COCCIDAE OF CALIFORNIA

EDWARD K. CARNES

REPRESENTATIVES OF THE PRINCIPAL CALIFORNIA FAMILIES OF COCCIDAE

PLATE II.

REPRESENTATIVES OF THE PRINCIPAL CALIFORNIA FAMILIES OF COCCIDÆ.

1. Mealy-bug (*Pseudococcus aurilanatus*), enlarged.

1*a*. Same, natural size, on coleus.

2. Mealy-bug (*Pseudococcus longispinus*), enlarged.

2*a*. Same, natural size, on coleus.

3. *Orthezia insignis*, enlarged.

3*a*. Same, natural size, on coleus.

4. Black scale (*Saissetia oleæ*), female, enlarged.

4*a*. Same, natural size, on orange.

5. Yellow scale (*Chrysomphalus aurantii citrinus*), ventral aspect of female, greatly enlarged.

5*a*. Same, slightly reduced, on orange leaf.

6. Red scale (*Chrysomphalus aurantii*), ventral aspect of female, greatly enlarged.

6*a*. Same, slightly reduced, on orange leaf.

7. Purple scale (*Lepidosaphes beckii*), ventral aspect of female, greatly enlarged.

7*a*. Same, slightly reduced, on orange leaf.

8. Cottony-cushion scale (*Icerya purchasi*), ventral aspect of female, greatly enlarged.

8*a*. Same, on orange twig, somewhat reduced,

STATE HORTICULTURAL COMMISSION

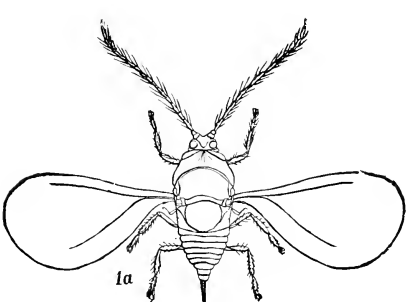
ELLWOOD COOPER, Commissioner

THE COCCIDAE OF CALIFORNIA

A Descriptive List of the Different Scale Insects Found in and Reported from California

BY

EDWARD K. CARNES



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1906

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THE COCCIDAE OF CALIFORNIA.

By EDWARD K. CARNES.

About sixteen years ago the State Board of Horticulture published a list of the Coccidæ (scale insects) of California, giving some twenty species found in the State. At that time comparatively little was known, by the residents of the State, about scale bugs or the amount of injury that could be caused by them; yet, to-day, there is no other single family of insects that is as important to the horticulturists of the world as are these minute creatures, and we can not know too much about them.

As a group they are very unattractive to the average entomologist, and even more so to the average horticulturist, yet a knowledge of the species and the best known methods of combating their attacks is a very essential part of the education of every successful fruit-grower. Fruit-growing is a competitive business, and the successful grower must avail himself of every opportunity to gain knowledge that will be of assistance to him in his business; therefore, it has been deemed advisable to bring before his notice the following list of species occurring in California, with illustrations and short descriptions of the more important varieties, in order to enable the grower to recognize and distinguish between the destructive species and those that are not so destructive. Since the first list was published, and especially during the last few years, there has been a very active period among the growers, orchardists, nurserymen, and those having greenhouse interests, to gain a knowledge of "scale insects." This activity has not been prompted by a love of the study of this particular branch of entomology, but purely as a business proposition, for these seemingly insignificant insects are capable of causing an enormous loss to the orchard, vineyard, nursery, or field in which they have gained a foothold. It must be remembered that each scale insect, after it has settled on the trunk, branch, or leaf of its particular host plant, virtually turns itself into an automatic pump and extracts the sap which is so vital to the life and growth of the tree. Usually the damage is done before the infestation is discovered, as many of our growers are absolutely without the slightest knowledge of scale insects. A tree, plant, or shrub will put forth every effort to sustain itself against the attack of the insect and will not show any immediate damage from the insects at work upon it, but even the strongest tree must ultimately yield to the persistent pumping of its life sap by the enormous number engaged in the work, and will suddenly

collapse and die. This damage and loss might easily be overcome had the grower possessed a slight knowledge of the nature and work of scale insects, for remedial measures could have been applied at the first notice of their presence and their ravages stayed. It is partly with the idea of presenting this knowledge to the grower that the writer has deemed it advisable to publish the following list of 132 species which have been reported from this State, but of which list only 114 are actually found here. This list, with the illustrations and descriptions, it is hoped will enable the grower to recognize the destructive species and, with this knowledge at hand, avoid the danger and loss which their presence, unmolested, would eventually cause.

By personally collecting over the State, and with the kindly assistance of many residents of the State who are interested in the study of Coccidæ, and who have sent many specimens from various localities, the writer has been able to bring together the present authentic list.

The nomenclature of the "Coccidæ of the World," by Mrs. Fernald, has been followed in connection with the classification of the species. In this valuable work on Coccidæ, California has been credited as the habitat of several very destructive species which, in fact, are not to be found in the State, having been reported from quarantine only; other species are found only in greenhouses; and still others, the presence of which I have personally investigated, are to be found in California which are not given in the catalogue mentioned; these latter species I have added to the list of California Coccidæ. Undoubtedly additional species could be added to the list by closer investigation and collecting, as several new species are being prepared for publication, but which I am sorry to say will not be completed in time for this report. Additional species will be added to the list from year to year as they are discovered or described. The writer has only included the species known to exist in California at the present time.

For the descriptions and classification of the species mentioned the writer has freely consulted most of the leading entomological works on the subject of Coccidæ, and wishes to acknowledge the aid received from the efforts of the many able writers who have contributed to this subject; also, takes this opportunity to thank all those persons who have assisted in the work and made it possible to compile the present list.

While the primary object of this paper is to serve as a list for the benefit of fruit-growers, at the same time it is hoped that it may be useful to those students of Coccidæ who are making a study of the California forms. The scientific descriptions may not be of much benefit to the former class, yet they are indispensable to the latter in determining species, and have been added to encourage the study of this most important family. At the same time, the writer has endeavored

to make the descriptions as plain as possible so that the average person can determine the different species with some degree of accuracy.

It must be remembered that when viewing one of the Diaspinæ externally, we are not looking at the real insect, but by carefully lifting up the shell-like covering the real culprit will be discovered underneath, as this covering only serves as a protection for the insect itself. Under the shell, the scale-bug appears as a legless, wingless, and almost shapeless form. For close study, by advanced students, it is removed from under the scale which covers it, and boiled in a solution of potash until colorless; it is then placed for about two hours in a water bath, and then mounted on a glass slide in glycerine jelly. The specimen is now ready for classification, and with the aid of a good compound microscope the distinguishing features can be easily recognized.

The descriptions of the more important species have been given, also reference has been made to others where the descriptions were not available. Illustrations of many of the species have also been added. Because of the fact that the amount of space which has been allotted to this paper is limited, the author has not been able to make it as complete as the importance of the subject demands; however, it is hoped that it will serve the purpose for which it is intended.

COCCIDAE OF CALIFORNIA.

(Scale Insects and Mealy-Bugs.)

Order **HEMIPTERA.** Family **COCCIDÆ.**

The following list of 132 species has been recorded, in the entomological literature of the world, as occurring in California. Those species included in this list designated by an asterisk (*) have been reported from quarantine and are not established in this State:

Subfamily **MONOPHLEBINÆ.**

Species.	Host Plant.
Icerya purchasi crawii Ckll.	Orange, Lemon, Grape-fruit, Acacia, Pittosporum, Laburnum, Broom, Rose.
Icerya purchasi maskelli Ckll.	Food plants, same as above.

Subfamily **MARGARODINÆ.**

Xylococcus quercus Ehrh.	Quercus chrysolepis.

Subfamily **ORTHEZIINÆ.**

Orthezia insignis Dougl.	Coleus, Verbena, Chrysanthemum, Citrus, Tomato, Strawberry. (In greenhouse.)

Subfamily **DACTYLOPIINÆ.**

Species.	Host Plant.
Asterolecanium quercicola Bouche	Oak.
Lecaniodiaspis rufescens Ckll.	Adenostoma oblongifolia.
Cerococcus ehrhorni Ckll.	Live Oak.
Cerococcus quercus Coms.	Oak.
Pollinia pollini Costa	Olive.
Kermes austini Ehrh.	Quercus oblongifolius.
Kermes cockerelli Ehrh.	Quercus lobata.
Kermes galliformis Riley	Oak.
Kermes nigropunctatus Ehrh., Ckll.	Oak.
Gossyparia spuria Modeer.	Elm.
Eriococcus adenostomæ Ehrh.	Adenostoma fasciculatum.
Eriococcus araucaria Mask.	Araucaria excelsa, A. bidwillii.
Eriococcus artemisiæ Kuw.	Artemisia.
Eriococcus palmeri var. *A.* Ckll.	Eriogonum fasciculatum.
Dactylopius coccus Costa.	Cactus sp.
Sphærococcus distichlium Kuw	Distichlis maritima.
Phenacoccus artemisiæ Ehrh.	Artemisia californica.
Phenacoccus simplex King.	Atriplex.
Phenacoccus stachyos Ehrh.	Stachyos bullata.
Phenacoccus kuwana Col.	Lichen on Picea breweriana.
Ceroputo bahiæ Ehrh.	Bahia.
Ceroputo yuccæ Coq.	Yucca sp.
Ceroputo yuccæ ceanothi Ckll.	Ceanothus oliganthus.
Pseudococcus aurilanatus Mask.	Araucaria bidwillii.
Pseudococcus azaleæ Tins.	Azalea. (In Japanese nursery.)
Pseudococcus calceolariæ Mask.	New Zealand Flax. [etc.
Pseudococcus citri Risso	Orange, Lemon, Ivy, Coleus, Croton,
Pseudococcus craw ii Coq.	Sagebrush.
Pseudococcus ephedræ Coq.	Ephedra californica.
**Pseudococcus iceryoides* Mask.	Fagus fusca.
Pseudococcus longispinus Targ.	Fern, Croton, Cycas revoluta, and many other plants.
Pseudococcus maritimus Ehrh.	Eriogonum latifolium.
Pseudococcus pseudonipæ Ckll.	Cocoanut Palm. (In greenhouse.)
Pseudococcus quercus Ehrh.	Quercus chrysolepis.
Pseudococcus ryani Coq.	Cupressus macrocarpa.
Pseudococcus salinus Ckll.	Grass.
Pseudococcus sequoiæ Col.	Redwood. [decurrens.
Pseudococcus andersoni Col.	Cupressus goveniana, Libocedrus
Pseudococcus dudleyi Col.	Cupressus macnabiana.
Erium eriogoni Ehrh.	Roots of Eriogonum.
Ripersiella kelloggi Ehrh., Ckll.	Roots of Bunch-grass.

SPECIES.	HOST PLANT.
Ripersia festucæ Kuw.	Festuca scabrella.
Ripersia villosa Ehrh.	Quercus agrifolia.
Antonina crawi Ckll.	Bamboo.

Subfamily **COCCINÆ.**

Pulvinaria bigeloviæ Ckll.	Bigelovia.
Pulvinaria camelicola Sign	Camellia. (In greenhouse.)
Pulvinaria ehrhorni King	Willow, Alder.
Pulvinaria innumerabilis Rathv.	Apple, Pear, Grape, Willow, etc.
Pulvinaria psidii Mask.	Fern, Pittosporum. (In gr'nhouse.)
Pulvinaria rhois Ehrh.	Rhois diversiloba. [tum.
Exæretopus caricis Ehrh.	Carex breweri, Trisetum subspica-
Ceroplastes ceriferus Anderson	Camellia. (In greenhouse.)
Ceroplastes cistudiformis Town, Ckll.	Pepper-tree.
Ceroplastes cirripediformis Comst.	Pepper-tree.
**Ceroplastes floridensis* Comst.	Citrus, Mango, Anthurium.
Ceroplastes irregularis Ckll.	Atriplex sp.
Vinsonia stellifera West.	Orchids, Ferns, Cocoanut Palms. (Orchid in greenhouse.)
Eucalymanatus perforatus News.	Kentia Palms. (In greenhouse.)
Coccus hesperidum Linn.	Orange, Lemon, Grape-fruit, Oleander, Ivy, Maple, Laurel, etc.
Coccus ventralis Ehrh.	Tuberous plants. (In Japanese Nursery.)
Eulecanium adenostomæ Kuw.	Adenostoma fasciculatum.
Eulecanium armeniacum Craw.	Apricot, Peach, Plum, Pear, Prune, Cherry, Grape, etc.
Eulecanium cerasorum Ckll.	English Walnut, Pear.
Eulecanium crawii Ehrh.	Acer macrophyllum.
Eulecanium magnoliarum Ckll.	Virginia Creeper, Grape.
Eulecanium prainosum Coq.	Prune, Apricot, Peach, Plum, Haw-
Eulecanium pubescens Ehrh.	Oak. [thorn, Rose, Apple.
Eulecanium quercitronis kermoides Tyr.	Oak.
Eulecanium tulipiferæ Cook	Cherry.
Saissetia filicum Bdv.	Ferns.
Saissetia hemisphærica Targ.	Orange, Cycas revoluta, Ferns.
Saissetia hemisphærica hibernaculorum Bdv.	Ferns, and various hothouse plants.
Saissetia nigra Nietn.	Palms. (In greenhouse.)

Species.	Host Plant.
Saissetia oleæ Bern.	Olive, Orange, Lemon, Grape-fruit, Peach, Prune, Plum, Apricot, Apple, Pear, Pomegranate, Oleander, Rose, Pittosporum, and many other plants and shrubs.
Physokermes insignicola Craw	Pinus insignis.
Physokermes concolor Col.	Abies concolor.
Physokermes taxifoliæ Col.	Pseudotsuga taxifolia.
Aclerda californica Ehrh.	Andropogon furcatus.
Aclerda tokionis Ckll.	Bamboo.

Subfamily **DIASPINÆ.**

**Chionaspis citri* Comst.	Orange.
**Chionaspis difficilis* Ckll.	Elæagnus.
Chionaspis orthelobis Comst.	Willow.
Chionaspis pinifoliæ Fitch	Pine and other coniferous trees.
Chionaspis quercus Comst.	Oak.
Chionaspis salicis-nigræ Walsh	Willow, Ceanothus.
**Chionaspis wistariæ* Cooley	Wistaria. (From Japan.)
**Howardia biclavis* Comst.	Orange.
Diaspis bromeliæ Kuw.	Pineapple.
Diaspis carueli Targ.	Juniper, Cupressus.
Diaspis cattleyæ Ckll.	Cattleya.
**Aulacaspis crawii* Ckll.	Elæagnus umbellata.
**Aulacaspis pentagona* Targ.	Flowering Peach, Plum, Sago-palm.
**Aulacaspis pentagona auranticolor* Ckll.	[Japan.) Osmanthus illicifolia. (From
Aulacaspis rosæ Bouche	Rose, Blackberry, Raspberry. (Infesting the canes.)
**Phenacaspis aucubæ* Cooley	Aucuba. (From Japan.)
**Phenacaspis chinensis* Ckll.	Quercus. (From China.)
**Phenacaspis cockerelli* Cooley	Palm. (From China). [Japan.)
**Phenacaspis latissima* Ckll.	Distylium racemosum. (From
Hemichionaspis aspidistræ Sign.	Aspidistar lurida. [Japan.)
**Leucaspis japonica* Ckll.	Broom, Maple, Peonia. (From
Leucaspis cupressi Col.	Cupressus goveniana. [nifica.
Leucaspis kelloggi Col.	Pseudotsuga taxifolia, Abies mag-
Fioriuia fioriniæ Targ.	Cocoanut-palm, Camellia, Ferns, Ficus sp.
Epidiaspis piricola Del Guer.	Pear, Plum, Apple, Peach.
Aspidiotus æsculi Johns.	Æsculus californica.
Aspidiotus hederæ Vall.	Oleander, Ivy, Lemon, Asparagus, Fern, Cycas revoluta, Palms, Orchids, Camellia.

Species.	Host Plant.
Aspidiotus juglans-regiæ Comst.	English walnut.
**Aspidiotus ostreæformis* Curt.	Pear, Apple.
**Aspidiotus perniciosus* Comst.	Apple, Pear, Peach, Quince, Apricot, Plum, Hawthorn, Rose, Currant, Raspberry, etc.
**Aspidiotus perniciosus albopunctatus* Ckll.	Orange, Plum. (From Japan.)
Aspidiotus rapax Comst.	Willow, Holly, Ivy, Acacia, Orange, Pittosporum, Camellia, Palms, Ferns, etc.
Aspidiotus californicus Col.	Pinus sabiniana, P. ponderosa, P. lambertiana, P. attenuata.
Aspidiotus coniferarum shasta Col.	Cupressus macnabiana.
Aspidiotus ehrhorni Col.	Under lichens on Abies concolor, Libocedrus decurrens.
Aspidiotus florenciæ Col.	Pinus ponderosa.
Pseudaonidia duplex Ckll.	Camellia. (In Japanese nursery.)
**Pseudaonidia pæonia* Ckll.	Peony. (From Japan.)
Chrysomphalus aonidum Linn.	Palms. (In greenhouse.)
Chrysomphalus aurantii Mask.	Orange, Lemon, Grape-fruit, Rose, Cycas revoluta, and species of Palms.
Chrysomphalus aurantii citrinus Coq.	Orange, Oleander, Palms.
Chrysomphalus tenebricosus Comst.	Maple, Apple.
Targionia bigeloviæ Ckll.	Bigelovia brachylepis.
**Odonaspis bambusarum* Ckll.	Bamboo. (From Japan.)
Lepidosaphes beckii Newm.	Orange, Lemon, Grape-fruit, Palms.
Lepidosaphes crawii Ckll.	Quercus cuspidatus.
Lepidosaphes gloverii Pack.	Orange.
Lepidosaphes ulmi Linn.	Apple, Pear, Plum, Willow.
Parlatoria pergandii Comst.	Orange.

