Some Insect Pests of the Salt River Valley and the Remedies for Them

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SOME INSECT PESTS OF SALT RIVER VALLEY AND THE REMEDIES FOR THEM.

By THEO. D. A. COCKERELL.

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PREFACE.

The attention of the Director of the Arizona Station having been called to the demand for knowledge concerning certain diseases and insect pests affecting crop plants and fruit trees in Southern Arizona, it was thought desirable to have a specialist visit the field and as far as possible, in a comparatively short time, look into those matters of most importance, report upon the present situation, and recommend measures for the exclusion or restraint of dangerous pests.

The Arizona Station being, in the absence of Professor Toumey, without an entomologist, it was our good fortune to secure the services of Professor T. D. A. Cockerell, of the New Mexico Agricultural Experiment Station for this work.

Professor Cockerell's observations were made in Salt River Valley, but apply in many instances to most of Southern Arizona. His suggestions regarding quarantine, for instance, are without doubt applicable to other localities entered almost entirely by railroad and where inspection could easily be arranged. The valley of the Upper Gila and of the Colorado near Yuma are cases in point.

The matter of more popular interest is put in large print and will serve to inform the busy reader on the more important topics. The more technical portions are in small print.

SOME INSECT PESTS OF SALT RIVER VALLEY AND THE REMEDIES FOR THEM.

By T. D. A. Cockerell.

The observations herein recorded were made from October 8th to the beginning of November, 1899. The writer spent most of his time in Phoenix and the vicinity, but also visited Mesa, Tempe, Glendale, and Buckeye. He desires to record his appreciation of the kind help given him by Professors Forbes, McClatchie and True of the Arizona Experiment Station; by Mr. Bettler, then of Mesa; and by others too numerous to mention.

THE ENTOMOLOGICAL SITUATION IN SALT RIVER VALLEY.

FREEDOM FROM PESTS.

Salt River Valley was found to be remarkably free from insect pests, and especially from injurious scale-insects. It would be difficult to find another locality so favored, and at the same time producing such an abundance of different crops. The olive trees, for example, which in California, the West Indies and Europe are notoriously scaly, are here without a trace of scale, or any other blemish that I could discover. Orchard after orchard was examined, always with the same result The orange, also overrun with scales everywhere, is here free from them; and while four distinct kinds of injury to the fruit itself were observed, there was no insect or fungus injury to the tree which in any appreciable degree affected the product. Hence, while a good many oranges might have to be rejected, those that remained were very large and healthy, nothing having sapped their vitality. The ornamental plants, such as palms and oleanders, were also found to be free from scale, with the exception of the date palms at the Experimental Farm, and a few oleanders in the neighborhood of the Adams hotel in Phoenix

REASONS FOR THE ABSENCE OF PESTS.

The reasons for this immunity are two: one, the peculiar climate, the other the isolation of the valley from other cultivated areas. While there are numerous native scale-insects, well adapted to the climate, with one exception (the Palo Verde scale) they have not proved seriously injurious. The introduced species, on the other hand, again with one exception (the Date Palm scale), all come from moister regions, and are not able to endure the full blaze of our summer sun. It is well known that on several occasions young orange trees infested with the black scale (*Lecanium oleae*) have been brought to Phoenix and set out in the orchards, yet in no case has the scale survived. The San Jose scale, as was observed by Professors Toumey and Forbes as well as the writer, when infesting somewhat exposed apple trees at Phoenix, lives on the north side of the trunk; the scales on the south side, when present, being dead at the end of summer. The pear trees at Glendale badly infested by San Jose scale are protected from the sun by a row of shade trees; and the oleanders in Phoenix infested by the soft shield-scale are all well shaded by larger trees, and even then the scale is accompanied by no soot-fungus. The common mealy bug was found only in a shady place, under a porch, at Tempe The hot dry summers also prove inimical to injurious fungi. Prof. McClatchie, who has long studied fungi in California, remarked on their extreme rarity in the Salt Eiver Valley. I found some spots on apricot leaves in Phoenix which 1 thought might be due to a fungus, but Mr. B. T. Galloway, of the Department of Agriculture, kindly examined them and found no fungus present; he further remarked, "The injury to the leaves resembles almost exactly that which is caused to peach leaves by the work of a mite related to Phytoptus."

The other reason—the isolation of the valley,—need not be enlarged upon. The pests being almost all introductions from without, they must be brought by man in order to reach the valley. Thus. the date palms at the Experimental Farm are scaly, because they were so when they arrived, though the scales were so few as to escape detection. The date palms in other parts of the valley are not scaly, because they were raised

from seed, and the scale cannot arise on them spontaneously. But they may at any time become infested through scales being carried (e. g. on the feet of birds) from the infested palms.

REASONS WHY THE NATIVE SCALE-INSECTS ARE RARELY INJURIOUS.

It might be supposed that the native scale-insects, perfectly adapted to the climate, would be especially dangerous. Such is not the case, partly because they seem only able to thrive on certain plants, but also because they are relentlessly pursued by their natural enemies. It results from the latter fact that they are only here and there injurious to the native plants on which they feed.

As an illustration of the prevalent condition of affairs we may mention a native mealy-bug (*Phenacoccus helianthi*) which feeds on sunflower and other plants. Although its food-plants abounded all over the valley, it was found only in two places, once on sunflower, and once—a large colony.—on *Tribulus grandiflorus*. In the latter instance it was observed to be preyed upon by its enemies to such an extent that it was threatened with annihilation.

There was an internal parasite (*Chiloneurus*, probably *albicornis*, Howard) and a predaceous enemy (*Hemerobius* near *occidentalis*,) for the identification of which I am indebted to the Division ot Entomology, Department of Agriculture. There was also a species of *Tetrastichus*, probably parasitic on the *Chiloneurus*.

