# MARYLAND

# Agricultural Experiment Station.

of the Maryland
BULLETIN No. 32.
Agricultural Experiment Station

## THE SAN JOSE SCALE.

COLLEGE PARK, MD.

April, 1895.

# MARYLAND

# Agricultural Experiment Station.



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ADDRESS,

MARYLAND AGRICULTURAL EXPERIMENT STATION,

COLLEGE PARK, MARYLAND.

Maryland Agricultur

Bulletin of the Maryland Agricultur
Experiment Station/

## LETTER OF SUBMITTAL.

MARYLAND AGRICULTURAL EXPERIMENT STATION,

DEPARTMENT OF PHYSIOLOGY AND ECONOMIC ENTOMOLOGY,

COLLEGE PARK, MD.

MARCH 10, 1895.

SIR:—

I take pleasure in submitting herewith a bulletin on the San Jose Scale, the most important, perhaps, of the insects which now affect the fruit interests of the State. Another bulletin on some of the insects which have lately attracted attention is in course of preparation.

Respectfully yours,

C. V. RILEY.

*To Robert H. Miller, Esq.,*

*Director, Maryland Agricultural Experiment Station.*

## INTRODUCTION.

No insect is just now of more importance to the fruit-growers of Maryland than that which has been designated as the San Jose Scale, a name, given to it because it first became known, or was first particularly noticed around San Jose, California. It is exceptionally injurious, usually causing the death of the affected trees; occurs on a great variety of deciduous trees and has great power of multiplication. It was only in the Autumn of 1893 that the presence of this insect, which is one of the worst with which California fruit-growers have had to deal, was suspected on the Atlantic Coast. It was then thought to be restricted in its range, and I had hopes that it might be effectually stamped out. But during the past year it has been found at, or reported from, so many new localities in the East, all the way from Florida to New York, including the States of Maryland and Virginia, that there is no hope of being able to exterminate it. It has come to stay, but as it is possible to very materially limit its injury and spread, and by proper precautions to prevent its introduction into districts in which it does not yet occur, I feel warranted in giving a pretty full account of the species in the present bulletin.

As will be seen from the context of this bulletin, it is already reported from points in Charles, Kent, Talbot, Anne Arundel, Prince George's, Washington and Frederick counties, Maryland, and it is my earnest hope that all into whose hands this bulletin may fall and who recognize the scale upon any of their trees will at once send to the Station specimens with as full account as possible of the extent of the infection. Other species, not in the same way to be dreaded, will frequently be confounded with it, and the entomologist will be glad to examine specimens that may be suspected and make proper report and, where necessary, visit the localities. It is only by making a thorough survey of the State for infected centers that we may hope to succeed in limiting or still further restricting the range of the species, and in this work the fruit-growers themselves may materially assist by correspondence with the Station and should do so for their own good.

The illustrations were prepared for the Department of Agriculture and are used by the courtesy of Secretary Morton.

C. V. R.

# THE SAN JOSE SCALE.

(*Aspidiotus perniciosus* Comstock.)

## A Serious and Recent Importation into Maryland.

*By Dr. C. V. Riley.*

### PAST HISTORY OF THE SPECIES.

The following history of the species up to the year 1892, may be reproduced from my Annual Report as Entomologist of the Department of Agriculture for 1893.

In the Annual Report of this Department for 1880, Prof. J. H. Comstock described under the above name, an insect which he had collected in Santa Clara County, Cal. He stated that from what he had seen of the species, he considered it to be the most pernicious scale-insect known in this country. He had never seen any other species so abundant as this was in certain orchards, and was told that it infested all the deciduous fruits grown in California, except the peach, the apricot and the black Tartarian cherry. As a remedy he suggested the use of strong alkaline washes.

Until very recently the San Jose Scale has been confined to the Pacific Coast, but has extended north to Washington, and south to the Mexican border, and has become, perhaps, the chief enemy to Pacific coast horticulture. Considerable attention has naturally been paid to the species by California horticulturists.

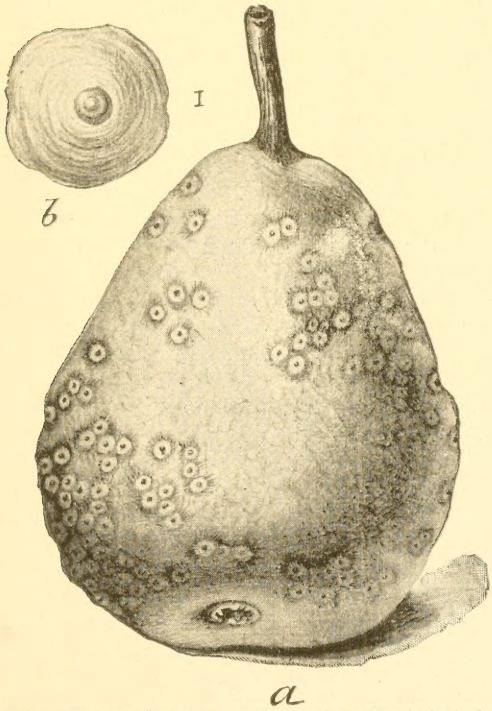


FIG. 1.—San Jose Scale: *a*, pear, moderately infested—natural size: *b*, female scale—enlarged. —(from *Insect Life.*)

In 1883, Matthew Cooke published figures of the larva, male pupa, and adult male, together with the adult female scales on twig and fruit. He stated that the insect was first noticed by fruit shippers as infesting fruit in 1873, at San Jose, Santa Clara County. From that time it spread rapidly until 1880, and but little effort was made to exterminate it. In the winter of 1881-82, crude petroleum was applied extensively; in some cases with good results, but in the majority of instances with great harm to the

trees, many trees dying from the effects. The remedies recommended were one pound of concentrated lye to a gallon of water, and six pounds of caustic soda to twelve ounces of potash, and eight gallons of water. These remedies were to be applied only at the dormant seasons. While the tree is in leaf: one pound of whale-oil soap, one-third of a pound of sulphur, and an ounce and a half of lye or caustic soda to a gallon of water was recommended.

In 1894 the late Dr. S. F. Chapin, in his biennial report as State Inspector of fruit pests, mentioned the San Jose scale, but stated that in Santa Clara County, where it first appeared, there had been a most gratifying decrease in its numbers, and in the destructive effects following its presence, both results having been brought about by the intelligent and well directed efforts of the fruit-growers. He stated that the scale had been found at that time in many different localities in the State, but had not caused any great decrease in orchard products. He urged that the pest should be watched and treated in its incipiency.

In the biennial report of the State Board of Horticulture of California for 1885-'86, the late W. G. Klee, then State Inspector of fruit pests, published a short account of the insect, illustrating its characteristic appearance upon twig, leaf and fruit. Mr. Klee stated that the insect has three distinct broods—one in June, one in August, and one in October; but that these broods overlap, and in consequence the summer washes are not thorough remedies unless frequently repeated. He therefore recommended winter treatment, consisting of the cutting back and thorough thinning of all trees above twenty feet in height, together with thorough scrubbing of the rough bark of the old trees, and the application of one-half pound of concentrated lye, one-half pound of commercial potash, and five quarts of water.

