

and by some it is regarded as somewhat analogous but more potent than the protective substances formed in the original Pasteur vaccine. In any event early reports would indicate that it is a very valuable immunizing agent and its limited use at this time is being observed closely by veterinarians and stockmen.

STATUS AND SYNONYMY OF THE DICTYOSPERMUM SCALE.*

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RECENTLY the dictyospermum scale, *Chrysomphalus dictyospermi* (Morgan) has been found by H. J. Ryan rather severely infesting palms out of doors in Los Angeles, California. This fact, coupled with the common knowledge that this scale is elsewhere a serious citrus pest, makes it a matter of importance to review our present knowledge concerning the insect, particularly with reference to its occurrence in California. It has, of course, often been found in the state before (Essig 1916) but in nearly all cases as a greenhouse species, never, apparently, having successfully established itself out of doors prior to this time. In the course of the present study, certain facts were brought out which seem to justify publication, particularly as there seem to exist certain ambiguities relative to the real identity of this species and to its actual economic status.

For a long time a closely related species, *Chrysomphalus pinnulifer* (Maskell) often has been confused with the true dictyospermum scale and in certain instances, particularly in Mediterranean citrus districts, the names frequently were used almost interchangeably. It thus becomes of primary importance to determine the answers to two questions: First, is the so-called dictyospermum scale of California, Florida and Louisiana identical with the citrus infesting dictyospermum scale of the Mediterranean, and are they all in turn identical with the form described in Morgan's original paper? Secondly, is the pinnulifer scale actually distinct from Morgan's species (*dictyospermi*) and if so how can it be separated therefrom?

Green already has published data answering the second question in the affirmative, and his conclusions now secure complete confirmation in the morphological findings of the present paper. In short, the pinnulifer scale, *Chrysomphalus pinnulifer* (Maskell),* is clearly morphologically distinct from the dictyospermum scale (*Chrysomphalus dictyospermi* (Morgan)). Both species have been reported from citrus but only the latter can, at present, be regarded as a serious pest.

It is unnecessary to go into detail in answering the first question. Owing to the kindness of E. E. Green and others I had the opportunity of examining a considerable range of specimens of both these species from various parts of the world. The comparative studies thus made possible and here reported upon indicate that so far as *morphological characters* are concerned the dictyospermum scale definitely occurs in

* This species was originally described under the genus *Diaspis* and as a consequence took a terminal "a" (*pinnulifera*) in order to agree in gender. *Chrysomphalus*, however, is masculine and the "a" should now be dropped.

California, Louisiana, Florida, Demerara (British Guiana), Connecticut (in greenhouses), England (under glass), Portugal, Spain, Italy, Madeira and Ceylon.

The fact that it is a serious pest of citrus in the Mediterranean regions indicates that it must be regarded as a real menace to the industry wherever it appears, although it is quite true that in the matter of host preference it seems to vary geographically. Thus, in Florida, while it is found on citrus, it is not a serious pest, but on the other hand is of considerable importance in relation to avocados. In California and Ceylon it seems to prefer palms of various sorts, while in Mediterranean regions, as before noted, it is primarily a citrus infesting species. But this, particularly in view of its large host list, does not justify the conclusion that this order of preference always will be maintained, or is, for that matter, even now firmly established. While there does seem to be positive evidence as to the reality of so-called physiological species or rather host-limited races, the data at hand are insufficient to make any categorical claims.

The distinctions between the pinnulifer and dictyospermum scale should be easily apparent from the following table and the accompanying self-explanatory illustrations (Figs. 108-113). Synonymy as well as host and locality records are summarized under the respective species headings. It is unnecessary to present complete systematic descriptions or a complete bibliography. Only historically important and significant recent references are given. Additional literature citations may be secured from the Fernald catalogue and elsewhere.

REFERENCES AND NOTES.

1. *Chrysomphalus dictyospermi* (Morgan).

