

number of the fluids used for the preservation of fruits, but had found none of them satisfactory.

Mr. Osborn thought that the aqueous preparations employed were open to the objection that they would freeze.

Mr. Smith had employed a method of killing and preserving larvæ similar to that described in the paper and agreed that alcoholic specimens as ordinarily collected and preserved were often of little use for the study of internal structures.

The following paper was then read:

THE DISTRIBUTION OF COCCIDÆ.

By T. D. A. COCKERELL, *Las Cruces, N. Mex.*

[Read by the secretary in the absence of the author.]

It would be difficult to point to any group of insect pests the ravages of which have been more seriously increased by human interference than the Coccidæ. As a general rule, when one finds Coccids under strictly natural circumstances, they are local in their distribution, and their attacks are confined to one or two species of plants. But now that we continually carry plants from one country to another, we take with them Coccidæ of many kinds, and already some scale-insects are so cosmopolitan by human introduction, that it is very difficult to guess where they originally came from.

It is a matter of common knowledge amongst economic entomologists that the evils thus arising are on the increase; and I would submit to you that the outlook is a very serious one.* Even in the temperate zone you have become familiar with the injuries done by Coccidæ in countries where they are not indigenous; but in the tropics the state of affairs is beyond anything one could easily imagine, without having seen it. Coming to New Mexico from Jamaica, I experienced a kind of surprise at not seeing the leaves of the roadside trees spotted with *Diaspinæ* and *Lecaniinæ*, although I knew quite well that such appearances were not to be looked for so far north. In Jamaica, if instructing an inexperienced person to collect Coccidæ, it would almost be sufficient to say "gather leaves of various trees that grow about the town."

The luxuriance of tropical vegetation is such that the harm done by Coccidæ is not so great as one might expect from their abundance; but still, their presence is often the occasion of annoyance and injury to

* I here assume that anything which decreases the food supply of the human race is disadvantageous. This is not the place to discuss those artificial conditions, whereby abundance is made a cause of scarcity, and the wealth of some depends upon the want of others.

growers of field and garden crops. On the whole I see no reason to doubt that Coccidæ do more injury in the tropics than elsewhere, although their ravages have not very frequently been recorded; and probably there is no tropical country whose Coccid fauna is not at the present time being increased by introductions.

Having said so much, I wish to call your attention to a few facts which have come under my own observation, hoping to illustrate thereby the more important phases of the subject.

The number and variety of neotropical Coccidæ have not been sufficiently realized in the past, owing to the fragmentary nature of our information concerning them. At the present time those of the West Indies are better known than the species inhabiting the mainland, but even here the records are exceedingly imperfect. Jamaica has 61 recorded species, but Cuba has less than half a dozen, and I can not discover a single record from Haiti. The Coccidæ of the Bahamas are almost entirely unknown, although the Caicos and Turks islands have each produced an interesting endemic form. In the Lesser Antilles, thanks to Mr. C. A. Barber, Antigua has 16 records; but of the other islands only one has as many as half a dozen, the figures being Barbados, 7 (only 5 actually published); Montserrat, 4; Grenada, 3 (records not yet published); and Nevis, St. Kitts, and Dominica 1 each. Trinidad has 14 species (some not fully identified), but owing to the exertions of Mr. F. W. Urich, I shall shortly be able to add considerably to this figure. The Mexican list stands at the absurdly low figure of 26, which includes 12 found by the present writer recently while traveling through that country. It will be understood how insufficient are the published records when I mention that not one of the species I found was previously known from Mexico, so far as I have been able to ascertain. The list from British Guiana exceeds 20, but very few species are known from other parts of South America. For Brazil I find mentioned about half a dozen, for Chile 4, for Ecuador 1, and so forth.

Yet these beginnings of knowledge already indicate some interesting facts in geographical distribution.

Aspidiotus articulatus, Morg., is known from Demerara, Trinidad (St. Ann's, on *Pandanus*, coll. by F. W. Urich), Barbados, Nevis, Jamaica, and Mexico (Vera Cruz). It has not been detected in Antigua, where it must be absent or rare, else Mr. Barber would surely have found it.

Aspidiotus personatus, Comst., is known from Demerara, Barbados, Cuba, and Jamaica. I did not find it at Vera Cruz; and what is more interesting, Mr. Urich, after some search, has been unable to detect it in Trinidad.

These two species, where they occur, infest many kinds of cultivated trees and shrubs, and are quite noticeable. Up to the present time, neither has been detected in the United States, although if introduced they might probably manage to exist in the extreme South. Both prob-

ably are spreading through human means. *A. articulatus* probably originated in South America; but *A. personatus* is more likely a native of the Greater Antilles, its absence in Trinidad favoring this supposition.