In the Proceedings of the Eighth Fruit-Growers' Convention, published in the report of the State Board of Horticulture for 1887-'88, Prof. C. H. Dwinelle, is said to have reported the most perfect success in fighting the San Jose scale in Sonoma County, Cal. A seriously infested orchard was treated with absolutely complete success by means of a wash composed of one-half pound of commercial potash, one-half pound of caustic soda, and five quarts of water. This was applied when the trees were in a dormant condition.

In the report of the same Board for 1889, a reprint is given of Comstock's description in an article upon scale-insects and remedies. Several formulæ for summer and winter washes are given, the most successful of which, and the one which has come into most general use, being the so-called lime-sulphur-salt wash. This wash consists of forty pounds of unslaked lime, twenty pounds of sulphur, fifteen pounds of rock salt, and water to make sixty gallons. The summer washes comprise potash and caustic soda, and whale-oil soap and sulphur, with a slight admixture of caustic soda and potash. In the report of the Board for 1891, Mr. Alexander Craw published an article entitled "insect pests and their extermination," in which he briefly discusses this species. He considers it to be a very serious pest of deciduous trees, but states that the

remedies just mentioned are so cheap and effective, that no excuse can be tolerated for a seriously infested orchard. He further states that a Chalcid fly(*Aphelinus fuscipennis* Howard) had been found doing such effective work in subduing the species in an orchard in the neighborhood of Los Angeles, that a complete restoration of the orchard was confidently expected.

In Bulletin 26, of this Division, Mr. Coquillett, in his report of the scale-insects of California, devotes four pages to this species. He states that its origin is uncertain, but that the fact of its being so frequently found upon plants imported from Japan would seem to point to that country as its original home. He states that the species never attacks citrus or coniferous trees, and that the LeConte pear, when growing in the midst of other varieties of pear, is almost exempt. The twice-stabbed ladybird (*Chilocorus bivulnerus*) is mentioned as being the most abundant and efficacious enemy of the scale, although Mr. Coquillett has never known an instance where even one single tree has been entirely or very nearly freed from the scales by the work of this beetle. The article concludes with a series of experiments with washes. The result of these experiments was that the resin and caustic soda wash recommended by Mr. Coquillett, in Bulletin 23, of the Division, was found to be superior to the others. This wash is to be applied only during the dormant season, and consists of thirty pounds of resin, nine pounds of seventy per cent. caustic soda, four and a-half pints of fish oil, and water to make one hundred gallons.

Mr. Coquillett's testimony as to the good offices of *Chilocorus bivulnerus*, coincides with that of other observers, but a surprising instance, which indicates that the species may occasionally prove effective, was mentioned in *The California Fruit Grower*, in 1892. It was there stated that Mr. N. W. Motheral, procured a number of these beetles in San Diego county, (date not given) and placed them in some orchards in Tulare county, which were badly infested with the scale. They did not appear to multiply greatly until the spring of 1892, when immense numbers appeared simultaneously and completely cleared the orchards of the county of the scale.

An interesting ladybird of the genus Scymnus was found in 1892, by Dr. Blaisdell, preying upon the San Jose scale at the Coronado parks, near San Diego. This species was described by Dr. Blaisdell, as *Scymnus lophanthae n. sp.*, but is one of the species imported by Mr. Koebele, from Australia, and has not proved very effective in destroying the Aspidiotus.

In the September, 1892, number of the *Agricultural Gazette*, of New South Wales, Mr. A. Sidney Olliff, reported the receipt of a typical series of *Aspidiotus perniciosus* on the fruit, leaves, and twigs of pear from West Maitland, New South Wales. Mr. Olliff further stated that although this species had not previously been recorded as occurring in Australia, it had been known to some fruit-growers for a number of years.

In an important paper read by Mr. Alexander Craw, before the State Horticultural Society, of California, December, 1892, the San Jose scale is stated to be unquestionably of foreign origin, and it is further sur-

mised, on the authority of Mr. John Britton, of San Jose, that it was introduced into California upon trees received from Chile by the late James Lick.

In Bulletin 7, of the New Mexico College of Agriculture, published in June, 1892, Mr. C. H. Tyler Townsend, entomologist of the station, records the occurrence of the species at Las Cruces upon apple, pear, plum, peach, quince and rose, and states that it was brought into New Mexico on young trees from California. The winter eggs are mentioned in Mr. Townsend's account as turning orange-yellow in spring and hatching the first or second week in May.

### ITS HISTORY IN THE ATLANTIC STATES.

Early in August, 1893, specimens of this species were first brought to my attention, while yet government entomologist, by Prof. B. T. Galloway, Chief of the Division of Vegetable Pathology, U. S. Department of Agriculture, who received it on a pear sent by Dr. C. H. Hedges, of Charlottesville, Va., who had mistaken it for a fungus disease. Recognizing the importance of the matter, I drew attention to this introduction at the meeting of the Association of Economic Entomologists, at Madison, Wis., the latter part of the same month. On the supposition that it might be restricted to Dr. Hedges' trees, I took active steps to furnish all possible information about the subject, and endeavored to interest the State Board of Agriculture of Virginia. I had the infested region at Charlottesville, carefully investigated by Mr. E. A. Schwarz and Mr. D. W. Coquillett, whose reports were published in *Insect Life*, Vol. 6, pp. 247 and 253. The insect was found upon pear, peach, plum, apple, quince, rose, currant, gooseberry and raspberry. The careful survey of the field thus made seemed to justify the belief that this was a local and restricted outbreak. At a meeting of the State Board of Agriculture at Newport, Va., I read a paper upon the subject, urging active measures for its extermination, and pledging, on Secretary Morton's account, the active co-operation of the National Department in such measures.

Believing that the most effective way to exterminate it was by the use of what is known as the gas treatment, i. e., the fumigation of the trees under a tent by means of hydrocyanic acid gas, this being known as a most effective insecticide and most likely to reach and kill all the insects, my first efforts were in this direction. It was the first time that efforts had been made to employ the gas treatment in the Eastern States, though this treatment has been used for many years and is very popular in the orange groves of California. Mr. Coquillett, who had been the agent of

the Division at Los Angeles and who had discovered and developed this gas treatment, was fortunately with me in Washington at the time, so that the treatment was entrusted to him. We had some difficulty, in the first place, in getting the tents manufactured, and still further difficulty in putting them in operation. There are various contrivances in California used for the operation of these tents, the simplest of which, perhaps, for average sized or small trees, are poles with which the two ends of a quadrangular tent are thrown over the tree, the tree itself supporting the sheet. In the Charlottesville case the tents were constructed of eight ounce duck and made in the form of an octagonal sheet, and were oiled with boiled linseed oil, two of them measuring twenty-eight and the other two forty-four feet in diameter. The fumigation was subsequently reported to have been successful in destroying the insect without injuring the trees, though some of these had already begun to leaf out or were in blossom. Later developments, however, showed that a few of the insects had escaped death just as I had found to be the case in the gas treatment at Montserrat.

