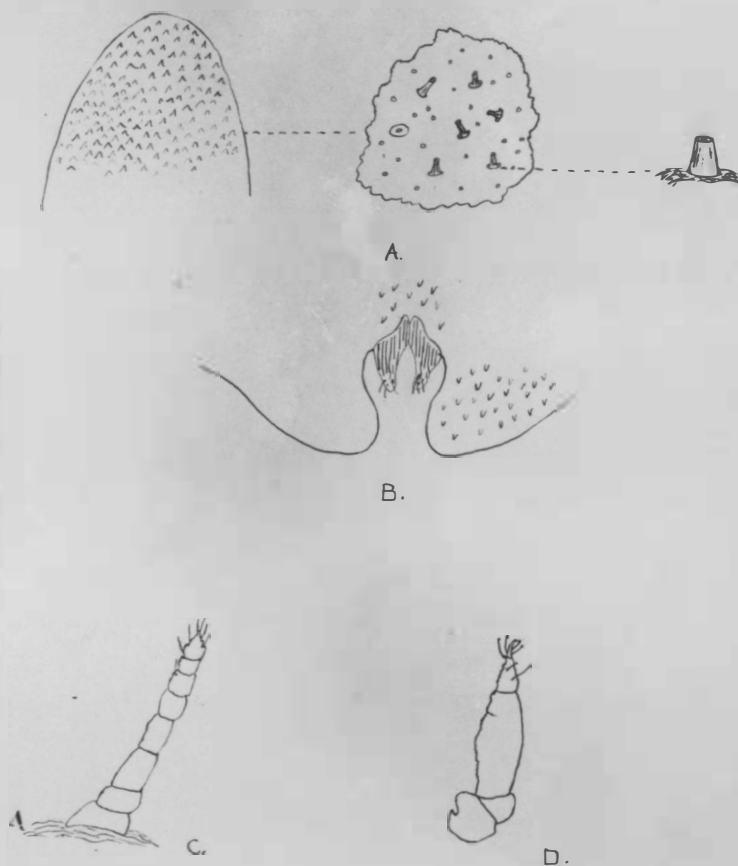
*Plindozoar curvi* Risso. A. Tip of body showing anal ring,  
and lobes. B. Carina on anal lobes. C. Ordinary cirrus.  
D. Antenna. E. Prothoracic leg.



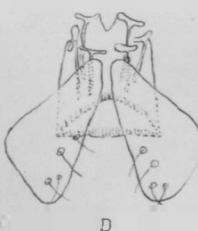
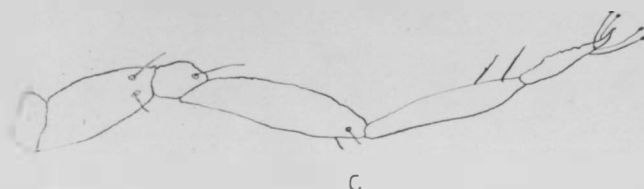
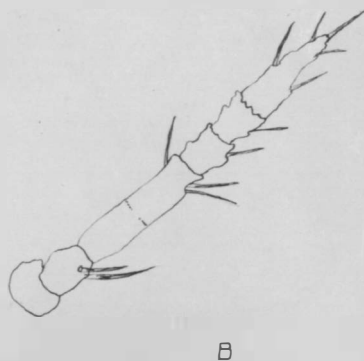
*Pseudococcus maritimus* Ehrhorn. A. Tip of body showing anal ring and lobes. D. Dorsal surface of lobe. V. Ventral surface of lobe. B. Antenna. C. Fore leg.



