

# Ohio Agricultural Experiment Station.

---

## BULLETIN 81

---

WOOSTER, OHIO, JULY, 1897.

---

### THE SAN JOSÉ SCALE IN OHIO.

---

The Bulletins of this Station are sent free to all residents of the State who request them. Persons who may receive duplicate copies, or who do not care to receive any, are requested to notify the Station. All correspondence should be addressed to

EXPERIMENT STATION, WOOSTER, OHIO.

---

NORWALK, OHIO:  
THE LANING PRINTING CO.  
1897.

1 Ex. Sta. Bul. 81



ORGANIZATION OF THE  
OHIO AGRICULTURAL EXPERIMENT STATION.

---

BOARD OF CONTROL.

|                             |                           |
|-----------------------------|---------------------------|
| SETH H. ELLIS.....          | Springboro                |
| R. H. WARDER.....           | North Bend                |
| J. T. ROBINSON.....         | Rockaway                  |
| THE GOVERNOR OF THE STATE   | } ..... <i>Ex officio</i> |
| THE DIRECTOR OF THE STATION |                           |

OFFICERS OF THE BOARD.

|                      |           |
|----------------------|-----------|
| SETH H. ELLIS.....   | President |
| R. H. WARDER.....    | Secretary |
| PERCY A. HINMAN..... | Treasurer |

STATION STAFF.

|                                   |                    |                                  |
|-----------------------------------|--------------------|----------------------------------|
| CHARLES E. THORNE .....           | Wooster .....      | Director                         |
| WILLIAM J. GREEN.....             | “                  | Horticulturist and Vice-Director |
| J. FREMONT HICKMAN, M. A. S ..... | “                  | Agriculturist                    |
| FRANCIS M. WEBSTER, M. S .....    | “                  | Entomologist                     |
| AUGUSTINE D. SELBY, B. SC.....    | “                  | Botanist and Chemist             |
| LLOYD M. BLOOMFIELD, B. AGR ..... | “                  | Assistant Chemist                |
| CHARLES W. MALLY, M. SC.....      | “                  | Assistant Entomologist           |
| PERCY A. HINMAN .....             | “                  | Bursar                           |
| WILLIAM HOLMES.....               | “                  | Foreman of Farm                  |
| CHARLES A. PATTON .....           | “                  | Ass't Foreman and Meteorologist  |
| W. A. PORTER .....                | “                  | Salesman                         |
| DELBERT A. CROWNER, B. SC. AGR... | “                  | Dairyman                         |
| ANNIE B. AYRES.....               | “                  | Mailing Clerk                    |
| S. J. BLAKE .....                 | “                  | Mechanic                         |
| W. E. BONTR GER.....              | “                  | Foreman of Greenhouses           |
| J. E. BARCLAY.....                | Neapolis .....     | Supt. Northwestern Sub-Station   |
| EDWARD MOHN .....                 | Strongsville ..... | Supt. Northeastern Sub-Station   |

---

The Bulletins of this Station are issued at irregular intervals. They are paged consecutively, and an index is included with the Annual Report, which constitutes the final number of each yearly volume.

BULLETIN  
OF THE  
**Ohio Agricultural Experiment Station**

NUMBER 81.

July, 1897.

THE SAN JOSÉ SCALE IN OHIO.

BY F. M. WEBSTER.

Bulletin 56, of this Station, was published in December, 1894, its issue closely following the first discovery of San José scale within the borders of the state, and before any studies or experiments could be made. This Bulletin was largely compiled from a similar one, issued by

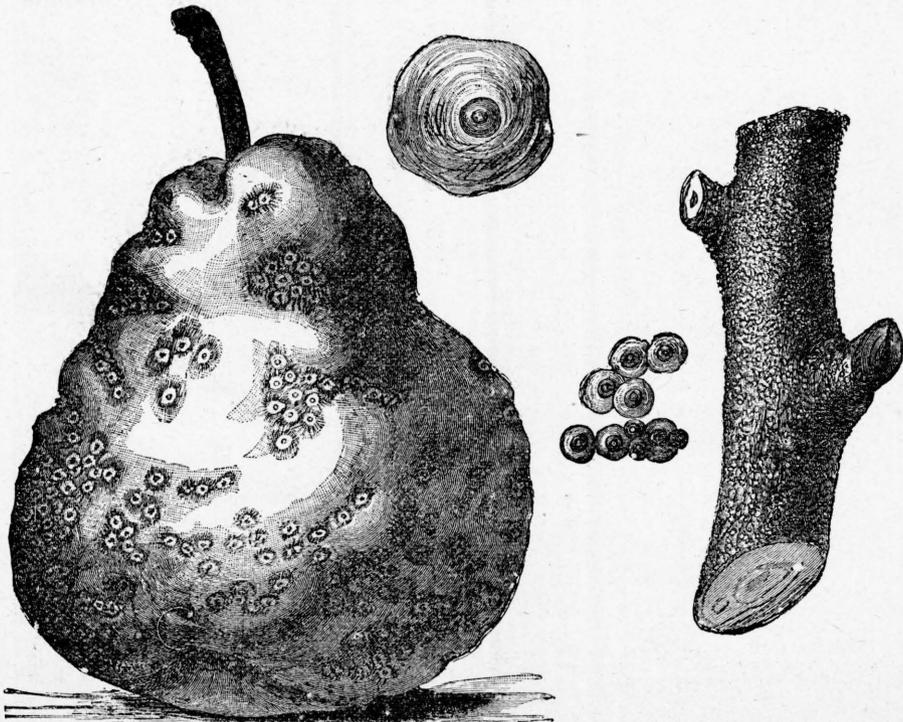
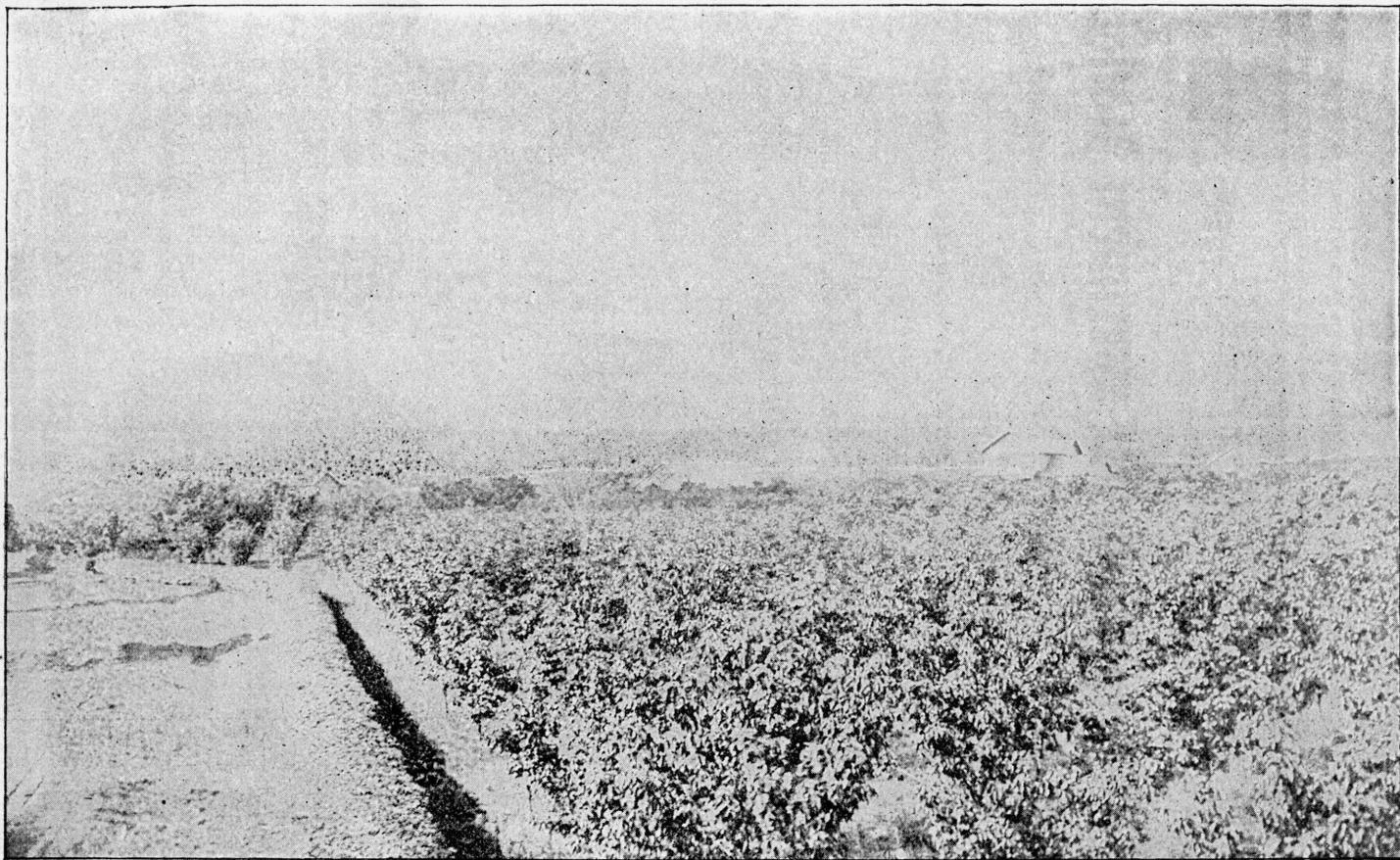
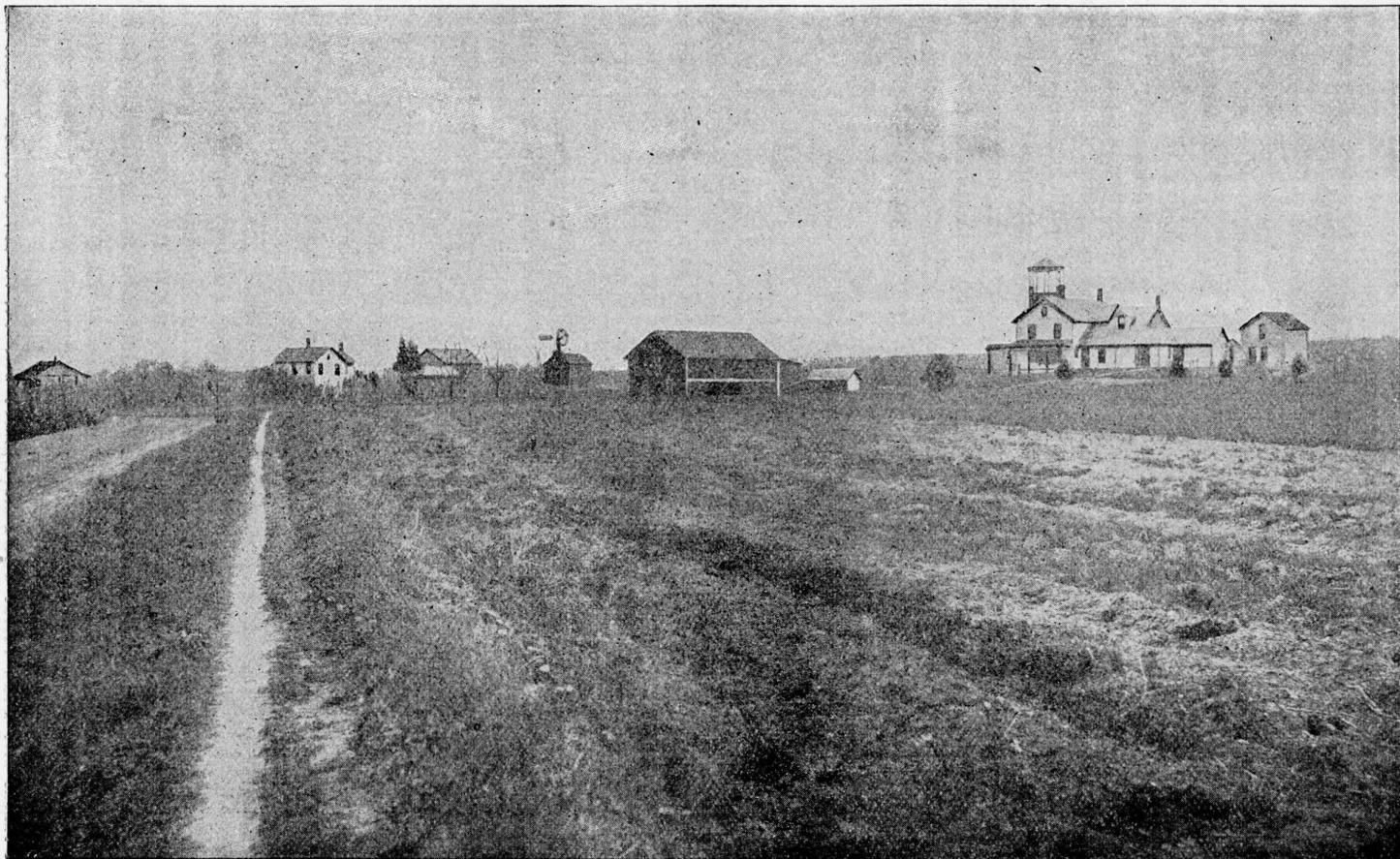


FIG. 1. The San José Scale, *Aspidiotus perniciosus*, on pear fruit and twig, with enlarged female, (the upper), and male, (the lower) scale. After Howard. From Year Book, U. S. Dept. Agr., 1894, p. 268.



