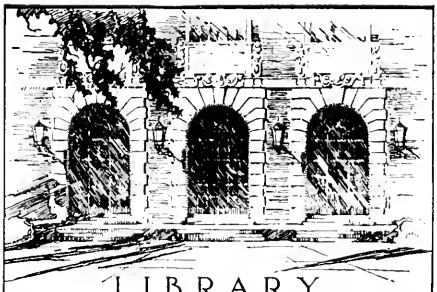

LIBRARY
OF THE
UNIVERSITY
OF ILLINOIS

630.7
I16b
no.49-60

AGRICULTURE

NOTICE: **Return or renew all Library Materials! The *Minimum* Fee for each Lost Book is $50.00.**

The person charging this material is responsible for its return to the library from which it was withdrawn on or before the **Latest Date** stamped below.

Theft, mutilation, and underlining of books are reasons for disciplinary action and may result in dismissal from the University.
To renew call Telephone Center, 333-8400

UNIVERSITY OF ILLINOIS LIBRARY AT URBANA-CHAMPAIGN

SEP 24 1999

L161—O-1096

UNIVERSITY OF ILLINOIS

Agricultural Experiment Station.

URBANA, MARCH, 1899.

BULLETIN No. 54.

SPRAYING APPLE TREES, WITH SPECIAL REFERENCE TO APPLE SCAB FUNGUS.

About eight months ago the Horticultural Department of the Illinois Experiment Station issued a bulletin on orchard cultivation, which closed with these words: "....while other things have greater or less effect upon an orchard's health and condition, the prime requisite to successful orcharding in Illinois is thorough and systematic cultivation." But while cultivation is the prime requisite, it is, after all, but *one* requisite, albeit the chief; for besides the struggle for the conservation of moisture in his orchard during drought, the orchardist has always with him the struggle against the insects and fungous diseases which prey upon his trees and fruit. The object of the present bulletin, then, is to assist the Illinois fruit grower in his fight against these active enemies of the orchard, and to point out to him, if possible, the best and most effective means of warfare.

The two enemies most menacing to the apple growing industry of Illinois are the apple scab fungus and the codling-moth. They, in turn, find their most deadly foes in Bordeaux mixture and Paris green. A little investigation will readily determine whether or not it is worth while for the Illinois apple grower to invest in spraying machinery and begin the work of exterminating, or at least checking, these nuisances.

According to the best authorities on the subject, Illinois has a larger apple acreage than any other state in the union. According to the Census report for 1890 there were at that time 3,016 acres of one, two, and three year old nursery apple trees in the state, or 1,000 acres more than New York, and 216 acres more than Ohio, the second largest, which means that these trees are today ten, eleven, and twelve years old, unless destroyed. About ninety per cent. of the trees on the above 3,016 acres were sold for planting in this state. Statistics show, too, that the number of acres planted to apple trees has yearly increased since that time, until today, according to the statistics compiled by the State Horticultural Society, there are more than 150,000 acres devoted to this fruit in southern Illinois alone. They say, to quote directly: "That for the counties of Richland, Clay, Jasper and Marion there is a total of 70,000 acres, with 50 trees to the acre, making a total of 3,500,000 trees. At ten years of age it is estimated that these trees will bear an average of ten bushels of apples to the tree, making a total for the four counties of 11,700,000 barrels, or 60,000 car loads. Think of this! 2,000 train loads of 30 cars each, and we have a faint idea of what the future for Illinois orchards will be." Granting that ten bushels per tree is too large an estimate, the fact still remains that there should be an annual production in these counties of at least 5,000,000 barrels. Or again, since every one of the 102 counties of the state has a very considerable apple acreage, we may safely reason from this as well as the above and other estimates, that the annual production of the state should be at least double the above figures, or 10,000,000 barrels of apples. But the fact that during the year just past there were very much less than 1,000,000 barrels of apples of first and second quality that matured, should cause each and every land owner of this state to reflect seriously on the causes of this shortage.