- 1889—*Aspidiotus dictyospermi* Morgan. Ent. Mon. Mag., 25:352.
 1893—*Aspidiotus dictyospermi* var. *arece* Newstead. Ent. Mon. Mag., 29:185.
 1893—*Aspidiotus mangiferae* Cockerell. Jour. Inst. Jamaica, 1:225.
 1897—A. (*Chrysomphalus*) *dictyospermi* Cockerell. U. S. Dept. Agric., Bull. 6, Tech. Ser. 23.
 1899—*Chrysomphalus dictyospermi* Leonardi. Riv. Pat. Veg., 7:218.
 1904—*Chrysomphalus dictyospermi* Hodgkiss. Mass. Agric. Coll. Report, p. 12, 2 plates.
 1914—*Chrysomphalus dictyospermi* Quayle. U. S. Dept. Agric. Bull. 134:15-17.
 1916—*Chrysomphalus dictyospermi* Essig. Monthly Bull. Cal. State Comm. Hort., 5:195-197, Figs. 68-70.
 1923—*Aspidiotus* (*Chrysomphalus*) *dictyospermi* Green. Bull. Ent. Res., 14:97.
 1923—*Chrysomphalus dictyospermi* Merrill and Chaffin. State Plant Board of Florida, Quar. Bull. 7:223.

Authority for determination.—Determined material from Mr. E. E. Green.

Distribution.—General, as a whole, in tropical and subtropical countries. I have positive determinations from those recorded localities marked by an asterisk.

United States of America: * California (Los Angeles on Kentia Palms), * Florida (on avocado), * Louisiana (on Ficus), * Connecticut (under glass), * England (under glass), * Italy, * Spain, * Portugal, Egypt, Algeria, India, * Ceylon, China, Brazil, British GUIANA (Demerara) TYPE LOCALITY, West Indies, * Madeira. In addition it is listed by Merrill and Chaffin from the following localities: (I am unaware of the source or authority for these records and probably many refer to *pinnulifera*.) Africa, Argentina, Bahama Islands, Barbados, British Honduras, Canary Islands, Corsica, Cuba, Dominica, Fiji, France, Guatemala, Honduras, Jamaica, Java, Mexico, Panama Canal Zone, Philippine Islands, Porto Rico, Russia, Seychelles, Sicily, South Africa, Spanish Honduras, Uganda, Zanzibar.

Food Plants.—The host list is a long one and includes the following species of plants:

Dictyospermum album, *Erythrina indica*, *Latania*, palms of various species, roses, mango, avocado, citrus, *Areca triandra*, *Cypripedium*, *Dendrobium*, *Anthurium*, *Aloe zeyheri*, tea and *Musa cavendishi*. In Florida alone Merrill and Chaffin (1923) report this scale from the following hosts: *Acacia* sp., *Agave* sp., *Albizia* sp., *Allamanda* sp., Apollo laurel, arbor-vitae, asparagus fern, avocado, Australian pine, *Bahia fastigata*, banana, Barbados cherry, bay, bottle brush, boxwood, *Caladium* sp., *Camellia* sp., camphor, canna, *Carissa* sp., century plant, cinnamon, *Citrus* sp., creeping fig, *Cycas* sp., English ivy, *Elacagnus* sp., *Eucalyptus* sp., *Eugenia* sp., fern, *Ficus* sp., guava, jasmine, *Ligustrum* sp., loquat, magnolia, mango, *Mammea* sp., mountain ebony, mulberry, oleander, orchid, palms, Panama hat plant, *Pandanus* sp., pecan, poinsettia, privet, *Rheedia aristata*, rose, rose apple, syzygium, tea plant, traveler's tree, willow and *Zamia* sp.

It is reported as being particularly injurious to avocados in Florida.

Remarks.—The general appearance of the dictyospermum scale is similar to the ordinary California red scale (*Chrysomphalus aurantii* (Mask.)), from which it may be superficially distinguished by its smaller size. Its life history has been treated briefly by Hodgkiss in Connecticut in 1904 and later by Quayle in Spain and Italy in 1914.

2. *Chrysomphalus pinnulifer* (Maskell).

1890—*Diaspis pinnulifera* Maskell. New Zeal. Trans., 23:4.

1894—*Aspidiotus dictyospermi* var. *jamaicensis* Cockerell. Can. Ent., 26:129.

1896—*Chrysomphalus minor* Leonardi. Riv. Pat. Veg., 6:214.

1900—*Diaspis pinnulifera* Green. Ind. Mus. Notes, 5:2.

1923—*Aspidiotus (Chrysomphalus) pinnulifera* Green. Bull. Ent. Res., 14:96.

Authority for determination.—Material determined as such by E. E. Green.

Distribution.—The recorded distribution is: FIJI, TYPE LOCALITY; Italy (doubtful); Jamaica, British Guiana (Demerara) and Madeira.

Food Plants.—According to Green this species has been found on *Croton*, *Cycas*, *Rosa* and *Magifera*.