Again, *Atriplex canescens* is a shrubby plant growing abundantly around Phoenix, bat only in one place could I find a tew examples of the leaf-inhabiting form of *Eriococcus tinsleyi*, and these had holes in them tfrom which parasites had emerged.

The crown-ofthorns (*Holacantha*) is common between Phoenix and Buckeye, bat only rarely was a plant found intested foy the scale *Diaspis toumeyi*, and then the *Diaspis* was being eaten up by the ladybird *Chilocorus cacti*. Exactly the same was true of the only colony of *Xerophilaspis parkinsoniae* tound on the palo verde.

The extraordinary scale *Toumeyella mirabilis*, found on the mesquite, used to exist in the town of Tularosa, N. M., but the colony—the only one known in New Mexico—has been utterly destroyed by the larvae of the moth *Laetilia*. Doubtless for a similar reason, *this* scale can no louger be tound on the mesquite close to the University of Arizona, where it was originally discovered.

The mealy-bug *Dactylopiaprosopidis* had only one known station in New Mexico—a mesquite bush in Mesilla; and now it has utterly perished from thence owing to the attacks of a Chalcidid parasite.

Many other illustrations could be given, but we may sum up by saying that *in a state of nature, scale insects are perpetually hunted "from pillar to post" by their enemies, so that they only survive in colonies here and there, though the food-plant may cover acres.* It therefore follows that if we could control the introduced scales as effectively by means of their enemies, as they are controlled in a state of nature, no artificial remedy would be required. This very thing has been done with the fluted scale in California and elsewhere, and with various scales in the Sandwich Islands, and there is no reason why it should not be done again.

WILL THE IMMUNITY FROM PESTS CONTINUE?

While the present condition of affairs in the Salt River Valley is highly satisfactory, the cheerful optimism which assumes that pests cannot live there is hardly justifiable.

Take, for instance, the codling moth (*Carpocapsa pomonella.*) This is the very worst insect-pest in New Mexico, yet it was unknown there not very long ago. It increases at a prodigious rate in warm climates, and inasmuch as it lives *inside* of apples and pears, it is neither affected by the dryness nor the scorching rays of the sun. It is not too much to say that if it gets into the Salt River Valley it will practically ruin the pear industry, which now looks so promising. This pest does not come in on young trees, but in wormy fruit. Let some fruit-dealer ship in a barrel of wormy apples; the worms will crawl out of the apples and spin up somewhere about the premises. In due time the moths will emerge, and then if a male and female pair, and the latter finds her way to an orchard, the insect will become established, to remain as long as pears or apples, or even peaches, are grown.

Nor are we safe in assuming that pernicious scales will not live. These creatures have wonderful powers of acclimatization, it would seem; for instance, the peach *Diaspis* will live in Washington, D. C., and in the West Indies. Moreover, it is proved already that some of the worst scales, as the San Jose scale, will flourish in Salt River Valley if protected from the direct rays of the sun. The black scale perished when introduced on young and almost leafless orange trees, but who will

say that it might not flourish ia the dense shade of the interior of our trees of larger growth? Still again, all introduced scales are not so susceptible to heat and dryness The date palm scale, coming from Egypt, does well enough on the leaves of the date palms, let the sun shine as it will. There are numerous other pernicious scales in Egypt and other parts of North Africa, any of which may be expected to thrive at Phoenix.

QUAEANTINE MEASURES.

All plants which are brought into Salt River Valley must necessarily (with possible rare exceptions) come by rail. It would, therefore, be a very simple matter to have a law or ordinance obliging the railroad companies to submit all consignments of plants or fruits to an inspector before delivering them to their owners. Considering the fruit-growing population of the valley, and the money invested, it should not be difficult to secure funds to support a horticultural quarantine officer, who might also inspect orchards for pests, and conduct spraying operations. The importance of having such an inspector is obvious, not only from what has been said above; but from the fact that a trained man, who knows what he is looking for, can see things which would wholly escape the attention of others, Moreover, the pests would be stopped at the railway stations, instead of being carried to the ranches and there dealt with.

In most cases, at least, infested plants should be destroyed or returned to the shippers. It is almost impossible to get certain scales off palms, for instance, even the treatment with hydrocyanic gas being ineffectual. Mr. C. L. Marlatt, of the Department of Agriculture, writes me on this point; "I have tried some experiments of such a nature as to convince me that hydrocyanic acid gas is not nearly so penetrating as one might suppose." It has occured to me that by placing the plants in an air-tight receptacle, and exhausting the air, and then admitting the gas, the latter might be got to penetrate every cranny. It is hoped to try this experiment at a later date.

It must not be forgotten that ornamental plants often carry scale-insects which are liable to do great damage to fruit trees For instance. I found a small palm *(Phoenix canariensis)* in a pot for sale in a fruit store in Phoenix, and on it were a mealy-

bug (*Dactylopius longispinus* and a small scale (apparently *Aspidiotus lataniae*), both injurious species, and new to the Salt River Valley. A few days later the palm had gone from the store, and was, I suppose, purchased and set out in somebody's garden.

In some cases trees or fruit from infested regions should be prohibited without inspection. Thus, no peach trees from districts where "peach yellows" is prevalent should be allowed to enter Arizona, whatever their outward appearance, Similarly. oranges from the parts of Mexico infested by the Morelos orange worm should be kept out of the United States, no ordinary inspection being effectual to detect the infestation.

KEROSENE EMULSION.

This remedy is referred to more than once in the following pages, and although the method of preparing it has been published in many places, it may be worth while to repeat it;

"*Soap formula*—kerosene, 2 gallons; whale-oil soap (or one quart soft-soap,) one to two pounds; water, one gallon.

