THESIS

SOME COCCIDAE OF THE GREEN HOUSE

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Thesis.

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Some Green House Coccidae.

In considering subjects for a thesis there seemed to be nothing more worthy to be worked up than that of the Coccidae of the green house. These insects. if not well understood and properly cared for, make life miserable for the florist who is trying to keep his plants free from pests. The ease with which they are carried from one place to another, and the rapidity with which they multiply make them very difficult to keep in check. For some of them proper and efficient remedies are difficult to find. When once they get a good start, there is scarcely any hope of keeping them in check, and if they become very numerous, they will destroy the plants.

These insects are not only of economic importance in conservatories but are of immense importance in orchards. Perhaps there is no pest which is more difficult to control. and which is now attracting more attention than the San Jose scale.

It is to some of the species found in the Michigan Agricultural College green house. however, that we have directed our attention. An attempt was made to differentiate the Coccidae by the character of the scales alone. But the determination of the species was made by use of the microscopic characters.

It is interesting. and indeed, necessary to know the position these insects have in nature before we make a study of them.

The sub-families Diaspinae to which belong the true scale insects Lecaninae to which belong the lecaniums. and others, and the Coccinae to which the mealy bugs and others belong are the three principal

sub-families of the family Coccidae.

The Coccidae constitute a family belonging to the group Homoptera of the order Hemiptera.

Interesting and valuable as it undoubtedly would have been to have worked out the life history of these troublesome insects, we decided at the outset of this work that owing to the limited amount of time, it would be wiser to omit all such experiments. For this reason we quote briefly from other works on the subject.

The newly hatched scale insect is oval in outline much flattened, with six legs, a pair of antennae, and an apparatus for sucking the juices from plants. After wandering about for a few hours, the young scale insect settles on some part of the plant and inserts its beak, and drawing its nourishment from the plant begins its growth. After a short time there appears over its body a slight covering of waxy or cottony material which serves both for protection and concealment. Soon afterward the larva commences to secrete a firm papery shieldlike covering which afterward becomes the permanent scale. During the completion of this scale the skin is shed once by the male and twice by the female. Both sexes lose their legs and antennae in shedding the skin thus becoming mere immovable scales capable only of feeding and secreting the scale.

After a time the insect molts a second time and changes to the pupa stage during which time the wings, legs, antennae and other appendages are formed inside the pupa skin. Before long the male emerges as a delicate two winged insect with one or two long, tail like appendages. As its life is very short thus requiring no food the adult male has no mouth parts well developed, and the two pairs of eyes take their place. The female always remains under the scale. After union of the two sexes the male dies and the female commences to lay her eggs, retiring into

one end of the scale and gradually shrinking during the process to a mere shriveled skin. The time when the eggs are laid varies in different species, many laying them during the autumn, but some remaining in a partly grown condition during the winter, deposit them in the spring.

In order that we may study the Coccidae to any advantage, we must have some method of classifying them. In classifying the sub-family Diaspinae we generally use the characters of the scales and not those of the insects. The form of the scales, the position of the exuviae, are the ones most used. The difference in form and color between scales of the different sexes is important. The presence or absence of the central carina and the comparative size of the exuviae are also important characters.

When the female scale is circular, or nearly so, with the exuviae more or less nearly marginal or central and the male scale is similiar, the insects are of the genus Aspidiotus.

When the female scale is circular with the exuviae in same position as other and the male scale elongated with exuviae at one end, the insect may belong to either of two genera: If the male scale is white with a central carina the insect is a member of genus Diaspis;

If the male scale is not white and with no central carina the genus is Parlatoria.

On the other hand, if the female scale is elongated with the exuviae at one end and the exuviae are small, the male scale being white and carinated. we have the genus Chionaspis.

If the male scale is white but not carinated we have the genus Poliaspis.

If the male scale is similiar in form to the female scale we have genus Mytilaspis.

If the exuviae are large and two molted skins visible on female

scale, the genus is Parlatoria.

If the exuvia are large and second skin is covered with a secretion we have Uhleria.