The fact is that most apple growers have not given sufficient attention to the several principles underlying orcharding, and especially that relating to spraying. It is also a fact that although Illinois was one of the pioneers in the matter of combating the codling-moth and other apple insects, today only a small percentage (perhaps less than ten) of our apple producers take any precaution whatever to check the ravages of this insect. Not only this, but not seven per cent. of the apple producers in the great apple region of Illinois sprayed their trees during the past year for their protection against the apple scab fungus. According to the observations carried on at this Station and in a number of private orchards in the state, this disease is responsible for the loss of at least $6,000,000, or sixty per cent. of the total loss above referred to, to the apple growers of Illinois during the past season. This estimate is based upon the supposition that apples were worth one dollar a barrel.

At the outset, then, let us ask if this disease is really responsible for this enormous failure; and if so, could the loss have been averted? The opinion held by many throughout the state in regard to the cause of the failure of apple orchards during the season of 1898 is that there was imperfect, or, in many cases, entire lack of pollination, due to the cold, wet weather during the time of blooming. That this was not true can be proved by calling attention to the fact that most apple orchards did set a considerable quantity of fruit, which, however, dropped prematurely in from one to four weeks after fertilization; or, again, by noticing the fact that one or more orchards did bear fruit and that of a superior quality in places where hundreds in the same localities failed to produce any. In each such instance that has come under our notice, the productive orchards were the only sprayed ones. According to our observations at the State Experiment Station and elsewhere, the true cause of the premature dropping of apples during the season of 1898, throughout the greater portion of Illinois at least, was an attack of apple scab fungus on the young apple and along its stem, thus cutting off the food supply from the fruit. If there had been no fertilization there would have been no development of the ovary whatever. If there had been imperfect pollination, the fruit would have been one-sided or deformed, as a result of the failure of one or more carpels to obtain pollen. Each apple has five cells called carpels, each usually containing two seeds. These pairs are fertilized by pollen which falls on the stigma attached to that carpel. If it chance that no pollen falls on a certain stigma, the seeds in that carpel will not develop and the apple will be one-sided. But a careful examination failed to bring to light fruit of this latter character, and in no instance did an examination of the fallen fruit show non-presence of the apple scab on the stem and fruit. But, again, if lack of fertilization was the cause of failure, why should one or more orchards out of a hundred or more in any particular locality escape the fate of the majority? Surely not because fertilization had taken place in but one orchard, but because that orchard had been systematically sprayed for several seasons, and had received judicious and careful cultivation, which enabled the tree to secure the necessary moisture for the production of strong fruit buds.

It is undoubtedly true that no one cause is responsible for the recurring failure of apple crops in this state, but it is a fact that the greatest loss is sustained as a result of the two above named enemies—the apple scab fungus and the codling-moth. The object of this bulletin is to arouse a greater interest in this subject among the mass of our Illinois apple producers. It has been said, and doubtless rightly, that the fruit grower who has not a belief in spraying and the results obtained thereby, has only himself to thank for lack of success. The many experiment station bulletins, horticultural society reports and

Fig. 1, p. 191.

Fig. 2, p. 191.

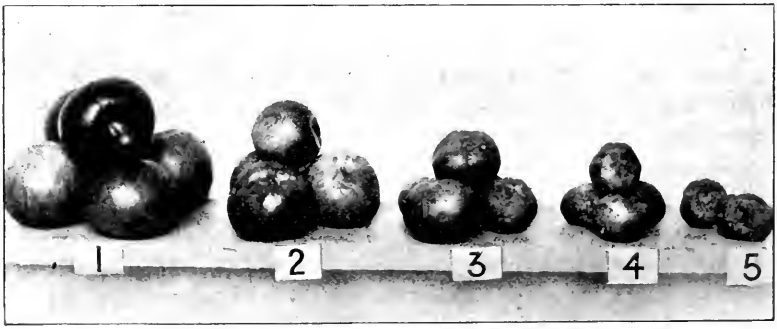

Fig. 3, p. 191.

periodicals, have contributed a fund of information bearing on this subject, and it is certainly to be regretted that so few growers have profited thereby. Those who have failed to get the principles of spraying well in hand during the development of the subject, often do not have these within their reach when the fact of its advantages has been finally made known to them. Indeed, there is at the present time a very great demand for elementary information in regard to this subject. During the past three months the Horticultural Department of this Station has received more than two hundred inquiries for light regarding spraying solutions and spraying machinery. It is because of the evident demand for this latter class of information that the section on spraying machinery has been inserted.