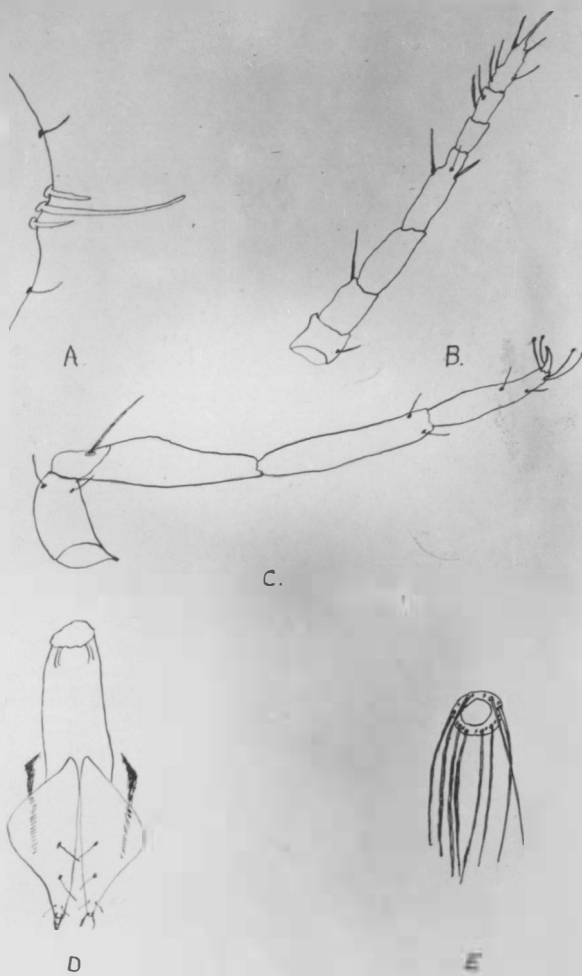
Plate-V  
VII.



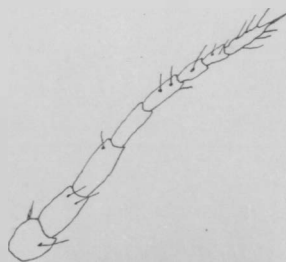
*Eriopeltis coloradensis* CKll. A. Dorsal section showing truncate dermopores. B. Anal cleft and plates. C. Antenna. D. Prothoracic leg.



*Lecanium corni* Bouche. A. Spiracular and marginal spines. B. Antenna. C. Prothoracic leg. D. Anal plates. E. Anal ring.



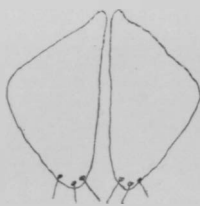
*Coccus hesperidum* Linn. A. Spiracular and marginal spines. B. Antennae. C. Prothoracic leg. D. Anal plates. E. Anal ring



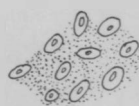
B



C



D



E

*Saissetia hemispherica* Targ. A. Spiracular and marginal spines. B. Antenna. C. Prothoracic leg. D. Anal plates. E. Derm pores.

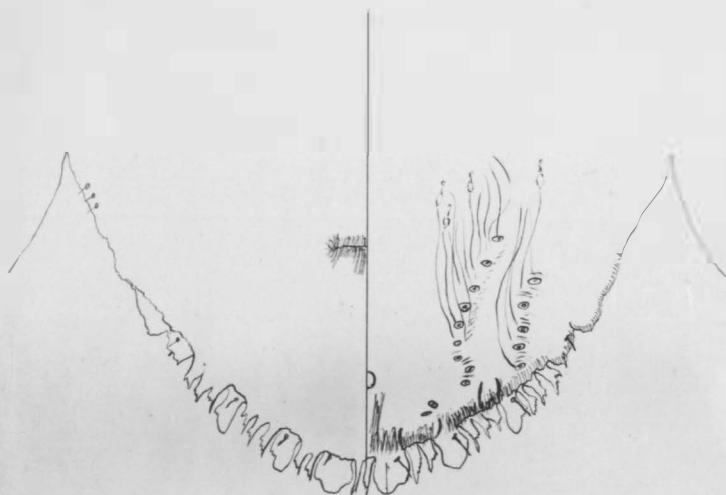


Fig. 1. Pigidium, *Chrysomphalus auratii* Mask.

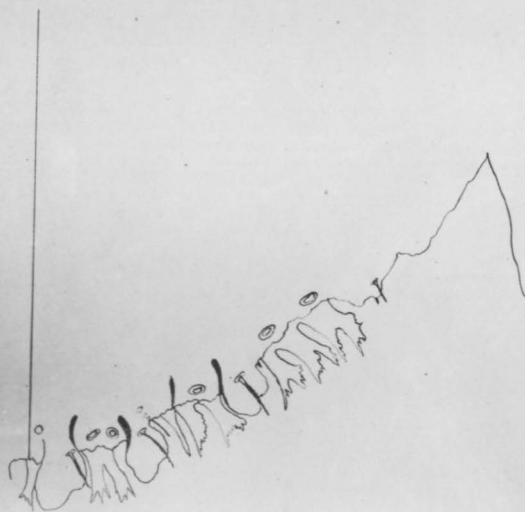


Fig. 2. Pigidial fringe, *Chrysomphalus auratii* Mask.