The Hadden place ( as it appeared a few years ago ) where the San Jose' Scale was first introduced on Catawba Island, Ohio. The pear orchard  
PLATE I. from which the Scale spread is shown in the foreground. Original



The Hadden place after the most seriously infested trees and the hedge had been cut out and burned. The house at the right had been remodeled since shown in Plate 1. Original.

the New Jersey Station, for the reason that the latter gave the latest information regarding this pest, and as my own bulletin was intended only for the presentation of information and not the results of original observations, it fulfilled its mission. Since the publication of the New Jersey bulletin, some errors have been rectified and much additional data secured, largely, by the Division of Entomology of the U. S. Department of Agriculture at Washington, and we have come to know this insect better, and, in fact, far too well in Ohio, so that further information in regard to its occurrence here is very desirable. The present discussion will deal with this scale especially with reference to its occurrence in Ohio, and how it came to be brought here. In treating the matter of introduction and spread of this pest, I shall use names and localities where justice appears to demand, and withhold such where the use of them would tend to work undeserved injury, or at best only satisfy public curiosity. So long as no injury is being caused and public safety is in no way being endangered, the publication of names will not only do no good but work a serious and irretrievable injury. With orchardists, there can come no injury from publicity, but a nurseryman might suffer, seriously, and yet be entirely innocent of wrong doing, either actual or intentional. The aim has been, in all cases, to protect both the public and the individual from pecuniary loss, unless such appeared necessary to public good. The presence of this insect on the premises of any one is a calamity, but the fact of its continuing uncontrolled on such premises, or being allowed to spread through carelessness or neglect is enough to render it a public danger, and this should not be tolerated.

#### HOW THE SAN JOSE SCALE WAS INTRODUCED INTO OHIO.

In the spring of 1887, a consignment of plum trees was sent from the San José valley, California, the original home of the scale in this country, though having doubtless been primarily introduced from some other country, to the Stark Bros.' nursery at Louisiana, Missouri. The firm state that the boxes on reaching them were opened, and the stock being below the grade contracted for, the packages were promptly closed, without removing the stock, and the consignor notified of their refusal to accept it, and asked what disposal they should make of the stock. The reply was to ship to two nurseries in New Jersey, the J. T. Lovett company, Little Silver, and the Parry Bros., Parry, New Jersey. This is the history of the first introduction as given by one of the firm of Stark Bros., at the meeting of the American Association of Nurserymen, at Indianapolis, Indiana, June 12 and 13, 1895, and published in the printed proceedings of the meeting.

From these two New Jersey nurseries have come the larger part of the introductions into this state, either directly or indirectly. Of the

twenty-three introductions now known to have occurred, (see map) seven came from the Lovett people direct, the seven including nine orchards; three from the Parry Bros., each including only a single orchard; two including four orchards, from a Baltimore, Maryland, nursery through local nurseries; the introduction on Catawba Island, by far the worst in the state, (see plates I and II), and one at least of the two infested or-



Map showing location of outbreaks of San José Scale in Ohio. Since this map was engraved, two additional outbreaks have been discovered, one in Lake county and another in Clermont county, neither of which are here represented. Original.

chards in Preble county, were brought about by the same lot of trees, which as near as can be ascertained, passed through the hands of two Ohio nurserymen, the first of whom purchased the trees of a Rochester, N. Y. firm. That the trees were not grown even there as was claimed by the Rochester firm, is shown by the date of the transaction, 1888, at which time but two Eastern nurseries were, so far as known, sending out infested stock. Two other introductions, each including a single orchard,

came through a Michigan nursery, but the stock, as near as could be determined, came also from Western New York, though not unlikely the trees were grown either in New Jersey or on Long Island. One introduction, comprising two orchards, came through a nursery whose premises had been inspected the same season the trees were sent out. Though coming into the state from New Jersey, the trees were in all probability grown at McClenna, Florida. Of the remainder, little can be definitely learned of the source from which the infection came, but with four exceptions it can be definitely shown that the trees were grown outside of Ohio, and in case of one of the exceptions, I found the pest on peach trees which were said to have been grown from the pits. There were no infected trees near by, and I am obliged to conclude that an infested tree had been planted out, died, and been destroyed and forgotten, but before its destruction, had infected the peach trees just mentioned. The other three probably came from Ohio nurseries on trees grown in and outside the state.\*

The object in citing these cases is to show that nurserymen may be perfectly innocent of wrong, and their own premises free of San Jose scale, yet they may, at the very time, be sending it out to their patrons. A nurseryman must include in his catalogues and trade lists everything that people want, else they will not deal with him. It is absolutely impossible for him to grow all that he desires for his customers, or he may have an unexpected call for such as he has grown, but of which his supply has become exhausted, and, in either case he must either purchase of his fellow growers or lose his customers. I can see no way that an honest nurseryman can do business without purchasing more or less of his stock, if he gives his patrons the best that the trade affords and his varieties are to be true to name. Yet it will be observed that the larger part of trouble here in Ohio comes from this perfectly legitimate feature of the business.

#### THE NURSERY PROBLEM.

Despite their wishes, desires or intentions, the nurserymen are in the very nature of the case, brought foremost in this matter. I do not believe there is another insect that is so destructive in its effects, that is so difficult to detect either in nurseries, unless of long standing, or upon nursery stock as is this. Against this most insidious pest both nurserymen and fruit growers are alike practically helpless in detecting its presence until it has ceased to be the insignificant atom that it at first appears, and becomes the master. Now there are two classes of nurserymen; one class have little reputation to lose, and are perfectly willing, for the sake of securing a few dollars' trade, to cause the loss of thousands of dollars not only to orchardists, but to their fellows in business. The forger and the counterfeiter are sent to the penitentiary, yet their victims are not one bit the less helpless than those of the unprincipled dealer in

---

\*Those grown in the state came from a small concern, doing only a local business, and the scale was promptly suppressed.

infested nursery stock. Why should one class of men, without principle, be allowed to damage or ruin another and reputable class? The better class of nurserymen desire to keep their premises and stock free from this insidious pest, and if there is any reason they should not be protected in doing this, that reason has yet to be made clear. If they do not purchase they will suffer a decrease in business, and if they do purchase they run the risk of sustaining a greater injury. Where, pray, is the justice in this? But this is not all. If I have a nurseryman for a neighbor, I can purchase elsewhere, infested trees, plant on my own premises, and either through carelessness or neglect allow this pest to overrun and destroy my neighbor's nursery stock and ruin his business. Not only this, but, during this time he has probably been sending his trees far and wide, carrying the scale and establishing it, possibly, over a dozen states and among people who are not even informed of the presence of the thing within a thousand miles of their premises. Not only this, but during the spring of 1897, both Parsons & Sons, of Long Island, and the Lovett Company sent invested stock into Ohio, if not knowingly, at least with a carelessness that was wholly unpardonable. In the one case the infested shrub was *Cotoneaster frigidum*, and this was destroyed before being transplanted on extensive private grounds, and in the other a consignment of peach trees was received and planted out, but the trees were afterwards condemned and destroyed by order of the Township Fruit Commissioners, on their being found infested by San José scale.

After all that has been said of these two firms it seems strange that people in Ohio will continue to deal with them. The continual occurrence of this scale on nursery stock, sent out by nurserymen whose premises have been inspected without finding it present, shows conclusively that infested stock is being placed on the market by some one whose stock has not passed inspection, and with numerous transfers that are frequently made between the grower and final purchaser it is not unfrequently difficult to trace the trouble to its origin. This always brings the final seller more or less into disrepute, even though he has used every precaution possible to keep clear of the scale. I know of no insect, the detection of which has given expert entomologists more trouble than this one. Its extreme minuteness, its close resemblance to other species, less harmful; and the frequency with which it is found concealed in cavities and about the wrinkles of the bark, or under buds, renders its detection, when present in limited numbers, a matter of extreme difficulty; and no efficient entomologist, even after having gone over a tree carefully, will care to say that he has not overlooked one or more of these insects. How much more difficult is it then for a nurseryman to detect it on his stock, in the hurry and bustle that always attends the fall and spring shipping seasons? Even if he desires to do so, a nurseryman is helpless to detect this pest on his trees, unless they are badly infested which, if grown by an honest nurseryman is not likely to be the case, for the grower will then detect it, and having done so, will

certainly not send out to his fellows. I have been continually amazed at the frequency with which this pest will continue for years in orchards and on private grounds without being noticed by those who are constantly going about among the infested trees. The outbreak on Catawba Island continued eight or nine years before its true nature was known, though the owner had noticed that "something" was the matter long before.

In discussing my paper on the subject of this scale, read at the twentieth annual meeting of the American Association of Nurserymen, at Indianapolis, June 12, 1895, so good an authority and so keen an observer as Prof. L. H. Bailey, stated that he had no special fear of the San José scale, and that about all that was required was close watching and prompt action.

It has since developed that the pest was, at the very time these statements were made, established near the entrance to the horticultural greenhouses at Cornell, the trees having come originally from Ellwanger & Barry, seven or eight years ago.\* I do not cite these cases in the spirit of criticism at all, but to show how easily the insect may be overlooked by those who can hardly be accused of carelessness, and also the possibility of neglect in cases where it is not at once recognized. Heretofore, we have regarded the orchard and nursery as being the only places in any special danger, but recent discoveries of the pest on ornamentals and forest trees show full well that there is not a public park, a cemetery or private grounds but that is almost in equal danger. We have found this pest on the following trees and shrubs here in Ohio, up to date, while the list is still probably far from complete.

- Black Walnut, *Juglans nigra* Linn.
- Carolina Poplar, *Populus deltoides* Marsh.
- Lombardy Poplar, *P. nigra italica* Du Roi.
- Goldenleaf Poplar, *P. deltoides aurea* (Nichol.).
- European Willow, *Salix viminalis* Linn.
- Cut Leaf Birch, *Betula*.
- American Chestnut, *Castanea dentata* Marsh.
- Elm, *Ulmus Americana* Linn.
- Osage Orange, *Toxylon pomiferum* Raf.
- Gooseberry, *Ribes Uva-crispa* Linn.
- Currant, *R. rubrum* Linn.
- Cotoneaster, *Cotoneaster frigidium*.
- Japan Quince, *Pyrus japonica* (Pers).
- Rose, *Rosa* sps.
- Flowering Peach, *Prunus persica* Linn.
- Flowering Cherry, *P. avium*, Linn.
- Sumac, *Rhus glabra* Linn.
- Grape, *Vitis labrusca* Linn.
- American Linden, *Tilia americana* Linn.
- European Linden, *T. europæa* Linn.
- Hardy Catalpa, *Catalpa speciosa* Warder.
- Mountain Ash, *Sorbus Americana* Marsh.