DESCRIPTION OF THE MORE IMPORTANT SPECIES, WITH NOTES.

Accompanying the descriptions of the more important species in the following pages will be found a number of illustrations, which will give the reader a fair idea of the general appearance of the different forms of scale insects, as well as a colored plate showing members of each of the principal subfamilies represented in California.

For the convenience of the County Horticultural Commissioners and Inspectors, as well as of others interested in this study, a number of plates have been added, showing original drawings of the last abdom-

inal segments of many of our more important species. In the study of scale insects, especially those members of the subfamily Diaspinæ, in order to make final determination of the species the first requisite is a good microscope. The last abdominal segment of the adult female presents peculiar organs, designated by distinct names. These terms must be recognized by their various names in order to accurately determine any given species from the technical description. A glossary of the scientific terms used in the descriptions of the Coccidæ is presented herewith. On Plate III will be found an illustration of the last abdominal segment of an adult female Diaspinæ, showing the form and position of the terms used. By careful study of this figure, aided by the glossary, the technical descriptions will lose their mystification to the beginner, and after a little practice any intelligent person, aided by the microscope, will be able to identify species with some degree of accuracy.

When the determination of a scale insect is wanted, first observe the name of the host plant upon which it is found, then turn to the list of species and note what scales are found upon that particular plant in California. In case there are several species, note the general description of the scale in hand and compare it with the illustrations, and, in many cases, the determination may be made from this alone. If this is not sufficient, read the description of the female, and in this case the final determination calls for the use of the microscope. By following the description and referring to Plate III the various organs used in the determination of the species will be seen and made clear. The descriptions have been systematically arranged according to subfamily and genus.

GLOSSARY OF TERMS USED IN DESCRIPTIONS.

Abdomen. All the hinder part of the insect, the third of the three main divisions of the body (head, thorax, and abdomen).

Anal Lobes; Anal Plates. A small pair of triangular processes forming a valve which covers the anal orifice.

Anal Orifice. The external opening of the intestine.

Anal Ring. A circumscribed ring encircling the anal orifice.

Anal Tubercles. A pair of prominent rounded processes on each side of the anal orifice.

Antennæ. A pair of jointed organs or feelers situated on the head.

Appendages. General term for antennæ, mouth parts, and legs of an insect.

Bicuspid. Having two points.

Carina. A keel or ridge.

Carinated. Keeled, ridged, or ribbed.

Castaneous. Shiny, reddish brown.

Caudad. Situated toward the tail.

Cephalic. Pertaining to the head.

Cephalothorax. The anterior part of the body, comprising the head and thorax.

Chitinous. Consisting of a horny substance present in the skin and harder parts of insects.

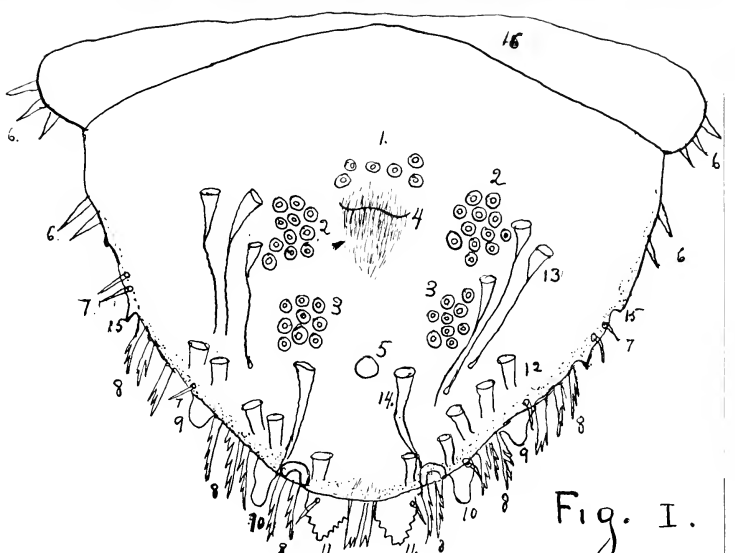


FIG. 1. PYGIDIUM OF FEMALE DIASPINÆ.

Circumgenital glands or spinnerets (in groups 1, 2, 3).

1. Median group.
2. Upper laterals.
3. Lower laterals.
4. Genital aperture.
5. Anal aperture.
6. Spine-like plates.
7. Spines.
8. Fumbriated plates.
9. Third pair lobes.
10. Second pair lobes.
11. First or median pair lobes—serrate.
12. Tubular spinnerets.
13. Trumpet-shaped filiform spinnerets.
14. Trumpet-shaped tubular spinnerets.
15. Marginal prominence.
16. Abdominal segment.

FIG. 2. BODY OF FEMALE DIASPINÆ.

1. Head.
2. Prothorax.
3. Mesothorax.
4. Metathorax.
5, 6, 7. Abdominal segments.
8. Pygidium.
9. Antennæ.
10. Rostrum.
11. Anterior spiracles.
12. Rostral setæ.
13. Posterior spiracles.
14. Spinnerets or circumgenital glands.
15. Genital aperture.
16. Pores of tubular spinnerets.

C. T. P., del.

VENTRAL SURFACE OF SCALE INSECT; SHOWING VARIOUS ORGANS.

Circumgenital Glands. Small circular glands in distinct groups around the genital orifice.

Coxa. The basal joint of the leg.

Depressed. Flattened from above downward.

Digitules. Appendages frequently present on the feet of Coccidæ.

Dorsal. Relating to the back or upper parts of the body.

Dorsal Scale. The part of the covering scale that lies above the scale proper and the part seen when viewing a scale externally; between this and the ventral scale is found the female.

Dorsum. The back or upper part of the body.

Exuviæ. The discarded skins shed at the periodical molts.

Femur. The thigh or upper part of the leg.

Filiform. Thread-like.

Honey-dew. A sweet, sticky substance exuded by the Coccidæ and other insects.

Incised. With marginal slits or notches.

Laterad. Toward the side.

Larva. The immature insect.

Lobe. Any prominent rounded process. (See illustrated plate.)

Mesad. Situated toward the middle.

Mesal. Relating to the middle.

Metamorphosis. The transformations of an insect during its development.

Ocelli. The simple or supplementary eyes.

Oviparous. Producing eggs.

Ovoviviparous. Producing eggs which are hatched within the body of the parent.

Parasitized. Containing parasites.

Pellicles. The "exuviæ" or cast larval skins.

Plate. Any broad, flattened piece.

Processes. Any prominent portions of the body not otherwise definable.

Pupa. The chrysalis or resting stage of an insect.

Pygidium. The compound terminal segment of the body. (See illustrated plate.)

Rostral Setæ. The four long, hair-like processes which together form the sucking tube.

Secretion. Matter produced by the various glands of the body, more particularly the cottony, waxy, silken substances of which the coverings of many scale bugs are composed.

Segments. The transverse divisions of the body.

Serrated. With margin notched like a saw.

Seta. A stout hair or bristle.

Spiracles. The respiratory organs.

Tarsus. The terminal joints of the legs.

Thorax. The second or main division of the body; that part which bears the legs and wings when present.

Tibia. The single joint of the leg immediately succeeding the "femur" and preceding the "tarsus."

Truncate. With end having appearance of being abruptly cut off.

Ventral. Relating to the under surface of the body.

Ventral Scale. The under part of the covering scale, between the insect and the plant.

Subfamily **MONOPHLEBINÆ.**

Icerya purchasi crawii Ckll.

Female (after forming ovisac).—Light pinkish or yellowish red; the margin orange, with bunches of short black bristles; the back is largely covered with yellowish-white secretion. Ovisac somewhat larger and longer than *maskelli*; femora decidedly more slender.

On orange, lemon, grape-fruit, acacia, pittosporum, broom, rose.

FIG. 1. *Icerya purchasi crawii.* Females on orange twig.

FIG. 2. Male of *Icerya purchasi crawii.*

Icerya purchasi maskelli Ckll.

Female (after forming ovisac).—Slate gray or very dark purplish gray, sometimes brownish in the middle, with marginal dull orange spots. Back little covered by secretion. More hairy at the cephalic end than *crawii*. Ovisac not so large as in *crawii*, tinged with yellow just behind the body of the insect. It is *purchasi* in the strict sense and agrees very nearly, though not entirely, with Maskell's description.

Food plants: same as *I. crawii*.

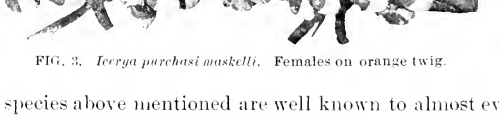


FIG. 3. *Icerya purchasi maskelli.* Females on orange twig.

The two species above mentioned are well known to almost every resident of California, and are commonly known as the cottony-cushion scale, the white scale, or the fluted scale. Until the introduction of their natural insect enemy (*Norius* [*Vedalia*] *cardinalis*) this pest engaged the attention of our citrus-growers more than any one thing, but within a few short months after its introduction, *N. cardinalis* had the pest practically controlled and has held it so for many years. To-day it is hard work to find enough of the scale to keep the breeding cases in our Insectary supplied with food. The two species mentioned are usually associated with each other on the same tree. They may be distinguished in the adult stage, however, as one is a light form and the other dark.

Subfamily **MARGARODINÆ.**

Xylococcus quercus Ehrh.

The specimen taken in October is very dark in color, blackish, the markings being only faintly indicated.

Egg quite large, of a light orange color.

Young larvæ dark orange-red, active, body broadly oval, about $\frac{2}{3}$ mm. long. Legs and antennæ light brown, well developed. Antennæ short, 6-jointed. Joint 1 stoutest, joint 6 longest, and joint 4 shortest. Formula: 6 5 1 2 3 4. Joints 2 and 5 with three bristles. Joint 6 with numerous long stout bristles. Legs moderately long, with femur quite swollen. Tarsus longer than tibia. Digitules of tarsus fine hairs; those of claw long stout clubs curved upward. Each segment of abdomen bears a backward-directed short stout spine. On each side of anal tube is a long fine bristle. Anal tube large, with numerous stout spines. Stigmatal tubes well developed.

Female (second stage).—Body crimson, shiny, nearly spherical, about $1\frac{1}{2}$ mm. long, 1 mm. broad, surrounded by cottony and waxy secretion. Antennæ and legs wanting. Anal tube well developed, producing a glassy rod, like a stout white hair, rather brittle. Last segment of body dark brown. When cleared in KHO, surface of body finely granulated, more so near caudal end. Stigmatal tubes are large and well defined. There are numerous spines and gland openings scattered over the body.

Third and fourth stages very similar to second stage, but larger in each case than the preceding, and varying in the further development of stigmatal and anal tubes, glands, spines, etc.

Adult Female.—Head, thorax, legs, and antennæ reddish brown, abdomen blackish brown, segmentation distinct. There is a distinct constriction between the thorax and abdomen. Length of body about $5\frac{1}{2}$ mm., breadth $2\frac{1}{2}$ mm., quite convex above. Ventral side of abdomen concave, with revolute margins. Insect quite active. When ready to deposit eggs crawls into some crevice and produces a cottony cushion, on which it rests and secretes considerable white cotton over its entire body. Antennæ 9-jointed. Joint 1 longest and broadest, next in length is 2, then joint 9, and then 3. Joints 4, 5, 6, 7, and 8 are subequal, and are a little shorter than 3. Formula: 1 2 9 3 (4 5 6 7 8). Legs long and stout. Tibia twice as long as tarsus, both very hairy. Claw long and stout. Digitules fine hairs. Body sparsely covered with long stout spines, especially along the margin and caudal end. Stigmatal tubes very prominent. Anal opening simple and quite large.

Adult Male.—About 3 mm. long and $1\frac{1}{2}$ mm. broad, slightly pubescent. Color of abdomen reddish brown. Mesothorax black, with four raised

knobs. Front part of head black, eyes very prominent, strongly faceted, black. Legs and antennæ black and very hairy. Ventral surface of abdomen dark brown, segmentation distinct. Mesosternum black, a small black line on poststernum, and an irregular black patch on metasternum. Abdominal brushes with long stout glassy bristles about 6 mm. long. Style short, stout, and conical. Antennæ 10-jointed, very hairy, reaching beyond end of abdomen. Joint 2 shortest, joints 3 and 10 a little longer, and the other joints subequal. Each joint with numerous hairs. Wings large, about 3 mm. long and 1 mm. broad, expanse about 7 mm.; smoky, slightly pubescent, with a costal space blackish brown; halteres resembling small wings with several hooks. Legs long, stout, and very hairy. Femur much shorter than tibia. Tibia about four times as long as tarsus. Digitules fine hairs. Claw long, slender, and well curved. Digitules short clubbed-shaped hairs.

On *Quercus chrysolepis*.

This wonderful insect is of little economic importance and requires close inspection to detect its presence. A long white, thread-like protuberance is first noticeable coming out of the cracks of the bark on the oak while the female is buried underneath.

Subfamily **ORTHEZIINÆ.**

Orthezia insignis Dougl.

(Colored Plate II.)

Adult Female.—Body broad oval; width, 1.2 mm.; length, 1.5 mm., exclusive of lamellæ; ochreous, mottled to dark green; distinctly segmented. Arranged around the body, beginning with the second thoracic segment, are white, waxy plates or lamellæ. In the adult female the lamellæ are united posteriorly, forming a long, parallel-sided marsupium, which contains the eggs and young. The arrangement of the lamellæ can be better shown by a figure (See colored Plate II) than by a description. Antennæ 8-jointed, all fulvous except the black, somewhat fusoid eighth joint; the first joint is very stout, the second the stoutest and shorter than the remaining ones. Legs light brown, the darker tarsi bearing numerous fine spines.

Adult Male.—The slender, dusky body is about 1 mm. in length, and bears two large ovate, transparent wings with two veins united at the base. Wing expanse, 2.5 mm. The last segment bears on each side a long, white filament.

This insect is strictly a greenhouse species, and sometimes is very destructive to coleus, verbena, and chrysanthemum.

Subfamily **DACTYLOPIINÆ.**

Pollinia pollini Costa.

This scale was introduced in 1887 from Italy on a shipment of olive trees, but its presence was not noticed until 1893, when the trees were destroyed and a careful search made for any other infestation. None has been noticed since that time, although a careful inspection has been made many times since, and it is reasonable to suppose that it was eradicated.

Kermes austini Ehrh.

Female Scale.—Spherical, about 4.5 mm. broad, 4 mm. long, 4 mm. high. Dorsum slightly covered with a waxy secretion. Scale not gibbous and segmentations indistinct, indicated by brown dots when seen through a lens. Color light brown, with several irregular white stripes running parallel with the segments. There is a distinct groove on the caudal portion of the scale, which is distinctly marked with brown. Scale more or less pitted; pits generally marked dark brown or black. Ventral scale is more or less flat and light brown. Keel not very prominent. When boiled in KHO derm is light brown, with several brown spots and numerous round gland-orifices, which are larger near the margin. A few short spines near the margin. Antennæ very short and stout, indistinctly 6-jointed. Joint 3 longest, 4 and 5 subequal.

Larva (taken from body of female).—Color pink, twice as long as broad; after boiling in potash, colorless. Antennæ and legs yellow. Antennæ 6-jointed. Formula: 3 6 (2 5) (4 1). Caudal tubercles large, with very long setæ and three stout spines—one at base of tubercle, one on its inner margin, and one near setæ. On the margin of body each segment has a stout spine. Legs stout. Tarsus not twice as long as tibia. Femur nearly twice as long as tarsus plus tibia. Claw slender and curved.

On twigs of *Quercus oblongifolius.*

Many specimens of this species are found to be parasitized.

Kermes cockerelli Ehrh.

Female.—Scale 5 mm. long, 4.5 mm. broad, and 4 mm. high, deeply segmented, dorsum usually marked with black lines and spots along the sutures, some specimens not showing any. There is a broad, median, longitudinal groove, where the segmentation is obsolete; on each side of this the segments are strongly gibbous. Color light brown, without any conspicuous black specks; derm, by transmitted light, brown with numerous oval glands, several large postulæ on body. Antennæ very small, 6-jointed; joint 3 very large, longer than the three following together; the others short, very little longer than 5, 4 shortest.

Larva elongated oval, rather more than twice as long as broad, yellow, greatest breadth behind the middle of body. Eyes red, caudal tubercles quite large, each bearing one long bristle and three stout spines, one near bristle and one on the outer and inner margins of tubercle. On the anterior margin of the head are six bristles; the sides of the abdominal segments are armed with stout, but not very long bristles. Antennæ cylindrical, 6-jointed; formula: (3 6) (1 2) 4 5; last joint rounded at tip with several hairs, one very long; rostral loop extending halfway between base of third pair of legs and anal ring. Legs quite large, claw long and curved; tibia shorter than tarsus.

On twigs of *Quercus lobata*.

Very much parasitized by undetermined chalcid.

Kermes galliformis Riley.

The following short description of this species is taken from Mr. King's article "The Genus Kermes in North America," and the description published in "Coccidæ of Ohio," by James G. Saunders:

"A large dirty-gray form, which turns to a nearly white color when exposed to a season on the twigs. Female scale 6 mm. long, 7 mm. broad, 6 mm. high, with black spots, and viewed with a hand lens the scale is seen to be covered with minute black specks. Newly hatched larva dirty gray."

On oak.

Kermes nigropunctatus Ehrh. and Ckll.

Female.—Scale 4.5 mm. long, 5.5 mm. broad, nearly 4 mm. high, not very pale ochreous, speckled all over with black, the black specks so small as to be readily overlooked without the use of a lens; segmentation obscure, but discernible, the sutures slightly impressed and marked by more or less pallid transverse bands; an obscure median longitudinal depressed line; under side of scale, where it touches the bark, flattened and entirely dark brown; derm by transmitted light yellow, with numerous round glands. Antennæ small, 6-jointed; joint 3 very long, about as long as 4, 5 and 6 together; joints 2 and 4 subequal and smallest. Formula: 3 1 6 5 (2 4).