During the period when the experiments were being made, or during March and April, 1894, fate had decreed that I should be absent in the West Indies. After making all due arrangements to have the work of extermination thoroughly prosecuted, and after having finished my Annual Report to the Department in which an illustrated article upon this San Jose Scale was included, I suddenly decided to make a trip to the West Indies, more particularly to study two scale-insects, viz., the Purple Scale (*Mytilaspis citricola*) and the Orange Scale (*Chionaspis citri*) which under the denomination of "blights," had been for some years killing out not only acres, but square miles of limes on the Island of Montserrat. This trip was taken at the earnest solicitation of the Montserrat Company, of Birmingham, England, without any cost to the Department of Agriculture and without any remuneration to myself. The importance of the

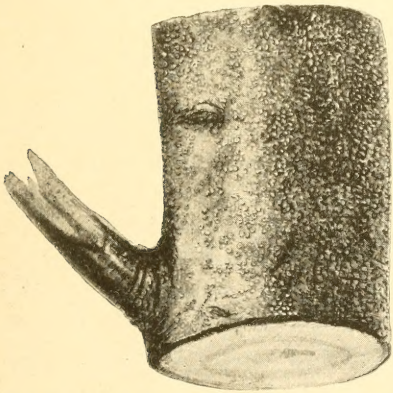

FIG. 2.—San Jose Scale: Apple Branch, with scales in situ-natural size.—(from *Insect Life*.

matter and the indirect bearing of the results on the management of these two scales, which also affect citrus trees in Florida, justified my request for leave of absence for this purpose. Very thorough fumigation was being carried on there by an expert, Mr. R. T. Mullard, from Los Angeles, as the washes usually effective with us, seemed less so there. The condition of things was most interesting and exceptional, and I felt that a study of it might prove valuable, not only to the Montserrat people, but to our own.

It was during this absence from the Department that specimens of the San Jose Scale were brought by Mr. E. Dows to Mr. L. O. Howard, my Assistant-in-charge, from Riverside, Charles county, Maryland. He at once had the matter investigated. Some twenty acres are planted to an orchard which contains some 2000 peach trees, having some 250 apple trees mixed with them. The introduction could be traced to the planting in the Spring of 1888, from stock obtained from the old established and well-known nurseries of John R. Parry, at Parry, N. J. Many of the older trees were found to be dead, and most of the others badly affected. Adjacent orchards within a radius of two miles, the stock of which had been obtained from other nurseries, were found to be quite free from the scale.

Later in March further specimens were received at the Department from De Funiak Springs, Fla. Here the insect, as subsequent evidence showed, was found not only upon peach and pear, but also upon pecan and persimmon. Mr. Howard, as Acting Entomologist, now deemed the matter of sufficient importance to issue a circular of warning. This gave a summary of the information at hand with certain figures that I had ordered prepared for an intended article in *Insect Life*. The circular was widely distributed both directly to Eastern fruit growers and through the newspapers, and, as a result, a number of new localities of infection were discovered, and among them Neavitt, Talbot county, Md. The infested orchard is located on one of the inlets of the Chesapeake Bay and contains about fourteen acres of peach trees, and all of the trees having been badly affected. So far as investigation could determine, both by Mr. Coquillett and Mr. Howard, the first trees planted in this orchard were received from the well-known nursery of my old friends, the Stark Brothers, of Louisiana, Mo.

Later, Mr. Marlatt discovered another infested locality in Maryland, on the place of Capt. R. S. Emory, at Chestertown, in Kent county, and the original trees were here also traced to the New Jersey nursery aforementioned.

The following correspondence is of interest in connection with the history of the species in the Atlantic States, and may be published now, since there can no longer be any object in keeping secret the name of the nurserymen who have been unwittingly instrumental in disseminating the pest. The Parrys have been most public-spirited in their efforts to stamp out the species, so far as their own nurseries are concerned, at a great sacrifice to themselves; and from a verbal report made to me by Mr. William Parry during the late meeting of the American Pomological Society in California, I am satisfied that there will be less danger in future from receiving stock from these nurseries than perhaps from others which have not been so thoroughly disinfected.

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APRIL 20th, 1894.

MR. WM. PARRY,
PARRY, N. J.

*Dear Sir:—*

I have just received from a gentleman in Lewisburg, Pa., pear twigs affected by the San Jose scale and he informs me that the insect was introduced upon pear trees which he purchased from you. I send you enclosed a copy of an emergency circular just issued from this Division, and hope it will induce you to examine your nursery stock and make every effort to destroy the insect. Above all things, I would strongly urge you not to send out any nursery stock this spring unless you are absolutely sure that it is clean. Can you give me the facts (not for publication, if you have any objection), as to how this scale could have reached your nursery? Yours truly,

C. V. RILEY,
*Entomologist.*

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PARRY, N. J., April 25th, 1894.

PROF. C. V. RILEY,
DEPT. OF AGR., DIVISION OF ENTOMOLOGY, WASHINGTON, D. C.

*Dear Sir:—*

We are in receipt of your esteemed favor of April 20th, and are surprised and alarmed to learn we have the San Jose Scale—although from samples sent Professor Smith, of New Jersey State Experiment Station, he expressed fears such was the case and we have made an appointment with him to visit our grounds—and as you recommend we will not send anything of which we have any doubts.

We have no positive evidence how this scale reached us. We have been in the habit of getting from California fruit and nut trees, principally from Japan varieties and generally imported. From your bulletin

I infer it does not attack nut trees nor Japan persimmons. By referring to our books, I find that in the spring of 1887, we ordered of John Rock, San Jose, Cala., a quantity of Kelley's Japan plums. These were shipped us by order of John Rock from Stark Bros., Louisiana, Mo. They were received in unsalable condition so that they were not sold by us but trenched out in nursery rows to recover. They never did recover, but stood in the nursery two or three years and were dug up and burned, and my recollection is they were infested with an insect and think it very probable that it was introduced in our nursery in that way. We would prefer that our name would not be published in connection with this pest, as we realize it would ruin our business. We also realize the danger of distributing any stock infested with it, and have since receipt of your letter destroyed over $1,000 of young nursery stock, fearing, possibly, it might have been exposed to the same insect. And, hereafter, will make arrangements to have grown for us such stock as is liable to the attack until we get rid of it—and grow only that free from it. * *

Thanking you kindly for calling our attention to it and esteeming any information or assistance you can render us in connection therewith.

I am very respectfully,

JOHN R. PARRY.

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MR. JOHN R. PARRY, APRIL 27th, 1894.

POMONA NURSERIES, PARRY, N. J.

*Dear Sir:—*

I have your long and satisfactory letter of the 25th inst. If you succeed in more positively ascertaining how the scale reached you, I shall esteem it a favor if you will notify me. In consideration of your intelligent appreciation of the situation and your promise to avoid further shipments of infested stock as well as to make every effort to destroy the insect in your nursery, it will be best, and most in accord with my own desires, for the department to say nothing in print regarding the means by which this insect has become distributed from your nursery for the present at least. No particular good could be accomplished by it, in view of your promise, though ultimately the historic fact will have to be recorded. I shall be glad if you will keep me posted as to the result of your operations against the insect.

Yours very truly,

C. V. RILEY,

*Entomologist.*

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PROF. C. V. RILEY, PARRY, N. J., May 1st, 1894.

DIVISION OF ENTOMOLOGY, WASHINGTON, D. C.

*Dear Sir:—*

Yours received. We think the San Jose scale was introduced into our grounds by stock (Kelley's plum) shipped by Stark Bros., Louisiana,

Mo., upon order John Rock, San Jose, Cala., as stated in previous communication.

We have destroyed nearly all our orchard trees, as well as nursery trees, of Japan plums which appear to be favorites of the scale. We have also dug out many large trees of Bartlett, Idaho and other pears.