---

\*This nursery has since been inspected and found free of this scale.

There seems to be but one way to stop the spread of the pest through nursery stock, and that is to place every nursery under a system of annual inspection by entomologists, designated by the secretary of agriculture, and, by national legislation, to prohibit the transportation from one state to another of nursery stock of all kinds unless it bears with it a certificate of inspection and apparent freedom from this pest. This will offer the same protection to the nurseryman that it does to the orchardist, and will eliminate the dishonest grower until he can conduct his business in a creditable manner.

With this object in view, the Ohio State Horticultural Society, in February, 1897, issued a call for a National Convention, composed of accredited delegates from horticultural societies and other similar bodies, to meet in Washington, D. C., March 5, 1897. This convention met in the parlors of the Ebbitt House in Washington, D. C., March 5 and 6, 1897.

The following is a synopsis of the work of this convention, followed by a proposed bill to provide for the inspection and treatment of nursery stock.

The convention was fairly national in regard to representation, and was composed of accredited delegates from horticultural societies, nurserymen's associations, state agricultural boards, granges, alliances and agricultural colleges and experiment stations.

The roll of delegates as presented by the committee on credentials and adopted by the convention is here appended:

- J. H. Hale, South Glastonbury, Conn., President Connecticut Pomological Society.
- William R. Sessions, Boston, Mass., Secretary State Board of Agriculture.
- D. Demarest Denise, Freehold, N. J., President of the New Jersey State Board of Agriculture.
- B. T. Galloway, Washington, D. C., Chief of the Division of Vegetable Physiology, and Pathology, United States Department of Agriculture.
- M. B. Waite, Washington, D. C., Assistant Pathologist, Division of Vegetable Physiology and Pathology, United States Department of Agriculture.
- W. W. Farnsworth, Waterville, Ohio, Secretary Ohio State Horticultural Society.
- S. A. Beach, Geneva, N. Y., State Experiment Station, New York.
- H. E. Van Deman, Parksley, Virginia, President Peninsula Horticultural Society.
- William B. Alwood, Blacksburg, Va., Virginia Agricultural Experiment Station and State Horticultural Society.
- H. Garman, Lexington, Ky., Kentucky Agricultural Experiment Station and State Horticultural Society.
- L. O. Howard, Washington, D. C., Entomologist, United States Department of Agriculture.
- M. V. Slingerland, Ithaca, N. Y., Cornell University and Agricultural Experiment Station.
- Wesley Webb, Dover, Del., Farmers' Institute of Delaware and Secretary Peninsula Horticultural Society.
- Otto Luggen, St. Anthony Park, Minn., Minnesota Agricultural Experiment Station and State Horticultural Society.
- J. Van Lindley, Pomona, N. C., President North Carolina Horticultural Society.

- Gerald McCarthy, Raleigh, N. C., Secretary North Carolina Horticultural Society, Entomologist North Carolina Experiment Station.
- M. J. Daniels, Riverside, Cal., State Board of Horticulture.
- S. B. Heiges, Washington, D. C., Pomologist, United States Department of Agriculture, President Pennsylvania Horticultural Society.
- W. W. Miller, Columbus, Ohio, Secretary State Board of Agriculture.
- V. H. Lowe, Geneva, N. Y., Entomologist New York Agricultural Experiment Station.
- C. M. Hooker, Rochester, N. Y., Western New York Horticultural Society.
- William M. King, Glencarlyn, Va., Virginia State Grange.
- E. M. Wardall, Los Angeles, Cal., State Board of Horticulture.
- F. M. Webster, Wooster, Ohio, Entomologist Ohio Agricultural Experiment Station
- N. J. Bachelder, Concord, N. H., Secretary Board of Agriculture.
- E. H. Cushman, Euclid, Ohio, President Ohio State Horticultural Society.
- Colonel S. E. Chamberlain, Loudon, Va., President Catactin Farmers' Club.
- Captain R. S. Emory, Chestertown, Md., Peninsula Horticultural Society.
- Colonel J. H. Brigham, Delta, Ohio, Master National Grange.
- W. C. Barry, Rochester, N. Y., President Western New York Horticultural Society and President Eastern Nurserymen's Association.
- Hon. E. S. Henry, M. C. (1421 K street, Washington, D. C.), Rockville, Conn. Connecticut Board of Agriculture.
- Colonel J. F. Brown, North Stonington, Conn., Connecticut State Board of Agriculture.
- H. K. Snow, Tustin, Cal., Tustin Fruit Growers' Association.
- H. J. Webber, Eustis, Fla., Assistant Pathologist United States Department Agriculture, Subtropical Laboratory.
- S. H. Derby, Woodside, Del., Peninsula Horticultural Society.
- C. M. Hobbs, Bridgeport, Ind., President Indiana Horticultural Society.
- Robert L. Gulick, Linkwood, Md., Farmers' Alliance.
- E. S. Goff, Madison, Wis., Wisconsin State Horticultural Society and Wisconsin Agricultural Experiment Station.
- W. G. Johnson, College Park, Md., State Entomologist of Maryland.
- G. Harold Powell, Newark, Del., Entomologist and Horticulturist Delaware Experiment Station.
- J. W. Baker, Nashville, Tenn., Tennessee Department of Agriculture.
- Walter H. Evans, Washington, D. C., Office of Experiment Stations.
- E. H. Bissell, Richmond, Va.,
- Hon. Jas. McLachlan, M. C., Los Angeles, Cal., Board of Supervisors Los Angeles county.
- W. A. Taylor, Washington, D. C., Michigan State Horticultural Society.
- The convention completed its permanent organization by electing E. H. Cushman, of Ohio, chairman, and J. H. Hale, of Connecticut, vice-chairman, Wesley Webb, of Delaware, and M. J. Daniels, of California, secretaries, and Robert Gulick, of Maryland, sergeant-at-arms.
- A committee was appointed to nominate a legislative committee who should consider and bring before the convention such recommendations as it thought best in regard to state and national legislation. This committee retired for consideration and later reported the following names and the convention unanimously elected these gentlemen to constitute its legislative committee:
- Wm. B. Alwood, of Virginia, chairman.
- F. M. Webster, of Ohio, secretary.
- D. E. Denise, of New Jersey.
- J. Van Lindley, of North Carolina.
- C. M. Hooker, of New York.

E. M. Wardall, of California.  
 N. J. Bacheider, of New Hampshire.  
 C. M. Hobbs, of Indiana.  
 E. S. Goff, of Wisconsin.  
 E. S. Henry, of Connecticut.

It was ordered by the convention that all propositions relative to state or national legislation should be referred to the legislative committee without debate, but that this committee should grant hearings to all persons who desired to appear before it, before making up its recommendations.

The legislative committee entered at once upon its work, gave full hearings to all persons who desired to appear before it, and labored patiently and harmoniously to unify the interests represented. After three protracted sessions they united in reporting two separate papers as given below, one dealing with state legislation and the other with national legislation.

#### REPORT OF COMMITTEE ON STATE LEGISLATION.

The committee on legislation recommended the following propositions to be embodied in appropriate state legislation as against the introduction or spread of dangerously injurious insects and plant diseases:

First—That each state should provide for the proper inspection of nurseries and other premises for the detection of the presence of the San José scale, or other dangerously injurious insects or plant diseases.

Second—That each state should provide for the proper and timely application of the most approved remedial or preventive treatment when found necessary.

Third—That should packages of nursery stock, etc., be shipped into a state contrary to law, *i. e.*, without proper inspection certificates attached, it ought to be so handled as to receive proper inspection and not be destroyed unless condemned by proper and competent authority.

Fourth—That each state should co-operate in securing the passage and enforcement of a national law, providing against the introduction and dissemination of San José scale and other dangerously injurious insects and plant diseases by means of imports or through inter-state commerce.

#### REPORT ON NATIONAL LEGISLATION.

(A PROPOSED BILL.)

#### AN ACT,

To provide for the Inspection and Treatment of Trees, Plants, Buds, Cuttings, Grafts, Scions, Nursery Stock and Fruit, imported into the United States, and for the Inspection and Treatment of Trees, Plants, Buds, Cuttings, Grafts, Scions and Nursery Stock grown within the United States, which becomes a subject of inter-state commerce.

SECTION 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress Assembled*, that the secretary of agriculture be, and he is hereby, authorized at the expense of the owner or owners to place and retain in quarantine all trees, plants, buds, cuttings, grafts, scions, nursery stock and fruit, imported into the United States at such ports as he may designate for such purposes, and under such conditions as he may, by regulation, prescribe, and that he may appoint inspectors for the purpose of examining such trees, plants,

buds, cuttings, grafts, scions, nursery stock and fruit for the purpose of ascertaining whether they are affected by any dangerously injurious insect or disease, the importation of which will be prejudicial to the horticultural interests of the United States, and provide for the treatment of such when found necessary.

SEC. 2. That when such trees, plants, buds, cuttings, grafts, scions, nursery stock and fruit shall be determined to be infested with any dangerously injurious insect or disease they shall be treated at the expense of the owner or owners in accordance with the regulations of the secretary of agriculture, or they shall be destroyed in case their condition is such as to warrant such destruction; but an appeal may be taken from the decision of the inspector to the secretary of agriculture if such appeal be taken within three days after such inspection and the decision of the secretary of agriculture shall be final.

SEC. 3. That when such inspection shall show that such trees, plants, buds cuttings, grafts, scions, nursery stock and fruit are apparently free from dangerously injurious insects or diseases a certificate to this effect, made in accordance with the regulations of the secretary of agriculture, shall be issued to the owner or owners thereof by the said inspector and this certificate shall operate to release all the objects above specified, when duly stamped or labelled with the same from further quarantine or restriction either at the said port of entry or in inter-state commerce. Any person who shall forge, counterfeit, or knowingly alter, deface, or destroy any of the marks, stamps or certificates, provided for in the regulations of the secretary of agriculture, on any such trees, plants, buds, cuttings, grafts, scions, nursery stock or fruit, or who shall forge, counterfeit, or knowingly and wrongfully alter, deface or destroy any certificate as provided for in said regulations, shall be deemed guilty of a misdemeanor, and, on conviction thereof shall be punished by a fine not to exceed five-hundred dollars, or imprisonment not to exceed one year, or both, at the discretion of the court.

SEC. 4. That whenever it shall appear to the secretary of agriculture that any foreign country shall have provided proper and competent inspection and treatment, in accordance with the provisions of this act, for the objects above specified as being subject to inspection and treatment, he may, by proclamation or otherwise, accept such inspection and treatment in lieu of inspection performed by officers appointed by himself, which acceptance or proclamation by the secretary of agriculture shall relieve all such articles specified in the forgoing sections of this act, when properly stamped or labled, from further quarantine or restrictions.

SEC. 5. That the secretary of agriculture shall cause to be inspected and properly treated at the expense of the owner or owners, prior to their shipment, all trees, p'ants, bu'ls, cuttings, grafts, scions and nursery stock which are subjects of inter-state commerce, and which are about to be transported from one state or territory or the District of Columbia, into another state or territory or the District of Columbia.

SEC. 6. That the said examination shall be made in the manner provided for by the rules and regulations prescribed by the secretary of agriculture, and that after each examination the trees, plants, bu'ls, cuttings, grafts, scions or nursery stock found to be apparently free from dangerously injurious insects or diseases shall be marked, stamped or labelled for identification, as may be provided for by said rules and regulations of the secretary of agriculture, and when so stamped or labelled they shall not be subject to further quarantine or restriction in inter-state commerce. Any person who shall forge, counterfeit or knowingly alter, deface or destroy any of the marks, stamps or said devices provided for in the regulations of the secretary of agriculture on any such trees, plants, buds, cuttings, grafts, scions and nursery stock, or who shall forge, counterfeit or knowingly or wrongfully alter, deface or destroy any certificate provided for in said regulations shall be deemed

guilty of a misdemeanor, and, on conviction thereof, shall be punished by a fine not exceeding five hundred dollars or imprisonment not exceeding one year, or by both such punishments at the discretion of the court.