Following we give a description of each of the species found and studied:

Ischnaspis filiformis

(Plate I A. I and 2)

This is in this latitude, a green house scale. It is not widely distributed but when found is very troublesome. It was introduced into this country from Europe. Scale of the female is long, narrow, almost the same width throughout though slightly narrowed at the anterior end. The exuviae is small and at one end of the scale. It has a rather prominent ridge running lengthwise and has several small cross lines. The exuviae varies in color from light brown to dark brown while the remainder of the scale is black, sometimes with a very narrow and delicate margin of white or lighter brown. The veutral scale is well developed; It is greyish white in color and is attached at the sides. Scale of male is about one third the length of the female scale and is also straight and narrow. It is usually the same color as the female scale although sometimes it varies from a light brown to black. On the scales of both sexes fine lines are found indicating different stages of growth. The edges of both scales are even and clean cut and not irregular. This species is quite abundant here and is found especially on the Date Palm.

Mytilaspis citricola (Packard)

(Plate I B. I and 2)

The female scale is light brown in color, very narrow anteriorly but greatly developed at the posterior end. The edges are curved and irregular. The exuviae are small in size and about same color as the rest of the scale. It has the ridge running lengthwise with the minute

cross lines as in Ischnaspis filioformis. The veutral scale is present well developed, white in color. Sometimes it is thinly developed in the center of the posterior end. The female scale has a thin delicate margin of white also. The shape of these scales vary greatly owing to the different positions on the leaf or stem. The male scale is about one half the length of the female scale but is very different in shape. Instead of being much larger at the posterior end it is nearly liniar very slightly enlarged at the posterior end. The male scale resembles the female in color and the exuviae are very similiar. Both male and female scales show the fine lines indicating growth. This species is a very troublesome one to the orange growers in Florida and elsewhere. It is very abundant, being found mostly on Citrus auriantica in our conservatory.

Aspidiotus ficus (Riley MSS)

(Plate II A. I and 2)

This species is the most abundant of any found in the green house. It will grow on nearly all plants and is very troublesome indeed. The female scale is circular or very nearly so, with the exuviae more or less central. The main part of the scale is black. It has, however, a margin of white. This margin varies in width in different stages of growth being narrowest when the insect is adult. The position of the first skin is shown by a slight prominence, the skin when fresh is white The second skin is brick red sometimes, covered with a thin film of white. The scales vary in size but the largest are about one-eighth of an inch in diameter. The male scale is about one-fourth the size of the female scale and often has a thin flap developed from one side, which is white or pale green in color. Otherwise, the scale resembles that of the female. This species has a long host plant list. being found on the

following plants in our green house:

1. Aralia sieboldi
2. Areca baneria
3. Kentia fosteriana
4. Kentia belmoriana
5. Raphis flabelli formis
6. Areca rubra
7. Cycas revoluta
8. Cypripedium insigne
9. Coelogyne cristata

Aspidiotus nerii Bouche'.

(Plate II B. I and 2)

The female scale is quite irregular in shape, varying from circular to nearly rectangular in some cases. The position occupied on the leaf has much to do with this. The first skin which is small, makes a slight prominence and the second skin which is larger and is much darker, has the appearance of surrounding the first one. The scale has a thinner margin around the edge which varies in width. The veutral scale is not well developed. The male scale is similiar but is very much smaller in size. Its outline is very irregular, having the thinner margin also. The texture and color of the male and female scales are alike. This species is not as abundant as A. ficus. It is found on two plants in our conservatory, Chamaerops praecox and Corypha australis.

Aspidiotus ancylus, Putnam.

(Plate III B. I and 2)

This scale was found quite rarely in the conservatory here, being found on Hypericum and on Euonymus only. It is quite abundant in open air however, having there a large host plant list. The female scale is rather irregular in shape, resembling A. nerii in this respect. It is usually wider than long with the exuviae slightly lateral of the center. The exuviae are covered with a thin film of white which can be easily removed leaving the exuviae, which are brick red in color, exposed. The remainder of the scale, which is white, is grey in color, sometimes, however, it is nearly black. The veutral scale is present, being very

thin and delicate. The male scale is similiar to the female scale, but is much smaller and slightly more elongate.