Professor Smith, of New Jersey Station, visited our grounds yesterday and probably has reported to you. Should there be any new developments, or anything of interest transpire in connection with our efforts to exterminate the scale, will advise you.

Respectfully,

JOHN R. PARRY.

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The insect formed the subject of two important papers at the Sixth Annual Meeting of the Association of Economic Entomologists in Brooklyn the following August. One of these was by Mr. Howard, giving a full account of the work done by the Department of Agriculture and its results, and the other by Prof. J. B. Smith, of the Agricultural Experiment Station, of New Jersey. As a result of the discussion at that meeting, the occurrence of the insect was subsequently established in parts of Columbia county, N. Y., lying on the East bank of the Hudson river, below Albany, and in several localities on Long Island.

Still later in the season, as shown by some further notes of the subject by Mr. Howard, which he has prepared for No. 4, *Insect Life*, not yet out, but of which he has favored me with proofs, other localities for the insect were discovered, viz., Southern part of Georgia; Clermont county, Ohio; Newcastle county, Delaware; City Point, Prince George's county, Virginia, and at Bristol, Pennsylvania; while three other localities were added to Maryland, one in Prince George's county, one in Anne Arundel county, and one in Washington county.

There can be no question but that future investigation will show that the insect is quite widely disseminated in many other localities yet undiscovered, not only in orchards and nurseries, but also in isolated grounds, and that this general statement will apply to Maryland as well as to the other States in which it has obtained a foothold; and, while the energetic efforts that have already been made to stamp it out will go far toward doing so, we must accept the situation, and acknowledge that the species has come to stay. While, therefore, I consider that its entire extermination from so many points of infection over so large an area is impracticable and not to be hoped for, yet there is no reason why its spread to other localities may not be very materially, if not entirely checked. This, however, can only be done by intelligent action, not only on the part of

individuals, but by systematic and concerted action of communities in the State, made obligatory, if need be, by proper legislation. As preliminary, a pretty thorough entomological exploration of the State would be advisable, and, in the meantime, the information conveyed in this bulletin, if widely disseminated, with that which has already gone out from the National Department of Agriculture, may help to produce the desired results.

## LIFE HISTORY OF THE SPECIES.

In order not to repeat too much in detail the phases of development common to this and other species of Scale-insects which belong to the same sub-family, viz: the Diaspinæ, or Armored-scales, it may be well, in this connection, to state a few characteristics which belong to almost all of them. This sub-family includes many of our worst scale-insects, like the Red Scale of the Orange in California (*Aspidiotus aurantii*) the Scurvy Scale of the apple (*Chionaspis furfurus*), the Oyster-Shell Bark Louse of the apple (*Mytilaspis pomorum*) and many others. The young or newly hatched individuals are almost microscopic creatures of white or pale yellow color, with body of ovoid form, flattened, with six legs, two short feelers having a varying number of joints, but rarely more than eight, and with two filamentous hairs at the end of the body. They are active but a brief period, sometimes but a few hours or even minutes, rarely more than a day or two and settle upon the bark near where they are born if there is a chance and it is not already too thickly covered with the parent scales. A long thread-like proboscis is gradually thrust under the epidermis and the insect becomes fixed and a flocculent waxy secretion begins to cover it. This increases until the larva underneath molts. The first larval skin becomes part of the secretion or shield and is known as the larval scale and the insect under it after this first molt loses its legs and feelers. The covering still further increases,


FIG. 3 San Jose Scale: *a*, young larva greatly enlarged: *b*, antenna of same—still more enlarged.—(from *Insect Life.*)

and a second molt takes place, and we have a covering which is known as the medial scale, and which either surrounds or extends from one end of the larval scale, according to the species. In the male the form of this scale is usually very much narrower than in the female, and often ribbed; it is, also, often markedly of a different color, or pure white, while the female scale is usually darker, or imitates the color of the bark. Thus the sexes are now distinguishable by their scales or shields while the insects, themselves, are also readily distinguished at this stage, the male having transformed to a pupa, with the limbs, feelers and wings foreshadowed, and the female remaining a mere yellow mass without such organs.

In the male a third molt takes place under this medial scale, and a delicate two-winged fly with long feelers and a single anal style backs out from the rear end. His color is usually pale, with a reddish or dusky band across the middle of the thorax, and the wings have but two delicate veins. The antennæ are variously jointed, the more common number of joints being eight. In the female scale, on the contrary, there is no particular difference of form after the second molt. She still grows and is destined to remain underneath her scale, which becomes much larger and forms what is known as the anal sack. Here after a third molt, she becomes fertile and either produces her young alive or lays her eggs. In either case the young in due time issue from the scale, and begin again the cycle of life, as already related. In those species in which the scale is more or less circular, like the one we are considering, the stages of the scale growth are not so readily separated as in the elongate species which resemble an oyster or a mussel shell. The larval scale is however, usually conspicuous, as a central raised point.

The different species of the sub-family are distinguished from each other not only by the peculiarities of their scales, which do not always offer trustworthy separating characters, but by the peculiar arrangement of the secretory pores on a darker and more chitinized anal plate, and by the peculiarities of the margin of this plate, especially in the female.

Our particular San Jose Scale is quite circular in form, very flat and pressed close to the bark. It grows from 1-16 to 1-8 of an inch in diameter in the female and about half this size in the male. It has the general color of the bark and the larval scale in the centre is a slightly raised point varying from yellowish to nearly black in color. It is perhaps, the smallest scale which occurs in Maryland, and is further characterized and distinguished from all others, which the fruit grower

has to deal with, by producing around the edge a reddish stain or discoloration, which penetrates for some depth in the formative tissues of the bark, and is particularly noticeable when the scales are sparse and not too crowded, or when upon fruit of an ordinary pale color. Another peculiarity is, the relatively large size and bright yellow color of the newly hatched young. At a short distance, when a branch or a tree is badly affected and the scales overlap each other, the tree looks as though it had been covered with lime or ashes, and when crushed or pressed or scraped the mature insects beneath the scales, if alive or fresh, produce a yellowish and rather greasy liquid. The accompanying figures, with the explanations underneath, show very well their appearance upon the pear, (Fig. 1); their general appearance on an apple branch, (Fig. 2); a ventral view of the young scale with a larger view of one of its antennæ

FIG. 4.—San Jose Scale: male adult—greatly enlarged.—(from *Insect Life.*)

(Fig. 3); a dorsal view of the male (Fig. 4); and a ventral view of the female (Fig. 5); with her young developing, and with a large outline of a portion of the anal plate—the three last figures being very largely magnified and the natural size approximately indicated within an accompanying circle. The ordinary fruit grower would hardly be able to separate it from several other common insects which have existed in Maryland from time immemorial, were it not for the smaller size and the reddening effect which it produces upon the bark.

The observations made in California, as well as those made in the East and especially at the Department of Agriculture and recorded

in Mr. Howard's paper already referred to, would indicate that there are no very exact limitations between the various generations or broods of this insect, and that there may be some five annual generations in the latitude of Washington, each generation occupying on the average some forty days. The females hibernate in various stages of development but mostly as mature and impregnated females, since the male does not hibernate. The species is viviparous, i. e., the young are born alive. This has been made quite clear by the observations in the East and especially at Washington, though some writers have stated that eggs are produced. It is quite probable that both statements may be based on facts, and that there may be variation in this respect according to season, locality or conditions. One thing however, is clearly determined, viz. that the species may be viviparous throughout the year.