SEC. 7. That it shall be unlawful for any person, persons or corporation to transport from one state or territory or the District of Columbia, into any other state or territory or the District of Columbia, or for any person, persons or corporation, to deliver to any other person, persons or corporation or to the postal service of the United States, except for scientific purposes by permission or direction of the secretary of agriculture, for transportation from one state or territory or the District of Columbia into any other state or territory or the District of Columbia any trees, plants, buds, cuttings, grafts, scions or nursery stock which have not been examined in accordance with the provisions in sections 5 and 6 of this act, or which on said examination have been declared by the inspector to be dangerously infested with injurious insects or diseases. Any person, persons or corporation violating the provisions of this section shall be guilty of a misdemeanor and upon conviction thereof shall be punished for such offense as provided in section 6 of this act.

SEC. 8. That whenever it shall appear to the secretary of agriculture that any state, territory, district, corporation, firm or person shall have provided proper and competent inspection and treatment in accordance with the provisions of this act for the objects above specified as being subject to inspection and treatment, he may by proclamation or otherwise accept such inspection and treatment in lieu of inspection and treatment by officers appointed by himself, which acceptance or proclamation by the said secretary of agriculture, shall relieve all such articles specified in sections 5, 6 and 7 of this act, when properly stamped or labelled, from further quarantine or restrictions in inter-state commerce.

SEC. 9. That the sum of fifty thousand dollars or so much thereof as may be necessary, is hereby appropriated out of any moneys in the treasury of the United States not otherwise appropriated to carry into effect the provisions of this act.

SEC. 10. This law shall take effect on and after the first day of July, eighteen hundred and ninety-seven.

The committee's report was carefully considered by the convention and unanimously adopted with some slight recommendations which have been incorporated in the copy as it appears herein.

The convention was permanently organized and provided an executive committee, composed of the following gentlemen: Wm. B. Alwood, chairman, Virginia; F. M. Webster, secretary, Ohio; J. H. Hale, Connecticut; E. M. Wardall, California; C. M. Hobbs, Indiana; who were empowered to act for it as will appear from the full proceeding shortly to be published. Further, it was voted that membership fee should be fixed at one dollar, and that the funds received from this source should be used by the executive committee for printing and further promoting legislation as recommended by it.

While in the main satisfactory, there have been some objections urged against the passage of this bill, and at the annual meeting of the American Association of Nurserymen, held in St. Louis, Mo., June 9th and 10th, of the present year, the following proposed bill was presented and endorsed by the association :

## AN ACT,

To provide rules and regulations for the inspection of trees, plants shrubs, vines grafts, cuttings and buds commonly known as nursery stock, imported into the United States. And for rules and regulations for the inspection of trees, plants, shrubs, vines, grafts, cuttings and buds commonly known as nursery stock, grown within the United States, which become subjects of inter-state commerce.

SECTION 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress Assembled.* That all trees, plants, shrubs, vines, grafts, cuttings and buds commonly known as nursery stock, imported into the United States from foreign countries, shall be subject to inspection in the hands of the owner, and before reshipment, sale or planting out, according to the rules and regulations prescribed by the secretary of agriculture, and when so inspected and found apparently free from dangerously injurious insects or diseases the certificate of the officer making such examination and finding, shall be issued to the owner or owners of such nursery stock. A copy of this certificate shall be attached to and accompany each carload, box, bale or package, and when so attached and accompanying, shall operate to release all such nursery stock from further inspection, quarantine or restrictions in inter-state commerce.

SEC. 2. Whenever it shall appear to the secretary of agriculture that any foreign country shall have provided proper and competent inspection for nursery stock about to be imported into this country, he may by proclamation or otherwise, accept such inspection and certification in lieu of the inspection as provided for in section 1, of this act. This acceptance by the secretary of agriculture shall operate to relieve all such nursery stock, when accompanied by a copy of the certificate of inspection, from further restrictions in inter-state commerce.

SEC. 3. All trees, plants, shrubs, vines and buds commonly known as nursery stock, grown within the United States, may become subjects of inter-state commerce, under the rules and regulations as hereinafter provided. The secretary of agriculture shall cause to be inspected all trees, plants, shrubs, vines and buds known as nursery stock, which are subjects of inter-state commerce, and which are about to be transported from one state or territory, or the District of Columbia into another state or territory, or the District of Columbia. This examination shall be made prior to September 1st of each year in the manner provided for, and prescribed by the secretary of agriculture, and if such nursery stock is found to be apparently free from dangerously injurious insects or diseases, the certificate of the officer making such examination and finding, shall be issued to the owner or owners of such nursery stock, a copy of which certificate shall be attached to, and accompany each carload, box, bale or package, and when so attached and accompanying shall operate to release all such nursery stock from further inspection, quarantine or restriction in inter-state commerce.

SEC. 4. That it shall be unlawful for any person, persons or corporation to deliver to any other person, persons or corporation or to the postal service of the United States, (except for scientific purposes or by permission of the secretary of agriculture) for transportation from one state or territory or the District of Columbia, to any other state or territory or the District of Columbia, any trees, plants, shrubs, vines or other nursery stock which have not been examined in accordance with the provisions of section 3, of this act, or which on said examination have been declared by the inspector to be dangerously infested with the injurious insects or diseases. Any person, persons, firm or corporation who shall forge, counterfeit, or knowingly alter, deface or destroy any certificate or copy thereof, as provided for in

this act, and in the regulations of the secretary of agriculture, or shall in any way violate the provisions of this act shall be deemed guilty of a misdemeanor and on a conviction thereof shall be punished by a fine not to exceed \$500.00 nor less than \$200.00, or by imprisonment not to exceed one year, or both at the discretion of the court.

SEC. 5. The rules and regulations herein provided for, shall be promulgated on or before the 1st day of July of each year.

SEC. 6. That the sum of \$100,000, or so much thereof as may be necessary, is hereby appropriated out of any monies in the treasury of the United States not otherwise appropriated, to carry into effect the provisions of this act.

SEC. 7. This act shall take effect on and after the 30th day of June, 1898.

The first of these measures provides for inspection and treatment at the expense of the nurseryman, and in this case it would seem that he might justly claim some protection from the carelessness or neglect of his neighbors. It is well known that nurserymen are obliged to select tracts of land, the soil of which is peculiarly adapted to the growing of nursery stock. And as but one crop can be taken from the same ground, except after long intervals of rest, this necessitates the scattering about of the young trees, rendering them more liable to become infested from adjacent orchards than would otherwise be the case. If this scale should become too prevalent over the country, it would not seem unreasonable for a nurseryman to demand the inspection of all premises adjacent to such as he may select for the purpose of propagating trees and shrubs. In other words, if nurserymen are to be compelled to protect the public, as well as themselves, at their own expense, they might justly claim the co-operation of the public in so doing.

But the bill endorsed by the nurserymen's association does not thus provide for the expense of inspection, and makes no provision at all for the treatment of stock already infested, thereby implying that the inspection is to be made at government expense and all stock found infested is to be prohibited from inter-state commerce. This is as it should be, and, if put into effect, will afford much protection from this quarter. It will be also observed that no provision is made for the prevention of the introduction of destructive insects in or on foreign fruit.

It would seem but justice to ourselves, as a nation, that whenever it shall appear that a destructive insect or disease is being introduced into this country, in or upon a particular kind of fruit, brought from some particular locality, and that such insect or disease is likely to cause destruction to the fruits of this country, the secretary of agriculture should have authority to protect each and every state from such intrusions, to the extent of prohibiting the importation of that particular kind of fruit from the localities where such destructive insects or diseases are known to exist.

Ohio apples can only gain admission into British Columbia by passing inspection, and being found free of codlin moth larvæ, and our nursery stock is, with that of Canada, prohibited from admission into Cape Colony, South Africa.

THE DISTRIBUTION OF THE SCALE THROUGH THE SALE OF  
INFESTED FRUIT.

It is well known that infested fruits grown in California are every year to be found in the markets of the towns and cities in the Eastern portion of the country. It is also true that infested fruit grown east of the Mississippi river has frequently found its way to the same markets. This has raised the question as to the probability of the San Jose' scale becoming established from this infested fruit. Indeed, it has been claimed that the danger from this source is almost as great as from nursery stock. While there is a certain amount of danger from this source, yet up to the present time not a single instance has been recorded where infections from this source could even be suspected. So far as known to me, every outbreak of this scale has been traced to nursery stock. One can readily see that if an apple, pear, or peach thoroughly infested with living scale, were to be thrown down in the midst of an osage orange hedge or in fact in a thicket of any other shrub or plant upon which the insect can readily thrive, the young might possibly make their way from the infested fruit to such plants and establish themselves thereon. But while there are possibilities of such an occurrence, the probabilities are few, and I know of no more efficient method of avoiding both possibilities and probabilities than that of stamping out the pests in the orchards where such fruit is grown. To inspect all of the fruit marketed, even in Ohio, without great delay and consequent injury and loss, would be a physical impossibility. It would certainly be far more practical and less expensive to place the orchards under surveillance through the aid of the township fruit commissioners. By this means no trouble or delay would be occasioned, unless this scale was actually present in the orchard. Whereas, otherwise, the damage caused by any delay in inspection would be even more apt to fall upon the grower of uninfested fruit than it would upon one whose fruit was really infested. It seems to me that the fruit problem can be best settled in the orchards where it is grown. This will apply to foreign orchards, but until this is done some measure of protection should be provided against other pests. And if there had been no other mode of introduction of San Jose' scale except by infested fruit we should have had little trouble with the pest.

TREATMENT OF INFESTED NURSERIES AND NURSERY STOCK.

I know of no greater calamity that could befall a nurseryman than to have the San Jose' scale become established on or about his premises. The difficulties in the way of proper and economic management of the pest, when it is known to occur, can only be appreciated by those who

have been obliged to eradicate it. The question very soon resolves itself into a negative instead of a positive one; that is to say it is more difficult to tell where it does occur, as trees more or less infested are to be found growing intermingled with others that may be perfectly free from infection. The only really safe course to pursue is to burn everything likely to have been infested and fumigate all stock on or about such premises with hydro-cyanic acid gas, using refined cyanide, 98 per cent. pure.

Regarding the application of this measure to infested nursery stock, I cannot do better than to quote from a recent paper by Mr. C. L. Marlatt, of the division of entomology of the U. S. Department of Agriculture, and published in the Year Book of that department for 1896:

The use of hydrocyanic acid gas originated in California, and was perfected by a long period of experimentation by an agent of this division, Mr. D. W. Coquillett. It has not been followed to any extent elsewhere, however; but in Southern California it is held to be the best treatment for citrus trees and is now better understood and more satisfactory than ever before. It is especially applicable to citrus trees, the abundance of foliage and nature of the growth of which enables comparatively heavy tents to be thrown over them rapidly without danger of breaking the limbs. With deciduous trees it has not been practicable to use tents to any extent, except in the case of nursery stock, which may be brought together compactly and treated in a mass under tents. This gas is also the principal agency used in disinfecting material coming into California from abroad.