Larva oval, about one and a half times longer than broad; greatest breadth about the middle; pink; caudal tubercles large and distinct, each bearing a moderately long bristle and three stout spines, one on the outer and inner margins and one near bristle. The sides of the abdominal segments are armed with stout, short bristles. Antennæ cylindrical, 6-jointed, formula 3 6 1 (4 5) 2; last joint rounded at tip with several hairs; joint 5 with a hair; rostral loop extending beyond third pair of legs; anal ring with six hairs. Legs stout, claw long and curved; tibia much shorter than tarsus.

The larvæ were found in body of female. It is something like *K. galliformis*, but distinguished by the impressed sutures.

On twigs of *Quercus*.

The four species of *Kermes* above mentioned are of little importance, although occasionally a tree may be found which will contain quite a few specimens of the scale, but in most cases they are heavily parasitized and are thus held in check and not allowed to increase to any extent.

FIG. 4. *Kermes nigropunctatus*. Larvæ and adults on twig of oak.

Gossyparia spuria Modeer.

(Elm-tree Scale.)

Larva.—The newly hatched larva is of an elongated oval form, narrower behind, of a clear yellow color, each segment with a strong lateral spine, and the front border of the body with six spines. The genito-anal ring has six hairs, around which is later formed a secretion, which renders them invisible. There is a double row of spines down the middle of the back; the antennæ are 6-jointed, joints 2 and 3 longest,

4 and 5 shortest. There is an elongated protuberance each side of the antennæ. The legs are short and slender, with the tibia shorter than the tarsus. The genito-anal ring has eight hairs.

The full-grown male larva has 7-jointed antennæ, joint 7 longest, the rest equal. After impregnation the female becomes more round, fixes herself, the secretion becomes much more abundant on the sides, making at first lamellæ, which afterwards unite into a cushion. The back becomes smooth and the segmentation becomes plainly visible. The dorsum is plane transversely, but curved longitudinally. Particularly after the birth of the young, the female becomes well separated from the waxy cushion, and is easily removed from it (even jarring will accomplish the removal), leaving the noticeably empty white cup with its fringed edges.

Dr. L. O. Howard gives the following description:

Male.—"The antennæ of the male are 10-jointed, the joints well separated. The wings are represented by pads of varying length. The poisers appear rather thick and fleshy, but lack the terminal hook.

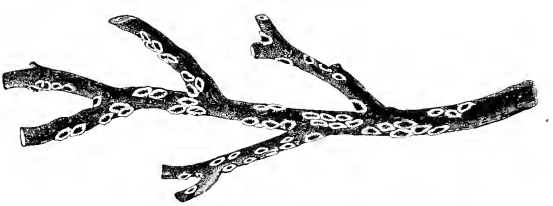


FIG. 5. *Gossyparia spuria*. On elm.

The abdomen is very stout, suboval, considerably broader than the thorax, and when seen from above covers coxæ, trochanters, and base of the femora. Its segments are not well marked. A few days after this form makes its appearance the cocoons begin to give out the perfect males, which issue with wings fully expanded. There seems to have been a molt between this pseudimago and the perfect males, for in no other way can we account for the difference in form. The antennæ possess the same number of joints (10), of about the same relative proportion, although joints 3 and 4 are longer, but the incisures are rather better marked. The poisers are lighter in color, and less fleshy in appearance, and the curved hook is plainly visible at tip. The abdomen is rather longer, much more slender, and tapers gradually from base to tip. Its segments are well incised and plainly separable from above. It does not cover the hind coxæ and trochanters. The tibiæ are longer in proportion to their tarsi. The anal segment gives off two waxy filaments as long as the entire body. These filaments were not noticeable in the pseudimago."

The cocoon of the male is rather close, though thin, flattened oval, and pure white, about 2 mm. long by 1 mm. wide, and is composed of rather coarse waxy fibers.

On elm trees.

We have but one generation of the scale a year in California. The young are brought forth alive during May, locate on the leaves and later settle on the branches.

In other states this species has proven a very destructive pest to the elms. In one locality in California it gained quite a foothold, but prompt remedial measures were applied and the scale has not been allowed to increase, although scattering specimens may be found on some of the trees originally infested.

Eriococcus araucaria Mask.

The presence of the black fungus which accompanies many species of coccids, usually first denotes the presence of this scale. The full-grown insects are contained in white cocoon-like sacks, which are often massed toward the ends of the twigs. The larvæ are inconspicuous and are found in the angles formed by the bases of the leaves. Both sexes are similar in the larval form. They are greenish yellow in color; the posterior end of the body is furnished with two prominent lobes, each terminated by a long hair. Between these lobes there is a conical mass of white waxy matter projecting backward. The margin of the body is fringed with a row of tubular spinnerets. The female when full grown measures 2.3 mm. in length. When the female is ready to lay her eggs, she excretes a cocoon-like covering to the body, composed of white waxen threads. This sac is dense, like felt, but easily torn, and appears to be open on the middle line of the ventral surface. It adheres to the tree quite firmly, remaining where excreted after the death of the insect.

FIG. 6. *Eriococcus araucaria*. On Araucaria bidwillii.

On *Araucaria excelsa*, *A. bidwillii*.

Eriococcus adenostomæ Ehrh.

Female.—Inclosed in an oval (at one end more or less pointed) sac about 3 mm. long and 1½ mm. broad, woolly, snow-white, of uniform

texture. Oval, about half again as long as broad, dark purple, turning bright crimson when placed in KHO. Body about 1½ mm. long. Antennæ light brown, 7-jointed; formula, approximately: (3 4 7) (1 2) 5 6; joint 3 equal to 5 and 6. Most of the joints with hairs; joint 7 with several comparatively long hairs. Legs light brown, large and stout; each joint with one or more bristles; femur quite swollen; tarsus a trifle longer than tibia. Claw stout and curved. Both tarsus and claw with long filiform digitules. Posterior tubercles short and rounded, with one very long, stout bristle and two shorter ones on their outer margin. Anal ring large, with eight long bristles. Derm colorless, with quantities of small spines and rounded glands distributed all over the dorsum.

Sac of male smaller and narrower than that of the female, color more creamy.

On *Adenostoma fasciculatum*.

Phenacoccus artemisiæ Ehrh.

Adult Female.—Elongate oval, about 3 mm. long and 1½ mm. broad, of a sage-green color; measuring with egg sac 4½ mm. Sac loosely woven without any grooves, eggs lemon-yellow. Legs and antennæ light brown. Body thinly covered with secretion, but not enough to hide color of body. Segmentation distinct. When placed in boiling KHO, body turns orange color, and leaves derm colorless after boiling. Antennæ 9-jointed; joint 2 always longest, joints 5, 6, 7, 8 subequal. Formula: 2 3 9 1 4 (5 6 7 8). Joints 1, 7, 8, and 9 with several stout hairs. Legs short and stout; femur about as long as tibia; tibia twice as long as tarsus. Claw stout and long, with tooth. Digitules fine knobbed hairs.

Adult Male.—Abdomen yellowish green, thorax and head dark green. Thorax marked with black longitudinal lines. Body slightly pruinose. Antennæ and legs light brown. Eyes dark red. Wings more or less pruinose, very delicate. Antennæ very hairy, 10-jointed; joint 3 longest, joint 1 shortest and stoutest, joints 7, 8, and 10 subequal, joints 2 and 9 subequal. Formula: 3 4 5 6 (7 8 10) (2 9) 1. Legs very hairy, long and slender; tibia much longer than femur; tarsus very short, less than one third of tibia. Claw long and very slender. Digitules fine hairs.

On *Artemisia californica*.

Phenacoccus stachyos Ehrh.

Adult Female.—About 2½ mm. long and 1 mm. broad, convex, tapering posteriorly, viviparous, of a sage-green color. Slightly covered with white secretion, which, when seen through lens, appears as minute white

dots. Segmentation distinct. There are two longitudinal rows of light brown dots on the meson. The dorsum and margin are thickly set with long fine iridescent spines, which are deciduous. Legs and antennæ light brown, quite hairy. Caudal filaments short and stout. When placed in boiling KHO, body turns reddish brown. After boiling, derm becomes colorless, antennæ, mouth parts, and legs remaining light brown. Antennæ long and slender, each joint with a few long fine hairs. Joint 3 longest, next comes joint 2, joints 4 and 5 subequal, joints 1 and 6 subequal, joint 8 shortest. Formula, approximately: 3 2 (4 5) 9 (1 6) 7 8. Legs long and stout, quite hairy; trochanter with very long bristle; femur a trifle shorter than tibia; tarsus about one third of tibia. Claw long and slender, with tooth. Digitules fine knobbed hairs. Lobes well developed, with a long seta, and two long fine bristles. Anal ring with six stout hairs. On each segment of the ventral surface, thorax, and on the head, there are numerous very long fine hairs, and there are numerous short fine spines and numerous spinnerets with club-shaped tubes scattered over the body.

Newly hatched larvæ orange colored, elongate oval. Antennæ 6-jointed, quite stout. Formula: 6 3 (1 2) (4 5). Legs short and stout; tarsus as long as tibia. Rostral loop extending beyond last coxæ. Caudal lobes and setæ quite prominent.

On *Stachyos bullata*.

Ceroputo bahiæ Ehrh.

Adult Female.—About 4 mm. long and 3 mm. broad, covered with white cottony secretion, with a distinct ridge of cottony tufts running longitudinally on the meson and two smaller ridges parallel with it. Each ridge has a large tuft at the cephalic end. Margin fringed with short, broad cottony appendages, getting longer toward caudal end. Legs and antennæ dark brown. Color of body is greenish yellow, with a brown patch on the meson. When boiled in KHO turns crimson at first, then derm becomes colorless, except a row of dark brown patches on the body near and running parallel with the margin. These grow larger caudad. Body is densely covered with round glands and stout conical spines. Anal ring large, with six long stout hairs and numerous stout hairs scattered over area surrounding it. Antennæ remain brown. Antennæ 9-jointed, long and stout. Formula: 3 5 9 6 7 4 8 1 2. All joints quite hairy, and joint 9 quite pointed with numerous hairs. Legs long, stout, and thickly covered with very stout hairs; femur and tibia subequal; tarsus about one third of tibia. Claw very stout and curved, with tooth. Digitules very long fine hair.

Immature Male.—Much like female, smaller and lighter color, about 2½ mm. long, 1½ mm. broad, Legs not as stout. Antennæ 7-jointed. Formula: 3 7 2 (1 4 5 6).

Sac of male snow-white, more or less irregular in shape, no distinct carina, about 4 mm. long, 2 mm. broad.

Adult Male.—Measures, without setæ, about 3 mm. long and 1 mm. broad. Head and thorax dark brown, abdomen greenish yellow, slightly covered with white secretion. Antennæ 10-jointed. Formula: (3 4 5) 6 7 8 9 10 1 2. Legs long, stout and very hairy. Wings dusky, pubescent, each about 2½ mm. long by 1 mm. broad. Halteres small, with two stout, well-curved hooks. Style long, stout and conical, forming a blunt hook at caudal end. The last abdominal segment has two groups of round gland openings; on the cephalic margin of each, two very long, stout spines arise, which run parallel caudad. There are also numerous stout hairs surrounding the glands.

On *Bahia* sp.

Pseudococcus aurilanatus Mask.

Adult Female.—Slightly elongated, nearly globulous, of a rich dark purple color, bearing on the dorsum a longitudinal band of bright golden-colored meal, with small patches of similar meal often visible on the edges. In alcohol or potash it produces a rich purple tint, and if crushed in the fingers stains them a dark red. The eggs, which are also purple, are laid in a mass behind the insect in a thin, white cottony web, the mass having thus a general dark gray appearance. Body obscurely segmented, length about $\frac{1}{11}$ inch. Antennæ usually of eight joints, often of seven; in the former case the fourth, in the latter the third, joint is the longest, the rest subequal, except the last, which is fusiform, and nearly equal to the longest; all the joints have a few hairs, the last bearing several.

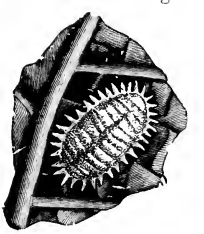


FIG. 7. *Pseudococcus citri.* (Common Mealy-bug.)

On *Araucaria bidwillii.*

This species is commonly known as the "golden mealy-bug," and is quite troublesome in the greenhouses on *Araucaria bidwillii.* I have also found it on the same host plant in the open.

Pseudococcus citri Risso.

(Mealy-bug.)

Adult Female.—Length 3.5 to 4 mm., width 2 to 2.5 mm., white or yellow with brownish tinge, darker than *P. longispinus*, and with less powdery secretions covering body. The seventeen lateral appendages are short and blunt; posterior appendages not much longer than lateral ones. Antennæ 8-jointed, less pubescent than in *P. longispinus.* For-

mula: 8 3 2 (1 7) (5 6 4). The penultimate segment bears on either side a very long seta and two or three very short ones, and two conical projections; the surface of the segment is dotted with orifices. Six slender setæ, one half the length of the setæ on the penultimate, are borne by the anogenital ring, which is somewhat projected from the penultimate segment. Female oviparous; deposits eggs in cottony sac, which increases in size as the female grows.

On citrus, *Cycas revoluta*, coleus, ferns, and many plants in hothouses.

This is the common mealy-bug and can be found in almost any greenhouse or private conservatory. In a few instances it has been reported as occurring in citrus orchards. In these cases a colony of *Cryptolæmus montrouzieri* (Coccinellid), known as the ladybird enemy of the mealy-bug, soon cleans up the pest. In the greenhouses they do not work so well, as the mature beetle flies against the glass and tries to escape, but in the open they control this pest wherever liberated.

Pseudococcus longispinus Targ.

(Mealy-bug.)

Female.—Length 2.5 to 3 mm., width 1.5 to 2 mm. White or tinged with yellow, with brown band on middle of back; each segment with a white waxy filament, which forms a border of appendages of varying lengths around the body; those near the posterior extremity longer, and four at caudal end very long, the inner the longer, sometimes longer than the body. Entire body appears as if dusted with flour, which is caused by the waxy secretion. Antennæ 8-jointed, each joint bearing seven hairs. Formula: 8 (2 3) (1 5) (4 6) 7. The legs are long, stouter than in *P. citri*, somewhat pubescent; tibia twice as long as tarsus. The penultimate segment presents on either side a rounded group of pores and two short, strong spines, also a seta somewhat longer than the anal setæ, and several shorter setæ. Anal ring large, dotted with six long setæ.

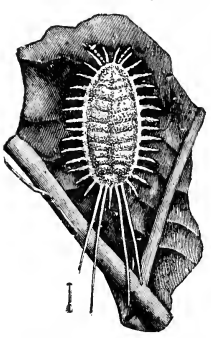


FIG. 8. *Pseudococcus longispinus.* (Mealy-bug.)

Larvæ.—The male and female larvæ are similar to adult female in shape and color, but the male larva has 7-jointed and the female 6-jointed antennæ.

On fern, croton, coleus, citrus, *Cycas revoluta*, and many hothouse plants.

This species differs from *P. citri*, as it has long threads or spines extending from the end of the body. Its habits are the same as *P. citri* and it is usually to be found on the same host plants.

Pseudococcus maritimus Ehrh.

Female.—Elongate oval, about 2 mm. long and 1 mm. broad, flattish, slightly covered with secretion. Color of body, reddish brown. Margin beset with stout, short, white filaments, which grow longer caudad. Caudal setæ about one-half length of body. Legs and antennæ same color as body.

Eggs orange-yellow. Egg sac well developed and has the appearance of *Pulvinaria camelicola*, but smaller—about 5 mm. long and 2 mm. broad.

Young larvæ light orange-yellow.

When boiled in KHO, female turns liquid purple and derm becomes colorless. Body thickly beset with long slender spines and many round glands. Each segment has a group of spinnerets on its margin, in the center of which are two short stout conical spines. Antennæ 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. The following formulæ will assist in determining the species: 8 2 (1 3) (5 7) 6 4. 8 2 (1 3) 5 (4 7) 6. 8 3 2 1 (5 7) 6 4. 8 1 (2 3) 5 7 (4 6).

Legs quite hairy, well developed, long and slender. Trochanter with long stout spine (128*u*). 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 setæ and two very stout conical spines. Anal ring large, with six very long stout hairs.

On *Eriogonum latifolium.*

Pseudococcus quercus Ehrh.

Female.—Slightly covered with white secretion, about 2½ mm. long and 1½ mm. broad, tapering at both ends. Color of body greenish brown, concealed more or less by secretion. Segmentation very distinct. Each segment bears a white filament on the margin. Caudal setæ about one third as long as body, white and very stout. Antennæ and legs dark brown. When placed in boiling KHO, body turns crimson; derm becomes colorless after boiling. Antennæ 8-jointed; joint 8 longest, joint 7 generally shortest. Formula, approximately: 8 3 2 (1 5) 6 4 7. Each joint has a ring of stout hairs. Joint 8 has numerous very long hairs. Legs long and stout, with numerous long fine hairs; femur about as long as tibia; tarsus about a third as long as tibia; claw

slender and well curved. Digitules long fine knobbed hairs. Anal ring small, with six fine hairs. Caudal lobes well developed, with very long setæ (280 μ). Groups of spinnerets, conical spines, and long slender hairs scattered over the dorsum.

On *Quercus chrysolepis*.

Pseudococcus ryani Coq.

This species is known as the cypress mealy-bug and is held in almost complete subjection by the Coccinellids (ladybirds), *Rhizobius ventralis* and *Exochomus marginipennis*. Of the sixteen species of *Pseudococcus* found in California, *P. citri*, *P. longispinus*, and *P. aurilanatus* are the most troublesome, although where New Zealand flax is grown *P. calceolariæ* is very abundant.