Dissolve the soap in water by boiling, and add boiling hot, away from the fire, to the kerosene. Agitate violently for five minates by pumping the liquid back upon itself with a force-pump and direct-discharge nozzle throwing a strong stream, preferably one-eighth inch in diameter. The mixture will have increased about one-third in bulk and assumed the consistency of cream. Well made, the emulsion should keep indefinitely, and should be diluted only as wanted for use. Tn limestone or hard water regions "break" the water with lye before using to make or dilute the emulsion, or use rainwater. Better than either, use the milk emulsion, with which the character of the water does not affect the result.

Milk formula—kerosene, 2 gallons; sour milk, 1 gallon,

Heating is unnecessary; churn as in the former case for three to five minutes, or until a thick, buttery consistency results, Prepare the milk emulsion from time to time for immediate use, unless it can be stored in air-tight jars; otherwise it will soon ferment and spoil

How to use the emulsions—For summer applications for most plant-lice and other soft-bodied insects, dilute with 15 to

20 parts of water; for the red spider and other plant raites, the same, with the addition of one ounce of powdered sulphur to the gallon; for scale insects, the larger plant bugs, larvae and beetles, dilute with 7 to 9 parts of water.

For subterranean insects, such as root lice, root maggots, "white grubs," etc., use either kerosene emulsion or resin wash, wetting the soil to a depth of 2 or 3 inches, and follow with copious waterings, unless in rainy season." *Year Book U. S. Department Agriculture.*

NOTES ON THE MOKE IMPORTANT INSECTS OP SALT RIVER VALLEY.

THE LEAF-CUTTING BEE. (*Megachilesp.*)

The bees of the genus *Megachile* use portions of leaves in the construction of their nests, and sometimes are quite destructive to cultivated plants. At Buckeye, on Oct. 12th, I saw a lot of young peach trees with the leaves almost wholly destroyed by these bees. The work of the bees may be recognized by the clear semicircular edges of the cuts, and the absence of any caterpillars or beetles upon the plants to account for the damage.

Remedies. No remedy is known at present, unless it might be to destroy the nests of the bees, which may be found in old stumps. Paris green sprayed on the leaves would not kill the bees, as they do not eat the leaves, but merely use them in the construction of their nests.

THE LEAF-CUTTING ANT. (*Attaversicolor*, Pergande.)

These ants have the habit of cutting off portions of plants and carrying them to their nests; and sometimes, in warm countries, they do a good deal of damage. I found them near Buckeye, going in a procession to their nests with leaves and flowers of a small wild plant of the genus *Euphorbia*. Mr. Ernest Andre, who identified the species for me, thinks it is only a variety of the Mexican *Atta octospinosa*.

THE PEACH BEETLE. (*Allorhinamutabilis*, Gory.)

This is the common large beetle, almost an inch long, mainly green in color, which is so injurious to ripe peaches. It is often called the June Beetle, an unfortunate designation, since it appears in July, and is by no means identical with the gen-

uine June beetle of the eastern states. I visited Phoenix too late to observe it, and only found a single dead specimen, but Dr. R. E. Kunze of Phoenix writes me: "One of our worst fruit pests is *Allorhina mutabilis.* This beetle destroys our first crop of figs, and much also of grapes, apricots, peaches, pears and others."

Remedies. No satisfactory remedy is known, but the beetles can be caught on overripe fruit and destroyed. An attempt to poison them by putting Paris green on overripe peaches on the trees resulted in killing portions of the trees, The beetles breed in the ground in old corrals and such places, and their grubs do not seem to injure the roots of plants.

THE POTATO-STALK WEEVIL. (*Trichobaris compacta,* Casey?)

I was not at Phoenix at the proper season for this insect, but Prof. McClatchie reported to me its injuries to the potato crop. It is a small gray beetle, with a snout, which breeds in potato stalks, causing them to wilt. From the locality, it is almost certain that the species is *Trichobaris compacta,* and not the common eastern species, *T. trinotata.*

Remedies, The potato stalks should be removed and burned at as early a date as possible. *T. compacta* breeds in New Mexico in the stems of *Datura meteloides,* a plant like the "Jimson weed," with very large, white strong-scented flowers. This plant is also common in Salt River Valley, and should be destroyed whenever found in the neighborhood of potato fields. The common wild *Physalis* or ground-cherry is also likely to harbor the weevils *

THE AMERICAN LOCUST. (*Schistocerca americana,* Drury.)

This large locust was common in Phoenix during October, flying around the electric lights at night. Both sexes were taken. The species was not noticed among the crops, and nothing was learned of its proving injurious. In the warmer regions to the south, as southern Mexico and Central America, it is abundant and injurious.

NOTE—A good account of the potato-stalk weevil, written by Mr P. J. Parrott, will be found in Bull. 82 of the Kansas Agricultural Experiment Station.

THE ANGULAR-WINGED KATYDID. (*Microcentrum retinerve*, Burmeister.)

This large green katydid was observed at Glendale, eating the leaves of the orange tree. It is easily recognized by its large size, (over two inches long), and its upper wings or tegmina, which are green and veined like a leaf. The creature is widely distributed, being known as an orange pest in Florida. I have found it also in the Mesilla valley of New Mexico.

Remedies. *It* is not destructive enough in the Salt River Valley to call for any special measures; but the eggs are laid on the orange twigs, and should be destroyed when seen They are pale elongate-oval flattish objects, laid in rows, overlapping one another like shingles. A full account of this insect, with figures, will be found in the Report of the U. S. Department of Agriculture for 1880.

THE CUCUMBER CAPSID. (*Pycnoderes quadrimaculatus*, Guer.)