FIG. 5—San Jose Scale: *c*, adult female containing young greatly enlarged: *d*, annal fringe of same—still more enlarged.—(from *Insect Life*.)

The large number of generations is exceptional though there is some compensation in that the individual is less prolific than in those species which produce fewer or but one annual generation. The individuals which have hibernated acquire full development and begin to produce young by the end of May or the first of June and from this time on there is a succession of generations. As in almost all other species of scale-insects the male scales, produced most in Summer, are, for the most part, formed on the leaves and show a tendency to gather along the midrib on the upper side.

The matter of most practical importance in the life history of the species is that *it continues multiplication from the beginning of June until late in the Autumn, or until Winter weather has fairly set in, and that during this time there is practically no period when the insect will not occur in almost every condition.*

### ORIGINAL HOME OF THE SPECIES.

From previous writings upon the subject, more particularly in California, it has been assumed that this particular insect was derived from South America and particularly from Chili, but later evidence obtained by Mr. Howard and brought together in his last communication upon the subject, (*Insect Life*, volume 7, page 290, 291) indicate that it is probably a native of the Pacific Coast, and that it may have spread thence to those countries in which it is known to occur, viz., Chili and parts of Australia and the Island of Kauai (where it has been found by Mr. Albert Koebele,) just as it has been introduced thence into the Eastern States.

### PARASITES AND NATURAL ENEMIES.

A widespread and minute parasite which attacks a number of other scale-insects of the same sub-family was reared from specimens origin-

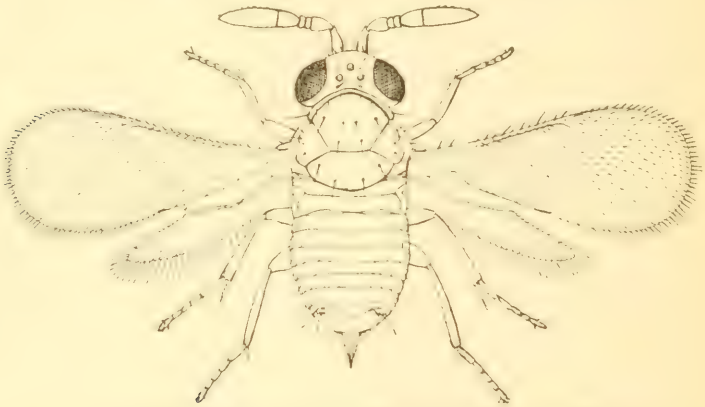

FIG. 6.—*Aphelinus diaspidis* How.: greatly enlarged (from *Insect Life.*)

ally collected at Riverside, Md., and has since been found elsewhere, as it was also previously known to occur in California. It sometimes does very effective work. It is a very minute Chalcid-fly (*Aphelinus fuscipennis* How.) which the average fruit-grower would not be able to distinguish from very many others of the same genus, and of which the accompanying figure of an allied species, very much enlarged, will convey a sufficiently accurate idea. The mature fly, having undergone its transformations beneath the scale, issues from a minute circular hole, and, whenever such minute and regular holes are discovered upon the scales, the presence of this, or some allied species of parasite, may be safely inferred. Another species (*Anaphes gracilis* How.) which also preys upon allied scale-insects, and especially on the common Oyster-shell Bark-louse of

the apple, has also been reared at the Department from the scales taken at Riverside.

Among predaceous insects which feed upon it, the following are recorded in my report, as U. S. Entomologist, as observed at Charlottesville, Va. The common little Malachiid Beetle (*Collops quadrimaculatus*) was observed feeding in small numbers upon the newly hatched larvæ. The Coccinellid beetle (*Pentilia misela*) and its larvæ were very abundant on the infested trees, and this species, Mr. Schwarz thinks, it a very important enemy of the scale. The beetles seem to prefer the full-grown female scales, while the larvæ feed upon Aspidiotus larvæ. The larvæ customarily transform to the pupa state within the calyx of the pears. This little cavity was always found literally filled with a mass of young and old scales, full-grown Pentilia larvæ and pupæ, and recent imagoes. The fact that this beetle, which is essentially an Eastern species, so readily and effectively began to feed upon this introduced scale is a very interesting one, entomologically, and would justify an effort to introduce and colonize it in California.

A few of the lady-birds introduced from Australia, have also been found to prey upon it in California, and especially a steel-blue species, *Orcus australasiæ*, and it would be well to bring specimens to the East.

MODE OF SPREADING.

It follows, from what has already been stated of this and other allied species of scale-insects, that of their own accord they can spread but a very short distance annually. Indeed it is a question whether the insect could ever spread from tree to tree wherever the trees are some distance apart and the branches do not interlock, were it not for other agencies which aid them. The principal methods by which these insects are carried from one tree to another and from one place to another, while yet in the newly hatched larval condition are, (1) by the agency of wind, (2) that of running water, (3) by being carried upon the feet or feathers and hair of birds or other animals, and (4) particularly by means of flying and crawling insects and gossamer spiders which frequent the same trees. In this connection I quote the following from my last report as United States Entomologist:

"Some interesting observations were made by Mr. Schwarz, upon the transporting of the young Coccid larvæ by other insects. This very Pentilia was, unconsciously, an active agent in this dangerous work. Hardly one of the beetles could be found which did not carry on its back at least one Aspidiotus larva, and sometimes three or four were found upon a single wing-cover of a beetle. A small black ant (*Monomorium minu-*

*tum*) was adundant upon the pears, attracted by the juice emerging from the cracks, and almost every one of these ants carried on its back one or more specimens of the Coccid larvæ. Specimens of a little Chrysomelid beetle (*Typophorus canellus*) were also found upon the trees. Red and black specimens of these beetles occurred, and the interesting observation was made that while the Aspidiotus larvæ crawled freely upon the black individuals, no specimens were to be found upon the red ones. This same peculiar fact was also found to hold with the ants, since the red ant (*Formica schaufussi*) was abundant upon the pears, but no specimens were found bearing Aspidiotus larvæ, while, as just stated, the little black Monomorium was always found carrying specimens. Curiously enough, no ladybirds other than Pentilia were seen. The common Twice-stabbed ladybird (*Chilocorus bivulnerus*), which is so active an enemy of scale-insects and plant-lice throughout the Southern States, was absent."

The scale-insects are, however, primarily carried to long distances, while shielded by the scales, through the instrumentality of man, upon scions and nursery stock. The agency of wind has frequently been noted in the more rapid spread of the insects in the direction of prevailing winds. This agency is not only direct, wherever the wind is sufficiently strong, as in severe storms passing over infested districts at the right season, but it is also indirect in that the flight of insects bearing the young scale-insects is also influenced thereby. The young scale-insect is not easily dislodged from the twig or branch of a tree, but there is every reason for believing that when the tree is very badly infested so that the scales are literally piled one upon another, the young lice, finding no means of support thereon, more readily attach themselves to the bodies of other creatures or deliberately let themselves drop, to be carried by wind or by running water, this last means being much more effective in aiding their spread in countries which are dependent on artificial water-supply and where irrigating ditches run near or through the orchards.