Remarks.—Green in 1923 examined some of Maskell's type material of this species and as a consequence raised it from its accepted rank as a variety or subspecies of *dictyospermi* to full specific rank. The basis of his separation was essentially that given in the preceding table.

3. *Chrysomphalus pinnulifer* var. *diversicolor* Green.

1923—*Aspidiotus (Chrysomphalus) var. diversicolor* Green. Bull. Ent. Res. 14:96-97 f. 8.

Authority for determination.—Part of Green's type material from Madeira.

Distribution.—Green records this distinct variety from Madeira, TYPE LOCALITY; South Africa and India.

Food Plants.—*Phoenix dactylifera*, *Phoenix canariensis*, *Dracaena*, *Musa cavendishi*, *Citrus*, *Buxus*, *Psidium* and asparagus.

Remarks.—This highly interesting and distinctive variety seems possibly of specific rather than varietal rank, but a definite decision must await more extensive study based upon a large quantity of material.

DISTINGUISHING CHARACTERS BETWEEN THE DICTYOSPERMUM SCALE
AND ITS CLOSEST RELATIVES.

<i>Chrysomphalus dictyospermi</i> (Morgan).	<i>Chrysomphalus pinnulifer</i> (Maskell).	<i>Chrysomphalus pinnulifer</i> var. <i>diversicolor</i> Green.
1. Dorsal pygidial wax duct areas reduced (Figs. 108 and 109).	1. Dorsal pygidial wax duct areas well developed (Fig. 110).	1. As in <i>pinnulifer</i> (Fig. 111).
a. Not more than 9 or 10 wax ducts in marginal row.	a. With at least 16-18 wax ducts in marginal row.	a. As in <i>pinnulifer</i> .
b. Not more than 6 or 8 ducts in central row.	b. With 12-15 wax ducts in central row.	b. With 18 or 20 wax ducts in central row.
c. Two or 3 ducts in vestigial median row.	c. As in <i>dictyospermi</i> .	c. As in <i>dictyospermi</i> .
2. Pinnuliform lobes small and relatively inconspicuous.	2. Pinnuliform lobes prominent and distinctly conspicuous.	2. As in <i>pinnulifer</i> .
a. Pinnuliform lobes always (at least one) serrate or dentate in some degree (Figs. 113 B, D, E, F, G, H, I, J).	a. Pinnuliform lobes always entire—smoothly and evenly rounded. Never dentate in any degree (Fig. 113 A).	a. Pinnuliform lobes as in <i>pinnulifer</i> (Fig. 113 C).
3. Pygidium in general tending to be more or less bluntly deltoid in shape (Figs. 108 and 109).	3. Pygidium tending to be distinctly acute—not broadly deltoid (Fig. 110).	3. Pygidium apparently even more acute than in <i>pinnulifer</i> (Fig. 111).
4. Pygidial plates somewhat variable but in general tending toward reduction and projections toward bluntness (Figs. 112 B, D and E).	4. Pygidial plates always strongly developed and projections always sharply acuminate (Fig. 112 A).	4. Pygidial plates as in <i>pinnulifer</i> (Fig. 112 C).
5. Median lobes in general tending to be distinctly convergent (Figs. 108, 109, 112 B, D, E).	5. Median lobes in general tending to be divergent (Figs. 110 and 112 C).	5. Median lobes as in <i>pinnulifer</i> (Figs. 111 and 112 A).
6. Third lobes with but 1 or 2 exterior notches (Fig. 113 B, D, F, G, H, I and J).	6. Third lobes with 4 exterior notches (Fig. 113 A).	6. Third lobes as in <i>pinnulifer</i> (Fig. 113 C).
7. Scale of adult female circular or subcircular, reddish brown to light chestnut in color, exuviae central or subcentral and shining. Ventral scale a thin secretion on leaf. Diameter 1-1.75 mm. Body of insect proper never immovably fused to the scale coverings (as in the ordinary red scale <i>Chrysomphalus aurantii</i> (Maskell)).	7. Essentially as in <i>dictyospermi</i> . Scale in general reddish or reddish brown in color.	7. As in <i>pinnulifer</i> except that it characteristically varies in color to a vast degree, extending from blackish to purplish, through various shades of brown, to almost pure white; the central exuviae are always reddish. All these variations occur in a single infestation—even on a single leaf.