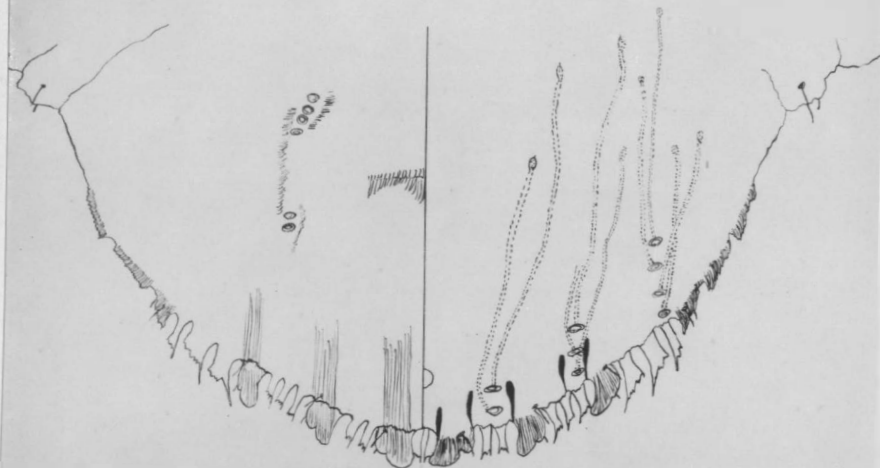


Fig. 1. Pigidium, *Chrysomphalus dictospermi* Morgan.

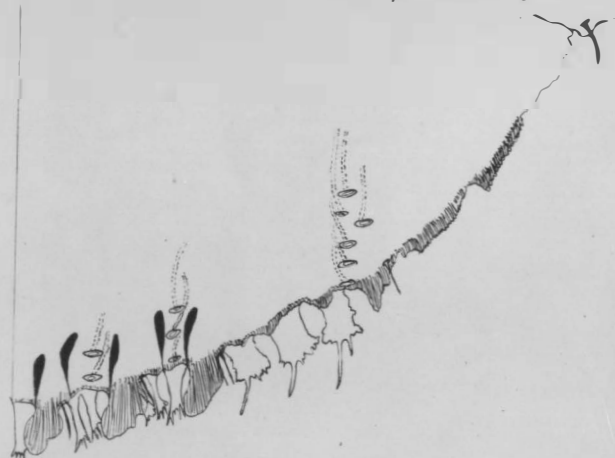


Fig. 2. Pigidial fringe, *Chrysomphalus dictospermi* Morgan.



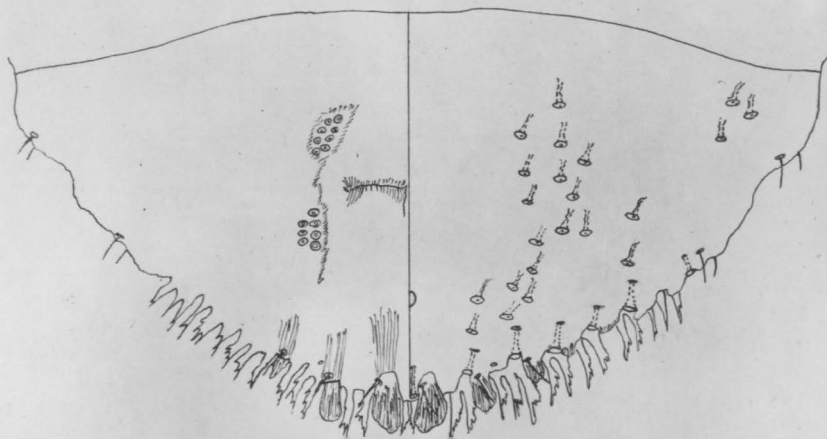


Fig. 1. Pigidium, *Aspidiotus hederæ* Vall.

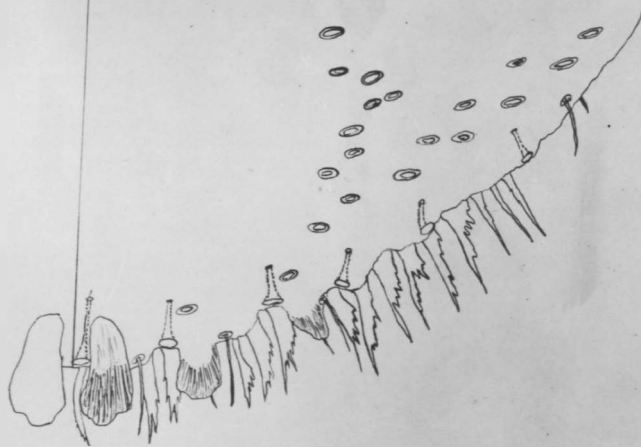


Fig. 2. Pigidial fringe, *Aspidiotus hederæ* Vall.