Erium eriogoni Ehrh.

Female.—Inclosed in a densely woven white felt sac about 2½ mm. long and 1 mm. broad; also secreting considerable loose cottony matter. Color light yellow, slightly covered with white powder, about 2 mm. long and 1 mm. broad. Last segment of body with two short white filaments. Legs and antennæ light brown. Young larvæ and eggs light yellow. When boiled in KHO, turns brown. Numerous very fine slender spines on dorsum. Antennæ 7-jointed, quite bristly. Sequence of the joints of the antennæ is quite variable. Joint 7 longest, then comes 3, then 1 and 2, but these are sometimes longer than 3. Joint 4 is next, but sometimes joint 6 is longer. Joint 5 is generally shortest. Formula, approximately: 7 3 1 2 4 6 5. Legs small and rather slender; femur, tibia, and tarsus all bearing rather large stout bristles; femur twice as long as tarsus; claw slender. Tarsal digitules long, slender, slightly knobbed. Digitules of claw slightly longer than claw, slender, knobbed. Anal lobes not conspicuous, bearing a long, rather stout seta, several stout conical spines, hairs and spinnerets. Anal ring median, with the usual six hairs.

On roots of *Eriogonum* sp.

Ripersia villosa Ehrh.

Female.—In clusters and single in the crotches of twigs of oak. Sac loosely woven of long white wool, oval, about 2 mm. long and 1 mm. broad.

When removed from sac bright crimson, slightly covered with white powder, skin shiny; about 1.5 mm. long, 1 mm. broad, tapering anteriorly and quite convex dorsally. When boiled in KHO, derm colorless, densely covered with slender hairs. Antennæ light brown;

7-jointed, joint 7 longest; sometimes joint 1 is next longest, but joint 2 is often longer than joint 1, and in many cases they are subequal; joint 6 usually next, although joint 3 may be longer than 6; joint 4 next, often subequal with 5; sometimes 3 shortest, sometimes 5; 3 and 5 often subequal. In fact, the sequence of the joints is quite variable, as is shown in the following antennal formulæ: 7 2 1 (3 6) (4 5). 7 (1 2) 6 (4 5) 3. 7 1 2 6 4 (5 3). 7 (1 2) 6 4 (5 3). Joint 1 is stouter than any of the others. Each joint with hairs, joint 7 with several stout hairs. Legs light brown, large and stout; each joint furnished with one or more rather long bristles. Femur, $80 \times 50\ \mu$; tibia, $70\ \mu$; tarsus, $50\ \mu$; claw, $20\ \mu$. Digitules of claw knobbed, moderately short and stout. Tarsal digitules long, fine, slightly knobbed hairs. Tubercles small and rounded, with long stout bristle. Anal ring with six stout hairs.

Larva, when newly hatched, color light red, rostral loop extending beyond body.

On *Quercus agrifolia*.

Subfamily **COCCINÆ.**

Pulvinaria innumerabilis Rathv.

This scale insect somewhat resembles the cottony-cushion scale (*Icerya purchasi*) and is often mistaken for it. It can be easily distinguished, however, being much smaller and the general appearance differing materially.

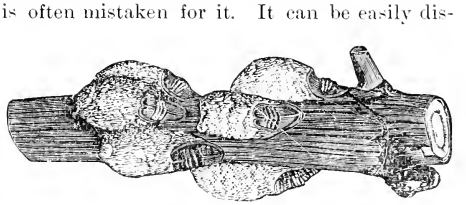


FIG. 9. *Pulvinaria innumerabilis* (Cottony Maple Scale). On Grape.

Female.—Oval in form; color dark brown. Near the posterior end are ridges, and the lines that separate them are darker than the other parts. The eggs are laid in the cottony sac; they are white when first laid, but change to a yellowish tinge before hatching. They are oval in form. The larva is yellowish white.

At one time this species was very troublesome, but the internal parasites *Coccophagus lecani* and *Encyrtus flavus* work on this pest most effectively in the larval form, and the *Rhizobius ventralis* clean up the egg sacs of those that escape the attack of the parasites in the larval form and mature.

The other species of *Pulvinaria* found in California are of no economic importance.

Pulvinaria camelicola Sign.

The female of this species is not unlike *Coccus hesperidum*, but the formation of the white ovisac is a clearly distinguishing character. In late summer the female often drops off to the ground, leaving only the ovisac observable on the leaf. According to Maskell, the adult female is yellowish or reddish brown, naked, slightly convex, elongated; skin smooth, with puncta; length variable, from about $\frac{1}{7}$ of an inch to $\frac{1}{9}$ of an inch. Antennæ, according to Signoret, with sometimes 6, sometimes 7, joints. Abdominal clefts and lobes normal. The insect excretes a narrow, white, cylindrical, cottony ovisac, which is conspicuous on the leaf of the plant, and the brown body of the female can be seen at one end of it. The eggs in the ovisac are numerous, perhaps some hundreds.

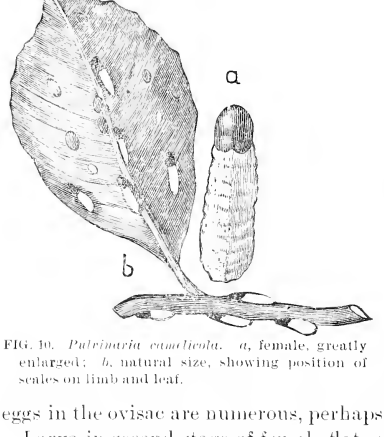


FIG. 10. *Pulvinaria camelicola*. *a*, female, greatly enlarged; *b*, natural size, showing position of scales on limb and leaf.

Larva in second stage of female flat, oval, yellowish brown.

On *Camellia japonica* in greenhouses.

Pulvinaria psidii Mask.

Adult Female.—Yellow or yellowish brown, sometimes with a greenish tinge; size variable, reaching $\frac{1}{12}$ of an inch before the ovisac is formed, but shriveling at gestation. The ovisacs cover the twig or leaf with masses of dirty-white cotton, usually accompanied by black fungus. Antennæ rather long and slender, of 8 joints, of which joint 3 is longest, joint 8 next, and the rest shorter and subequal. Feet also rather long; the trochanter is large, and bears a very long hair; tarsus curved, and about half as long as the tibia; upper digitules fine hairs, lower pair long and dilated at the end. Abdominal cleft moderate; anogenital ring with several hairs. The margin of the body bears a row of spiny hairs.

Female of the second stage yellow, flattish, elliptical; length about $\frac{1}{20}$ of an inch. Antennæ 6-jointed.

Larva yellow, flat, elliptical. Antennæ 6-jointed.

Male unknown.

On ferns, orange, coffee, pomegranates, and alligator pears at quarantine.

This species was very destructive to the coffee plantations of the Sandwich Islands, but since the introduction of the ladybird *Cryptolaemus montrouzieri* from California it has been cleaned out.

Pulvinaria rhois Ehrh.

Female.—Found on limbs and under side of leaves, single and in clusters. Length of female with ovisac, about 9 mm., width about 3.5 mm.; scale brown, largely covered with white secretion, ovisac snow-white, distinctly grooved longitudinally, sometimes curved, sometimes lifting scale off limb; scale shrunken, broadly oval, clay color. Female before forming ovisac something like *Coccus hesperidum*, but more convex, reddish brown; anal plates distinct; dorsum covered with white, waxy secretion in rows, the mesal row has the largest secretions, and they diminish in size as they approach the margin; edge of scale has short, simple hairs; in each anterior incision is a large spine, with a short one on each side. Anal plates yellowish brown, longer than broad, forming a diamond when closed; two very small spines at tip; anogenital ring with six long hairs; rostral loop reaching to middle pair of legs. Antennæ 8-jointed; formula: 3 (1 2 4) 5 8 6 7. Joint 3 much the longest, joints 2, 4, 5, and 6 each with long hair, joint 8 with several hairs. Legs ordinary, coxa and trochanter very stout, tarsus half as long as femur; tarsal digitules long fine hairs with knobs.

Larva.—Light yellow, flattish, elliptical, about 0.5 mm. long.

Male.—Small, oval, black, with numerous pale, wart-like prominences.

On *Rhus diversiloba*.

Ceroplastes cirripediformis Comst.

(Barnacle Scale.)

Adult Female.—Average length 5 mm., width 4 mm., height 4 mm. When naked the color is dark reddish brown; the shape sub-globular; with a strong spine-like projection at the anal end of the body. The waxy covering is dirty white, mottled with several shades of grayish or light brown, and even in the oldest specimens retains the division into plates, although the form is more rounded and the dividing line by no means as distinct as at an earlier age. There are visible a large convex dorsal plate, and apparently six lateral, each with a central nucleus; the anal plate, however, is larger, and shows two nuclei, and is evidently two plates joined together. Antennæ 6-jointed. Legs long; tibiæ nearly twice as long as tarsi; digitules of the claw very large. The other tarsal pair very long and slender, but with a very large button. The skin is seen in places to be furnished with many minute, round, transparent cellules, probably spinnerets, and along the border

are small groups of constricted arrow-shaped tubercles, but there are no bristle-shaped spinnerets.

On pepper-tree.

Ceroplastes floridensis Comst.

(Florida Wax Scale.)

Adult Female.—Sub-globular in form, the point of attachment to the twig or leaf being concave. Length, from 2.5 mm. to 3 mm. Color, when naked, reddish brown; covered with an apparently homogeneous

FIG. 11. *Ceroplastes cirripediformis* (Barnacle Scale). Branch infested with scale. *a*, female, much enlarged.

FIG. 12. *Ceroplastes floridensis* (Florida Wax Scale). *a*, young female; *b*, adult female, much enlarged.

layer of waxy excretion, which is usually brownish on the dorsum and dirty white toward the edges; some specimens are irregularly mottled brownish and yellow-white. Antennæ 6-jointed, joint 3 nearly as long as all the others together. Legs normal in all respects. The margin of the body in the region of the stigmata is furnished with groups of minute arrow-shaped tubercles, constricted at the base, and between these groups are bristle-shaped spinnerets.

On citrus, mango. (At quarantine.)

Ceroplastes irregularis Ckll.

In certain sections this *Ceroplastes* can be found very abundant on sagebrush in the foothills, but has not attacked any other host plant as yet, and has been known in California for a great many years. One other species has attacked a pepper-tree in this State, but the tree was cut down and burned and its presence has not again been noticed. Owing to the fact that it was discovered in a section where the strictest inspection is maintained, it is safe to say that it will not gain a foothold.

Ceroplastes ceriferus Anderson.

(White Wax Scale.)

Female.—Test of adult female white or yellowish white, waxy, convex, thick; frequently agglomerated in large masses covering the twigs of the food-plant (as shown in Fig. 13). Separate individuals may range in size from $\frac{1}{5}$ to $\frac{1}{2}$ of an inch. Marginal tuberosities not distinguishable, though the margin is sometimes slightly flattened and irregular. The apex of the test is sometimes produced in a short pointed horn, not erect but bent over the test. The wax is rather soft and greasy. Test of the second stage slightly convex, elliptical; color grayish white. Median dorsal region usually smooth, separated by a narrow depression from the marginal region, which exhibits eight tuberosities, three on each side and two terminal. Average length of test about $\frac{1}{7}$ of an inch.

FIG. 13. *Ceroplastes ceriferus* (White Wax Scale). Infesting camellia.

Adult female brown, very convex, elliptical, hollow beneath. Form lecanid, but the anal cleft and lobes are not easily made out, being contained in a conspicuous cylindrical "tail" or prolongation of the abdomen. Antennæ 6-jointed, joint 3 being much the longest. Feet rather thick, but not at all atrophied; tibia scarcely longer than the tarsus; upper or tarsal digitules slender knobbed hairs, lower pair on the claw rather long, thick, and expanded at the end. Rostrum rather large; mentum doubtfully dimerous. Near the spiracles, on each margin, is a group containing eight large conical spines and about twenty-four smaller ones. Epidermis bearing many circular spinneret orifices. When the "tail" is subjected to the action of potash and subsequent pressure it is seen to contain at its extremity the abdominal lobes and the anogenital ring, which has six rather strong hairs.

Female of the second stage brown, elliptical, slightly convex. Form lecanid, exhibiting the normal cleft and lobes; there is no "tail," but the region surrounding the lobes is thickened. Antennæ and feet as in

the adult, but the feet are more slender. The margin bears a row of very fine spiny hairs, and four spiracular groups of large conical spines. There are many small circular spinnerets on the epidermis.

Larva yellow, elliptical, flattish; length about $\frac{1}{70}$ of an inch. Form normally lecanid, the anal lobes bearing long setæ. Antennæ thick, with six rather confused joints.

Male unknown.

On camellia. (In greenhouse.)

I have often met with this scale on many plants from Japan at the quarantine station in San Francisco. Judging from the number found infested it must be plentiful in that country. The camellia on which I found it in California was in a Japanese nursery, and was promptly destroyed.

Eucalymanatus perforatus Newst.

Adult Female.—Irregularly oval, bluntly acuminate in front, broadly rounded behind; sometimes almost dull colored; usually asymmetrical; flattish; median area very slightly convex, margins very thin. Under surface flat; a small hollow on each side of abdomen. Color dark castaneous, paling to fulvous or greenish yellow at margin. Dorsal area divided into numerous irregular plates, forming an intricate marqueterie pattern, more conspicuous after treatment to potash. The pattern is roughly but not absolutely symmetrical on the two sides of a median line. The number of separate tesseræ vary slightly in different individuals by the confluence of adjoining plate, but the main plan is constant, viz., four series on each side of the median line, indicated on the surface by a series of depressed, irregularly polygonal spaces, divided by slight carinæ. Dermal cells numerous but ill-defined, irregularly oval, groups of them often forming irregular rosettes; but there is also near the margin of each plate, more particularly on those of the median series, a series of minute translucent pores, bearing a fanciful resemblance to rivet holes for the attachment of armor plates. Eyes minute, black, marginal. Marginal hairs small, simple. Submarginal tubercles five to seven on each side. Stigmatic clefts with three (rarely four) stout spines, the median one longest and projecting beyond the margin. Anal cleft rather more than one quarter the total length of the insect. Scales of anal operculum together forming a square, their extremities rather acutely pointed. Anal ring with six hairs; two or three stout

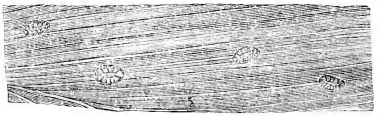


FIG. 14. *Eucalymanatus perforatus.* Section of palm leaf infested with scale.

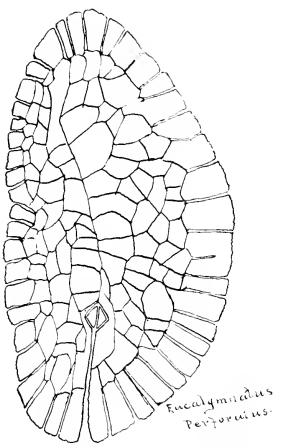


FIG. 1. *Eucalymnatus perforatus*, dorsal aspect.

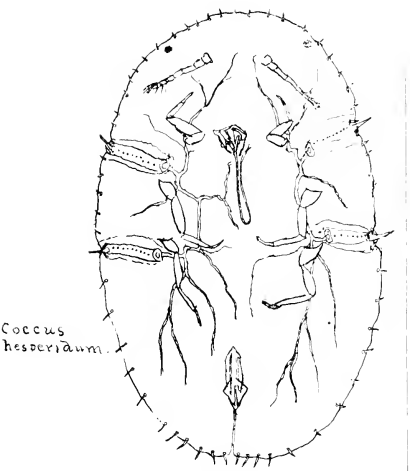


FIG. 2. *Coccus hesperidum*, ventral aspect.

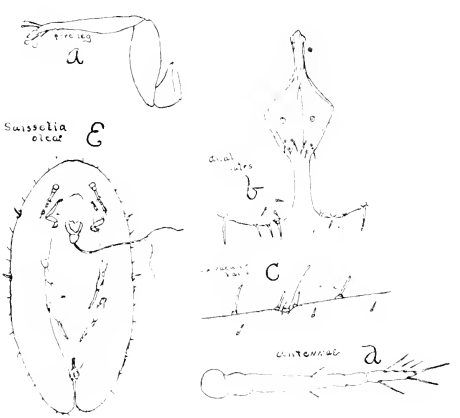


FIG. 3. *Saissetia oleæ*—*a*, foreleg; *b*, anal plates; *c*, spiracular hairs; *d*, antennæ; *e*, *Saissetia oleæ*, ventral aspect.

C. T. P., del.

hairs, each surmounting a small conical tubercle, on each side of ventral aperture. Antennæ with eight joints, the divisions between third and fourth often very indistinct, division between seventh and eighth diagonal; formula variable, joint 8 always considerably the longest, joints 6 and 7 shortest, joints 2 to 5 subequal. Legs rather small but well developed; tarsus shorter than tibia; digitules normal. Length, 3 to 4.75 mm.; breadth, 2 to 3 mm.

Young larvæ crowded beneath the body of the parent, which is apparently ovoviviparous.

Male unknown.

On palms. (In hothouses.)

Coccus hesperidum Linn.

Adult Female.—Bright yellow or greenish yellow, minutely specked by red-brown, with specks sometimes agglomerated into transverse bars, especially on the median abdominal regions; in other parts tending to form dotted lines radiating from center to margin. Dried specimens straw colored and much wrinkled. Form oblong-oval, often very irregular in outline; narrowest in front; more or less convex above, according to age. Eyes minute, black, marginal. Stigmatic clefts with three spines; the median one very long and pointed, projecting well beyond margin. Marginal hairs simple, pointed; rarely a few, more particularly at posterior extremity, divided or frayed at tip. Submarginal tubercles, four to five on each side. Scales of anal operculum with outer edge slightly longer than base; the latter slightly concave in outline. Derm cells scattered, small, circular, inconspicuous. Antennæ 7-jointed; formula: (3 7) 4 2 1 6 5. Legs normal. Anal ring with eight stout hairs. Length, 2.25 to 3.50 mm.; breadth, 1.25 to 2.50 mm.