Aspidiotus ficus, Riley Ms., Ashm., abounds in Jamaica, and is also known from Cuba and Florida. It is likewise common at Vera Cruz, Mexico. Probably it is a native of the Greater Antilles, but possibly of Mexico; it has apparently been taken to Japan, whence it was brought to California, according to Mr. Craw. It does not appear to occur yet in the Lesser Antilles, Trinidad, or Demerara. It is against its being of Mexican origin that I could not find it on oranges sold in that country, except at Vera Cruz, which is a most likely place for any scale to be imported. Mr. H. Tryon reports it from Australia.

This, like the two before mentioned, feeds on many plants. It seems probable that unless means are taken to prevent their introduction into various countries on plants, all three are destined to become universal in the tropics. Any one who has seen them in Kingston, Jamaica, where they all abound in the same locality, will appreciate the undesirability of this, from an agricultural and horticultural point of view.

Aspidiotus aurantii, Mask., has a very curious distribution: Australia, Tahiti, California, New Zealand, South Europe, and the West Indies. Who shall say where it originally came from? But the curious thing about it is, that in Jamaica it is not found on Citrus trees, but principally on lignum-vitæ (*Guaiaecum*)—occasionally also on Cycas* (at King's House) and Areca. Its place on the Citrus trees in Jamaica is occupied by *A. articulatus*.

Aspidiotus punica, Ckll., presents another instance of difference of food plant according to locality. In Jamaica it is found principally on pomegranate, never, so far as I know, on cocoanut; but in Dominica Mr. Barber found it infesting the cocoanut palm, just in the way that *Aulacaspis boisduvalii* infests it in Jamaica.

A fact that should not be lost sight of is, that tropical Coccidæ may be taken from one side of the world to the other, via hothouses in temperate climates. It is wonderful what a lot of interesting forms have turned up in hothouses in Europe. Signoret mentions no less than 48 found in such situations; and Douglas and Newstead have recorded several from greenhouses in England, the most recent addition being *Pseudin-glisia rodriguezia*, Newst., which appears to be referable to my genus *Conchaspis*. Some time ago, I wrote to Kew, urging that an entomologist should be appointed to inspect the plants distributed by that institution to all parts of the world. Mr. D. Morris kindly replied in great detail, stating that at Kew they took all possible care, and that probably private importers and exporters were in most cases responsible for the wide distribution of certain Coccidæ. Be this as it may, it is clear that the scale insects manage to travel, and it is difficult to see how Kew or any large dealer in exotic plants can avoid transmitting

* Mr. Cockerell subsequently wrote us that this is not *A. aurantii* but probably *A. dictyospermi* Morg.—Eds.

pests unless the plants are under the strict supervision of an entomologist. This leads one to think of quarantine regulations which have not yet been dreamed of in England; and so far as present methods go, no doubt Kew is altogether superior to the average of private firms, as Mr. Morris states. The consequence of this state of affairs is, that one never knows what will turn up in a given locality. *Chionaspis minor*, Mask., described from New Zealand, now proves to be common in the West Indies. *Dactylopius calceolaria*, Mask., from New Zealand and Fiji, is discovered in Jamaica. *Lecanium mangifera*, Green, from Ceylon, is detected in Jamaica and Demerara. A *Ceroplastes* from Antigua, which I believe to be the same species as *C. cassia*, Chav., of Brazil, does not appear to differ from *C. dugesii*. Licht. MS., Twms. (of which I have specimens), from Mexico, and these again seem identical with the Indian *C. ceriferus*, Anders. Mr. Maskell pointed out this latter fact to me, and he has been so good as to forward Indian specimens of *C. ceriferus*, which seem to bear out his opinion as to the identity. I have all three now before me, but Mr. Maskell had only compared the Antigua form with *C. ceriferus*.

Such instances become more numerous as fresh information comes to hand. Thus *Asterolecanium* (vel *Planchonia*) *pustulans*, Kkll., known from Demerara, the West Indies, and Florida, was lately detected by myself at Vera Cruz, Mexico; and Mr. Maskell writes me that he knows it from Brazil and the Sandwich Islands. When I promised this paper, I thought of preparing something more elaborate than these few notes; but the distractions attendant on a change of residence, and the temporary detention of my books in Mexico City, through the blundering of a transfer company, have made it impossible to adequately gather together the statistics. Nor have I tried to discuss the distribution of Coccidæ within the United States, as I have nothing fresh of importance to contribute, and among those present are some doubtless much more competent to speak on this subject than myself. Yet the principles are the same throughout, and the evident indications are that we should endeavor to increase the knowledge of coccid distribution by all possible means, and so far as possible to prevent their importation into fresh countries. If my view is correct, now is the time to insist on the necessary precautions, as in fifty or a hundred years it will be altogether too late.