The practice of "gassing" or "fumigating," as it is called, differs very little from the method employed a number of years ago when the process was first perfected the main difference being in the fact that refined cyanide (98 per cent.) is generaly used in preference to the fused 58 per cent. grade hitherto employed. The latter gives good results when it is uniform, but, fortunately, this is rarely the case, and even in different parts of the same barrel great variation often occurs. Only about two-thirds as much of the stronger cyanide is used as of the weaker grade. The following table, prepared by Mr. John Scott, horticultural commissioner of Los Angeles county, gives the proportion with the stronger cyanide for trees of different sizes:

| Height of tree (feet). | Diameter through foliage (feet). | Water (fluid ounces) | Sulphuric acid (fluid ounces). | Cyanide potassium (ounces). |
|------------------------|----------------------------------|----------------------|--------------------------------|-----------------------------|
| 6                      | 4                                | 1                    | $\frac{1}{2}$                  | $\frac{1}{2}$               |
| 8                      | 6                                | $2\frac{1}{2}$       | $1\frac{1}{4}$                 | $1\frac{1}{4}$              |
| 10                     | 8                                | $3\frac{1}{2}$       | 2                              | 2                           |
| 12                     | 10                               | 6                    | 3                              | 3                           |
| 12                     | 14                               | 9                    | $4\frac{1}{2}$                 | $4\frac{1}{2}$              |
| 14                     | 14                               | 10                   | 5                              | 5                           |
| 16                     | 16                               | 12                   | $5\frac{1}{2}$                 | $5\frac{1}{2}$              |
| 18                     | 16                               | 13                   | 6                              | 6                           |
| 20                     | 16                               | 13                   | $6\frac{1}{2}$                 | $6\frac{1}{2}$              |
| 22                     | 18                               | 15                   | $7\frac{1}{4}$                 | $7\frac{1}{4}$              |
| 24                     | 20                               | 16                   | 8                              | 8                           |
| 26                     | 20                               | $16\frac{1}{2}$      | $8\frac{1}{4}$                 | $8\frac{1}{4}$              |
| 30                     | 20                               | $17\frac{1}{2}$      | $8\frac{1}{2}$                 | $8\frac{1}{2}$              |

The old statement that less time is required for small trees or plants than for larger ones is found to be an error, and, in fact, it is reasonable that an insect is no more easily killed on a small plant than on a large one. The limit in application of gas is to apply it at a strength and for a length of time, forty to forty-five minutes, as great as the tree can stand, and, in fact, the tender terminals of the tree should be slightly scalded, which is proof that the gas is of proper strength, and treatment of this character is necessary to destroy the red scale and the young of the black scale. For very compact trees with dense foliage from one-fourth to one-third more gas should be generated, and this is true also of the moister coast regions, or within ten miles of the coast, the moisture or the cold surface of the leaves condensing a certain proportion of the gas. In the case of young trees and nursery stock there is much less danger of scalding if the gas be generated slowly, either by employing a greater amount of water or using the cyanide in large lumps.

The applications are made at night because the action of sunlight powerfully increases the scalding effect of the gas on the leaves. Most of the work is done by contract or under the direct supervision of the county horticultural commissioners. In Los Angeles county the horticultural commissioner furnishes tents and material at a mere nominal charge, together with one experienced man to superintend the work, while a crew of four men operate the tents. The wages of the director and men are paid by the owner of the trees.

The tents now employed are of two kinds, the "sheet" tent of octagonal shape for large trees, and the "ring" tent for trees under twelve feet in height. The ring tents, or, as they are also called, the bell tents, are bell shaped and have a hoop of half-inch gas pipe fastened within a foot or so of the opening. Two men can easily throw one of these tents over a small tree. An equipment of thirty-six or forty ring tents can be handled by four men. They are rapidly thrown over the trees by the crew, and the director follows closely and introduces the chemicals. By the time the last tent has been adjusted the first one can be removed and taken across to the adjoining row. An experienced crew, with one director, can treat 350 to 400 five-year-old trees, averaging in height ten feet, in a single night of eleven or twelve hours. The cost under such conditions averages about eight cents a tree.

If the cyanide treatment is to be introduced into the East it would be well for fruit growers to obtain the services for a year or more of an experienced man from California to give them a practical illustration of methods, and even in California it is recognized that such work is much more economically accomplished when given over to experienced persons and done under contract. The gas treatment is probably the most thorough of all methods, but complete extermination is very rare. Fumigation must therefore be repeated every two or three years, or as often as the scale insect reappears in any numbers."

The preceding will indicate the best measure to be applied to nursery stock, and to larger trees in case it should appear profitable to do so, as, for instance, in case of trees of extraordinary value. It is very doubtful, however, if this method can be applied profitably in the orchards of Ohio. Nor must this measure be understood as infallible, especially where the scales are densely massed upon the tree, as in such cases more than one fumigation will probably be found necessary.

In generating the gas fused potassium cyanide, 98 per cent. pure (and the strength should be guaranteed), commercial sulphuric acid and water are used, the proportions being one ounce by weight of the cyanide,

slightly more than one fluid ounce of acid, and three fluid ounces of water, to every 150 cubic feet of enclosed space.

For a generator, use any glazed earthenware vessel holding one or two gallons. Place this within the enclosure, add water, acid and cyanide, this last in lumps, in the order named. From one-half to three-fourths of an hour will be long enough to allow the stock to remain in fumigation, and bright or hot sunshiny days should be avoided when fumigation is being carried on. For the purpose of fumigating nursery stock, small buildings lined with felt in order to render them air-tight, may be constructed, or a section of a store house might be partitioned off for this purpose, care being taken to provide a sufficient number of doors so that the fumes may be allowed to escape quickly at the end of the required time. But nursery stock of the size ordinarily sent out can be brought together within a small space and treated in large quantities at the same time, thus reducing the expense of treatment to a minimum. Potassium cyanide is itself of a very poisonous nature and must be kept beyond the reach of children and animals, and during the process of fumigation great care must be taken to prevent the inhaling of the gas by human beings or domestic animals.

It must be borne in mind that the value and efficiency of fumigation depends entirely upon the care and thoroughness with which it was applied. A careless application will practically be little better than none at all.

Infested nursery stock in reality presupposes an infection of other and more permanent trees, plants and shrubs growing upon or about the premises. The only really safe way of dealing with these is to dig them out and burn them, even though but slightly infested. Simply cutting down and leaving a stump projecting above the surface of the ground is not sufficient, for very frequently the young shoots thrown out from these stumps will only serve to continue, if not, indeed, to increase the danger. By far the best course to follow will be to grub everything out, and place the ground under cultivation to some crop demanding the cleanest and most thorough culture, and make no attempt to grow nursery stock of any description in the near vicinity. While fire is perhaps the most expensive measure that can be applied, it has the redeeming feature of being the most efficient, and in fact the only one that can be relied upon as being thoroughly effective.

#### TREATMENT OF INFESTED ORCHARDS AND GROUNDS.

There are no less than forty-five orchards distributed in twenty-one counties in Ohio that are known to be infested with the San Jose scale at the present time, or have been too recently infested to give full assurance that the pest has been entirely exterminated, (See map,) although this is probably true of four of them, and it must be admitted that in

these four cases the infested trees were all promptly taken out and burned as soon as their condition was discovered. In several cases the owners of the orchards have fought the scale faithfully, and while it has been to a greater or less extent controlled it has yet to be exterminated. In fact, it is doubtful if it can be exterminated where it has once become thoroughly established on large or medium sized trees, by the use of any of the washes at present known, except by continued applications during spring and fall for a series of years. It is not so difficult to destroy a very large per cent of the scale so many in fact, that, to all appearances, extermination has been actually accomplished. But we find after a year or two that almost invariably a few have escaped and the effort must be renewed. While it may seem a sacrifice to destroy trees with such an apparently insignificant insect scattered sparingly over the trunk or branches or both, yet where we have been fighting this pest for the last three years the owners of the trees have been forced to acknowledge that the expense of treatment has been greater than the present value of the trees, and the scale has yet to be exterminated. I have no desire to magnify the seriousness of this matter, but treatment with encouraging result is one thing, while extermination is quite another.

All things considered, the best results have been secured at the least expense by the application of the whale oil soap mixture, at the rate of two pounds of soap to one gallon of water, yet I have seen fruit seriously infested with this scale, that had grown upon trees which had, the previous season, been three times sprayed with this mixture; though of course the soap was of an uncertain and inferior quality.

At the Buffalo, N. Y., meeting of the Association of Economic Entomologists in speaking of the scale I made the following statements: "In two orchards near New Richmond, Ohio, kerosene in an undiluted form has been used with marked success, both last year and this, without the least injury to the trees, either apple or peach. I am unwilling to recommend this treatment for general use as yet, but the results gained as against the San José scale are so valuable that I give the details, with the hope that equally good results may be obtained elsewhere during other years. Where the top was seriously infested with scale this was cut away and burned, the trunk was painted with kerosene, and at the proper season grafts were placed in the stubs of the old limbs that had been left sufficiently long for the purpose. In this case a new top has been grown on the old trunk, often a more symmetrical top than the original, the tree thereby losing but little by reason of the attack by the scale. Last July I went through the orchard and found many of the trees thus treated growing nicely and free from scale.

A less successful experiment was to cut away the trunk, a couple of feet above the ground, paint with kerosene, and later graft on this stump, the idea being to secure a new trunk as well as top. But in this case the grafts grew so rank that they were twisted off by the winds, and the

result for this reason was not satisfactory. Where trees were known to be slightly infested, or as a means of killing the scale on any trees not known to be infested, an entire orchard, consisting of both apple and peach trees, was sprayed with undiluted kerosene during February, and in order to make sure that no scale escaped alive, a second application was made to the apple trees shortly after. I saw the orchard in April and again in July, and in neither case did I notice any injury whatever to the trees, either apple or peach. Different conditions might alter results, but in this case I have to report a complete success during two successive years in the same locality."\*

These statements brought out so much discussion, interspersed with criticism, that I decided to write the owner of one of these orchards and get from him an up-to-date statement in regard to both the applications and results. I herewith append a reply to my request for such information. I have no additions or qualifications to make to the letter of reply by Mr. Nichols, in whom I have perfect confidence:

NEW RICHMOND O., September 11, 1896.

F. M. WEBSTER:

DEAR SIR: Yours of the 8th instant came to hand yesterday. Contents noted, and in reply I wish to say that the kerosene (clear coal oil, such as we use in our lamps) which we used was applied principally in the month of February when the ground was frozen. We applied it with a small varnish brush to some small trees to the entire tree, on others only to the limbs that were the most affected. My brother used a barrel sprayer, applying 40 gallons of pure coal oil on 500 apple and 15 peach trees. A part of the orchard he sprayed the second time. The applications were made, respectively, on the 17th and 24th days of last February—cold and frozen.

Trees that we used the clear coal oil on two years ago, as well as those last winter, have made splendid growth and the entire lot of trees look as though they had been rubbed smooth and varnished.

Kerosene and a sprayer is the remedy for the San José scale.

Yours truly,

D. H. NICHOLS.

Soon after the meeting above referred to I received the following letter from Prof. John B. Smith, Entomologist of the New Jersey Experiment Station which I take the liberty of including herewith:

NEW BRUNSWICK, N. J., October 21, 1896.

PROFESSOR F. M. WEBSTER, Wooster, Ohio.

DEAR MR. WEBSTER: I send you inclosed herewith a copy of a letter which may interest you somewhat. Of course I did not know anything about this matter at Buffalo, but it is curious that so soon after the meeting so strong a confirmation of the Ohio experience should turn up. In fact the experience is even more satisfactory and remarkable than that recounted by you.

Sincerely yours,

JOHN B. SMITH.

October 13, 1896.

PROFESSOR J. B. SMITH:

Your kind letter of the 12th duly at hand. I first tried pure kerosene oil on a Beurre d'Anjou pear tree early in July, treating several branches at first thoroughly, using a clean paint brush. At expiration of about two weeks I noted that the treated branches were not injured, but improved in health, as the terminals seemed to be making a more vigorous growth than before the application. I noticed that the San José scale was entirely killed. Being thus encouraged I then applied the kerosene as before, but to the entire tree, even to the smallest twigs, and so copiously that the oil ran down the trunk, through not penetrating the ground. I also treated other pear trees—a Seckel and an Idaho, at the same time, about July 20, the result being the same in each case,—the entire destruction of the scale, without injury to the tree, except in one instance. In a fork of the branches of the Beurre d'Anjou, where the bark was thicker and rougher than elsewhere on the tree, the oil seems to have killed the bark, but not enough is involved to seriously injure the tree.