FIG. 15. *Coccus hesperidum* (Soft Orange Scale). An orange branch thickly infested.

The insect is ovoviviparous; living larvæ are usually found beneath the body of the parent.

On orange, lemon, grape-fruit, oleander, ivy, myrtle, and various other plants.

This scale at one time was considered quite a pest by the citrus-growers of this State, and is commonly known as the soft orange scale. It is completely held in check by internal parasites and is not considered a pest now.

Coccus ventralis Ehrh.

Scale of Female.—About 4½ mm. long, 3 mm. broad, 1 mm. high. Oval when seen from above. Soft texture, very much like *C. hesperidum:* light brown, not very convex, and a dark brown border near margin. Dorsum pitted and margin moderately wrinkled, an indistinct mesial ridge.

Female.—Color greenish yellow, with a brown longitudinal line on the dorsum, also two brown lines forming a double cross with the dorsal line, more or less wrinkled and pitted. Ventral view shows the abdomen a dark purple brown with very distinct segmentations. Viviparous.

After boiling in soda, derm colorless. Margin with small curved spines. Lateral incisions with long, stout, curved spine and two shorter ones. Anal plates large, with blunt tips, bearing several hairs and notched on outer margin, together forming a square. Each plate has a distinct brown projection into the body. Anogenital ring with six hairs, which are very long, extending two thirds over the plates. Legs stout, coxa and femur each with a stout hair; femur one third longer than tibia. Tarsal digitules long, knobbed hairs, digitules of claw broad and thick. Claw stout and curved. Antennæ 7-jointed; formula: 3 4 7 2 1 (5 6). Joints 1 and 2 with two hairs each, 4, 5, 6, and 7 with several hairs; joint 3 very little longer than 4; 5 and 6 subequal.

Larva lemon-yellow, very flat, shiny, oval, about twice as long as broad.

On tuberous plants (in Japanese garden).

Parasites: *Eucyrtus flavus* and *Coccophagus lecanii* were reared from this species.

Eulecanium armeniacum Craw.

(Apricot and Prune Scale.)

Adult Female.—Color light brown. In shape resembles *Coccus hesperidum*, but is much larger and more convex. In the center of the dorsum is a prominent shining circular protuberance, from which radiate a number of small ridges; these are more noticeable upon the posterior half of the scale. From the convex center to the anus is a low carina,

also noticeable in front. Length, from .20 to .27 of an inch; width from .12 to .15 of an inch; height, from .05 to .10 of an inch. Antennæ tapering to the point, 7-jointed; joints 1 and 3 subequal; joint 2 nearly three times as long as joint 1; joint 4 slightly longer than joints 5 and 6; joint 7 is nearly same as joint 3, and tapers to a point; a few bristles at the tip and upon each joint.

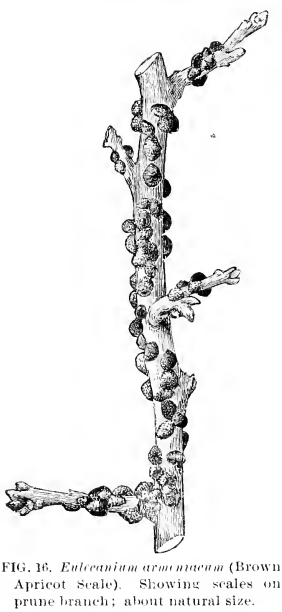


FIG. 16. *Eulecanium armeniacum* (Brown Apricot Scale). Showing scales on prune branch; about natural size.

Eggs.—These are smaller and lighter colored than *Saissetia oleæ*.

Larvæ.—Are long, oval, light yellow, darker down the center, and can be distinguished from the larvæ of *oleæ* in not having the four reddish-brown marks upon the dorsum.

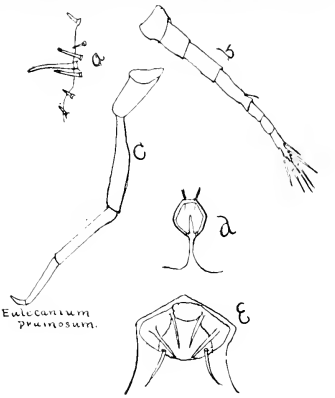
Like other species of *Eulecanium* that produce but one generation a year, their development is slow. They generally hatch in June and locate upon the leaves, where they go through their molt, and then move to the young wood. In the spring they grow rapidly and throw off great quantities of excrement, into which the spores of the black smut (*Fumago salicina*) adhere and grow, injuring the health of the tree and the market value of the fruit.

On apricot, prune, plum, cherry, peach, pear.

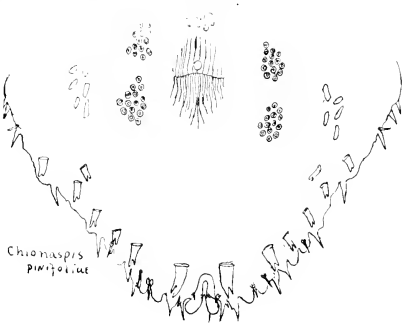
This species is commonly known in this State as the brown apricot scale and is usually associated with *E. pruinosum*. The parasite *Comys fusca* has held this scale in subjection for many years, usually accomplishing the work the second year after a colony has been liberated.

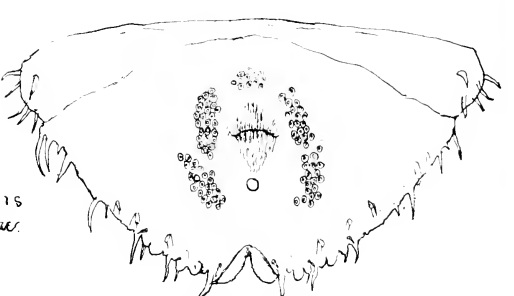
Eulecanium cerasorum Ckll.

This pest was first noticed in this State in 1904, a party having brought in a branch of English walnut which was quite thickly infested with the scale. Since then it has been found on pear trees. Dr. Howard kindly verified my identification of the specimen sent at that time as *Eulecanium cerasorum*. In tracing back the introduction of this pest I find it came from Japan on an ornamental plant, which was planted under the walnut tree above mentioned.



c, spiracular hairs; *b*, antennæ; *c*, hind leg; *d*, anal plate; *e*, anus.





C. T. P. del.

DETAILS OF CALIFORNIA COCCIDÆ.

Eulecanium crawii Ehrh.

Female.—Scales not crowding each other; hemispherical, about 3 mm. long, 2 mm. broad, and 1½ mm. high; oval, shiny, brown, getting darker with age. Margin generally lighter than dorsum.

Before gestation light brown, shiny. Derm, by transmitted light, brown, with numerous oval gland-orifices. Marginal hairs very short and slender. Lateral incisions each with three stout but not long spines. Antennæ 7-jointed; joint 3 longest, twice as long as 4; joints 5 and 6 very short, joints 1 and 2 about equal. Formula: 3 4 7 (1 2) 5 6. Anal plates broad, but not very large. Anogenital ring with six moderately slender hairs. Legs quite stout; coxa and femur with stout hair; femur very little longer than tibia; tibia and tarsus about equally long. Claw stout and curved. Tarsal digitules moderately stout, knobbed hairs. Digitules of claw not stout, a little longer than claw, more or less club-shaped.

Larva light yellow, with distinct ridge on dorsum, dividing scale lengthwise. Oval, about twice as long as broad. Rostral loop extending to third pair of legs.

On *Acer macrophyllum.*

Parasite: *Comys fusca* was reared from this species.

Eulecanium pruinosum Coq.

(Frosted Scale.)

Adult Female.—Pale brownish, thinly covered with a whitish powder, which does not conceal the ground color. Body oblong in out-

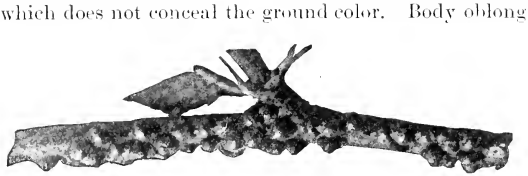


FIG. 17. *Eulecanium pruinosum* (Frosted Scale). On prune; about natural size

line, very convex above, not distinctly carinate, the surface very uneven. Margins nearly perpendicular; dimensions as follows: Largest specimens, length, .28 of an inch; width, a trifle over .20 of an inch; height, .12 of an inch. Smallest full-grown specimen, length, .16 of an inch; width, .12 of an inch; height, .08 of an inch. Antennæ much thickest at the base, 7-jointed; joint 6 the shortest, then 5, then 1 and 2, which are subequal in length; joints 3, 4, and 7 are also subequal in length, each nearly twice as long as 6; joint 7 tapers to the tip, and is furnished with a style, being about three fourths as long as this joint; anal cleft

and lobes normal. The eggs are of the usual ovoid form of the *Eulecaniums*, and of a yellowish-white color, and are laid in May, June, and July.

Larvæ.—A few weeks after the eggs are deposited, the larvæ hatch out from under the old scale; they are of a pale color, having a distinct dorsal ridge extending the entire length of the body, and with many smaller ones (about twenty-four on each side) extending from it to the margin, some of them being divided into two branches.

The larvæ as soon as hatched locate upon the leaves; their development is slow until they take up their position upon the under side of the young shoots, where they remain throughout the winter, and, in fact, the balance of their lives. Upon the ascent of the sap in the spring they grow rapidly, and in April they assume the characteristic powdery or frosted appearance peculiar to this species.

On apricot, peach, prune, plum, pear, apple, rose, grapevine, hawthorn, and occasionally on orange.

This scale was first observed in California in 1887 on apricot. Several species of *Coccinellidæ* attack the young of this scale, also other predaceous insects, and have succeeded in keeping this species from becoming troublesome.

Eulecanium pubescens Ehrh.

Female.—Scale about 4 mm. long, 2½ mm. broad, and 2 mm. high, moderately soft, before gestation covered with very soft hair. Color blackish brown, more on the black, with a yellow longitudinal band on the dorsum. Dorsum pitted and margin slightly wrinkled. Some specimens show a lighter color. When removed from twig the insect leaves a small amount of white powder. Derm, by transmitted light, colorless, except margin, which is light brown, with numerous small round gland-pores. Margin with a double row of minute simple spines, lateral incisions with one moderately stout spine and two short ones. Anal plates large, outer corner forming a right angle, with several hairs at tip, and a long, stout hair on each plate. Anogenital ring with six long, stout hairs. Legs slender; tibia and tarsus about equal; femur a little longer than tibia; coxa, trochanter, and femur each with a hair. Claw curved, with slender knobbed digitules. Tarsal digitules with very fine, long, knobbed hairs. Antennæ 7-jointed; formula: 4 3 (1 2) 7 (5 6). Joint 4 very little longer than 3; joints 1, 2, 4, 6 each with a hair; joint 7 with several hairs.

Male.—Scale glassy white with median ridge, about 1½ mm. long. Body dark red-brown; legs and antennæ light brown. Wings extend one third beyond body; color iridescent. Thorax with two elevated ridges much darker than body. Antennæ very hairy.

On *Quercus* sp.

Eulecanium tulipiferæ Cook.

This species is known as the "soft tulip scale," and is quite a serious pest in the East. It was first noticed in California in 1905, but had evidently been here for some time, as I found quite an extensive area infested. The species seems to confine its attack to cherry trees, usually on the under side of the larger lowest limbs.

This is a very large *Eulecanium* (?), dark brown in color, about ¼ of an inch high and of about the same width. The scale has a rather frosted appearance, in this respect somewhat resembling *E. pruinosum*, only much larger. There are two distinct irregular, black longitudinal lines on the dorsal surface of the scale. Steps were immediately taken to control its further spread and to eradicate the present infestation.

Saissetia hemisphærica Targ.

(Hemispherical Scale.)

Adult Female.—Shape approaching hemispherical, with the edges flattened. Average length, 3.5 mm.; width, 3 mm.; height, 2 mm. The shape and proportion vary somewhat, according as the scale is formed upon a leaf or twig. Upon the rounded twig it loses something of its hemispherical form, becomes more elongate, and its flattened edges are bent downward, clasping the twig. The color varies from a very light brown when young to a dark brown, occasionally slightly tinged with reddish, when old. The oval cells of the skin vary in length from .01 mm. to .04 mm.; and each cell contains a large granular nucleus. The antennæ are 8-jointed, with joints 1 and 2 short and thick; joint 3 is the longest, and the succeeding joints decrease gradually in length to joint 8, which is longer than the preceding. The legs are long and rather slender. The bristle on the trochanter is long. The articulation of the tarsi is very well marked. The tarsal digitules are, as usual, two long and two short; those of the claws spreading widely at summit and very stout at the base. The anogenital ring is furnished with eight long hairs. The anal plates are triangular, with rounded

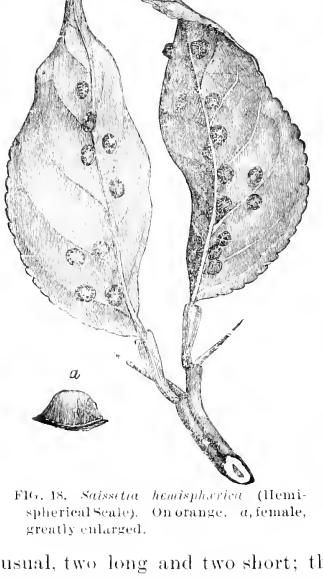


FIG. 18. *Saissetia hemispherica* (Hemispherical Scale). On orange. *a*, female, greatly enlarged.

corners, and are furnished with two long hairs upon the disk and three much shorter ones at the tip.

On orange, lemon, grape-fruit, oleander, pepper, ferns, sago palms, etc.

The parasite *Scutellista cyanea* also attacks this species, and where it is found in the open holds it in subjection.

Saissetia oleæ Bern.

(Black Scale.)

Adult Female.—Densely chitinous; dark brown, almost black in color, surface roughened and minutely specked with small grayish waxy granules. Form highly convex; length, 4 to 5 mm.; height, 3 mm. Dorsum with a median longitudinal carina, and two transverse carinæ, the latter dividing the body into three subequal portions; frequently the longitudinal ridge is more prominent between the transverse ridges than elsewhere, thus forming with them a raised surface of the form of a capital **H**. Eyes inconspicuous. Scales of anal operculum pointed at extremities; outer edge rounded; base straight or slightly concaved; outer edge twice length of base. Marginal hairs rather long; extremity dilated and often deeply divided. Submarginal tubercles six on each side. No stigmatic cleft. Stigmatic spines three, prominent and sharply pointed, the median spine nearly four times the length of the others. Antennæ with eight joints, of which the third is always the longest. Legs rather slender; tarsus about three fourths length of tibia; digitules of claw rather long. Dermal cells large, irregular polygonal, with rounded angles; the margin of each cell distinctly

FIG. 19. *Saissetia oleæ* (Black Scale). On olive branch, showing the larvæ of the ladybird *Rhizobius ventralis* at work destroying the scales.

marked on the surface. On the denser marginal area the cavities of the cells are filled with a dark brown deposit, and (in very old scales) all the cells may be similarly darkened.

Early adult female and female of second stage dull pale brownish yellow.

Male Puparium (observed in California).—Grayish color, but almost colorless; length, 1 to 1.5 mm.; width, from .5 to .8 mm.; very glassy; oval. Dorsum with distinct longitudinal carina and two delicate transverse carinæ.

Winged Male.—Orange color, with lighter-colored wings; length of body, exclusive of style, 1.2 mm.; style, .4 mm.; anal plates, .5 mm. Antennæ 10-jointed; the first three joints are short, the second is swollen and pyriform, the fourth is longest and equal to the first three in length; balance of joints gradually diminish in size. Entire length of antennæ, .55 mm.; wings, 1.1 mm. Legs slender and about .8 mm. in length. Eyes six in number—two anterior compound, two ocelli at sides of head, and two compound eyes at posterior part of head. (B. W. Griffith.)

On orange, lemon, grape-fruit, olive, peach, prune, plum, apricot, apple, pear, pomegranate, oleander, rose, and many other plants.

In California the males begin to issue from the pupæ the latter part of November. I have male pupæ before me now that were collected the first of November last year.

This is the "black scale" of the olive and orange, although it has a great range of food plants and is one of the most widely distributed scales of California, being found practically in almost every section. An internal parasite, *Scutellista cyanea*, introduced a few years ago from South Africa, has in many cases completely controlled this pest and is swiftly robbing it of its terror. The ladybird enemy, *Rhizobius ventralis*, has for many years done excellent work against this pest and in certain favorable localities has held it in subjection.

Aclerda californica Ehrh.

Female.—Covered with wax resting on a thin white secretion. Color orange-ferruginous, shiny, varying greatly in size and shape. The average specimens are about 3 mm. long, 1½ mm. wide, and 1 mm. high; generally pyriform, but it is difficult to give any special form, as the insect adapts itself to the position on the plant. After boiling in KHO derm is colorless, mouth parts, glands, and caudal portion remaining brown. There are indications of antennæ, which are very small and very bristly, segmentation not visible. There are four large disk-like spiracles on the ventral surface; each disk contains numerous

glands. There is a row of thick, blunt spines on each margin, and one on the dorsum. These marginal spines are shaped like a spearhead set in a socket. With these there are several rows of round spinnerets. Rostrum attached to a prominence, which, however, varies with the position the insect adopts. End of abdomen strongly chitinized, with the margin strongly crenate and plicate, and deeply cleft in the middle as in *Eulecanium*. Numerous round glands scattered near its margin, and several strong spines on margin at intervals. Anal ring with numerous (eight?) stout hairs. On the ventral surface opposite the anal ring there is a round projection with four stout spines. This is inserted in the cleft of the anal lobes.

On roots of bunch-grass.