Specific Directions.

The following summary of points to be remembered in spraying apple trees for scab and codling-moth are the best that can be given from the many series of experiments carried on at this Station and elsewhere.

The early spraying with copper sulphate on the dormant wood is not always advisable, since the application must often be made when the ground is so soft as to make the injury done by trampling greater than any benefit received from the spray.

The first application of the combined solutions of Bordeaux mixture and Paris green made just before the flower buds open is, with respect to the apple scab fungus, the most important spray of the season.

The second application of Bordeaux mixture and Paris green, made immediately after the blossoms fall is, with respect to the codling-moth, the most important; yet is of great value, too, for the apple scab fungus. In regard to this point Professor Slingerland, on page 59, bulletin 142 of the Cornell University Experiment Station, says: "The important thing for the fruit grower to do is to watch the blossoming of his trees and the developing of the young fruit, and not depend on anything or anybody else. Simply see to it that there is a good dose of poison put into each blossom end, and that it is not washed out by rains before nature gets it protected with the closed calyx lobes." The sooner this second application can be made after the blossoms fall the greater will be the percentage of larvæ of codling-moth killed. From 50 to 90 per cent. of fruit that would otherwise be ruined by this insect can be saved by spraying, and at little expense.

A third application of Bordeaux mixture and Paris green should be made in eight or ten days after the blossoms have fallen, and in many instances another after a period of two weeks.

Fig. 4, p. 191.

Fig. 5, p. 195.

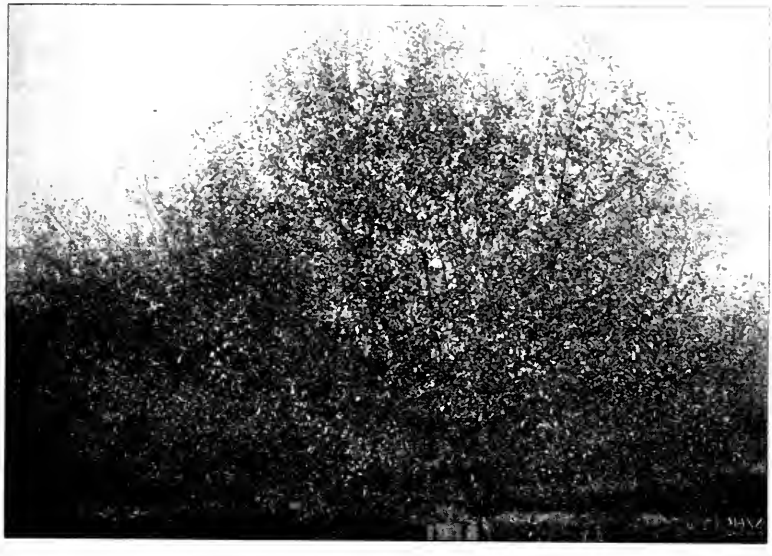

Fig. 6, p. 195.

Fig. 7, p. 195

Some Spraying Experiments.

The Illinois Experiment Station has, since its inception in 1888, annually carried on experiments with insecticides and fungicides and their use for controlling fruit enemies. While many valuable results have been obtained from time to time as a consequence of these systematic and thorough investigations, they were in most instances merely duplications of work carried on and published by other stations. Moreover, these were conducted upon plants which were grown for some purpose other than the direct test with spraying solutions, and lacked the material for illustration which could only be secured by operations carried on in commercial orchards. Accordingly, in the spring of 1898, these were supplemented by a thorough set of experiments carried on for the most part in several acres kindly offered for the purpose by Mr. H. M. Dunlap of Savoy. These experiments were inaugurated for the sole purpose of furnishing accurate illustrations of what could be accomplished in Illinois by thorough and systematic spraying, and by varying degrees of thoroughness. They had for their object a consideration of the best methods for controlling apple scab fungus, codling-moth and scurfy bark louse. The latter will not be considered in the present discussion. For the sake of brevity the details of this work will be omitted, giving only the results obtained, which are well illustrated in the accompanying plates.