About October 1st I applied kerosene as before, to the trunks and larger branches of several peach trees, which were thickly encrusted with the scale, the uniform result being the total destruction of all scale reached by the oil, and as far as I can discern without injury to the peach trees. I would state that the peach trees are unusually vigorous, hence have resisted the scale attacks better than have the slower growing pear trees, and for the same reason are safer subjects for the kerosene treatment. My fruit trees are on Jersey City Heights, in a thickly populated section—southern aspect, well protected, soil a very fertile sand loam. My deductions from these experiments are that a single application of kerosene oil will not injure any vigorous tree, but is instantly fatal to the scale. Should the oil be applied to an enfeebled tree, especially if under such conditions that it could not quickly evaporate, it would probably be harmful. I conclude that the most favorable time for such application would be when the tree is rapidly growing, when the scale is most active, and when hot weather would favor rapid evaporation of the oil. It seems to me that such a time would be July.

I hope to continue this treatment next season on other trees, carefully noting results. Would like to hear from you upon this and kindred subjects. I am an enthusiast in fruit culture, and if at any time my observations can be made available by you they are at your service.

Respectfully yours,

M. H. KELSEY.

With this information before me it seemed at least possible to save some of the infested trees in Ohio orchards, where these were not too far gone already, provided we could find a low grade of kerosene that, carefully applied, would penetrate the scale and kill it, and evaporate before penetrating the bark, and without destroying the tree. With this end in view we not only made a series of experiments on apparently healthy trees on our own grounds, but I urged orchardists to use kerosene on trees that were too badly infested to be allowed to stand and trust to the uncertainty of whale oil soap mixture, and yet not so bad but that, if the scale could be promptly and effectually destroyed during the winter, they might be left another year with a hope of possible ultimate recovery. In all cases the uncertainties as to results were explained and applications advised only during cold weather—the colder the better—

and cautiously, only a very fine spray to be used, sparingly, or a light brushing, and on trees that otherwise would have to be destroyed; but in many cases these instructions were not followed and the trees were literally drenched and during quite warm weather.

The following are the results of the whole series of tests: The two orchards belonging to the Nichols Bros. near New Richmond, Ohio, were sprayed with kerosene again during the winter of 1896-7.

Apple trees only were treated and these with kerosene of the grade known as "Headlight." The young peach trees that had been sprayed the winter before with kerosene were not again treated. These orchards were visited by me May 17th of the present year, and with two exceptions the trees were in, apparently, a thrifty condition; in the case of two exceptions both trees had been so severely injured the previous year from an attack of scale that it was very evident that they had not been killed by remedial measures. A somewhat hurried examination of the trees that had been treated seemed to indicate an almost, if not indeed a complete extermination of the scales. In this case the kerosene was applied both with spray pump and with a brush, but I could see no difference in the appearance of the trees, all being alike in a healthy condition. No exact data as to temperature when the application was made could be obtained, further than that it was quite cold, with the ground slightly frozen. A liberal amount of kerosene seems to have been applied.

The orchard at Silverton, Ohio, had been examined in the fall preceding, and seventeen trees marked for destruction. The owner, however, desired to try the effect of kerosene before destroying them, which he did by spraying most of them twice with kerosene, grade not known, during the winter and early spring. Under date of May 30, 1897, the owner furnished me with the following information regarding their condition at that date: All the peach trees were dead, and three of the four apple trees that had been cut back to stubs and one not cut back were also dead, while six apple trees, also treated, seemed to be in good condition. In this case, all of the trees were more or less weakened through the effect of the scale and the treatment—that of double spraying—being rather severe, we would naturally look for a greater mortality among the trees so treated.

In case of one of the Delaware county outbreaks, the trees seemed to be more severely injured, most of them being dead when examined by Mr. C. W. Mally, about June 20, 1897. One apple tree had leafed out, but did not seem to be in a healthy condition. The outbreak in Columbiana county was in two plum orchards, in both of which the variety treated with kerosene was the Satsuma; in this case the trees were literally scrubbed with kerosene of a grade unknown, and which seemed to have been fatal to the trees to which it was applied.

A more extended application was made in the infested orchards on

Catawba Island, the grade of kerosene used here being 120 degrees flash test and the application was made to trees that were already badly infested by the scale and their vitality probably more or less affected thereby. Here, too, the peach trees appear to have been killed, but up to June 4, 1897, the most of the pear and plum trees seem to be doing fairly well. It will be noticed that except at New Richmond in all of the foregoing tests the application of kerosene has been made to trees that could not be considered in a perfectly healthy condition, and any ill effect appearing after treatment with kerosene would represent only the effect of the insect plus that of the treatment. Besides, instead of a light spray, just sufficient to wet the surface of the bark lightly, or a light brushing, the trees were often drenched and during mild weather.

In order to eliminate as far as possible these uncertainties, a considerable number of trees on the horticultural grounds of the Experiment Station, that, with but two exceptions, to all appearances were vigorous and healthy, were treated in a manner similar to the preceding, in order, if possible, to determine the actual effect upon trees that had not already been weakened. The applications were made by Mr. C. W. Mally during March of the present year—the trees being selected by the Horticulturist, Prof. W. J. Green. Those that were to be treated with kerosene, applied with a brush, were severely pruned, and the application was made with a small, white-wash brush, care being taken to cover every bud and twig as well as the entire trunk. Temperature 34° to 38° Fahr. The trees that were to be sprayed with kerosene were not pruned, and during the application, the temperature varied from 40° to 45° Fahrenheit. The following are the tabulated results obtained.

| Kind of tree. | Variety of fruit. | Pruned. | Unpruned. | Grade of oil*.  | Method of application. | Condition of tree†. | Temperature. | Remarks.                              |
|---------------|-------------------|---------|-----------|-----------------|------------------------|---------------------|--------------|---------------------------------------|
| Pear .....    | Domingo.....      |         | X         | Water white ... | Brushed .....          | Injured.....        | 34°-38° F    | Tree recovering.                      |
| " .....       | Seneca .....      |         | X         | Elaine .....    | Sprayed.....           | Dead.....           | 40°-45° F.   |                                       |
| " .....       | Vermont Beauty..  |         | X         | " .....         | " .....                | Uninjured.....      | "            | Tree apparently in perfect health.    |
| " .....       | Lincoln.....      |         | X         | " .....         | " .....                | " .....             | "            | Tree shaken, drenched about base.     |
| Apple .....   | Canada Red.....   | X       |           | Water white ... | Brushed.....           | " .....             | 34°-38° F.   |                                       |
| " .....       | " .....           |         | X         | " .....         | Sprayed.....           | Slight injury..     | 40°-45° F.   | Only tips of twigs injured.           |
| " .....       | Paradise Winter   |         |           |                 |                        |                     |              |                                       |
| " .....       | Sweet .....       | X       |           | Elaine .....    | Brushed.....           | Uninjured.....      | 34°-38° F.   |                                       |
| " .....       | " .....           |         | X         | " .....         | Sprayed.....           | Slight injury..     | 40°-45° F.   | Tree recovering.                      |
| " .....       | (?) .....         | X       |           | Eocene.....     | Brushed.....           | Uninjured.....      | 34°-38° F.   |                                       |
| " .....       | " .....           |         | X         | " .....         | Sprayed.....           | Dead .....          | 40°-45° F.   | Leafed sparingly and later died.      |
| Peach .....   | Crosby .....      | X       |           | " .....         | Brushed.....           | " .....             | 34°-38° F.   | Only 80 buds started May 14th.        |
| " .....       | " .....           |         | X         | " .....         | Sprayed.....           | " .....             | 40°-45° F.   | Only 36 buds started May 14th.        |
| " .....       | " .....           | X       |           | Water white ... | Brushed.....           | " .....             | 34°-38° F.   | Not a single bud started May 14th.    |
| " .....       | " .....           |         | X         | " .....         | Sprayed.....           | Badly injured..     | 40°-45° F.   | Will probably recover.                |
| " .....       | " .....           | X       |           | Elaine .....    | Brushed.....           | " .....             | 34°-38° F.   | "                                     |
| " .....       | " .....           |         | X         | " .....         | Sprayed.....           | Dead .....          | 40°-45° F.   | 132 buds started May 14th.            |
| Plum.....     | Brunswick .....   | X       |           | Water white ... | Brushed.....           | Uninjured.....      | 34°-38° F.   | Sickly at first. Recovered, June, 28. |
| " .....       | Burbank .....     | X       |           | Eocene.....     | " .....                | " .....             | "            | "                                     |
| " .....       | Wild Goose.....   | X       |           | Elaine .....    | " .....                | " .....             | "            | "                                     |
| " .....       | Lombard .....     | X       |           | Water white ... | " .....                | " .....             | "            | "                                     |
| " .....       | " .....           |         | X         | " .....         | Sprayed.....           | Slight injury..     | 40°-45° F.   | Tree recovering very slowly.          |
| Cherry .....  | Reine Hortense... |         | X         | Elaine .....    | " .....                | Dead .....          | "            | "                                     |
| " .....       | Napoleon.....     |         | X         | Eocene.....     | " .....                | Nearly dead ...     | "            | Will probably not recover.            |

\*These grades run about 120 degree flash test, as that grade complies with the Ohio laws and they seldom run much above the requirements.

†This applies to condition of trees June 28, 1897, the last examination that was made.

Of the cherry trees the sour variety, *Reine Hortense*, died, as shown; while one of the sweet variety, *Napoleon*, was nearly dead June 28th but another of the same variety and lot, not treated, was in even a worse condition.

Of the two infested pear trees treated, it should also be stated that one of them died, while the other and less seriously infested one, survived, these being the two first mentioned in the table. Two other pear trees, very badly infested with *San José* scale, and not treated, also died.

Of the peach trees it will be noted that four out of the six died, but here again we have a complication, because several other peach trees, in a row next to these, and not treated, were also in a very sickly condition.

A slight defect in the experiments is caused by the trees severely pruned being all brushed, and, at a lower temperature, while those sprayed were not pruned. The defect was not observed until the results were being written up, but, taken together with results obtained in the *Clermont* county orchards, there would seem to be less danger in cutting back and brushing, than in leaving trees unpruned and spraying them. From the results also gained in our own experiments, there was no perceivable difference in the effect of different grades of oil on the trees to which they were applied.

Judging from all the information we have gained, it seems that kerosene (coal oil) cannot be safely used on peach trees, or on plum trees of tender varieties; but that, if applied lightly, with a brush, to the more hardy plums, pears and apples, especially the latter, it can be used safely, especially if the trees are cut back to trunks and bases of limbs. In the case of the apple, I feel quite encouraged, believing that if used sparingly and evenly during winter, and while a low temperature prevails, it will save many trees that otherwise would have to be destroyed.

In the use of whale oil soaps it is better to deal with the manufacturer direct and insist upon his furnishing an article of a uniform grade.

This will have the most satisfactory effect if applied early in the fall or late in the spring, or, better yet, apply both fall and spring.

No other washes have been found effectual. *Fay's* prolific currant and some raspberry bushes growing near trees sprayed with *Elaine* in the former case, and with *Eocene* in the latter, received the spray that drifted on to them but in neither case sustained any injury.