Physokermes insignicola Craw.

This is a large, almost spherical dark brownish-black scale which infests the Monterey pines (*Pinus insignis*). When a tree becomes infested it presents a sickly, stunted appearance, with scant foliage, and is covered with honey-dew and black fungus. The scales cluster very thickly around the small shoots and usually at the tip of the branches. They are oviparous, with but one generation a year. The young are elongated, dark brown in color, with a short fringe along the edges and a deep abdominal cleft. As soon as they hatch they attack the tender pine shoots, afterwards removing to the harder wood, where they locate permanently.

FIG. 20. *Physokermes insignicola*, a large, almost black, spherical scale, infesting the Monterey pines.

The *Rhizobius ventralis* (Coccinellid) and an internal parasite do good work toward controlling the ravages of this pest. In isolated cases, however, where the insect enemies of this scale have not made their appearance, I have found many trees that have been killed by the scale.

Subfamily DIASPINÆ.

Chionaspis ortholobis Comst.

(Willow Scale.)

Scale of Female.—Moderately elongated, broadest near the middle of the scale; dirty white. Exuviæ .8 mm. long, brown.

Female.—Median lobes straight and parallel, having the appearance of being set closely together; rounded on their extremities, sometimes obscurely serrate on the sides. Second and third pairs, with the inner lobule larger than the outer, a little oblique; entire or obscurely serrate.

The gland-spines are arranged as follows: 1, 1–2, 1–2, 2, 4–5. The first one is small and blunt. Second row of dorsal gland-orifices represented by the anterior group consisting of 4–7 orifices. Third row with 7–9 orifices in anterior and 5–8 in the posterior group. Fourth row with 10–11 orifices in the anterior and 5–9 in the posterior group. Median group of circumgenital gland-orifices, 10–25; anterior laterals, 18–35; posterior laterals, 16–24.

FIG. 21. *Chionaspis orthobius.* On section of willow leaf.

Scale of Male.—Length, .6 to .8 mm. Oval, without carinæ; exuviæ pale brown or almost colorless.

Eggs.—Dark purple in color.

On willow.

Chionaspis pinifoliæ Fitch.

(The Pine-leaf Scale.)

Scale of Female.—Snow-white; with bright orange or brown exuviæ, shape depending upon width of leaf or host, but usually broadened posteriorly and very convex. Length, 3 to 4 mm.; length of exuvia about 1 mm.

Scale of Male.—Length, 1 to 1.5 mm. The pale yellow exuvia occupies about one third the length of the tricarinate, posteriorly broadened scale.

Female.—Three pairs of well-developed, thin, striate lobes; the median almost circular in outline, entire, separated by about one third their width, slightly diverging at the apex and joined anteriorly by an arched chitinous process. Inner lobule of second and third lobes the larger and subtruncate. The gland-spines are arranged as follows: 1, 1, 1, 1, 1–3, becoming shorter toward median lobes. The spines on the ventral surface are short and inconspicuous, situated over mesad of the base of the first, second, third, and fourth gland-spines respectively. Those on the dorsal surface are longer and situated mesad of the corresponding ventral spine. Second row of dorsal pores represented by anterior group of 2–4; third row by 3–5 in anterior and 4–6 in posterior group. Median lobes of circumgenital gland-orifices, 7–13; anterior laterals, 12–20; posterior laterals, 14–18.

The *eggs* are purplish, ellipsoidal; length, .25 mm.

On pine and other coniferous trees.

This species is held in check by an internal chalcid parasite.

Chionaspis quercus Comst.

(Oak Scale.)

Scale of Female.—Long, narrow at anterior end, much widened posteriorly, quite convex. Exuviæ brownish yellow, remainder of scale white, though often appearing gray from dust and hairs from the stem to which the scale is attached.

Body of Female.—The last segment with the anterior group of spinnerets consisting of about 10, the anterior laterals of from 17–20, and the posterior laterals of from 10–18.

This species is peculiarly characterized by having an undivided lobe on the meson; this lobe is large and rounded distally. The second and third lobes of each side are very small and are laterad of small incisions in the margin of the segment. In each case there is a reniform thickening of the body wall bounding each incision anteriorly. There is also a similar incision with a rudimentary lobe and reniform thickening of the body wall about midway between third lobe and the penultimate segment. The plates are inconspicuous and spine-like; there are usually one or two laterad of second ventral spine, two or three between third and fourth lobes, and usually five between fourth lobe and penultimate segment. The penultimate and antepenultimate segments bear six each; those on the latter are much expanded at the base.

The spines are long and conspicuous; those on the dorsal surface are situated as follows: One on each side at the base of the lateral margin of median lobe, one laterad of each of the second and third lobes, and a fourth one near the center of the anterior group of plates. Those on the ventral surface are as follows: A short one nearly ventrad of the first dorsal spine, a large one laterad of each of the second and third dorsal spines, and a fourth one a little cephalad of the fourth dorsal spine.

Scale of Male.—The scale of the male is snow-white, with the larval skin very light yellow. The texture of the scale is quite loose and the carinæ prominent. Length, 1.25 mm.

The adult male is as yet unknown. Pupæ mounted in balsam are bright yellow in color, with eyes purplish black. Fully grown male larvæ in balsam are yellowish brown.

On white oak (*Quercus lobata*). The females occur on the bark of small limbs; the males on the leaves.

Chionaspis wistariæ Cooley.

Scale of Female.—Length, 1.8 to 2.3 mm. Plainly broadened posteriorly, rather thin in texture, dirty white in color. Exuviæ .8 mm. long, brown.

Female.—Median lobes larger and more conspicuous in proportion to the other lobes than is usual in this genus; usually parallel in general direction, though sometimes slightly divergent; rounded or indistinctly pointed at the extremities, firmly united at their bases, the chitinous thickened process which unites them extending anteriorly for a distance about equal to the length of the lobes. Second pair distinct and entire, but much smaller than the median pair; outer lobule smaller than the inner. Third pair usually obsolete, but sometimes represented by low serrate prominences. The gland-spines are arranged as follows: 1, 1, 1, 1, 1–2, 2–4. The first one is short and blunt, scarcely surpassing the median lobes. Second row of dorsal gland-orifices represented by the anterior group of 2–3 orifices. Third row with 3–4 orifices in the anterior and 4–5 in the posterior group. Fourth row with 3–4 orifices in the anterior and 4–6 in the posterior group. Median group of circumgenital gland-orifices, 8–15; anterior laterals, 19–31; posterior laterals, 13–23.

Scale of Male.—Length, about 1 mm. Sides nearly parallel, distinctly tricarinate. Exuviæ yellowish brown, occupying about one third of the length of the scale.

On wistaria from Japan. (In quarantine.)

Of the seven species of *Chionaspis* found in California no single species is considered a real pest. *C. ortholobis* may be found the most plentiful, but the host plant is not of much commercial importance. As to the others, they are, in a majority of cases, held in check by parasites. At times *C. pinifoliæ* gets a good start on the pines, but is soon overtaken by the parasite.

Howardia biclavis Comst.

(Mining Scale.)

Scale of Female.—Very nearly circular; the exuviæ are marginal, and project beyond the edge of the scale

Female.—The characters presented by the last segment of the female are as unusual as those presented by the scale. The pores on the dorsal surface of the segment are very small. Scattered over the ventral surface are numerous minute spines. The groups of spinnerets are wanting. The mesal lobes are large, oblique, nearly twice as broad as long; approximate at the base; the mesal margins diverge slightly, distal margin serrate; mesa-distal angle rounded and produced into a lobule. The second lobe is very small, being simply an angular projection of the body wall. The third lobe is about three times as wide as the second lobe; but it projects only a little beyond the margin of the segment. The plates are simple and spine-like. There are two minute ones between lobes; two between first and second lobes; two or

three between second and third lobes; a group of three or four larger ones laterad of third lobe; and another group of four or five still larger ones about midway between this group and the penultimate segment. Each of the three segments preceding the last bears on each lateral margin about seven plates. Two spines accompany each group of plates, one on the dorsal surface and one on the ventral. The first and second spines of each side are very small; the third, which is between the second and third lobes, is the largest; the fourth and fifth are successively smaller. There are two conspicuous club-shaped organs which appear like thickenings of the body wall, but which are really within the body cephalad of the mesal lobes. These organs are about three times the length of the mesal lobes; they converge caudad, and the cephalic end of each is suddenly enlarged. This species may be distinguished from any other known American coccid by the presence of these organs.

FIG. 22. *Howardia biclavis*. (Mining Scale.)

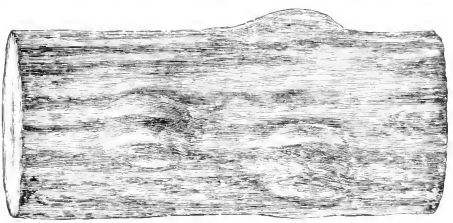


FIG. 23. Section of branch showing the mining habits of the scale. Greatly enlarged.

This scale is not to be found in California. Occasionally it is met with at quarantine, but is never permitted to pass, as the plant upon which it is found is immediately burned. At one time 325,000 orange trees infested with this and other scales were burned at quarantine at the port of San Pedro, and probably it was owing to this fact that it has been accredited as "Habitat: California."

Diaspis bromeliæ Kern.

(Pineapple Scale.)

Scale of Female.—Circular, with the exuviæ nearly marginal. The scale is white; the exuviæ are very light yellow. The first larval skin is usually naked; the second covered with a delicate film. Diameter of scale, 2 to 2.4 mm.

Female.—The body of the female is broadly ovate in outline; it is variable in color; it is usually a pale dirty yellow, with a faint tinge of purple; some are whitish yellow, with irregular pale-purplish markings;

and others are of a reddish-yellow tint. The last segment presents the following characters: The mesal group of spinnerets consists of from 9–15, usually 10 or 11; the cephalo-laterals, of from 20–27, usually 23; the caudo-laterals, 15–23, usually 16 or 17. The mesal lobes are small, separated at their base by at least the width of one of them, and divergent. The second and third lobes of each side are deeply bifurcated, with the lobes divergent; in each case the lateral lobule is more rounded than the mesal one. The fourth lobe is present, but much less developed than the other lobes; the lateral margin of this lobe is serrate.

The plates are simple and pointed. There are four or five plates, subequally distant from each other, between the fourth plate and the penultimate segment.

The spines on each side of the ventral surface are situated as follows: First mesad of the first lobe; second, third, and fourth laterad of the second, third, and fourth lobes, respectively; and the fifth between the seventh and eighth plates. All the ventral spines are very minute except the first pair, which are very conspicuous.

Of the dorsal spines the first is very delicate and is situated laterad of the first lobe; the second is large and is on the second lobe near its lateral margin; the third and fourth are laterad of the third and fourth lobes, respectively; and the fifth is about midway between the sixth and seventh plates.

Between the fifth and sixth plates there is a triangular prolongation of the body which bears an elongated pore. The penultimate and antepenultimate segments bear plate-like spinnerets.

Eggs.—The eggs are yellow; those recently deposited are paler than those ready to hatch.

Larva.—The recently hatched larvæ are orange yellow, with the eyes dark purplish.

Scale of Male.—The scale of the male is strongly tricarinated; the exuviæ are yellow.

On pineapple. (In greenhouses.)

This species has been reported from quarantine, on pineapples (fruit) from the Hawaiian Islands. It was also observed on growing plants in greenhouse.

Diaspis carueli Targ.

Scale of Female.—Circular, snowy white, with the exuviæ central, naked and yellow. Diameter of scale, 1 to 1.5 mm.

Female.—Body yellow, circular, slightly elongated posteriorly. The last segment of the body presents the following characters: The anterior group of spinnerets consists of about 8, the anterior laterals of

from 10 to 16, and the posterior laterals of about 8. There are four lobes, which are nearly in a straight line, the end of the body being truncate. These lobes are quite small, rounded posteriorly and equally distant from each other. The second lobe of each side is deeply incised, but the lateral lobule is very small, and in many cases concealed by the margin of the segment. Each lateral margin of the segment is divided into three subequal, more or less distinct lobes; each lobe ends posteriorly in one or more lobules, each of which bears an elongated pore on its dorsal surface. The plates are short, and in some cases subtruncate at extremities; they are situated as follows: Two between median lobes; two inconspicuous ones laterad of first lobe of each side; two laterad of second lobe; usually one on the anterior part of the first lobe of the lateral margin; one or two near the middle of the second lobe of the lateral margin, and two or three on the third or anterior lobe of the lateral margin. Dorsal spines: One on first lobe near lateral margin; one on lateral lobule of second lobe; and one a short distance mesad of the mesal plate of each of the three lobes of lateral margin. The ventral spines accompanying the first and second lobes of each side are obsolete. There is one at the base of the plate of the first lobe of the lateral margin; one between plates of second lobe, and one near the middle of the third or anterior lobe of the lateral margin.

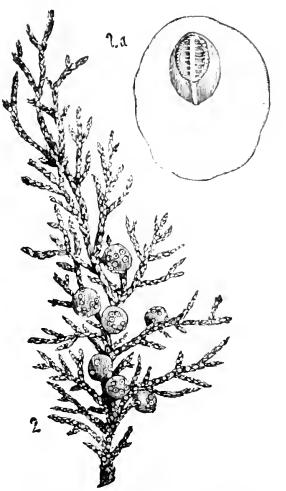


FIG. 24. *Diaspis carueli* (Juniper Scale). 2, adult females and larvæ on branches; 2*a*, female, greatly enlarged.

Scale of Male.—The male scale is white, and very small, being only 1 mm. in length; it is elongated, with a prominent median ridge: the larval skin is naked and light yellow in color.

Male.—Color of body light orange yellow, thoracic band yellow. The terminal joints of the antennæ are enlarged.

On juniper (*Cupressus* sp.).

In several sections this scale may be found very abundant upon juniper, but seems to confine its attack to this host plant and *Cupressus* sp. It is not considered as troublesome.

Aulacaspis rosæ Bouche.

(Rose Scale.)

Scale of Female.—Circular or irregular, snowy white, sometimes with yellowish tinge; 2.3 mm. in diameter; exuviæ sublateral; first larval skin naked, showing the segmentation; second covered.

Scale of Male.—1.25 to 1.5 mm. in length; white and tricarinated.

Female.—Body elongated; the antepenultimate segment prominently lobed and bearing 8 to 10 gland-spines. Median lobes large, approximated at base, serrulate, diverging, attached to body for entire length.

FIG. 25. *Aulacaspis rosæ* (Rose Scale). Branch showing scales on rose. *a*, male scale; *b*, female; both greatly enlarged.

Inner lobules of second, third, and fourth lobes rounder and larger than the other lobule. Fourth lobe nearly obsolete. There is a gland-spine laterad of each of the four lobes, and 2 to 4 near penultimate segment, enlarging as they are farther removed from the meson. On the dorsal surface the spines are situated as follows: one very small one on the median lobe, and one slightly larger on the outer lobe of the second, third and fourth lobes respectively, and one about three fourths of distance to penultimate segment. The spines on the ventral surface are slightly mesad of the corresponding dorsal ones. Dorsal spines in three rows; second row represented by anterior group of 2–3; third row,

anterior group 4–5, posterior group 5–6; fourth row, anterior group 4–6, posterior group 6–8. Mesad of second and third lobes respectively is an elongated pore, appearing like a lobe. Anterior group of circumgenital gland-orifices distinct, rounded, 18–22; anterior laterals, 25–32; posterior laterals, 26–34. Lateral groups indistinctly separated, sometimes almost continuous.

On rose, blackberry, and raspberry, infesting the canes.

This is a very common species in this State, and may be found on old rose bushes, and on the canes of blackberry and raspberry. In many cases it entirely coats the cane for some distance, giving it the appearance of having been whitewashed. When remedial measures are applied and all visible scale removed the horticulturist is somewhat surprised to again see the plant infested in a short time, owing to the fact that this species breed at or near the root of the host plant. When remedial measures are applied, the ground should be removed from around the base of the plant so that the wash will reach all the scale.

Hemichionaspis aspidistræ Sign.

Eggs.—Reddish fulvous. *Larva.*—Pale yellow (newly hatched).

Scale of Female.—Length, 1.8 to 2.6 mm. Distinctly broadened posteriorly and usually broadly rounded at the extremity, but occasionally bluntly pointed. Very thin and delicate in tissue or moderately thick and strong. Pale yellowish brown to brown. Exuviæ .7 to .9 mm. long, of the same color as the secreted portion of the scale, but slightly brighter.

Female.—The first four segments anterior to the pygidium very pronounced, being often produced at each side into a conspicuous protuberance. The first and second pairs of lobes well developed, third very rudimentary or wanting. Each median lobe with three distinct notches on the outer curved edge. Lobules of the second lobe long and narrow, spatulate in form; edges thickened at the base. The gland-spines are arranged as follows: 1, 1, 1, 1, 2–5. As a rule the fifth group contains 2–3 spines, although 5 have been observed. The marginal gland-orifices between the first and second lobes, if situated on a large, conspicuous prominence. Second row of gland-orifices wholly absent. Third and fourth rows with 2–5 orifices in their posterior groups. Anterior groups absent. Median group of circumgenital gland-orifices, 5–15; anterior laterals, 15–22; posterior laterals, 17–23.

Scale of Male.—Length, 1 to 1.3 mm. Exuviæ bright yellow.

On *Aspidistra lurida* (in greenhouses).

Epidiaspis piricola Del Guer.

This species has become quite troublesome to pear-growers in the Santa Clara Valley, and is often mistaken for the San José scale. It is easily distinguished from that species by the male scale, which in this species is of an elongated oval form and much flattened. A feeble carina extends along the middle, but the sides are not carinated. The color is white; the larval skin is light yellow and usually is about one third the length of the scale, while in the San José scale the male scale is nearly black and resembles the female scale in shape.

The female scale is circular, dark ash-gray in color, with the margin lighter, varying in color to nearly white. The exuviæ are nearly central, dark brown, naked and glossy.