As already indicated, it has been proved to have been introduced from California on nursery stock at Parryville, N. J., and there are probably other centres of infection, like that in Missouri, from which the insect has been brought directly from California. It would be unjust, however, to charge the nurserymen with the sole responsibility of this distribution, because there is every reason to believe that it has been introduced into other localities upon fruit, the rejected rind or peel of which, carrying the insect, has been thrown out of car windows or from

houses. This conclusion is justified by the frequency with which the insect has been found in our large Eastern markets, upon fruit, especially pears.

### PREVENTIVE MEASURES.

It is obvious, from what has preceded, that most of the influences at work in helping the insects to spread are essentially local, and would hardly cause it to overrun the State for very many years to come. Yet, through man's instrumentality, there is constant danger of importation from infested regions long distances away, either upon fruit or nursery stock. It is, as a consequence, very desirable and necessary that every fruit grower in the State, whose trees are now free from the attacks of this pest, should be on his guard against such introduction. *No fruit should be brought on from an open market without first being inspected, and no buds, scions or trees from any nursery should be received without a similar, first careful inspection.*

### REMEDIES.

When the emergency circular, already referred to, was issued by Mr. Howard from the Department of Agriculture, remedial suggestions necessarily had to be based on past experiments with this species confined to California, and with other species in other parts of the country. This experience was given in the following form:

*Insecticides.*—Where trees are found to have become badly infested the safest and, in the long run, the most economical course will be to cut them down and burn them, trunk and branch. Where the infestation is less marked, insecticide washes and sprays may be used. The young lice, before they have begun to secrete scales (and at this time they can only be discovered with the help of a magnifying glass), may be destroyed by spraying with kerosene-soap emulsion. A formula for this mixture follows:

| | | | |
|---|---|---|---|
| Kerosene | gallons | 2 | =67 per cent. |
| Common soap or whale-oil soap | pound | ½ | 33 per cent. |
| Water | gallons | 1 | |

Heat the solution of soap and add it boiling hot to the kerosene; churn the mixture by means of a force pump and spray nozzle for five or ten minutes The emulsion, if perfect, forms a cream which thickens upon cooling, and should adhere without oiliness to the surface of glass. If the water from the soil is hard, or has a large percentage of lime, add a little lye or bicarbonate of soda, or else use rain water. For use against scale-insects, dilute one part of the emulsion with nine parts of cold water.

For the older scales, the washes may be divided into those which can be used in summer without damage to the trees, and those which are so strong that they can only be applied during the winter season when the tree is dormant. None of the summer washes are perfectly efficacious, and

it is doubtful whether any of them will prove of more benefit than the kerosene emulsion just mentioned. Owing to the fact that we have had no summer experience with this insect in the East, we can not state positively the strengths of certain washes which may be used successfully without damage to the trees during the summer. In California, however, one of our agents, Mr. D. W. Coquillett, has used with success, during the summer, a resin wash which was made in the following proportions:

| | | |
|---|---|---|
| Resin | pounds | 20 |
| Caustic soda (70 per cent. strength) | do | 5 |
| Fish oil | pints | 3 |
| Water sufficient to make | gallons | 100 |

It is probable that this mixture will not be too strong for eastern trees, since, in general, with other insecticides, the climate of California seems to render trees rather more susceptible to injury than is the case in the East. For a winter wash the same ingredients may be used in the following proportions:

| | | |
|---|---|---|
| Resin | pounds | 30 |
| Caustic soda (70 per cent. strength) | do | 9 |
| Fish oil | pints | 4½ |
| Water sufficient to make | gallons | 100 |

The most favored winter remedy in California, however, is the lime, salt, and sulphur mixture. This is generally used throughout the State by progressive fruit growers. It consists of:

| | | |
|---|---|---|
| Unslaked lime | pounds | 10 |
| Sulphur | pounds | 5 |
| Stock salt | pounds | 4 |
| Water to make | gallons | 15 |

This wash will do great damage to the trees if applied during the growing season, *and should be used only in winter.* All the sulphur and half the lime are placed in a kettle, and 8½ gallons water added, after which the contents of the kettle are boiled briskly for about an hour. The solution, which at first is yellow from the sulphur, will turn very dark brown, assuming more or less of a reddish tint, and will finally change from a thick batter to a thoroughly liquid condition, the product being ordinary sulphide of lime. All the sulphur is added to the remaining five pounds of lime and the latter slaked, after which the slaked lime and salt are added to the sulphide of lime already obtained, the whole being then diluted with water to make fifteen gallons. This should be strained before application, as it does not form a perfect liquid solution, on account of the considerable quantity of undissolved lime, which will soon settle to the bottom, unless the solution is constantly stirred while being sprayed.

In the experience of the Division in California and Washington, this solution has not been as successful as could be desired, but it has considerable popularity among the fruit-growers of California.

*The Gas Treatment.*—This method has not been extensively used in California against this insect, but has been used with very consider-

able success against the so-called Red Scale upon orange and lemon trees. It is an expensive operation, but is unquestionably more thorough than spraying. Trees infested with different kinds of Aspidiotus have been entirely freed by a single application of this gas.

The treatment consists in enveloping the tree in an air-tight tent and afterwards filling the tent with hydrocyanic acid gas, generated from fused potassium cyanide, sulphuric acid, and water. This gas is much lighter than air and as soon as generated rapidly rises and fills the tent. It is of course fatal to all forms of animal life, and care must be exercised in using this treatment. The tent is usually constructed in the form of an octagonal sheet, of what is ordinarily known as 8-ounce duck, and is afterwards oiled with boiled linseed oil. A tent of this kind, measuring 40 feet in diameter, will cost about $50, and other sizes in like proportion. Almost any glazed earthenware vessel will answer the purpose of a generator. The potassium cyanide used is usually of 60 per cent. strength and the sulphuric acid is of the ordinary commercial brand. The proportions are, 1 ounce by weight of cyanide 1 fluid ounce of the acid, and 3 fluid ounces of water. This is sufficient for 150 cubic feet of space inclosed by the tent.

The water is first placed in the generator, the acid added, and after the generator is placed under the tent the cyanide is added to the solution. The cost of the chemicals mentioned is small. The tree is subjected to the action of the gas for about half an hour. In treating trees 10 feet high or less, the tent can be placed over the tree by hand, but for those of greater height than this some sort of apparatus must be used for the purpose of elevating the tent over the tree. An apparatus in the form of a tripod, with a pulley at the top, serves this purpose very well.

The following table of the relative amount of ingredients to height and girth of tree top will be found useful:

| Height of tree. | Diameter of tree top. | Water. | Sulphuric acid. | Potasisium cyan de. |
|---|---|---|---|---|
| *Feet.* | *Feet.* | *Fluid ozs.* | *Fluid ozs.* | *Ounces.* |
| 6 | 4 | $\frac{2}{3}$ | $\frac{1}{3}$ | $\frac{1}{3}$ |
| 8 | 6 | 2 | 1 | 1 |
| 10 | 8 | $4\frac{1}{2}$ | $2\frac{1}{4}$ | $2\frac{1}{4}$ |
| 12 | 10 | 8 | 4 | 4 |
| 12 | 14 | 16 | 8 | 8 |
| 14 | 10 | 10 | 5 | 5 |
| 14 | 14 | 19 | $9\frac{1}{2}$ | $9\frac{1}{2}$ |
| 16 | 12 | 16 | 8 | 8 |
| 16 | 16 | 29 | $14\frac{1}{2}$ | $14\frac{1}{2}$ |
| 18 | 14 | 26 | 13 | 13 |
| 20 | 16 | 36 | 18 | 18 |
| 22 | 18 | 52 | 26 | 26 |
| 24 | 20 | 66 | 33 | 33 |

The best results will be obtained by treating the trees during the colder portion of the year or at night, as the gas is more liable to injure

the trees when used in very warm weather than it is when the weather is cooler.