In conclusion I will give a list of the coccids I found this year in the Marine Gardens, Kingston, Jamaica. This locality is in the midst of the town, and it will afford an illustration of the coccid fauna of the island, as now found on cultivated plants. It may be seen at a glance that nearly all the species have been found in distant localities, and it may well be doubted if the scale insects as a whole belong any more to the original fauna of Jamaica than the plants on which they are found do to the flora.

Coccidæ of the Marine Gardens, Kingston, Jamaica, April, 1893.

Species.	Plants infested.	Distribution elsewhere.
1. <i>Dactylopius longifilis</i> , Comst.	On a palm; and 1 juv. on upper side of leaf of star-apple.	District of Columbia (under glass).
2. <i>Dactylopius virgatus</i> , Ckll.	Several juv. on leaf of cocconut.	(Endemic so far as known.)
3. <i>Asterolecanium pustulans</i> , Ckll.	On pink oleander; very abundant and injurious.	Montserrat, Demerara, Florida, Mexico, Brazil, Sandwich Islands.
4. <i>Lecanium oleæ</i> , Bern.....	On Terminalia; on pink oleander, and many on twigs of star-apple, attended by ants.	Antigua, Mexico, California, Florida, South Carolina France, Australia, New Zealand.
5. <i>Lecanium terminaliæ</i> , Ckll.	On Terminalia.....	Mexico.
6. <i>Lecanium hesperidum</i> , L..	One on a palm; found by my wife.	Mexico, Sandwich Islands, South Africa, Europe, Georgia, Utah, California, Florida, New York, District of Columbia, Ohio.
7. <i>Lecanium hemisphæricum</i> , Targ.	On an orchid; on a palm	Trinidad, Antigua, Montserrat, New Zealand, Pennsylvania, California, Australia, Europe (under glass).
8. <i>Ceroplastes floridensis</i> , Comst.	On oleander; on upper side of leaves of star-apple.	Florida, Louisiana, Barbados (on leaf, apparently <i>Chrysothylum</i>).
9. <i>Aspidiotus articulatus</i> , Morg.	On oleander, with newly hatched larvæ, which are orange; on Citrus; on upper side of leaves of star-apple.	Nevis, Barbados, Trinidad, Demerara, Mexico.
10. <i>Aspidiotus ficus</i> , Riley MS., Ashm.	On upper side of leaves of pink oleander; on under side of leaves of rose; on Citrus; many on upper side of leaves of an orchid.	Cuba, Florida, Mexico, Japan, New Zealand (under glass), Australia.
11. <i>Aspidiotus sacchari</i> , Ckll. . .	On sugar-cane	(Endemic so far as known.)
12. <i>Aspidiotus personatus</i> , Comst.	On a palm	Barbados, Cuba, Demerara.
13. <i>Diaspis lanatus</i> , Ckll.	On oleander	Antigua.
14. <i>Aulacaspis boisduvalii</i> , Sign.	On cocconut, ♀ pale lemon yellow.	Barbados, Trinidad (Urich), Europe (under glass).
15. <i>Pseudoparlatoria ostreata</i> , Ckll.	On Acalypha	(Endemic so far as known.)
16. <i>Chionaspis minor</i> , Mask . . .	On a palm	Trinidad, Antigua, New Zealand.
17. <i>Ichnaspis filiformis</i> , Dougl.	On a palm	Trinidad, Antigua, Grenada, Demerara, District of Columbia (under glass), London (under glass).
18. <i>Pinnaspis pandani</i> , Comst.	On cocconut	Trinidad, Massachusetts (under glass).

Thus, of 18 species, all but three are known outside of Jamaica (and it is very doubtful if these are confined to the island, although not yet found elsewhere), while eleven have been detected outside of the neotropical region.

The following paper was then read:

NOTE AND RECORD KEEPING FOR THE ECONOMIC ENTOMOLOGIST.

By A. D. HOPKINS, *Morgantown, W. Va.*

There is nothing of greater importance in the work of an economic entomologist than a well-organized system of keeping notes, records, and references. Especially is it important as a primary feature of the office and laboratory organization of the Experiment Station entomologist.

One of the objects of the law establishing the Agricultural Experiment Stations was to "stimulate original research and experiments