This species is subject to the attack of several species of Coccinellids (ladybirds), which serve as a partial check to its increase. In some sections the lime, sulphur, and salt spray is used against this species, with good results.

A plate showing the characters of the last abdominal segment, made from specimens collected at San José, Cal., will be found on opposite page.

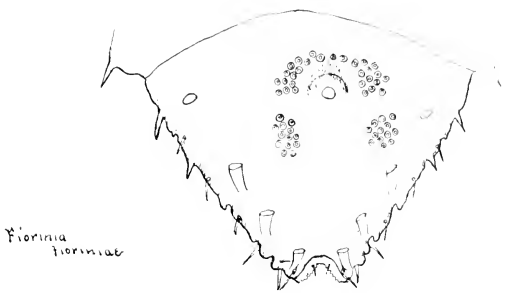
Aspidiotus æsculi Johns.

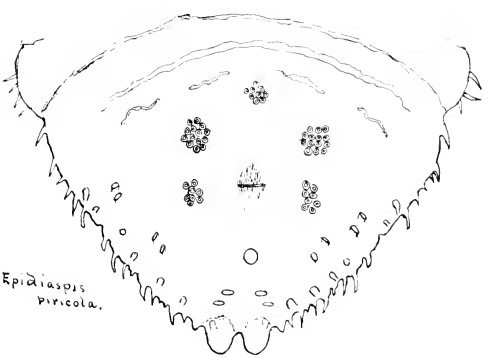
Scale of Female.—Circular, rather convex; diameter 1.5 to 3 mm.; color, dirty gray, conforming to color of bark; exuviæ a little to one side of center, and covered with excretion. In rubbed specimens the protuberance indicating the position of the exuviæ is orange-red and surrounded by a band a little darker in color than the rest of the scale; ventral scale delicate white, adheres to the bark.

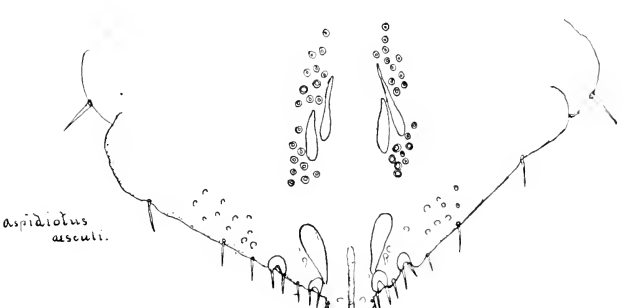
Scale of Male.—Elongate oval; 1 to 2 mm. long and half as wide; darker than the female. Larval scale marked by a nipple-like prominence between the center and the anterior margin; this is usually covered with a slight excretion, but when rubbed it is orange-red. Ventral scale white, slightly thicker than that of female.

Mature Male.—Yellowish; eyes and antennæ prominent; body stout; legs long, lighter yellow than rest of body; wings large; thoracic shield with band distinct and with margins indistinct in some specimens. Length, .60 mm.; style, .39 mm.

Mature Female.—Ovate, rather plump; yellow, last segment a little darker yellow. Four groups of spinnerets, number in each group extremely variable; anterior laterals, 5–17, average 10; posterior laterals, 4–11, average 7; number variable on opposite sides of same individual; one pair of lobes, nearly as broad as long, notched on lateral margin near the tip. Plates simple and inconspicuous, one usually just laterad of the lobe and two between the second and third spines. Spines prom-







C. T. P., del.

DETAILS OF CALIFORNIA COCCIDÆ.

inent, usually one pair to each segment, a rather deep incision just laterad of the lobe; anal opening about twice as distant from the base of the lobes as the lobes are long; spinnerets grouped about curious club-shaped organs.

On *Æsculus californica*.

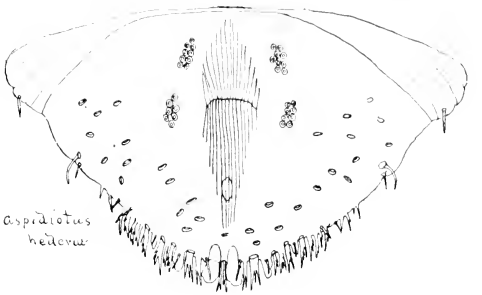
Aspidiotus hederæ Vall.

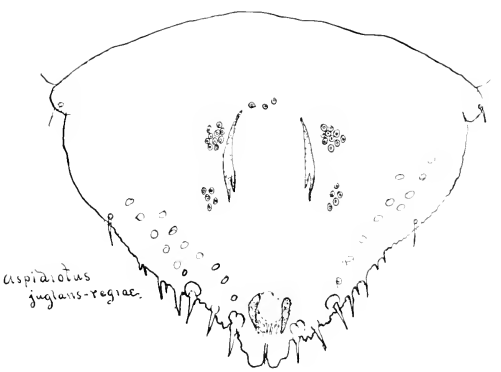
(Oleander and Lemon Scale.)

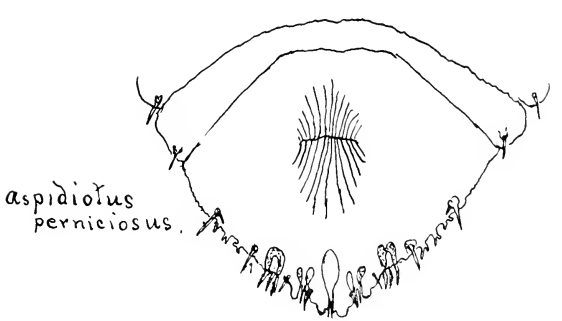
Scale of Female.—Flat, lightish or light gray in color, and with exuviæ central or nearly so; exuviæ dull orange-yellow; the first skin usually showing the segmentation distinctly, the second skin more or less covered with secretion, often appearing only as an orange-colored circle surrounding the first skin. Ventral scale a mere film applied to bark of plants. Diameter of fully formed scale, 2 mm.

FIG. 26. *Aspidiotus hederæ* (Oleander Scale). On branch of oleander, showing leaves thickly infested.

Female.—Body of adult nearly circular, with abdominal segments forming a pointed projection; light yellow in color, mottled with darker yellow; the last segment presents the following characters: The anterior lateral group of spinnerets consists of about 9, and the posterior laterals of about 7. There are three pairs of lobes; the first and second are well developed, the third quite small. The plates are well developed; they are long and usually fringed; there are two small ones between the median lobes; those of each side are as follows: Two between the first and second lobes; three between second and third lobes; and usually seven laterad of the third lobe, of which usually four are fringed and three simple. The number of the last-named group varies from four to nine. There is on each surface of the segment a spine accompanying each lobe; one between the fourth and fifth plates laterad of third lobe, and one at







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about one third the distance from this spine to the penultimate segments. In each case the spine on the ventral surface is a little laterad of the one on the dorsal surface.

Eggs.—Very light yellow in color.

Scale of Male.—The scale of the male is slightly elongated, with the larval skin nearly central; it is snowy white, with the larval skin light yellow. Longest diameter, 1 mm.

Male.—Yellow, mottled with reddish brown; central part of thoracic band reddish.

On oleander, magnolia, ivy, palms, etc.; also on lemons.

This is another of the common species of the State, having quite a range of host plants. It does not confine its attack to plants in the greenhouses, but is met with in many places in the open. It also attacks the lemon, usually infesting the fruit only; in such cases all the fruit on the tree is removed, either fumigated or destroyed, and the pest usually controlled.

Aspidiotus juglans-regiæ Comst.

(English Walnut Scale.)

Scale of Female.—Circular, flat, with the exuviæ laterad of the center; it is of a pale grayish brown color; the exuviæ are covered with secretion; the position of the first skin is indicated by a prominence which is pink or reddish brown. The ventral scale is a mere film which adheres to the bark. Diameter of scale, 3 mm.

Female.—The color of the female when fully grown is pale yellow, with irregular orange-colored spots; oral setæ and last segment dark yellow. This segment presents the following characters: There are either four or five groups of spinnerets; the anterior group is wanting or consists of from 1 to 4 spinnerets; the anterior laterals consist of from 7 to 16, and the posterior laterals of from 4 to 8.

There are two or three pairs of lobes. The median lobes are well developed, but vary in outline; the second lobe of each side is less than one half as large as the median lobes, elongated, and with one or two notches on the lateral margin; the third lobe is still smaller and pointed, or is obsolete.

There are two pairs of incisions of the margin, one between the first and second lobes of each side, and one between the second and third lobes. They are small, but are rendered conspicuous by the thickenings of the body wall bounding them.

The plates are simple, inconspicuous, and resemble the spines in form. The larger ones are situated one caudad of each incision.

The spines are prominent, especially those laterad of the second and third lobes; the fourth spines are a little nearer the first lobes than the penultimate segment; and the fifth are near the penultimate segment; there is also a spine at or near the union of the last two segments.

Scale of Male.—The scale of the male resembles that of the female in color; it is elongated, with the larval skin near the anterior end; this skin is covered by excretion, but its position is marked by a rose-colored prominence, as in the scale of the female; the anterior part of the scale is much more convex than the posterior prolongation, which is flattened. There is a rudimentary ventral scale in the form of two narrow longitudinal plates, one on each side of the lower surface of the scale. Length, 1.25 mm.

On English walnut, infesting the larger limbs, usually on the under side.

Aspidiotus perniciosus Comst.

(San José Scale.)

Scale of Female.—Circular, slightly convex, 1 to 2 mm. in diameter; gray or dark gray, except the prominent, covered, pale or reddish yellow exuviæ. The exuviæ are nipple-like, with a shallow, depressed ring about them, which is quite characteristic of this species.

FIG. 27. *Aspidiotus perniciosus* (San José Scale).

Scale of Male.—Black in color, rather convex, with the nipple-like prominence and depressed ring still more noticeable than in the female.

Female.—Two pairs of lobes well developed. Median lobes prominent, rounded at the apex, notched on the outer margin near the middle, though somewhat variable and converging. The thickened inner margins of the median lobes extend anteriorly, encircling the anal orifice in a characteristic manner. The second lobes are smaller and narrower, though distinct, quite close to the median, notched on the outer margin, pointed and converging. Between the median lobes and bounding each incision of the segment are club-shaped, chitinous processes; the inner usually the larger. There are two conspicuous plates between the median lobes, two caudad of the first incision, and three small, laterally serrate ones caudad of the second incision. Often laterad of second incision are wide, furcated extensions of the margin of the segment. The spines of the ventral surface are situated laterad of the corresponding dorsal spines at the bases of the first and second lobes; the third pair laterad of second

incision; the fourth pair at one half the distance to penultimate segment. Groups of circumgenital gland-orifices are absent. Rows of dorsal spines are not prominent, though variable.

On apple, pear, peach, quince, apricot, plum, hawthorn, rose, currant, raspberry, etc.

This scale is known the world over as the San José scale, yet it is a fact that it is very scarce at San José or in the district surrounding that city. At one time this species was extremely troublesome in California, but the internal parasite *Aphelinus fuscipennis* has done such excellent work that it is not a pest in California any more. We also have several species of Coccinellids (ladybirds) that prey upon it and have materially assisted in the work of controlling this once serious pest.

Aspidiotus rapax Comst.

(Greedy Scale.)

Scale of Female.—Very convex, gray, almost white, translucent, appearing yellow because of insect beneath; the sub-central exuviæ marked by a brown or black dot and a concentric ring. Ventral scale snow-white and usually entire.

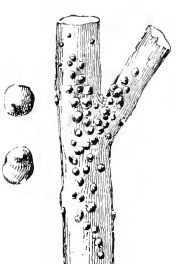


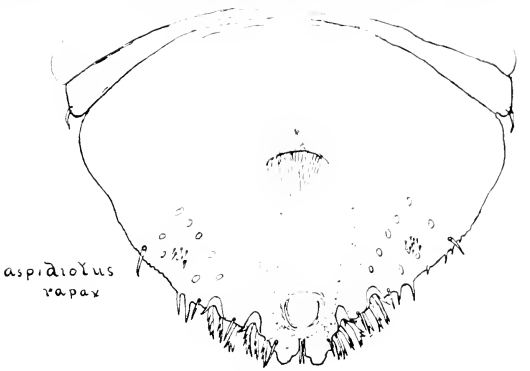
FIG. 28. *Aspidiotus rapax.* (Greedy Scale.)

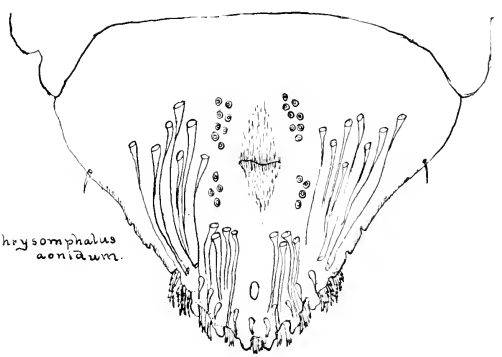
Scale of Male.—Similar to scale of female; scarcely so convex, with exuviæ sublateral.

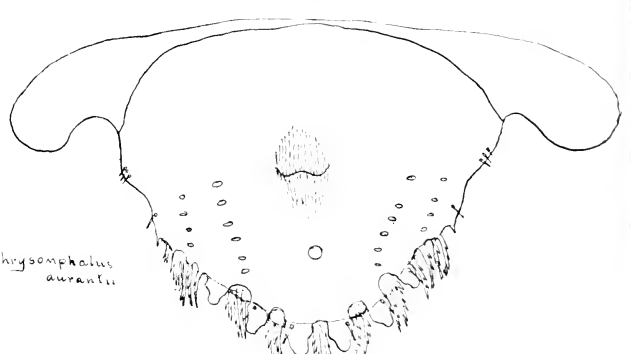
Female.—Only median lobes well developed and prominent, sharply notched on either side, the mesal notch near the apex. Second and third lobes are represented by small, pointed projections on the margin. A deep incision laterad of the median and second lobes, bounded by subequal chitinous processes. Two irregular toothed or branched plates caudad of each incision, with a simple one between them and two or three simple or furcated ones laterad of the third lobe. On each surface, spines are located at the lateral basis of each lobe; the fourth spine at about two thirds of the distance to the penultimate segment. The ventral fourth spine is slightly laterad of the corresponding dorsal spine. Groups of circumgenital gland-orifices absent. Dorsal pores in two or three irregular rows; the second of about six; the third of about four. The anal orifice is very large.

On willow, holly, ivy, acacia, orange, pittosporum, camellia, palms, etc.

This species is commonly known as the greedy scale, and it is well named, as it certainly seems to have no choice as to host plant, but thrives on almost any one of our shrubs. An internal parasite is par-







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tially effective against it in this State, but does not do good enough work to be of much use. This species is distributed all over the State, and while it is troublesome to individuals, yet it has not attacked any of our commercial trees or plants extensively enough to be really considered of much economic importance.

Pseudaonidia duplex Ckll.

Scale of Female.—The female scale is about $2\frac{2}{3}$ mm. in diameter, subcircular, moderately convex, dark blackish brown, with the large round exuviæ nearly to one side, and orange in color. When upon the stems and larger twigs of the camellia the scale has the same brown color of the bark and is easily overlooked. When removed the scale leaves a white patch on the branch.

Female.—Pale orange, broadly oval or subcircular, with the large cephalic portion separated from the rest by a deep suture. Mouth parts large; skin on dorsum very strongly, transversely grooved, the grooves linear, often anastomosing. Four groups of ventral glands in the usual situation; caudo-laterals of 28 to 30, cephalo-laterals of 42; median group represented by two orifices, not very close to each other. Besides these groups there is a group of 17 to 22 orifices, quite similar in character, on each side of the mouth parts; these groups are oval in outline. The anus is about on a level with the anterior ends of the caudo-lateral groups. There are four (two on each side) long tubes or ducts originating about the region between the caudo-lateral groups and the anus, and passing hindward, practically parallel, to the end of the body. On the dorsal surfaces the segments are marked by rows of oval pores. The pygidium shows on the dorsal surface a very distinct lattice-work, as in *A. theæ* and *Ischnaspis filiformis*. Median lobes very large, brown, rounded at the ends, but notched on each side so as to be trilobed; the lateral lobes very small and passing into the straight parallel sides. The median lobes are very close together, but distinctly separated, not touching, not diverging. There are three other pairs of lobes, small, narrow, rounded at ends, very inconspicuous and easily overlooked among the scale-like plates. Plates not extending beyond lobes, scale-like, not separately distinguishable, but forming a continuous fringe, which rapidly narrows beyond the fourth lobe, and ceases before the deep notch which indicates another segment. Margin cephalad of fourth lobe distinctly serrate, serrations coarse.

On *Camellia japonica* (in greenhouses).

Chrysomphalus aonidum Linn.

(Florida Red Scale.)

Scale of Female.—Circular, moderately convex, smooth; dark olivaceous brown or reddish brown, paler at margin. Pellicles reddish yellow, always partially obscured by a layer of secretion, which is reddish brown above the first, and pale olivaceous above the second pellicle. In the center of circular raised disk is usually exposed, the secretionary covering being here worn off. In young specimens the center is covered by a raised patch of opaque white secretion. The first pellicle convex above; the second often slightly concave; the form

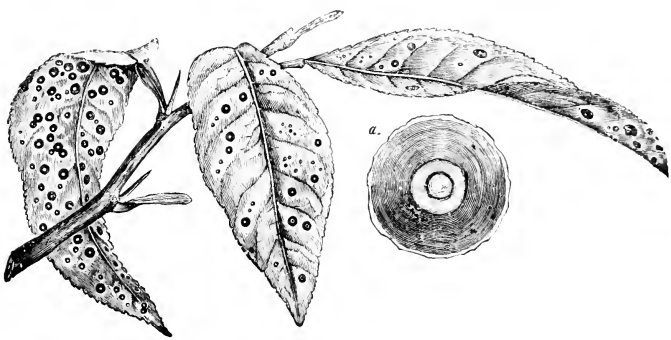


FIG. 29. *Chrysomphalus aonidum* (Florida Red Scale). On orange twig. *a*, female, greatly enlarged.

may best be observed from the inside of the scale, where the exuviae are more fully exposed. Ventral scale obsolete. Diameter, 1 to 2 mm.