The very poisonous character of the potassium cyanide itself and of the hydrocyanic acid gas must be strongly impressed upon those who undertake to use this treatment for the first time. The cyanide must be kept where children and animals can not get at it; it must be kept in tightly closed vessels, and must be plainly labelled "Poison." During the process of treatment every care must be taken to prevent human beings or domestic animals from inhaling the gas.

Judging from the experiments at Charlottesville, Va., under the auspices of Mr. Coquillett, and from those which were conducted so extensively in Montserrat on limes, even this gas treatment fails to destroy all the eggs where the insects are at all thickly crowded on the tree, so that a single fumigation can hardly be depended upon to be perfectly effective in extermination. I learn also from Mr. Howard that the pear trees seem to have materially suffered in the cracking of the bark, as a consequence of this gas treatment.

*Summer and Winter Washes.*—It so happens, also, that the different insecticides vary in their efficacy according to climatic and other conditions, and there is yet a wide field for careful experimentation bearing on these differences. In an address recently given before the American Pomological Society at its late session (Jan. 30, 1895,) in Los Angeles, Cal., I commented on these facts in the following language, which may be repeated in this connection:

"We must know the effect of a specific insecticide, or a certain mixture, upon the vitality of a given plant at a particular time of day, at a particular season, with a particular sun exposure, and under certain conditions of the plant, both as to vigor and exposure. We must know how different species of plants are affected under the same conditions. We have much to learn yet as to the possibilities of combining a fungicide and an insecticide. In some cases this combination may be made with great advantage, in other cases it is just as clear that no advantage has been derived. But what I wish particularly to call your attention to, is that all these different insecticides will act somewhat differently according to the varying conditions indicated, and that experience between the states east of the Rocky Mountains and the Pacific Coast is more particularly conflicting. The kerosene-emulsions, and especially the whale-oil kerosene-emulsions, have proved of the utmost value in the warfare against the scale-insects of the East; while some of the washes, especially your winter washes, which have, according to the best of evidence, given satisfaction to you, have proved, by contrast, of much less

value with us in the East. This has been particularly noticeable in a series of experiments which I conducted during the years 1893 and 1894, through Messrs. Marlatt, Coquillett and Pergande, and the results of which are embodied in a paper by the former, *Insect Life*, Vol. VII, pages 115-126). Some of the reasons for these varying experiences are not far to seek. As a State, California has many peculiarities, especially this, the southern portion of the State. It is essentially the land of scale-insects, and why? In the East the majority of our most injurious species produce but one generation annually, and the periods of hatching and developing, and the stages in which hibernation takes place are pretty definitely marked. Thus, for a period of about two weeks, generally in the month of May, all the young will hatch from eggs that were hibernated under the female scale. And by spraying the plants affected during this comparatively brief period, when the young and tender insects are so easily destroyed, the plants are, for the most part, easily protected.

"The species which hatch out very irregularly and produce more than one generation annually are the exception there. Here with you, on the contrary, all your most injurious species go on multiplying the year round, and there is scarcely any definite demarkation between the different broods, or the periods of hatching or the different stages of development. There is hardly any absolute period of rest, properly speaking, to be compared with the winter period of from four to nearly eight months in the East. Thus the winter washes, more particularly, vary in their effect in the two sections, as the scales in the East, being more thoroughly dormant, are not so easily killed."

It is evident, from the irregular and continuous production of the young of the San Jose scale during the summer months that the summer washes, useful if repeated with sufficient frequency, can hardly be depended upon to exterminate the insect or entirely rid the tree affected with it. The necessity of their frequent use makes them, also, more expensive. Any treatment that will be effective by one application is preferable, especially if this can be applied in the dead of the year when other horticultural operations do not command so much time. Hence our chief reliance must be on what are known as winter washes, or on the gas treatment already described.

The lime-salt-and-sulphur wash which is used with so much satisfaction against this insect in California proved much less satisfactory in a series of experiments which I had made during the winter 1893-1894 both on the Department grounds on other species of armored scales and on my own place at Sunbury. The experiments were made on American

and Japanese Euonymus affected by *Chionaspis euonymi* as also on a hedge of Japanese quince affected by the common Scurvy Scale *Chionaspis furfurus*. The resin washes were also found in experiments upon the same insects to be less effectual than they are in California.

The results since obtained at the Department of Agriculture give a very high relative value to the ordinary commercial whale-oil soap, applied at the rate of two pounds or more to the gallon of water, and next to this the resin wash used five or six times stronger than indicated in the ordinary formula. My own more recent experience this winter confirms the efficacy of the strong whale oil soap solution. Unfortunately both these washes are expensive, but in this as in so many other things the best, even if the most expensive, is the cheapest in the end, and where trees have already become infested by this pernicious insect they will be very likely to succumb in the end, unless some remedial measures are taken or unless some special efforts are made to introduce and encourage the parasites and natural enemies already treated of.

Mr. Howard, in his latest article, already referred to, summarizes in the following record a series of experiments in November and December, 1894, under rather disadvantageous circumstances, because of heavy rains intervening:

### *Whale-oil Soap.*

1. Three pounds dissolved in one gallon of water. Fatal to all the scales on the trees sprayed with it.
2. Two pounds in one gallon of water. Same result.
3. One and one-half pounds in one gallon water. Fatal to ninety per cent. of the scales.
4. One pound in one gallon of water. Fatal to eighty per cent. of the scales.
5. One-half pound in one gallon of water. Fatal to one-half the scales.

### *Resin Wash:*

6. Six times summer strength. Resin, 120 pounds; caustic soda, 30 pounds; fish-oil, 15 pints; water sufficient to make 100 gallons. Fatal to all the scales on the tree sprayed with it.
7. Four times summer strength. Resin, 80 pounds; caustic soda, 20 pounds; fish-oil, 10 pints; water sufficient to make 100 gallons. Fatal to eighty-five per cent. of the scales.

### *Kerosene Emulsion.*

8. Pure. Fatal to ninety per cent. of the scales.
9. One part of emulsion and one of water. Fatal to eighty per cent. of scales.
10. One part of emulsion and two of water. Fatal to one-half the scales.
11. One part of emulsion and three of water. Fatal to thirty per cent. of scales.
12. One part of emulsion in four of water proved fatal to only a small percentage of scales. (On potted plants in Insectary.)
13. One part of the emulsion in six of water, fatal to a very small percentage of scales. (On potted plants in Insectary.)

### *Hard Laundry Soap:*

14. Two pounds dissolved in one gallon of water. Fatal to eighty-five per cent. of the scales.
15. One and one-half pounds in one gallon of water. Same result.
16. One pound in one gallon of water. Fatal to sixty per cent. of the scales.
17. One-half pound in one gallon of water. Fatal to twenty per cent. of scales.
18. One-fourth pound in one gallon of water. Fatal to ten per cent. of scales.