On November 2d my attention was called to some cucumber plants at Phoenix, which were being injured by a small hopping bug. The bugs were extremely numerous and some which 1 collected were kindly determined for me by Mr. Heidemann of the Department of Agriculture. The bugs are about one* eighth of an inch (3 mm.) long, black, mottled with gray and whitish, with the hind end (membraneous portion of the hemelytra) dull white. The legs are very pale yellowish, the hind femora having the apical two-fifths black. The appearance of the insects on the plants is suggestive of the flea-beetles. Although they were collected on cucumber, there is good reason to believe that they injure beans and other garden crops.

Remedies. No experiments have been made with this particular insect, but its appearance and habits are so like those of the garden flea-hopper (*Halticus uhleri*) of the eastern states, that it may be treated in the same way. Mr. F. EL Chittenden of the Department of Agriculture suggests for the flea-hopper a spray of kerosene emulsion, or as an alternative, jarring the insects on to sheets saturated with kerosene or into pans of water on which a thin scum of kerosene is floating. It may be added to this that the bugs undoubtedly winter among the debris of

garden plants and weeds, and it will therefore be advisable to clear everything of the kind off the land, and so far as possible avoid having weedy fields in the neighborhood of the garden.

THE GREEN ALFALFA-HOPPER. (*Stictocephala festina* Say.)

This is excessively abundant in Salt River Valley, not only on alfalfa, but also on all sorts of weeds, and on fruit trees, as for example the almond trees at Mesa. It is a bright green creature, about a quarter of an inch long, with a rather triangular shape, big in front, tapering behind. The wings are transparent and membranous; the thorax is prolonged posteriorly almost to the end of the wings, ending in a fine point, like a thorn. Directly the alfalfa is disturbed, as by walking through it, these insects fly in all directions, but only for short distances.

Remedies. This insect is extremely common in the Mesilla Valley of New Mexico, and it is not considered worth while to take measures against it. But I never saw it quite so abundant as it was around Phoenix in October, 1899. It sucks the sap of the alfalfa, and doubtless is more or less injurious, although in New Mexico it does not prevent us from having excellent crops. The hopperdozer, a large pan with an upright back, containing cloth saturated with kerosene, drawn by horses, could be used against it.

Enemies. The large spider *Argiope transversa*, Emerton (det. Banks) was observed to prey on *S. festina* at Phoenix on October 10.

TOWNSEND'S SCALE. (*Aspidiotus townsendi*. Cockerell.)

A small, flat, circular, whitish scale, more or less reddish in the centre, on leaves of ash trees along the streets of Phoenix. It had only been found previously in the state of Coahuila, Mexico. As the scales occur scattered, only two or three on a leaf, they do no appreciable harm. On Oct. 17 the same scale was found in small numbers at Mesa. A different scale (*Aspidiotus juglansregiae, var. albus*, Ckll.) was found in small numbers on the bark of an ash tree in Phoenix, Oct. 10.

THE PALO VEEDE SCALE. (*Xerophilaspis parkinsoniae*, Cockerell.

A very small white scurf-like scale Infesting the palo verde near Phoenix, causing the branches to turn yellow. It was only observed on one palo verde tree which was growing not far from Mr. Wilson's ranch. The scale, viewed with a lens, is seen to be white with a black central spot, the exuviae. This is a native scale, and was not expected to be of any economic importance. But one day in the streets of Phoenix I observed a young ash tree in a very shaded situation which* had died from some cause. On examining it I found it literally smothered

with a scale, which on a microscopical examination proved to be identical with that of the palo verde. Some bird must have accidentally carried the larvae of the scale on its feet from a palo verde to the ash, thus starting the infestation.

Enemies. This scale is fortunately devoured by *Chilocorus cacti*, a black ladybird with two red spots, common in Salt River Valley.

Remedies. Infested trees may be sprayed with kerosene emulsion, or the trunks wiped with cloths saturated in kerosene, The infestation of the palo verde is easily recognized from a long distance by the yellowing of the branches; when it is observed, it will be well to cut the infested branches off and so minimize the danger of the scale being carried from the palo verde to some valued tree. It may be remarked that inasmuch as the scale infests the palo verde and ash, trees by no means related, it is not unlikely to attack a variety of other trees.*

THE DATE PALM SCALE, (*Parlatoria blanchardi subsp. victrix*, Cockerell.)

This insect has already been discussed and figured by Prof. Toumey in the bulletins of the Station. It is extremely plentiful on the date palms at the Experimental Farm, but I found it nowhere on the date palms growing in other parts of the valley, or in gardens in Phoenix, all these latter having been raised from seed. The scale seems to confine itself entirely to the date palm; the pomegranates and other shrubs, and even a *Washingtonia* palm, growing close to the infested palms remain wholly without infestation.

Enemies. The ladybird *Chilocorus cacti*, which preys upon the native scales *Diaspis toumeyi* and *Xerophilaspisparkinsoniae*, on the crown-of-thorns and palo verde respectively, has found the date-palm scale, and is doing good service in devouring it. Thus it appears that native scales may possess a certain utility, inasmuch as they support a predaceous enemy, which is on hand to attack a foreign scale when introduced.

*NOTE. Mr, C. L. Marlatt would refer this species to *Aspidiotus yuccae*, Ckll., which infests *Yucca* in New Mexico and northern Mexico; but it seems to me quite distinct.

AFFINITIES. This insect is a native of Egypt. In Algeria is found the *Parlatoria blanchardi* which differs in its uniformly much paler scale. When studying the *P. victrix* alive, it occurred to me that it was closer to *P. blanchardi* than had been supposed, and Prof. S. J. Hunter of the University of Kansas was so kind to make for me a careful comparison between the insects, using very numerous examples, with the result that *P. victrix* is reduced to a subspecies of P. *blanchardi*. Prof. Hunter will publish the full details, with figures, hereafter.

Remedies. The usual remedies have been employed, without exterminating the scale. The scales have the habit of getting into all sorts of cracks, even between the folds of the unopened leaves, and it may be impossible to destroy them all without killing the trees. I observed that birds had been nesting in the palms; this should not be permitted, as the scale, in its larva stage, is liable to be carried on the birds' feet to other palms.