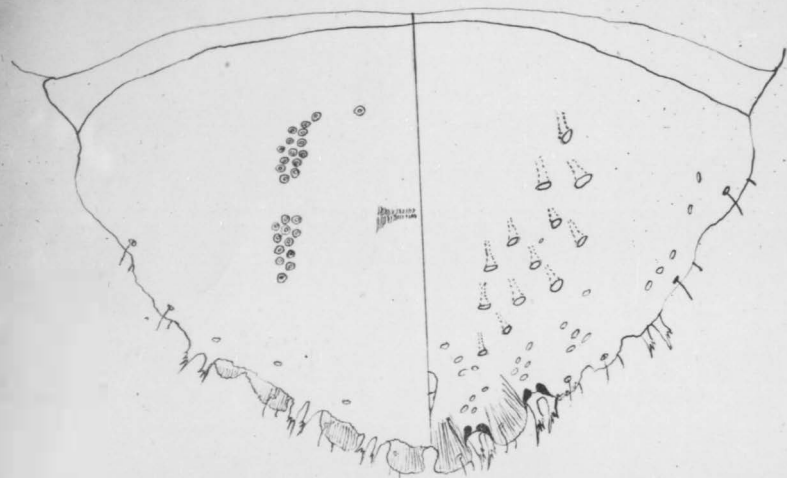


Fig. 1. Pigidium, *Aspidiotus ancylos*. Putnam.



Fig. 2. Pigidial margin, *Aspidiotus ancylos* Putnam.



Fig. 1. Pigidium, *Parlatoria pergandii* Comst.

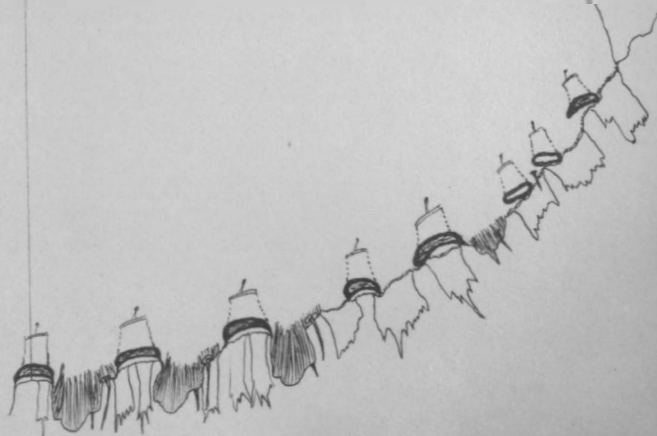


Fig. 2. Pigidial fringe, *Parlatoria pergandii* Comst.

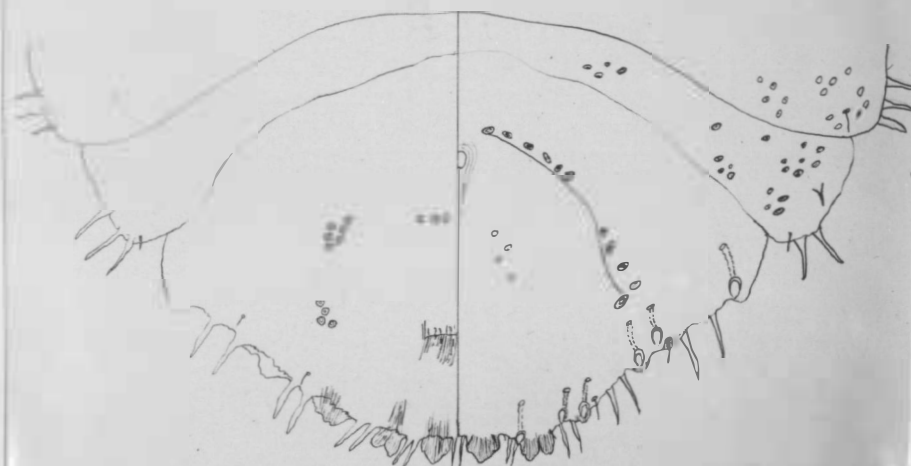


Fig. 1. Pigidium, *Lepidosaphes gloverii* Packard.