#### NATURAL ENEMIES.

As far as any practical service is concerned, this subject might be dismissed with these words, "there are none." Whole trees, of my own selection, have been cut into sections, boxed and sent to us from *Catawba Island*, *Preble* county and *Irville*. This material was kept in such a manner that nothing could escape, and in only one case, that of the

Irville material, have we succeeded in rearing anything. In the lot from this last locality were reared a number of the minute, black lady beetle, *Pentilia misella*, Fig. 2, but in too limited numbers to indicate much influence, and besides there is nothing in the orchard itself to indicate that it has had any influence in even holding the pest in check. We have found the little twice stabbed lady beetle, *Chilocorus bivulnerus*

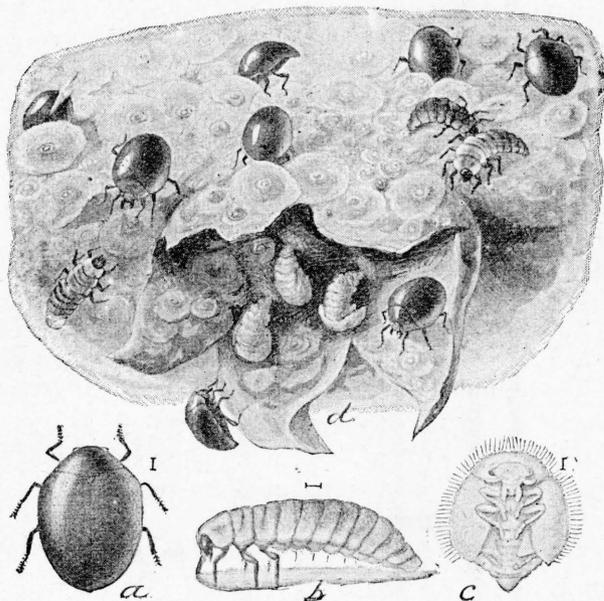


FIG. 2. The minute, black Lady Beetle, *Pentilia misella*; *a*, beetle, *b*, larva, *c*, pupa; *d*, blossom end of pear, showing scales with larvæ and pupæ of *Pentilia*, with the former feeding upon them, and the pupæ of *Pentilia* attached within the calyx—all greatly enlarged. After Howard and Marlatt. From Bull. 3, N. S. U. S. Dept. Agr. Div. Ent. p. 52.

in infested orchards but sparingly, though I know it breeds abundantly all over the state. No fungous disease of this scale has as yet been found in Ohio. From the foregoing it will be seen that we have little if anything to expect, for the present at least, from the aid of natural enemies.

#### MEANS OF DISTRIBUTION.

As has been previously indicated, transportation by means of nursery stock, of various kinds, is, so far as we are now aware, the only way that this scale has yet been introduced into the state. After becoming established however, it may be distributed over comparatively limited areas by several means. The young are not supposed to travel any considerable distance, and, while I have no proof to the contrary, and

have never made any experiments to demonstrate the fact, in several instances trees, not located in the near vicinity to other trees that were infested, have been found thickly covered with scales, from the surface of the ground well up toward the base of the lower limbs, while the limbs and branches appeared entirely free; at any rate a very careful inspection failed to reveal their presence. In one instance an apple tree, standing so near at hand that its branches inter-mingled with those of some peach trees, affected in this manner, was apparently entirely free from the pest. A considerable number of pear trees that had been allowed to stand from the nursery row and where they had been growing for a number of years, were found to be entirely free from scale by both Mr. Mally and myself, while some young seedling pears growing up among them were found to be badly infested. Besides this, I have found the young pear shoots, growing up about the bases of older ones, quite seriously attacked, while the old trees appeared entirely exempt. In all of these instances I could not account for the introduction of the scale among the very smallest and youngest trees, some of which were but little more than a foot in height, while the older ones seemed to escape entirely, or for the base of the peach trees being badly infested, while the upper portion escaped, unless the young scale travel much farther than we suppose them to be capable of doing, or else there are some of the undomesticated quadrupeds that we have not before suspected of being capable of doing so, which have distributed the young, and left them very near the surface of the ground.

That they are carried considerable distances and left upon the branches of trees by birds, we have ample proof. On Catawba Island, where the birds were nesting in the badly infested osage hedge, and where other birds were nesting in both infested and uninfested trees, isolated trees were found by the Fruit commissioners with a single limb seriously affected, and located in the midst of orchards at considerable distances from either hedge or infested trees. In fact, one of the best places to search for isolated colonies of the scale, in an infested district, is about old bird-nests.

The young scale have been carried on the bodies of ants that were running about over the infested trees, and there seems to be no reason why they should not crawl upon the bodies of grasshoppers or, in fact, any other insect that frequent branches of trees, and by them be transported considerable distances. The wind is probably an important factor in the distribution of the scale, and it is not uncommon to find them scattered at a much greater distance from the trees upon which they had clearly been introduced, in the direction toward which the prevailing wind blew during the summer season. In the midst of an orchard, two infested trees were located in the bottom of a deep gully, and while the scale had not spread down this gully at all, they had been carried for a considerable distance upward. The conditions were simply

such that the direction of the wind had been up the gully and its influence on the distribution of the scale in the orchard was well illustrated. In another case a team had been used in the cultivation of an orchard that had been infested for some years. Both the team and cultivator were taken directly to another orchard, located upward of a half a mile away and at a considerable higher elevation, cultivation beginning in this last orchard along the side farthest removed from the infested one. The following spring a few scales were found upon the outer row and it is supposed that the scale that had given origin to these, had been transported from the one orchard to the other, upon the horses, and had been rubbed or brushed from their backs as they passed under the over-hanging branches.

From the foregoing it will be clearly observed that as a few badly infested trees are a perpetual menace to the entire orchard, so an infested orchard, continually endangers every other orchard, park or cemetery in the immediate vicinity, and the longer the danger is allowed to continue the greater are the probabilities for infection.

A good illustration of the truth of this is shown by the outbreak on Catawba Island, which originated in a pear orchard, set out in the spring of 1889, and separated from the highway by a hedge fence as shown in Plate I. During eight years the pest had spread to the hedge and followed it for a considerable distance, in either direction, and crossed the highway into an adjacent orchard, besides extending back from the hedge for a considerable distance and affecting from fifteen to twenty thousand fruit trees belonging in all to eleven orchards and scattered over an area of upwards of one hundred acres. Plate II shows the condition of the premises after the worst infested trees and the hedge had been destroyed. While this is the most serious outbreak, on account of its close proximity to other orchards, there are several others in Ohio where the disaster has been just as severe and the premises have been left equally barren by the means for extermination made necessary. But for these premises being isolated the destruction would have been equally as great. Yet in all these cases the trouble has originated from the introduction of a very few apparently insignificant and well nigh microscopic insects.

#### NECESSITY FOR DRASTIC MEASURES.

It is usually the case that, as we become more familiar with a species, some vulnerable point will be found or a certain stage during which it can be managed with greater ease than at other times. It must be confessed that in the case of the San José scale, the better we come to be acquainted with it the more we see to fear of its ravages and of the great labor involved in its eradication. No one who has not seen the work of this pest where it has had full sway can understand its fearfully

destructive nature. And no one who has not searched for it, scattered about singly, over the twigs and branches of trees and shrubs can fully understand the difficulty with which it is observed, before it has gained such headway and is in full possession of the area over which it has become distributed. Even those whose eyes have been schooled by years of training, have need to be continually on the watch lest they overlook the tiny depredator or mistake it for some others vastly less dangerous, but very much like it in appearance.

How much more danger then is there to be feared from those who are wholly unacquainted with insects of almost every description, and who may not see their orchards, to scan them critically, from one year's end to another, and who would not detect it until the tree became thoroughly encrusted! For this reason, while the useless destruction of property is to be in every way deprecated, the welfare of the community will depend upon the prompt and effectual extermination of this pest as soon as discovered. When we consider that every portion of the surface of both trunk, branches and twigs, even to their very tips, must be reached and covered with the whale oil soap mixture, and that this must be done continually for several years, at least twice each year, fall and spring, before a reasonable degree of safety can be expected, it will be seen at a glance that unless the trees are valuable ones and the injury already done not sufficiently severe to permanently affect the tree, it will be far cheaper to destroy it than to incur the expense of treatment and the continual worry through fear that an occasional one has escaped destruction. If then, the variety of fruit attacked is not satisfactory, or if the trees are old and have passed their best, or if the inner bark has become pretty thoroughly discolored, it would be far better to end the matter at once and save expense and trouble by burning the trees. And even in the case of treatment it would be better to cut back the top as severely as possible and burn it immediately. The old saying that the only good Indian is the dead Indian, will apply equally well in this case, as the only scale to be trusted is the dead scale.

#### DIFFICULTY IN DETECTING THE SCALE.

The carrying out of the state law, published in full in Bulletin 72, of this Station, has necessitated the appointment as Township Fruit Commissioners, persons who are unfamiliar with insects in general and the San José scale in particular. It is to be expected that even the best of these will make mistakes, and unless great caution is exercised they are likely to cause destruction of trees unnecessarily. It is extremely difficult to describe this scale in print, or even verbally, with sufficient distinctness to prevent such mistakes. Fig 3*a* will illustrate a twig infested with the scale natural size, while at *b* is shown a section as it will appear under a hand lens, and showing the scale in its various stages of develop-

ment from the very young, of a yellowish color, and whose legs are easily detected, to the adult covered by the scale itself. See also Fig. 1.

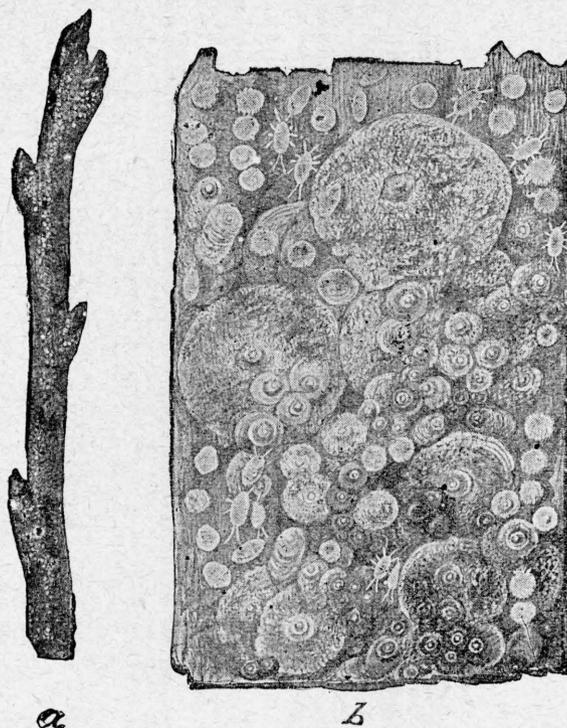


FIG. 3. Appearance of San José Scale on bark; *a*, infested twig, natural size; *b*, bark as it appears under hand lens, showing scales in various stages of development and young larvae. After Howard and Marlatt. From Bull. 3, U. S. Dept. Agr. Div. Ent. N. S. p. 36.

If this prints as clearly as it should, it will enable any one provided with an ordinary hand lens to determine the pest with a reasonable degree of accuracy, but in case there should be any doubt, and invariably before any trees have been destroyed, specimens should be referred to the Experiment Station for examination. We will at all times give fruit commissioners all the assistance in our power, that will enable them to identify the insect. Much time and trouble may be saved by comparing the scales found on trees with Figs. 1 and 3 or with Fig. 4*d*, the last of which gives a very good illustration of the appearance of the upper surface of the scale. It will be noticed that it has a minute tip or nipple arising from a depressed surface. On the tree this has the appearance of a little point with a ring around it. If this be searched for, it will prevent confusing the San José scale with several other, very common scales, found more or less abundantly in orchards. Some of these scale insects that are so common in orchards, in Ohio, are shown in Figs. 5, 6, 7, 8, 9 and 10.

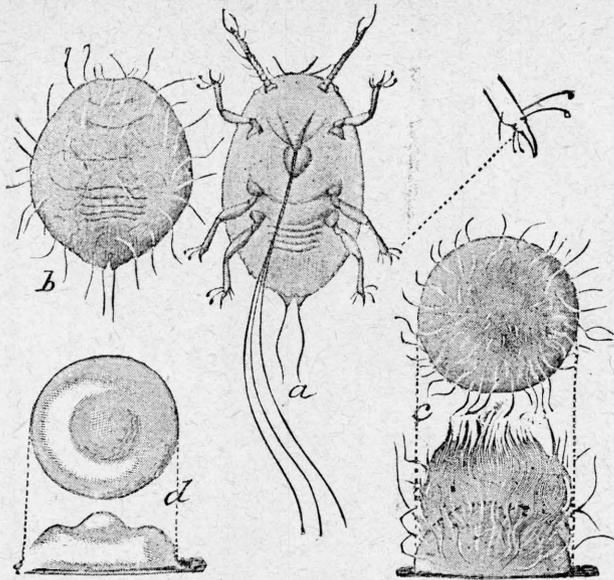


FIG. 4. Young larva and developing scale; *a*, view of larva from below, showing sucking mouth with setae separated, with enlarged tarsal claw at right, *b*, back view of same, somewhat contracted, with the first waxy filaments appearing; *c*, side and back view more contracted; *d*, later stage of same. Greatly enlarged. After Howard and Marlatt. From U. S. Dep. Agr. Bull. 3, N. S. Div. Ent. p. 35.