THE SAN JOSE SCALE. (*Aspidiotus perniciosus*, Comstock.)

A scurf-like greyish scale infesting deciduous fruit trees; introduced into Arizona doubtless from California, but probably a native of Japan. It occurs abundantly on pear trees in an orchard at Glendale, and in less numbers on apple trees at one place a little east of the water-works in Phoenix.

Remedies. This scale will flourish in Arizona only when shaded from the direct rays of the sun; and, as in New Mexico, it spreads very slowly. It will ruin the trees if left alone, but it is easily controlled by cutting back the infested trees as much as possible during the winter, and wiping the trunks and limbs with a cloth saturated in kerosene. Birds should not be allowed to nest in infested trees, as they are liable to carry the young larvae to other trees on their feet.

THE ARIZONA COCHINEAL. (*Pseudococcus confusus* Subsp. *newsteadi*, Cockerell.)

On Tempe butte this insect was found by Mr. Irish and the present writer, infesting a cactus of the genus *Opuntia*. It appears as a mass of white secretion, readily adhering to whatever touches it, and containing the female insects, which on being crushed give a vivid carmine color. This cochineal is of no commercial value, and is only mentioned because of general

interest, and sometimes troublesome on cacti in cultivation.

THE LAREEA LAC-INSECT. (*Tachardia larreae*, Comstock.)

Deep orange resinous masses are often seen surrounding the twigs of the *Larrea* in the Salt River Valley (notably on Tempe butte): these are secreted by a species of lac-insect, and yield not only a good lac, but a fine crimson pigment. Near Buckeye the lac-insects on the *Larrea* were numerously attended by a small ant, the *Cremastogaster atra*, Mayr (det. Andre.).

THE COMMON MEALY-BUG. (*Dactylopius citri*, RISSO.)

A honeysuckle growing on a shaded porch at Tempe was observed to be badly infested by a mealy-bug, recognizable by its masses of white secretion. The material was too old for satisfactory study, but I could not separate it from the well-known *Dactylopius citri*.

Remedies. This insect can be treated with kerosene emulsion. Its importance is greater than the single infestation mentioned might "suggest since it is a general pest of garden plants, and also of citrus fruits, in other localities. It is probable, however, that it will not flourish greatly in the Salt River Valley, owing to climatic conditions.

THE SOFT SHIELD-SCALE. (*Lecanium hesperidum*. Linne.)

Mr. Bettler of Mesa pointed out to me the fact that certain oleanders in Phoenix were infested by a scale, which proved to be *Lecanium hesperidum*. It is a flattish, brownish insect, oval in outline, found especially on the under sides of the leaves, near the *midrib*. Elsewhere it is usually accompanied by the soot-fungus (*Meliola*), which greatly aggravates the mischief, but in Phoenix the fungus was wholly absent.

*Remedies** To be sure of getting rid of the scale I should advise the destruction of the infested oleanders. This because the scale is elsewhere a notable pest of the orange, and of all sorts of other plants. It was observed that in Phoenix it occurred only on oleanders which were well shaded from the sun, but it is likely that it might live on our larger orange trees, the central parts of which are effectively shaded.

THE ALFALFA BUTTERFLY. (*Colias eurytheme*, Boisduval.)

This is the orange butterfly with black borders so common in Salt River Valley, flying over the alfalfa fields. The males have the border solid black, while in the females it is spotted with yellow- A variation of the female is white instead of orange. 1 never saw these butterflies so extraordinarily abundant as they were last October at Phoenix. The alfalfa growers believe that in some way they were accountable for the poor crop of that plant; but after investigation I concluded that heat and drought were far more responsible for the condition of the alfalfa than any insect. The butterfly, of course, cannot eat alfalfa leaves: but it lays its eggs on the plant (a female was observed laying eggs on Oct. 7.) and from these come a worm or caterpillar which lives on the leaves These caterpillars being very numerous. must eat a great many leaves, and so reduce the crop, but it is probable that their ravages would not be very noticeable under favorable conditions of moisture and temperature. At all events, is is not practicable to take any measures against them.

There is another and quite different complaint against the alfalfa butterfly, voiced by the bee-keepers. It is well known that the bees collect a great deal of the nectar which goes to make honey from the alfalfa flowers, so much so that the product is spoken of as "alfalfa-honey." Now the butterflies, sucking the nectar but making no honey, must interfere with the success of the bees, especially when they become very numerous. The alfalfa flower contains a curious explosive mechanism; the column of coherent stamens, enclosed within the keel-shaped portion of the flower, is strongly elastic, and on being liberated springs upwards, and is unable to return to its former position. This may be seen by poking the point of a pin far into the alfalfa flower, which brings about the explosion- A bee. on visiting the flower, liberates the staminal column, in the midst of which is the pistil, and gets dusted on the under surface with pollen. The next flower the bee visits supplies more pollen, while at the same time the stigma strikes the spot where the first pollen was deposited, and so cross-fertilization is effected

Mr. P. M. Irish of Tempe suggested to me that the butter-

flies might take the nectar from the flowers, but having very slender tongues, fail to explode the mechanism or bring about cross-fertilization. At Tempe, on Oct. 19, I watched a number of alfalfa butterflies sucking the alfalfa flowers, and in no case did they cause an explosion, verifying Mr. Irish's hypothesis. In the field examined very few flowers had exploded, I should say only about 2 per cent, and no bees were observed,

It was further suggested that the butterflies might interfere with the seeding of the alfalfa. The bees, after visiting many unexploded flowers and finding them exhausted of nectar, might well be expected to go elsewhere, leaving the butterflies in possession. The latter, as we have seen, do not effect cross-fertilization.