Fig. 2. Pigidial fringe, *Lepidosaphes gloverii* Packard.

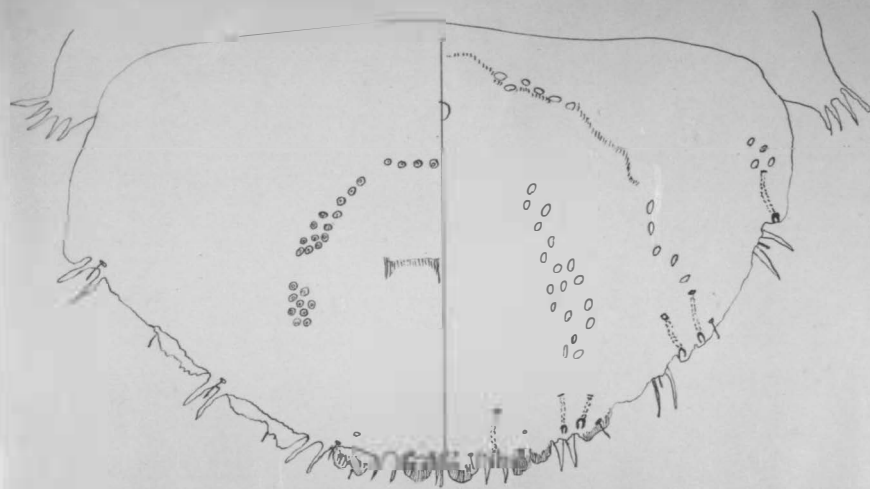


Fig. 1. Pigidium, *Lepidosaphes beckii* Newman.

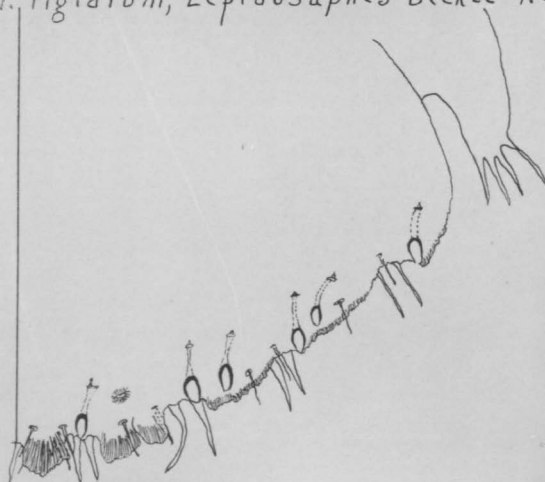


Fig. 2. Pigidial fringe, *Lepidosaphes beckii* Newman.

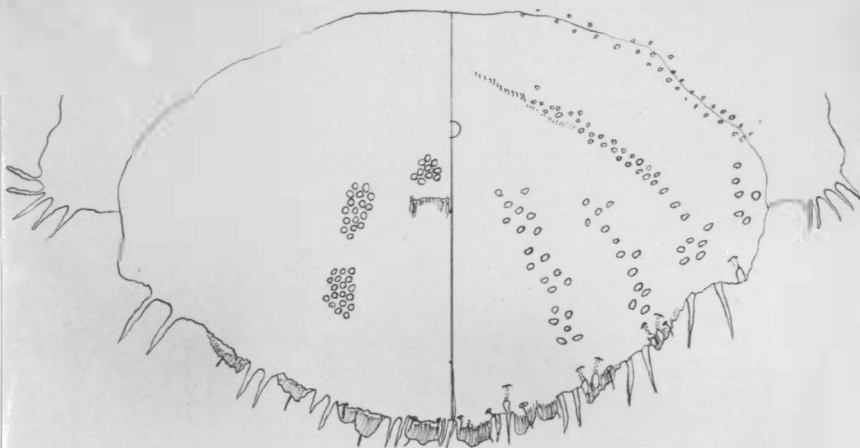


Fig. 1. Pigidium, *Lepidosaphes ulmi* Johns.



Fig. 2. Pigidial fringe, *Lepidosaphes ulmi* Johns.





Fig. 1. Pigidium, *Chionaspis americana* Johns.



Fig. 2. Pigidial margin, *Chionaspis americana* Johns.