Diaspis cacti Comstock

(Plate III A. I and 2)

This scale which is very injurious, takes its specific name from the host plant. It is found on nearly all cacti. The male scale is long, slender, white and unincarinated. The exuviae vary in color from pale yellow to brown, while the remainder of the scale is white, thus making a very striking appearance. The outline is quite regular, being nearly straight. The female scale varies from white to pale green in color with the exuviae of a dark color, varying from yellow to dark brown. The female scales of the genus Diaspis, are circular with the exuviae more or less central, while the male scales are long, white, and carinated with the exuviae at one end. While in the genus Chionaspis, the female scales are also long with the exuviae at one end. The female scale of Diaspis cacti is somewhat larger than most circular scales.

Chionaspis euonymi Comstock,

(Plate IV A. I and 2)

The female scale is a dull brown in color. The scale, like all those in this genus, is long with the exuviae at one extremity. In this species, the first skin is yellow in color, the second is darker, nearly as dark as the rest of the scale. The anterior end is narrow, but near the center of the second skin, the scale begins to widen very much, and is three or four times as wide at the posterior end as at the anterior end. It has quite a regular margin. The scales differ much in shape owing to the different positions occupied on the plant. Some of the scales are straight and some more or less gently curved. The ventral scale is well developed being joined to the dorsal scale at the sides, but free at the posterior extremity. The male scale is long, with parallel

sides, white and tricarinated. The exuviae is pale yellow. The outline of these scales is quite regular, and they do not vary much in shape. This species takes its specific name from its host Enouynius.

Chionaspis aspidistrae Signoret

(Plate IV B. I and 2)

This scale is found on ferns in our conservatory. The female scale varies from clear yellow to brown in color and is rather regular in outline. The exuviae is small, of the same color as the other part of the scale. The first skin is of the normal size but the second skin is larger and has quite a prominent ridge, which is absent in the species euonymi belonging to the same genus. The female scale, instead of being straight or gently curved as in euonymi, is very abruptly curved in most of the specimens examined. The female scale is slightly smaller in this species than in euonymi. The male scale is white and carinated as in the other species. The outline of male scale of aspidistrae is much more irregular than that of euonymi. In some species it is very irregular more so than the male scales of any other species studied. This species is found mainly on Pteris serrulata cristata but it is also found on Cycas revoluta.

The sub-family Lecaninae is classified as follows:

A. Body naked or nearly so.

I. Female secreting a mass of cottony material in which the eggs are laid----------Pulvinaria

2. Female not secreting a cottony material, and laying her eggs beneath her body ----------Lecanium

B. Body covered with a layer of wax.---------- Ceroplastes

The genus Lecanium is the only one studied. We found, we believe, three species, two which we determined and one which we could not.

IX.

Lecanium tesellatum (Signoret)

(Plate V. B.)(Plate VII, I.2 3 and 4)

This lecanium is flat, much longer than broad, and usually narrowed anteriorly. Somtimes the shape which is usually oval, is much varied owing to different positions on the leaves. The color is usually a chestnut brown but is lighter along the margin. The surface is distinctly reticulated. Under the microscope the surface appears to be covered with quadrilateral figures which are connected with transparent lines. These figures become longer nearer the edge and the lines wider. When seen under a higher power, the legs antennae, the anal plates and the mouth parts can be plainly seen. The antennae are eight jointed and vary in length as follows: The first is rather short, the second is much longer, the third is longer than the second. the fourth is slightly longer than the first but shorter than the second, the fifth is same length as second, the sixth is same as fourth, the seventh is shorter than first and the eighth is about the same length as the third but is much narrower and is notched in three places on each side. The legs are four jointed, having three digitules arising from the base of the tarsal claw. Two of them are long. slender and pointed. The other one is stout with a knob on the end. This species is found on Latania also very abundantly on Dactyllifera. the Date Palm.