However, Hermann Muller quotes Hildebrand as having shown that unexploded flowers will produce seed by self-fertilization, Hermann Muller, in Europe, made some observations which throw further light on the subject. He says that he never saw the honey bee effect explosion, because "the bee probably finds it unpleasant to have its proboscis struck by the exploding column at each visit; for it prefers, even in the case of young flowers, to insert its probocis laterally close to one of the alae, so that no explosion results."

Mtiller goes on to say: "Butterflies visit the flowers in great numbers, and it is doubtless by them that explosion and cross-fertilization are effected; but they are generally too wild to permit close observation of their movements. Once I had a good view of *Hesperia thaumas*, Hufn., sucking a young unexploded flower, but like the bees it inserted its proboscis from the side and did not cause explosion. A fine needle inserted in the middle line of the flower causes explosion, and the thin proboscis of a butterfly is undoubtedly sufficient to do the same." Thus it appears that Muller's theory does not agree with the facts observed at Tempe; and, It may be added, there is still opportunity for further observations 011 other and larger species of butterflies, and on other bees.

Knuth says that Burkill in England saw great numbers of bumble bees (*Bombusagrorum*) busily sucking the flowers, and exploding them in so doing. It also appears that Henslow found the honey bee to behave in the manner described by Muller, not exploding the flowers* At Las Vegas, New Mexico, the following bees were observed to visit the flowers of alfalfa last summer:

(1.) *Anthophora bomboides*, Kirby, male, June 15. (Cockerell.)

(2.) *Megachile*, two species, June. (Cockerell.)

(3.) *Melissodesagilis* var *aurigenia*, Cresson, male. July 22. (Wilmatte Porter.)

(4.) *Apis mellitera;* honey bee July 15. (A. Garlick.)
(5.) *Prosapis mesillae*, Cockerell Female. June 19. (Cockerell.)

In Europe, bees of the following genera have been found to visit alfalfa flowers: *Apis, Bombus*, *Cilissa*, *Coelioxys*, *Colletes*, *Halictus*, *Megachile* (4 species,) *Osmia, Rhophitoides*, *Xylocopa*. *Anthidium*, *Eucera*, *Andrena*.

In Kansas, it would seem that the honey bees commonly explode the flowers; and further, that the unexploded flowers do not seed well. Prof- S. J. Hunter, of the University of Kansas, collected seed from two fields of alfalfa, one of which had been freely visited by honey bees, while the other had only been visited by native insects, being 25 miles from the nearest hives. The result showed that the alfalfa visited by honey bees had more than twice as much seed as the other, and that the pods averaged more seeds. Moreover, in the presumably self-fertilized plants, at least one-third of the pods had small and shriveled seeds, while the pods were few in a cluster, short, and with few spirals.

THE GRANULATED CUT-WORM. (*Feltia annexa*, Treitschke.)

The moth which produces this cut-worm was collected in Phoenix, and determined for me by Dr. J. B. Smith. The worm, or caterpillar, is about an inch and a half long, smooth, dark grey, closely covered with very minute blackish granules. It has the habit of cutting off young plants which have just appeared above the surface of the ground; and is known to injure many differeut plants. including cereals, peas, beans, clover, cabbage and cotton,

Remedies. The worms may be destroyed by placing clover or cabbage leaves, poisoned with Paris green. about the fields, It is also advisable to burn all rubbish about the fields, and plow up the land.

THE CORN-WORM. (*Heliothis armiger*, Huebner.)

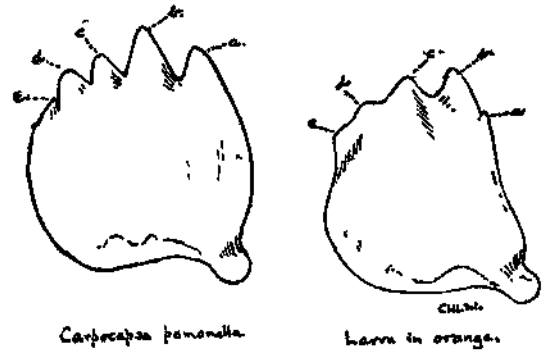
This well-known pest was reported to me as very injurious to corn at Buckeye, and I was able to find evidences of its work as late as Oct. 12.

Remedies. Late fall plowing has been recommended; also the use of poisoned bait; but it is next to impossible to do anything against an insect which is breeding abundantly, not only in the corn-fields, but on the surrounding wild vegetation. It

has been found in New Mexico that sweet-corn planted later than usual escapes the ravages of the worm, the moths having already laid their eggs in the earlier plants. On the same principle, in the South, corn is planted ahead of the cotton and after a while destroyed, with the result that the cotton is less injured,

THE NEW ORANGE-WORM.

On October 23, I found near Phoenix two oranges on the same tree, which were affected by a worm or caterpillar. The oranges had turned color prematurely, and dropped off at the least touch. From the apex hung in each case a small amount of debris, proclaiming the presence of a worm, and distinguishing them from the fruits affected by the black rot. On opening one of the oranges, the worm was found to occupy a small space near the apex, living on the soft tissues. It resembles in appearance the codling-worm of the apple, which, however, does not occur in the Salt River Valley. My efforts to breed the moth were fruitless, but one of the worms went so far as to change to a pupa, *inside the orange.* Herein it differs materially from the codling-worm, which leaves the fruit and pupates under the loose bark of the tree. The reason for the difference is obvious, the trunk of the orange tree affording no shelter. A microscopical examination shows that the mandibles of the new orange-worm differ considerably from those of the codling-worm. (See accompanying figures.)