The species of scale most likely to confuse Fruit Commissioners is the Putnam scale, *Aspidiotus ancylus*, of which we are not able to present an illustration. It seldom becomes as abundant on trees as the San José scale, though sometimes this is the case, and I have found it to be as abundant on the Fay current as the former could possibly be and though it does not increase as rapidly, seldom if ever killing trees, it is fatal to the currant if present in great numbers. It is only when scattered about over trees in limited numbers that it becomes a confusing element, not only to the unentomological but not unfrequently to the expert as well. In the Putnam scale there are microscopic differences in the female whereby the species are readily distinguished, but these are beyond the reach of ordinary lenses and require a compound microscope. The fruit grower or Commissioner will be the most likely to detect the difference in the shape of the scale, though even in this there can be no hard and fast rules given for the separation of the two. The Putnam scale is slightly more rounded in appearance, and usually lacks the depression from out of which the little nipple-like elevation arises, as shown in Fig. 4 *d*, and the point itself is more often of a yellowish hue and the whole scale usually of a lighter shade in color. As stated before, however, it will always be best, where there is any doubt as to the identity of the scale, to send specimens for determination to professional entomologists before trees are condemned for destruction.

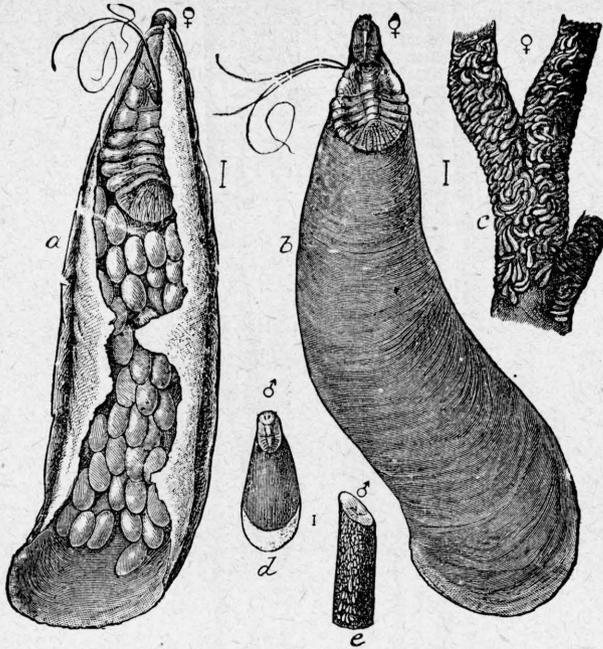


FIG. 5. The Oyster-shell Bark-louse, *Mytilaspis pomorum*; *a*, female scale as it will appear if removed from bark, showing under side; *b*, showing the same as seen from above—both much enlarged; *c*, the female scale, and *d*, male scale, also enlarged; *e*, the male scales on twig.

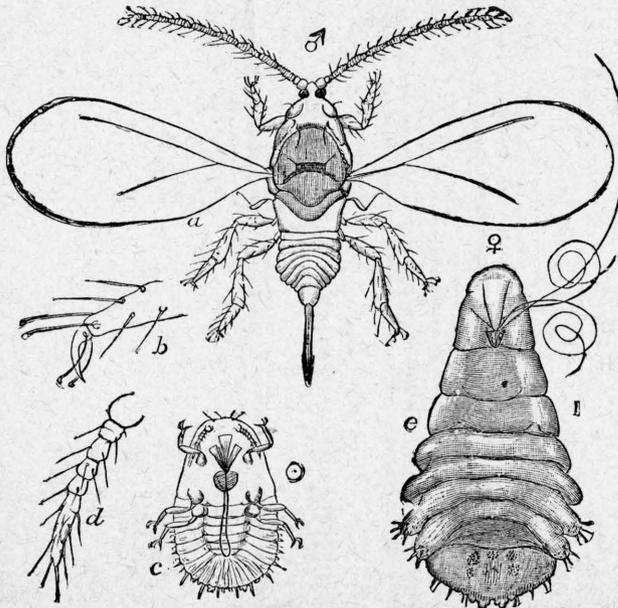


FIG. 6. Oyster-shell Bark-louse; *a*, adult male; *b*, the foot; *c*, young; *d*, antennæ of same; *e*, the adult female taken from under scale, as shown in upper right hand figure in Fig. 5. All greatly enlarged. After Howard. From U. S. Dep. Agr., Year Book for 1894, pp. 258 and 259.

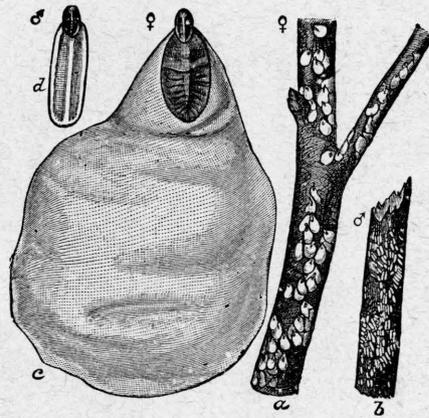


FIG. 7. The Scurfy Bark-louse, *Chionaspis furfurus*; a, c, females; b, d, males — a and b, natural size, c, and d, enlarged.

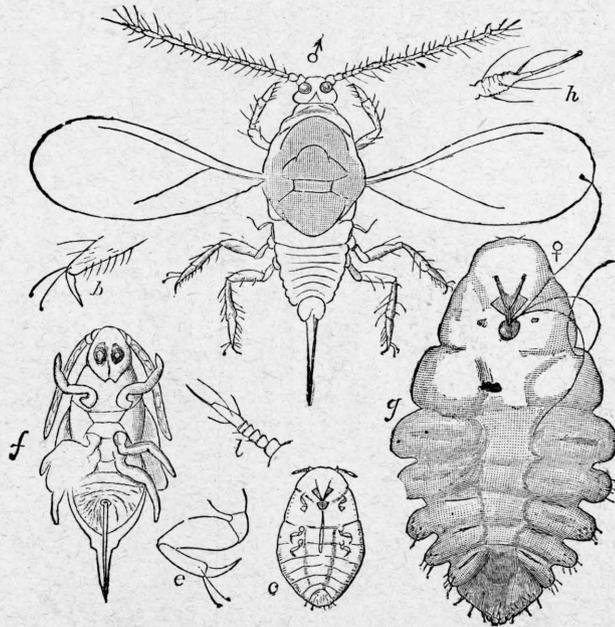


FIG. 8. Scurfy Bark-louse. Adult male above greatly enlarged; g, female removed from under scale, as shown in Fig. 7, at right; other figures show young and various parts of the insect. After Howard. From U. S. Dep. Agr., Year Book for 1894, pp. 259 and 260.

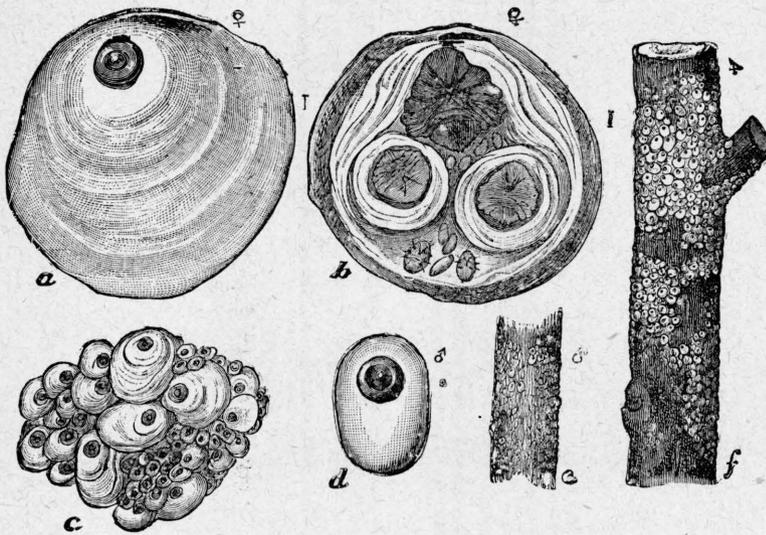


FIG. 9. The Greedy Scale, *Aspidiotus camelliae*; *a*, female scale from above; *b*, same from below; *c*, mass of scales as appearing on bark; *d*, male scale; *e*, male scales on twig; *f*, female scales on twig. *e* and *f*, natural size; *c*, considerably enlarged; *a*, *b*, *d*, greatly enlarged. After Howard. From U. S. Agl. Dep., Year Book for 1894, p. 261.

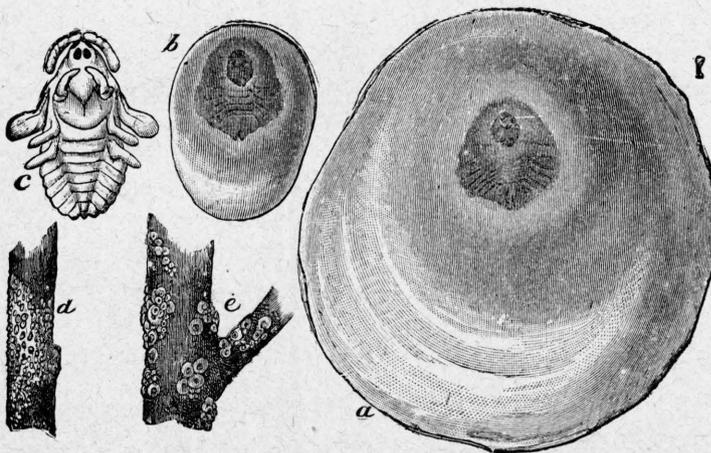


FIG. 10. The English Walnut Scale, *Aspidiotus juglans-regiae*; *a*, female scale; *b*, male scale; *c*, male chrysalis; *d*, male scales on twig; *e*, female scales on twig — *a*, *b*, *c*, enlarged; *d*, *e*, natural size. After Howard. From U. S. Dept. Agr., Year Book for 1894, p. 263.

## TREES ATTACKED.

Besides the ornamental trees and shrubs, a list of which has been given, nearly all kinds of fruit trees are attacked. The quince, in our observation, has not suffered as badly as other fruits, while the Early Richmond cherry seems to be proof against the scale.

I have seen a case where the limbs of one of these cherry trees interlocked with those of a pear tree that had been killed by the scale, yet the cherry was free. In another case, an Early Richmond tree had been grafted onto Mahaleb stock, and a shoot of the original stock had been thrown out from below the graft. This shoot was thickly populated with scale, while the tree itself was entirely free.

I have never yet found it attacking Mulberry, even though trees were standing in the midst of dying trees, killed by this scale.

## LIFE HISTORY AND HABITS.

To what has been given in Bulletin 56, of this station, there is comparatively little of practical value to add. The young may be observed crawling about with the first settled warm weather of spring.

I have found them in this condition crawling about over sections of infested trees that had been cut in December, and kept for a couple of days in a warm room. On account of the extremely warm weather of April, 1896, the pest began breeding very early, and seems to have continued uninterrupted until fall. As a consequence, trees but slightly infested in the spring, were thoroughly coated with scale by the time the leaves dropped in the fall, probably in November. There is little doubt but there are four or five generations each year, and during that time a single female may be the progenitor of 1,608,040,200 individuals.

These figures are those given by Howard and Marlatt, in Bulletin No. 3, U. S. Dept. Agr. Div. Entomology, and I see no reason for doubting their accuracy.