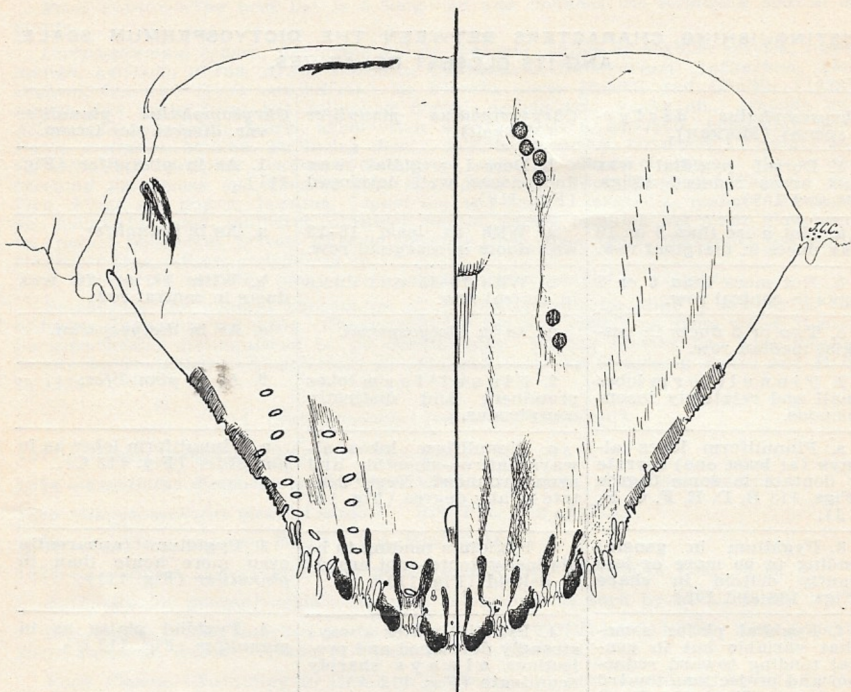


FIG. 108. *Chrysomphalus dictyospermi* (Morg.) Pygidium of a specimen from Los Angeles on Kentia.

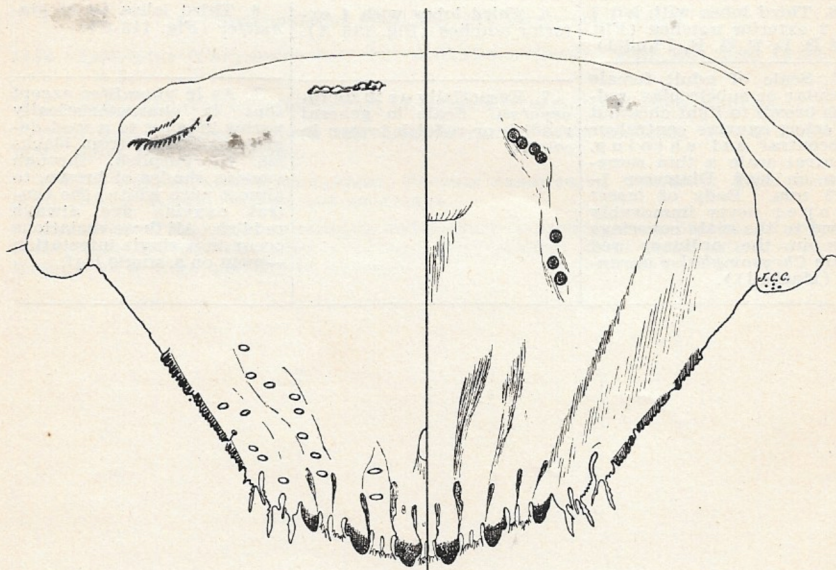


FIG. 109. *Chrysomphalus dictyospermi* (Morg.) Pygidium of a specimen from Italy on Lemon.