The mandible of the codling-worm has five cusps or denticles, the second largest, but all the first four large and only the fifth minute. That of the orange-worm has the first denticle a mere rudiment, the second and third about as well developed as the third and fourth of the codling-worm;

and the fourth and fifth practically absent, or reduced to the merest rudiments. No doubt the more degenerate mandible of the orange-worm results from the soft, pulpy nature of its food; and we may fairly conclude that the worm belongs properly to the orange, and is not a native species which has changed its habits.*

Remedies. The obvious remedy is to watch for the oranges which turn color prematurely, pick them off. and burn them, The oranges affected by the black rot may well be confounded with those containing the worm, but for practical purposes this matters little, as all should be destroyed. For the reasons stated above, we may fairly assume that the worm is not a native insect, so if it is eliminated from the orange orchards. it will not reappear unless brought from without the valley.

THE DROSOPHILA FLY.—(*Drosophilaampelophila*, Loew.)

The *Drosophila fl{/*, variously called fruit fly or vinegar fly, is abundant in the Salt River Valley. It is a very small fly (one eighth inch long) ochreous, with the tip of the abdomen dark, the abdomen also banded with blackish, and the eyes bright vermillion red in life. It is by the red eyes that it is most easily distinguished,

(1.) *Habits of the Genus Drosophila.* *Drosophila* is a genus of small flies, some of which breed in decaying substances, and others in the living leaves of plants. Mr. D. W. Coquillett (Insect Life, VII, 382) says:

"The Genus *Drosophila* contains two groups of species which, while closely related by structural details, differ from each other in regard to food-habits. In one of these groups, which contains the well-known vinegar-fly (*Drosophila ampelophila*, Loew), the larvae live in fermenting or decomposing vegetable substances of a liquid nature; while those of the second group mine the leaves of growing plants. The species of the latter group have been separated into a distinct genus under the name of *Scaptomyza* by the English entomologist, Hardy; but the authorities on this subject accord it only subgeneric rank."

(2.) *Habits of Drosophilaampelophila.* The first time I observed this

*Affinities.—This worm must not be confounded with the Morelos orange-worm, which turns to a fly, while our worm becomes a moth. It seemed to me that the worm must surely belong to the Tortricidae and be allied to the codling-worm; font Dr. C. H. Fernald, whom I consulted on the subject, says it may be Torticid, Phycid or Tineid.

species, it was breeding abundantly in decaying apples at Mesilla, N. M., the apples having been previously attacked by the codling moth. Mr. G. J. Bowles, in *Canadian Entomologist*, June, 1882, gives a detailed account of the insect, and records that it was bred from pickled plums, decaying peaches and pickled raspberries. Dr. Williston bred it from decaying pears. In short, it breeds in all sorts of fermenting fruits or substances containing acetic, citric, or similar acids. On Oct. 9, at the Experimental Farm at Phoenix I noticed the flies about some green olives in a bucket at the house. On Oct. 23, and at other times, I observed that they bred abundantly in rotting oranges in Salt River Valley. Specimens bred from an orange were confirmed by Mr. Coquillett as the true *D. ampelophila*.

(3.) *Observations by Mr. F. M. Irish.* Mr. F. M. Irish, of the Normal School at Tempe, wrote me as follows on Dec. 9, 1899 "I am at present interested in a small fly found on the oranges at the Camel Back. It attacks the cracked fruit, or that which has the rind punctured at any point, or which is too open at the 'navel' end. The fly is about 3 mm. in length, moves with a slow steady flight like that of a mosquito, is of a red-brown color, the females having a larger abdomen than the males, turgid and whitish, the abdomen of both sexes being tipped with black at the posterior extremity. Placed upon fresh pieces of oranges the flies paired, and maggots appeared in a very few days, when first observed being 2 mm. long, nearly the color of the pulp of the orange, and as they lie parallel with the vesicles of the pulp are almost indistinguishable, except when moving, being then disclosed by the darker anterior extremity. The puparia are formed in about ten days and glued to the rind of the fruit or to the sides of the containing jar. These are light buff in color. The perfect insect emerges in about 14 days from the time the parents are placed on the fresh fruit. The maggots reduce an entire orange to a pulpy mass in six to eight days. In every case the development of the insects has been accompanied by the presence of what I take to be a wild yeast in the juice of the orange producing alcoholic fermentation."

It now becomes necessary to consider the circumstances which render the oranges fit for the development of the flies.

(4.) *The four reasons why oranges prematurely change color.* During October I visited many orange orchards in Salt River Valley. The fruit at that time was still green, unless affected by some disease, or otherwise injured. In no case did I find a sound fruit which had changed color, though some appeared so until, on cutting them open, the black rot was revealed. The causes for the premature coloring of the fruit were four, as follows:

(I.) The new orange-worm, discussed in a previous paragraph, only observed in two instances.

(II.) The splitting of the fruit. This is due to no insect or fungus, but results from the rind being unable to expand with the growing fruit, the result no doubt of the dry climate and the methods of irrigation, whereby water is withheld for a time and then abundantly supplied.

(III.) The sapsucker, which often pecks holes in the fruit. These sapsuckers breed in the giant cactus, so it curiously results that the presence of the cacti is inimical to the orange industry. No doubt if the cacti were cut down in the vicinity of orange orchards, the sapsuckers would go elsewhere as they have no other convenient breeding places. But, as one orchardist suggested, Arizona without the cacti would be impossible! Nitidulid beetles as well as the *Drosophila* were found in the holes made in the oranges by sapsuckers.

(IV.) The black rot of the navel orange (*Macrosporium, n. sp.*) This effects the apical or navel end of the fruit, and causes it to become rotten. On cutting open the fruit the rotten area, varying in size but usually about as big as the end of one's thumb, is found, this area being easily distinguished because of its black or blackish color.