The *male puparium* is dark brown, with pale gray margins. Pellicle reddish fulvous. Length, .8 mm.

Adult Female.—Yellow, or white mottled with yellow. Body broadly rounded in front, tapering suddenly to a point behind. On the margin of the mesal thorax is a small thickened patch bearing a stout thorn-like spine. Pygidium with six prominent lobes subequal in size, each notched on the lateral edge. At a short distance beyond the lobes the lateral margin is thickened and projecting, with minute serrations and two deep indentations. Plates deeply fringed; two in the mesal and first spaces, three in the second space, and three beyond the third lobe, these last being bifurcate and fringed on their lateral edges. Circumgenital glands in four groups; lower laterals with 2 to 4, upper laterals

with 6 to 8 orifices. A large number of conspicuous tubular spinnerets, varying from the filiform to the trumpet-shaped type, some opening by inconspicuous dorsal pores in two series on each side, others opening on to the margin near the extremities. Anal aperture small, close to extremity; genital aperture between the upper and lower groups of glands. Length, .8 to 1 mm.

Adult Male.—Orange yellow in color, with dark brown conspicuous transverse band crossing the thorax in front of the scutellum.

Eggs and young larvæ yellow.

On palms (in greenhouses).

Chrysomphalus aurantii Mask.

(Red Scale of California.)

Female.—The female is light yellow in color in the adolescent stages, becoming brownish as it reaches maturity. When fully developed the thorax extends backward in a large rounded lobe on each side, projecting beyond the extremity of the abdomen, and giving the body a reniform shape. The last abdominal segment presents the following characters: Three pairs of well-developed lobes, the first pair abruptly narrowed at about half their length; the notch on the mesal margin is often nearer the distal end of the lobe than that of the lateral margin. The lobes of the second and third pair are abruptly narrowed at half their length on the lateral margin, and often bear a notch on the median margin near the distal end. Laterad of the most lateral plate is a triangular lobe on the margin of the segment, which is separate.

The plates are deeply fringed; those between the first pair of lobes on their distal margins, the others on their lateral margins. They are all well developed, exceeding the lobes in length, and are situated as follows: Two between the first pair of lobes, two between the first and second lobes of each side, two between the second and third lobes, and three between the third lobe and the lobe on the margin of the body. The first plate laterad of the second lobe and the three plates laterad of the third lobe are each deeply bifurcated, and each bifurcation is fringed on the lateral margin.

On the ventral surface there is a spine near the base of the lateral margin of each of the four lobes except the first; there are also about three small slender spines on the margin of the body near the penultimate segment. On the dorsal surface there is a spine with each lobe. The first spine is very slender and inconspicuous, but as long as the lobe; it is situated at the base of the lateral margin of the lobe in such

a manner that it can be moved either above or below the lobe. Each of the other spines is situated near the middle of the base of the lobe it accompanies. Female viviparous.

Scale of Male.—The scale of the male resembles that of the female, excepting that it is only one fourth as large; the posterior side is pro-

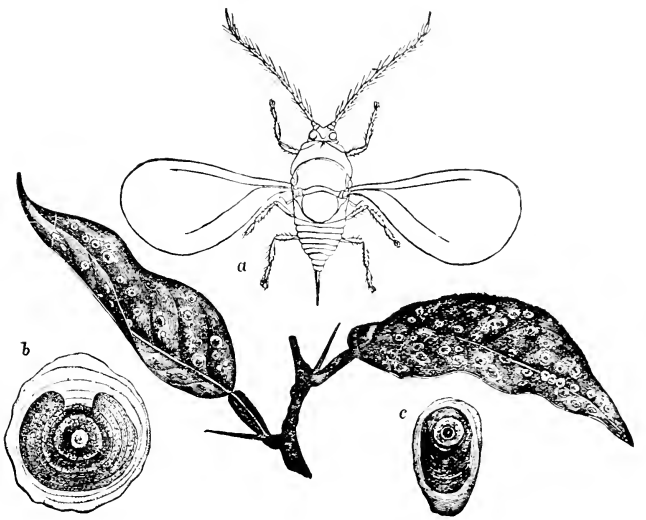


FIG. 30. *Chrysomphalus aurantii* (Red Scale). *a*, male; *b*, female scale, greatly enlarged; *c*, male scale, greatly enlarged

longed into a flap, which is quite thin; and the part which covers the larval skin is often lighter than the remainder of the scale.

Male.—The male is light yellow, winged, with the thoracic band brown, and the eyes purplish black.

On orange, lemon, grape-fruit, sago palms, rose and various palms.

While this species is called the "Red Scale of California," it is an introduced species. It is also a very serious pest in other countries, having been reported from Australia, China, Japan, New Zealand, Samoa, Fiji, Hawaiian Islands, West Indies, and many other countries, as well as several states in our own country. In California it is mostly confined to the southern part of the State, where it is well known to our citrus-growers. By strict quarantine, fumigation, and the use of various sprays it has been practically held in subjection in some of the counties, while in others it has been allowed to gain quite a foothold.

While Australia has been credited as the home of this pest, later investigations seem to show China to be the real home.

Chrysomphalus aurantii citrinus Coq.

(Yellow Scale of the Orange.)

This species differs but slightly from *C. aurantii*, but in its habits and color there is a very marked difference. The female scale is circular, with the exuviæ slightly to one side; the scale is not as convex; the

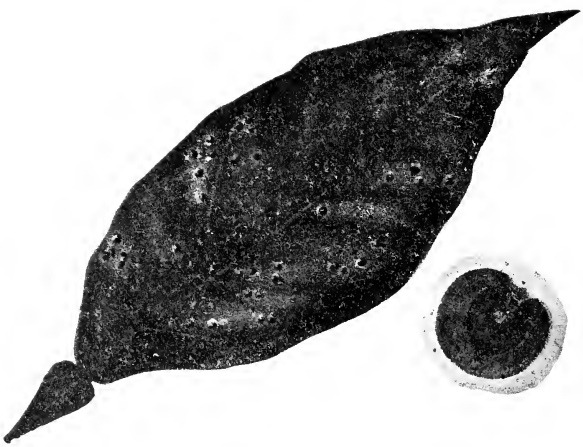


FIG. 31. *Chrysomphalus aurantii citrinus* (Yellow Scale). On orange leaf. Female, greatly enlarged.

margins are wider and a light gray. The body is a pale yellow; the ventral scale is light colored and remains attached to the upper one, making it difficult to remove the insect from the scale.

A curious fact about this insect is that it seldom attacks the wood, even when the foliage and fruit are covered with them. On this account the fruit-grower can readily determine between it and *aurantii*, as the latter infests the young shoots and even the large branches.

On orange and lemon.

This scale was introduced into this State in 1872 and for a number of years proved to be very destructive. It is now held in almost complete subjection by its natural enemy, *Aspidiotophagus citrinus* Craw, a minute chalcid fly introduced from Japan.

Lepidosaphes beckii Newm.

(Purple Scale.)

Scale of Female.—The scale of the female is long, more or less curved, and widened posteriorly. It is brown, with the exuviæ of the same color and with a delicate margin. The ventral scale is well developed; it is white, and consists of a single piece which is slightly attached at

FIG. 32. *Lepidosaphes beckii* (Purple Scale). On orange branch.

its sides to the lower edge of the scale, and is more or less incomplete posteriorly. Length of scale, 3 mm.

Female.—The female is yellowish white. The characters of the last segment are as follows: The anterior group of spinnerets consists of about 6; the anterior laterals of about 18, and the posterior laterals of about 9.

The median lobes are well developed, with the margins crenate; the second lobe deeply incised, with the margins of the lobules either entire

or crenate; the third lobe is quite inconspicuous, projecting but little beyond the body wall, the margin crenate and one large notch in the center of the lobe.

The plates are long, simple, and tapering. There are two of them in each of the following places: between median lobes; between first and second lobes; between second and third lobes; laterad of third lobe; and about midway between this lobe and the penultimate segment.

There is an elongated pore between first and second lobes; two laterad of each of the third and fourth pairs of plates; and one laterad of the fifth pair of plates. The penultimate segment bears at least four plates upon each lateral margin.

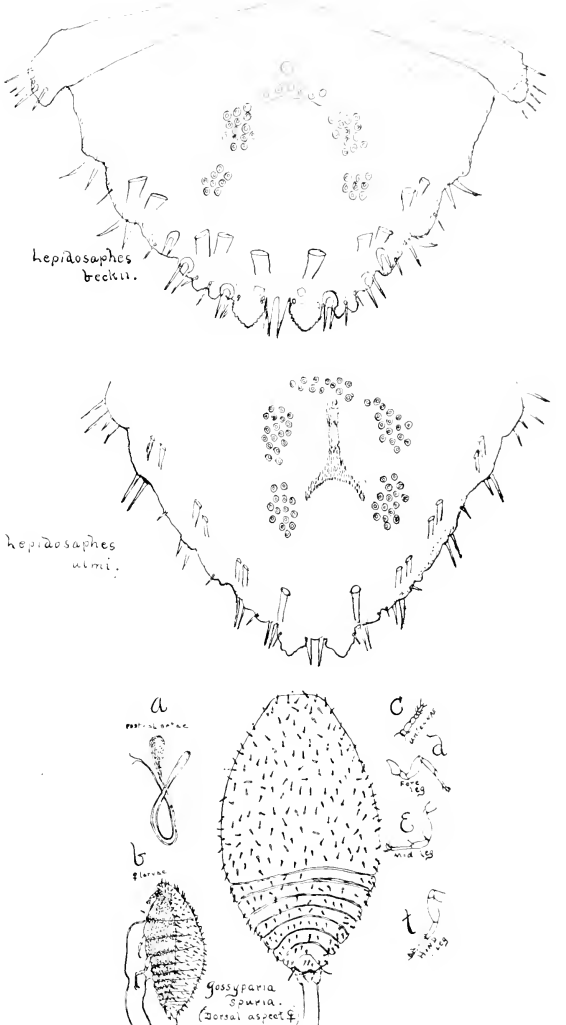
The spines upon the dorsal surface are long, and are situated as follows: one at the base of each margin of the first lobe; one dorsad of incision of second lobe; one dorsad of the notch of third lobe; and one about midway between the fourth and fifth pairs of plates. Those of the ventral surface are as follows: cephalad of the bases of the first pair of plates are two small spots which resemble the bases of spines, and are doubtless the homologues of the first pair; the second spine of each side is near the base of the lateral half of the first lobe; third spine laterad of lateral lobule of second lobe, and fourth and fifth spines between the members of the fourth and fifth pairs of plates respectively.

Eggs.—The eggs are white, and are arranged irregularly under the scale.

Scale of Male.—The scale of the male is usually straight, or nearly so; the same color as that of the female, or in some specimens varying to a very dark brown, almost black, the larval skin light yellow. At about one fourth of length of the scale from the posterior extremity, the scale is thin, forming a hinge, which allows the posterior part of it to be lifted by the male as he emerges. Length, 1.5 mm.

On orange, lemon, grape-fruit, sago palms.

This species is well known to many of our citrus-growers, and is commonly known as the purple scale. It was introduced from Florida on orange stock, and is to-day one of the most serious pests we have in the State. By strict quarantine it has been practically confined to certain districts, and with the use of insecticides and fumigation its spread has been checked. At the Insectary we are now working on material from which we hope to get its natural insect enemy, and if successful, our past experience in this line gives us the hope that at last we may be able to successfully control this pest.



a, rostral setæ; *b*, female larva; *c*, antennæ; *d*, fore leg; *e*, middle leg; *f*, hind leg.

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Lepidosaphes crawii Ckll.

Scale of Female.—The female scale is narrow, measures $2\frac{1}{3}$ mm. long and $\frac{1}{2}$ mm. wide; pale orange yellow; exuviæ concolorous.

Adult Female.—Yellow; four groups of ventral glands, caudo-laterals of 3, cephalo-laterals of 4 in a row. Median lobes very large, roundish at the ends, their edges finely serrate. They are closely adjacent at a point at the base, being separated, however, by a pair of small spine-like plates; thence they diverge at nearly a right angle to their rounded ends; thence rapidly sloping, the outward slope longer than the inner, and diverging from it at an angle of about 80 degrees. Next to the outer side of each median lobe is a small spine-like plate, then a sac-like incision, then the small second lobe, shaped much like the last joint of a finger, and in bulk hardly one tenth of a median lobe. Following this is a small sac-like incision, then a pointed projection, then two succular incisions, then after a short interval a spine-like plate, then another sac-like incision, then a long interval of smooth margin, then another sac, then another interval, in the middle of which is a small spine. Below the sac-like incisions are transversely elongate pores.

The scale is extremely inconspicuous, as it lives beneath the epidermis, on the under side of the leaf, along the mid-rib. By this habit, and the large median lobes, it will be readily distinguished from *M. grandilobus* Maskell, which has the large median lobes; it is known, too, by the entirely different color of the scale, etc. Several of the specimens were parasitized.

On the under side of the leaf beneath the epidermis of *Quercus cuspidatus*.

This species represents one of the smallest members of this destructive family. Its mining habits and size make it extremely difficult to detect.

Lepidosaphes ulmi Linn.

(Oyster-shell Scale.)

Scale of the Female.—Mussel shaped, more or less curved, of a purplish-brown color, with the exuviæ yellowish. Length, one sixteenth of an inch.

Adult Female.—The body is light yellow. The last segment presents the following characteristics: The anterior group of spinnerets consists of from 11 to 17; the anterior laterals and posterior laterals each of 16 to 21. The median lobes are large and wide, with the sides parallel; they are only about three fourths as long as broad. Each lobe is narrowed on each side near the distal extremity by one or two notches, and then rounded. The second lobe of each side is about as wide as

the first, and is deeply incised; mesal lobule with mesal margin as long as lateral margin of the first lobe, and rounded posteriorly; lateral lobule about half the length and width of mesal lobule, and similar in shape. Third lobule obsolete. The plates are long, simple, and tapering.

Eggs.—These are white, and are arranged irregularly under the scale.

Scale of Male.—The scale of the male of this species is usually straight and of the same color as that of the female. At about one quarter of the length of the scale from the posterior extremity, the scale is thin, forming a hinge which allows the posterior part of it to be lifted by the male as he emerges. Length, .06 of an inch.

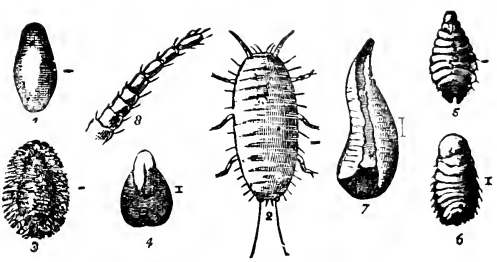

FIG. 33. *Lepidosaphes ulmi* (Oyster-shell Scale). 1, egg; 2, young insect (larva); 3, appearance of secretion as it hardens and forms shell over insect; 4, immature scale; 5 and 6, appearance of insect after casting skin, limbs, and other appendages; 7, dorsal view of insect at maturity; 8, antennæ. (All greatly enlarged.)

The male is translucent, corneous gray, with a dorsal transverse band on each joint, and the portions of the mesothorax and metathorax darker, or purplish gray, with the members somewhat lighter.

According to climate and locality the young scale hatch from the middle of March to June. Color, yellow. They begin to form the cottony excretion after twenty-four hours, and in from two to four days the insect is completely covered with a dense excretion, which increases as the larva grows.

On apple, pear, plum, hawthorn.

In several of the older apple orchards of the State this species can be found in limited numbers, also in the grounds of private residences where the trees are neglected. An internal parasite and predaceous insects prey on this species, causing a partial check to its increase.

Parlatoria pergandii Comst.

(Chaff Scale.)

Scale of Female.—Circular to elongated, irregular, dirty gray, 1.6 mm. in length; exuviæ marginal, brown, the first naked and the second covered by a thin skin of secretion, occupying nearly one third of length of scale.

Scale of Male.—Long and narrow, lateral margins prominent, not carinated, light gray with terminal exuviæ darker.

Female.—Three pairs of well-developed lobes, nearly equal in size, broadest near the middle, tapering anteriorly, notched deeply on each side of the apex. A rudimentary fourth lobe, produced into a papilla, halfway between third and penultimate segment. A crescent-shaped thickening of the body wall appears between the median lobes, between median and second, second and third, and two thickenings between third and fourth lobes and penultimate segment. The plates are as long as the lobes, and fringed on the distal margins; two between median lobes, two between median and second, three between second and third, three between third and fourth, and three palmate plates cephalad of fourth lobe. On the three segments preceding the last are five or six plates, each produced into a papilla. A spine on the dorsal surface of each lobe near the margin; on the ventral surface the spines are situated laterad of the second, third, and fourth lobes respectively. Four groups of circumgenital gland-orifices, each of about 7, but varying from 5 to 10.

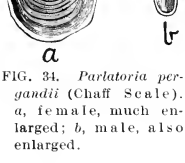

FIG. 34. *Parlatoria pergandii* (Chaff Scale). *a*, female, much enlarged; *b*, male, also enlarged.

On orange. (On palms in greenhouse.)

This is a very difficult scale to detect on the orange, being so near the same color as the bark. In California this scale has not gained a foothold, being known in the open in only two districts. The author once found in a new section thirteen trees that were badly infested, and the entire infestation was on the trunk and lower branches up to the main fork of the tree. This scale seems to prefer the lower branches and trunk and requires close inspection to detect its presence.

Carnes, Edward K.

The Coccidae of California: a descriptive list of the different scale insects found in and reported from.....