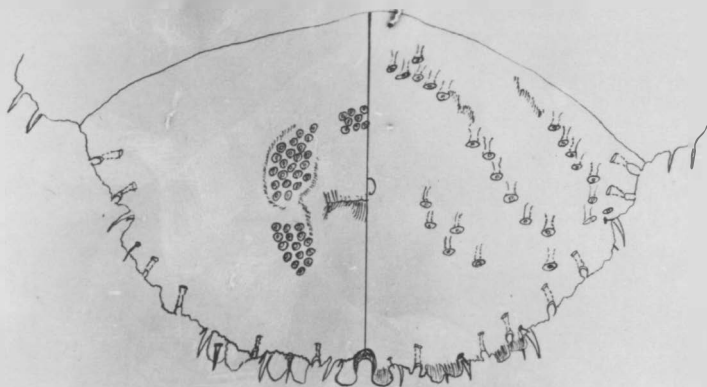


Fig. 1. Pigidium, *Chionaspis pinifolii* Fitch.

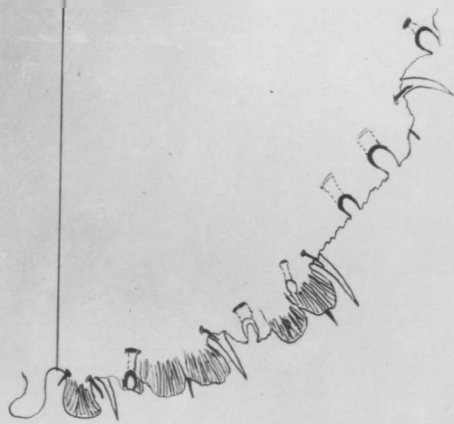


Fig. 2. Pigidial margin, *Chionaspis pinifolii* Fitch.

plate-XXI.

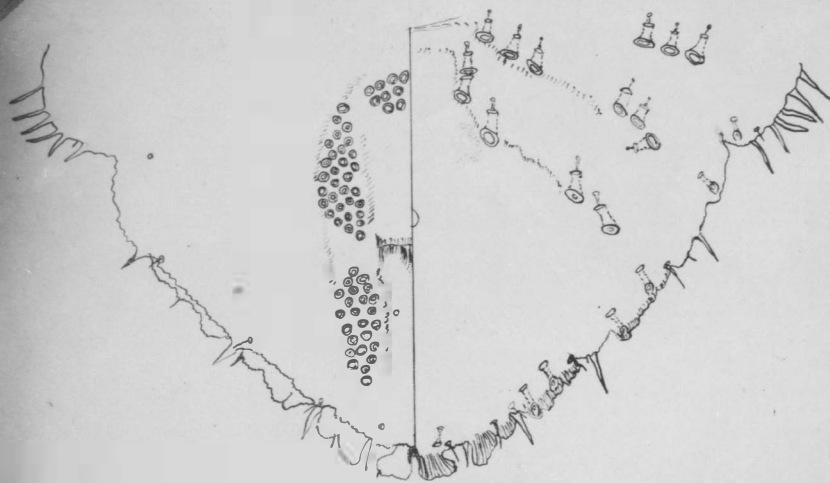


Fig. 1. Pigidium, *Chionaspis furfura* Fitch.



Fig. 2. Pigidial margin, *Chionaspis furfura* Fitch.



Fig. 1. Pigidium, *Chionaspis salicis-nigrae* Walsh.

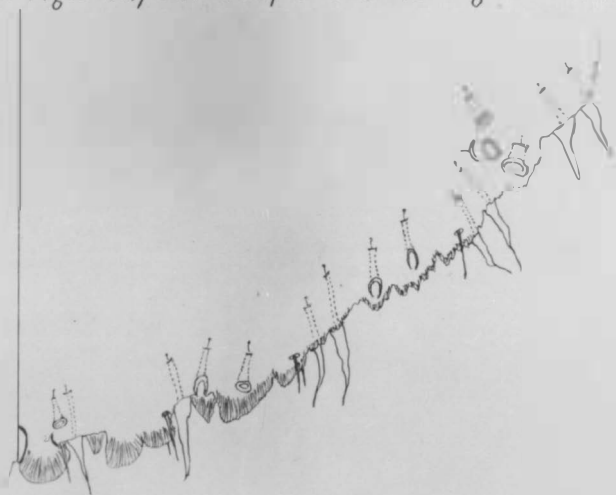


Fig. 2. Pigidial fringe, *Chionaspis salicis-nigrae* Walsh.