### *Concentrated Potash Lye:*

19. Two pounds in one gallon of water. Fatal to eighty-five per cent. of scales.
20. One pound in one gallon. Fatal to seventy-five per cent. of the scales.
21. One-half pound in one gallon. Fatal to one-half the scales.
22. One-fourth pound in one gallon. Fatal to twenty per cent. of the scales.

### *Fish-oil Soap, Home-made:*

23. One and one-half pounds in one gallon of water. Fatal to half the scales.
24. One pound in one gallon. Fatal to twenty per cent.
25. One-half pound in one gallon of water. Fatal to five per cent. of the scales.

### *Oregon Winter Wash:*

26. (Ordinary strength.) Sulphur, 15 pounds; slaked lime, 15 pounds; bluestone, 1¼ pounds; water sufficient to make 100 gallons. Fatal to a comparatively small percentage of the scales.

27. (Double strength.) Sulphur, 30 pounds; slaked lime, 30 pounds; bluestone, 2½ pounds; water sufficient to make 100 gallons. Quite a large percentage of the scales escaped destruction.

### *California Lime-sulphur-and-salt Wash:*

28. (Ordinary strength.) Sulphur, 25 pounds; lime, 50 pounds; salt, 18 pounds; water sufficient to make 100 gallons. Fatal to a comparatively small percentage of the scales.

29. (Double strength.) Sulphur, 50 pounds; lime, 100 pounds; salt, 36 pounds; water to make 100 gallons. A rather large percentage of the scales not destroyed.

NOTE.—Experiments 8 to 11 and 14 to 25 were followed in from seven to ten hours after the application of the washes by a hard shower of ten or fifteen minutes' duration. Experiments 3 to 7 had been on the trees a little over twenty-four hours previous to this rainfall. The other experiments were of earlier date, and were not influenced by rains for a considerable time after the applications were made.

*Insecticide Apparatus.*—In Bulletin No. 23, of the Station, in treating of the best means of spraying apple trees for preventing the ravages of the Apple Worm or Codling Moth, I have given some account of the machinery required in connection with the use of the arsenites. On large trees and for orchards the same machinery will apply for the use of the washes and emulsions just treated of for scale-insects, and may be repeated here.

A good, strong double-acting force pump should be purchased and mounted on a large stout barrel with the supply tube reaching well down to the bottom. It has become the custom to mount the pump in the end of the barrel, but except in the case of the Nixon Tripod, it will be almost as easy to mount it on the side of the barrel, which is easily held in place by a skid near either end, and is then more compact and stable than when standing on the end while the handle of the pump comes lower and is more easily worked.

It will be well to buy the pump without the attachments. About 25 feet of ¼ inch cloth insertion rubber tubing is attached to the discharge

orifice, or to each of the orifices in case there are two. To the end of the tube is fitted one of the modifications of the Cyclone or Riley nozzle and the outer 8 or 10 feet are clamped or wired to a light pole or bamboo fishing rod for convenience in elevating the nozzle into the larger trees. The tank or barrel is mounted on a cart or sled and driven between the tree rows, one man driving and pumping and other holding and directing the extension pole and nozzle.

I have mentioned the cyclone nozzle for the reason that, all things considered, I believe it, in some of its modifications, to be the best for orchard work. The Climax nozzle manufactured and sold by the Nixon Nozzle & Machine Company is also a good nozzle, but it is rather large and clumsy, its spray hardly so fine, and it will not answer for fungicides containing lime, since it clogs easily. The Vermorel modification of the Cyclone nozzle possesses a little attachment which quickly unclogs the orifice when once stopped up, and is therefore preferable. Moreover, neither the Cyclone nor the Vermorel modifications is patented, which, other things being equal, is in their favor. Both are manufactured by Thomas Somerville & Sons, Washington, D. C., and Robert Leitch & Sons, also of Washington, or may be made by any brass and iron worker from the descriptions in my official reports.

For application to nursery stock or to smaller trees one of the smaller hand-pumps advertised by various manufacturers, especially pump-makers, as hydronets or aquapults, will answer the purpose, though better still would be the use of what are known as knapsack pumps. The price of these ranges from $10.00 to $20.00.

### IMPORTANCE OF THE MATTER: FINAL ADVICE.

It is very doubtful whether the fruit-growers of the Eastern States or whether those of Maryland have yet awakened to a realization of the importance of taking active measures to stamp out if possible, this pernicious scale-insect, or at least to protect from it trees not yet affected. It has been introduced within comparatively few years, and there is therefore, an excellent chance of restricting its range, or of ridding particular orchards of it. Prof. J. B. Smith, Entomologist of the New Jersey Experiment Station, has issued a special bulletin upon the insect, which is more widely distributed in that State than elsewhere in the East and which, in fact, as we have already seen, has been largely distributed to other parts from that State. He closes his bulletin with a series of recommendations which have been very widely distributed and even copied in the official bulletins of other states, and which, though excellent in themselves, are, I fear, rather calculated to discourage those who have extensive orchards to disinfect. The chief of these recommendations are as follows:

*First.* Every orchard that has been set out within the last six years should be thoroughly examined to ascertain whether or not the scale is present.

*Second.* If it proves to be present and is confined to a few trees, the trees had better be taken out and destroyed, unless the infestation is so slight that the trees can be gone over with a stiff brush and all the scales actually brushed off.

*Third.* If the orchard is young, and the trees are not too large to be handled, it will be best to use a stiff brush and, taking each tree separately, brush off all the scales. This looks like a good deal of mechanical work; but it will pay in the end. It can be done at any time during the winter; it will be absolutely effective and, with care, there need be no further trouble from this insect in an orchard so treated.

*Fourth.* If the trees are too numerous to be treated by hand, or are too large to be conveniently handled, prune back liberally, removing as much wood as the tree can easily spare. The cuttings should be carted off and burnt as a matter of precaution, and what remains of the trees should be washed with the potash solution above described. This should be done as soon as may be, and a month later, during a moderately mild spell, the trees should be again treated, this time with the kerosene emulsion, made as above described and diluted five times. The object of this double treatment is, first, by means of the potash to dissolve or corrode the scales to a greater or less extent, and to kill off a considerable proportion of the insects themselves. At the end of a month the potash will probably have been washed down and all dissolved away, so as to exert no further action. The scales, however, will be thinned down, riddled or loosened from their hold, and an application of the kerosene emulsion then made will give it abundant opportunity to reach the insect. If both these materials are applied thoroughly, the kerosene will finish any work left undone by the potash and not a single specimen need escape.

I have serious doubts whether anything is to be gained by the stiff brush treatment urged by Prof. Smith, involving, as it does, an infinite amount of labor and the severe pruning which he conjoins with it, since crushing off the scales is impracticable on the smaller twigs and branches. Any winter wash that is effective will obviate the necessity for this preliminary labor.

The other treatment recommended is most valuable, but requires two sprayings, viz., one of the potash solution and one of the kerosene emulsion. *As a result of later experiments the past winter, as set forth in this bulletin, it becomes evident that any thorough spraying of the two-pound-to-the-gallon-solution of the whale-oil soap will be perfectly effective, and may be depended upon as a substitute for the treatment urged by Prof. Smith.* Cost of materials and convenience in obtaining will otherwise influence each individual in the choice of the comparatively few satisfactory winter washes, as indicated in this bulletin.

## THE SAN JOSE SCALE.

### A SERIOUS AND RECENT IMPORTATION INTO MARYLAND.

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## TABLE OF CONTENTS.