Lecanium hemisphaericum (Targioni-Tozzetti)

(Plate V. A.)(Plate VI.I, 2 and 3)

This species is very abundant on the Sago Palm (Cycas revoluta) and is also found on Pteris serrulata. The specific name was suggested by its form. This is hemisphaerical with a flattened margin. The longitudinal carina is sometimes very prominent but more often is rather obscure or entirely wanting except at the ends of the body. The transverse carinae are usually present and quite prominent when the longitudinal carina is prominent, but when it is indistinct, they are usually

wanting. When under the microscope. the surface is seen to be covered with numerous pits, usually circular or elliptical but sometimes oval and quite large. The antennae are eight jointed and the joints vary in length as follows: The first is rather short, the second is a little shorter, the third is longest, the fourth is slightly shorter then the third, the fifth is about the same length as second, the sixth is shorter than the second, the seventh is shorter than sixth and the eighth is next as long as the third, being narrow with three notches on eaoh side opposite each other. The legs are four jointed, having four digitules arising near the base of the tarsal claw, two long slender ones knobbed and two rather short, stout ones having a large knob on the ends. This species varies in color from a chestnut brown to a seal brown.

Lecanium species(?)

(Plate VIII)(Plate IX.I,2.and 3)

We found on Pittosporium tobira a lecanium which is quite different from the other two species found in our conservatory. It is very much smaller in size and lighter in color, being nearly tan in some specimens and varying to chestnut brown.The longitudinal carina is present and quite distinct. The transverse carinae are always well developed, thus differing from hemisphaericum in this respect. The scale is nearly as wide as long and is flatter than hemisphaericum. The antennae are eight jointed. The first is short. the second is slightly longer. the third longest the fourth longer than second but shorter than third, the fifth is about the same as first. the sixth is slightly longer than fifth, the seventh is shortest, the eighth is shorter than third, narrow with the edges three notched on each side opposite each other. The leg in this species has three digitules, two short, stout ones with large knobs and one long.slender one with a small knob.

List of Works Consulted During the Fore-going Study.

I. Second Report of the Cornell University Experiment Station, 1882-3.

2. Agricultural Report of the Entomologist for 1880.

3. Comstock's Manual of Insects.

4. Comstock's Introduction to Entomology.

5. Report of Agricultural Experiment Station of University of California for 1894-5.

6. Essai sur les Cochenilles, Par M. le docteur V. Signoret.

7. First Annual Report of State Entomologist of Minnesota for 1895.

Explanation of Plates.

I. A. Ischnaspis filoformis — I. Female scale, 2. Male scale.

B. Mytilaspis citricola — I Female scale, 2. Male scale.

II. A. Aspidiotus ficus — I. Female scale, 2. Male scale.

B. Aspidiotus nèrii — I. Female scale, 2. Male scale.

III. A. Diaspis cacti — I. Female scale. 2. Male scale.

B. Aspidiotus ancylus — I. Female scale, 2. Male scale.

IV. A. Chionaspis euonymi — I. Female scale, 2. Male scale.

B. Chionaspis aspidistrae — I. Female scale, 2. Male scale.

V. A. Lecanium hemisphaericum

B. Lecanium tesselatum

VI. Details of Lecanium hemisphaericum

I. Antenna. 2. Leg. 3. Anal Plates.

VII. Details of Lecanium tesselatum

I. Antenna. 2. Leg. 3. Anal plates. 4. Insect much enlarged, showing tesselations.

VIII. Lecanium species?

IX. Detail of Lecanium species?

I. Antenna. 2. Leg. 3. Anal plates.

Table Showing Difference Between the Three Species of Lecaniums Studied.

Species	L. Tesselatum	L. Hemisphericum	Species(?)
Size	4 x 3,1/2 m.m.	3 x 3, 1/2 m.m.	2,1/2 x 2mm.
Color	Chestnut brown	Varies from light brown to nearly black.	Varies from tan to chestnut brown.
Form	Very flat. sometimes convex.	Very convex,slightly emarginate.	Somewhat convex, emarginate.
Skin Texture	Tesselate	Evenly punctuate. Rather oval.	Punctuate around edges, not in center.
Surface	Slightly reticulate.	Dull, evenly sprinkled with very fine points. Sometimes carinated. I.longitudinal 2.transverse.	Carinated medially dull, evenly sprinkled with fine points.
Antennae Number of joints in order of size.	3-8-2-5-6-4-2-I-7	3-8-4-I-5-2-7	3-8-2-4-6-5-I-7
Legs digitules	I Club shaped. digitule knobbed. 2 long narrow ones pointed.	2 club shaped ones knobbed. 2 long,slender ones knobbed.	2 club shaped ones knobbed. I long, slender one knobbed.