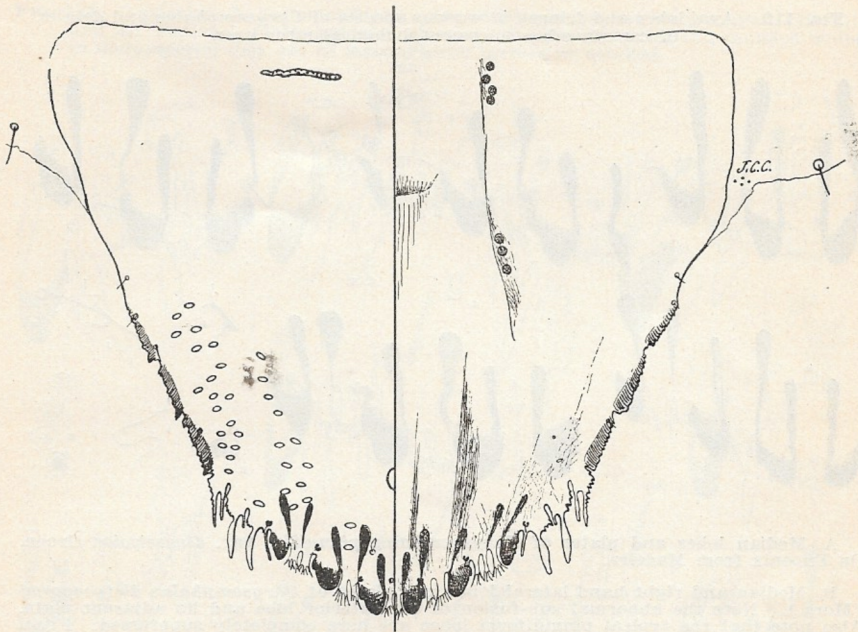


FIG. 110. *Chrysomphalus pinmifer* (Mask.) Pygidium of a specimen from Madeira on Ivy.

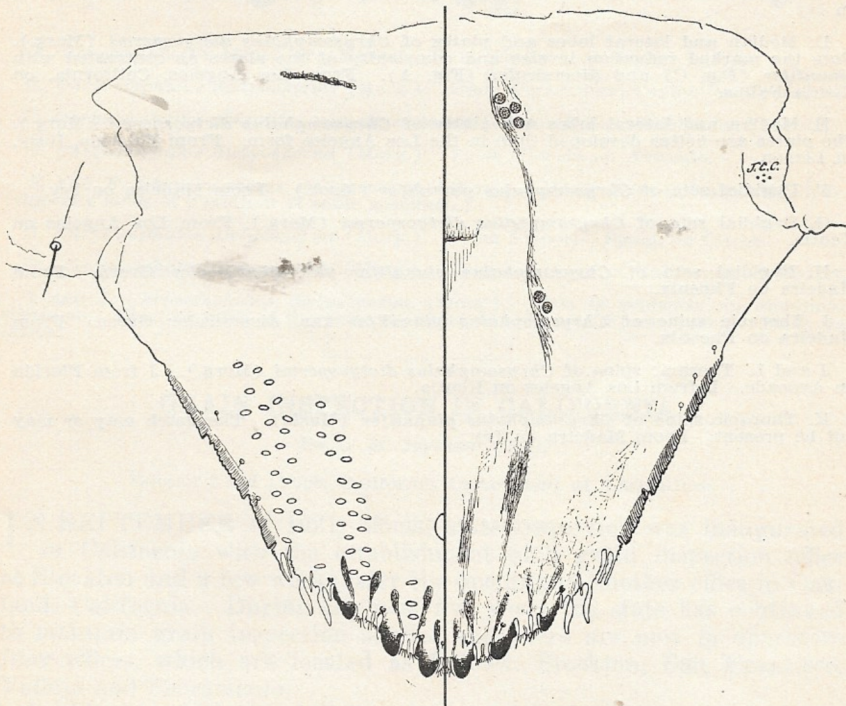


FIG. 111. *Chrysomphalus pinmifer* var. *diversicolor* Green. Pygidium of a specimen from Madeira on Phoenix.

FIG. 112. Anal lobes and fringes of various species of *Chrysomphalus* and details of certain other micromorphological structures.



A. Median lobes and plates of *Chrysomphalus pinnulifer* var. *diversicolor* Green. On Phoenix from Madeira.

B. Median and right hand lateral lobes and plates of *Chrysomphalus dictyospermi* (Morg.). Note the abnormal sub-fusion of the exterior lobe and its adjacent plate. Also note that the typical pinnuliform lobes are here completely suppressed. From Peradeniya, Ceylon, on Cycas.

C. Median lobes and plates of *Chrysomphalus pinnulifer* (Mask.). From Madeira on Ivy.

D. Median and lateral lobes and plates of *Chrysomphalus dictyospermi* (Morg.). Note the marked reduction in size and complexity of the plates as contrasted with *pinnulifer* (Fig. C) and *diversicolor* (Fig. A). From Los Angeles, California, on Kentia Palms.