(5.) *The Black Rot of the Navel Orange.* This disease has been studied in California by Mr. Newton B. Pierce of the Department of Agriculture, who writes me as follows under date Jan. 9, 1900:

"Black rot of the navel orange is a disease which I studied and named several years since. The cause of the trouble Is a *Macrosporium* (*Alternaria*), a description ot which was prepared by Mr. Ellis for use when publishing an account of the life history of the fungus, which I have worked out from single-spore cultures on orange-pulp cells. Several India ink plates have been prepared illustrative of the diseased fruit and of the various stages of the parasite. A bulletin on the disease is also partly written. The percentage of loss from this cause has been ascertained by cutting large numbers of oranges in the orchards, taking the entire yield of trees for this purpose. This work was conducted at several orange centres in Southern California. It will be of special interest if you are able to demonstrate the manner in which the spores of this fungus are disseminated. You will find a few notes on this disease on page 239 of the Report of the Secretary of Agriculture for 1892."

At the place cited in the last paragraph we read:

"Black rot of navel oranges is a fungus disease which has only recently

attracted the attention of orange-growers in Southern California. It has been found, however, that it has as wide a distribution in the state as the navel orange itself, and that it is caused by a new species of fungus belonging to the genus *Macrosporium*. Its more important effects are to cause the premature ripening and fall of the fruit. During the earlier stages of the disease there are usually no external signs of its action except this premature ripening, and when this occurs after the main portion of the crop has changed color the diseased oranges cannot be easily distinguished before they fall from the tree When work on the disease began, no correct estimate of the annual loss could be made, but when the amount of diseased fruit from a large number of varieties of navel oranges was studied it was ascertained that as high as 10 per cent. of the Washington navels were in some instances affected."

From my own observations in Salt River Valley, I should say that the percentage of fruit there showing the black rot is very small, not at present great enough to be of very serious consequence, though of course it is liable to increase at any time. Also, it appeared to me that nearly all the fruits affected by the rot prematurely ripened. I was not in the orchards when the crop was ripe, but I had the pleasure of eating, and seeing eaten, a great many Salt River Valley oranges, chiefly from the Wilson and Ingleside orchards, which I know to be (in common with all the others) affected by the rot, but in only one instance was an orange found to have the rot, and then only in very slight degree. In these orchards the prematurely ripening fruit was I believe all destroyed, and was in no case shipped; so it resulted that what was shipped was, with the rarest exceptions, free from blemish.

(6.) *The relation of the Drosophila fly to the rot.* Inasmuch as the *Drosophila* breeds abundantly in the rotting oranges, I have no doubt that it must get more or less dusted with the spores; and it is in the highest degree probable that the fly is the means of infecting sound oranges. It is significant that the rot is confined to the navel orange, which is open at the apical end, and that it always starts at that end. The flies can be observed running about everywhere, looking for places to breed, and what is more natural than that they should visit the navels of the oranges, and there unwittingly leave fungus spores? The case is not actually proven, and some experiments I started to elucidate the matter have not yet been reported on, but it is at

least probable that the above surmise is correct.*

(7) *Remedies.* The obvious remedy is to watch in October for all fruit which prematurely colors. and pick it off and burn it. If this is faithfully done all over the valley it is probable that the rot will never cause serious trouble. It is useless to take any measures against the flies, except to see to it that piles of rotting apples and other fruit are not left near the orchards, so as to breed the flies in quantities Even with all possible care, it is probable that the flies will breed somewhere and find their way to the oranges, so it is not recommended that any great amount of labor be expended in the effort to check or destroy them.

THE PEAR-LEAF BLISTER MITE. (*Phytoptupyri*, Scheuten.)

This is a microscopical mite which lives in the tissue of pear leaves, forming dark brown thickened patches or galls. which are generally arranged in irregular rows, one on each side of the midrib, but some distance from it. With a hand lens it can be observed that there are minute orifices, like pin-pricks, in the galls. This mite was observed rather commonly at Mesa and Tempe, but it did not seem to cause much injury.

Remedies. When the attack is first observed, and not many leaves are affected, it is well to pick off and burn all those showing the presence of the mite. At first the raised patches will be reddish or greenish, and not easily observed, but later they become dark and conspicuous. Fall and winter spraying. with kerosene emulsion is recommended when the mites are very numerous.

THE BRYOBIA MITE. (*Bryobiapratensis*, Garman.)

This mite was observed infesting almond trees at Mesa, Phoenix and Glendale. It is best recognized by the clusters of small red globular eggs, which may readily be seen on the twigs

*NOTE.—It has since been learned that the oranges which Professor Cockerell cut with a sterilized knife and *covered* (with cheese cloth?) in order to exclude the flies, rotted just as did the cut and *uncovered* ones. This does not prove that the flies may not, occasionally, carry the fungus spores, but indicates that the rot is mainly spread in some other way, perhaps by the wind.—*R. H. Forbes.*

with the aid of a good hand lens. When the eggs have hatched, the shells appear white The mites themselves are very small, red when young, dark brownish when older. The effect of their attack upon the trees is characteristic, the leaves become pale with a sort of gloss, in fact anaemic from the loss of sap. An affected tree can thus often be detected from a considerable distance.

Remedies. The lime, salt and sulphur wash of California, sprayed in the winter, has been found an excellent remedy both in Colorado and in South Africa. It is made as follows. Unslaked lime, 40 lbs : sulphur, 20 lbs.; salt, 15 lbs. One-fourth of the lime is first slaked and boiled with sulphur in 20 gallons of water for two or three hours; the remainder of the lime is slaked and, together with the salt, is added to the hot mixture, and the whole boiled for half an hour or an hour longer. Water is then added to make 60 gallons of wash. This can be used also against scale insects.

Prof. Gillette of Colorado has also used whale-oil soap in the proportion of one pound to four gallons of water; and kerosene emulsion diluted so that the kerosene is one-eighth of the mixture; and in both cases he found the eggs of the mite could be destroyed, or the mites killed after hatching.