E. Median and lateral lobes and plates of *Chrysomphalus dictyospermi* (Morg.). The plates are better developed than in the Los Angeles form. From Palermo, Italy, on Lemon.

F. Pygidial seta of *Chrysomphalus pinnulifer* (Mask.). From Madeira on Ivy.

G. Pygidial seta of *Chrysomphalus dictyospermi* (Morg.). From Los Angeles on Kentia.

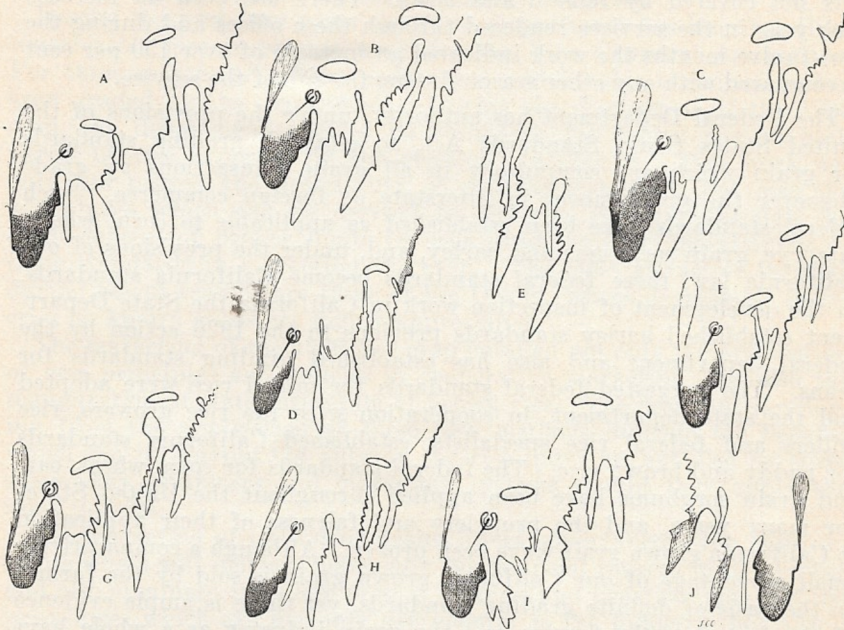
H. Pygidial seta of *Chrysomphalus pinnulifer* var. *diversicolor* Green. From Madeira on Phoenix.

I. Thoracic spine of *Chrysomphalus pinnulifer* var. *diversicolor* Green. From Madeira on Phoenix.

J and L. Thoracic spine of *Chrysomphalus dictyospermi* (Morg.). J from Florida on Avocado. L from Los Angeles on Kentia.

K. Thoracic spine of *Chrysomphalus pinnulifer* (Mask.). The notch may or may not be present. From Madeira on Ivy.

FIG. 113. Variations in the pinnuliform lobes of *Chrysomphalus dictyospermi* (Morg.) and its relatives. Note that *pinnulifer* has these lobes entire and rounded while in *dictyospermi* they are at least slightly serrate or notched.



- A. *Chrysomphalus pinnulifer* (Mask.). From Madeira on Ivy.
 B. *Chrysomphalus dictyospermi* (Morg.). From Peradeniya, Ceylon, on Cycas.
 C. *Chrysomphalus pinnulifer* var. *diversicolor* Green. From Madeira on Phoenix.
 D. *Chrysomphalus dictyospermi* (Morg.). From Florida on Avocado.
 E and F. *Chrysomphalus dictyospermi* (Morg.). From New Orleans on Ficus. (Opposite sides of pygidium of same specimen.)
 G. *Chrysomphalus dictyospermi* (Morg.). From Piaporte, Spain, on Citrus.
 H. *Chrysomphalus dictyospermi* (Morg.). From Los Angeles, California, on Kentia.
 I and J. *Chrysomphalus dictyospermi* (Morg.). This is evidently an abnormal specimen. The two sides of the same specimen are shown. From Palermo, Italy, on lemon.

GRAIN INSPECTION IN CALIFORNIA.

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IN SEPTEMBER of 1921, official state inspection was inaugurated in California with the establishment of a grain inspection office at Stockton and a few weeks later the opening of another office in Oakland, California. During the past five years the state has continued to maintain grain inspection service and there are now in operation four offices, which are located as follows: Stockton, San Francisco, Vallejo and Sacramento.

In this period of time the offices have rendered to growers and dealers inspection services through federal licensed inspectors for those grains