Applications Made.

It should be borne in mind that both the apple scab fungus and the codling-moth were in no instance treated separately. That is to say, when Paris green was applied for the sake of experimentation in controlling the codling-moth, it was done only in connection with the Bordeaux mixture, thereby furnishing a like experiment for the scab. This was because of the fact that it is no longer deemed advisable to make separate applications for these two pests, since one is entirely sufficient and the time and labor saved by combining the two is great.

Trees were first treated with the copper sulphate solution March 31st, and the last application of this was made April 8th. This solution was applied in varying strengths to different trees, using in some cases one pound to fifteen gallons of water, while in others one pound to ten gallons of water and one pound to five gallons of water was tried. A careful examination by Mr. Clinton, Assistant Botanist of this Station, made May 6th, revealed the fact that trees so treated had a much smaller percentage of scab than than those not treated. At this date too he found that the trees treated with the strongest solution of copper sulphate had very little or no scab on the young leaves, while in the case of the one-to-ten solution they were not so free, and on those treated with the one-to-fifteen solution there was considerable scab present. These stronger

Fig. 8, p. 195.

Fig. 9, p. 195.

Fig. 10, p. 195

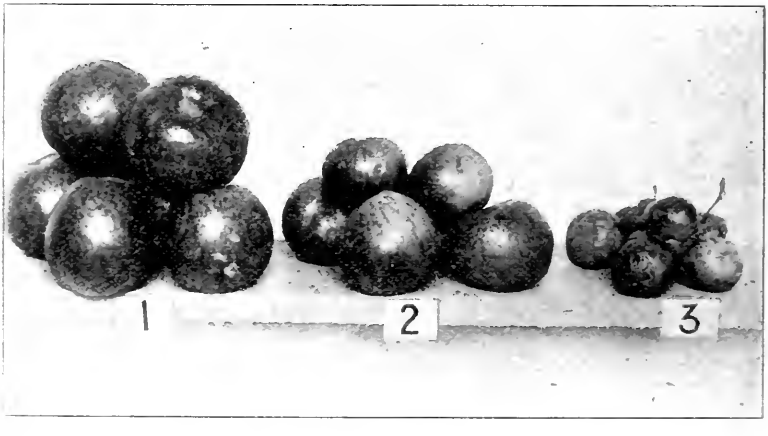

Fig. 11, p. 195.

solutions of copper sulphate were in no way detrimental to the trees; but in all three cases the effect was soon lost and the three had a similar appearance when the applications were not followed by the Bordeaux mixture.

A lime wash was also applied to several trees at the same time, and in each case consisted of a solution of 2 lb. quicklime to 1 gal. water, or 2 lb. quicklime to 1 and ½ gallons of water. Checks were left in each case, and an examination on May 8th showed the treated trees to be practically free from apple scab: yet on May 31st, where these first applications were not followed by Bordeaux mixture the trees presented practically the same appearance as the untreated ones, as regarded the prevalency of the scab.

The second set of applications, made May 5th and 6th, consisted of Bordeaux mixture and Paris green, in the proportion given in the formula on page 203, the solutions being combined and both applied at once. These were sprayed on trees on which the former application had been made and on trees not before treated, leaving checks in each case. A photograph of trees so treated, that is, with but one application of Bordeaux mixture before blossoms opened, is given in figure 5.

The third application, consisting of the combined mixtures as in the second application, was made May 10th and 11th, after blossoms had fallen, and in each case applying it to trees before treated and to previously untreated trees. Another application of this kind was made May 25th.

The accompanying illustrations, which are actual photographs taken of these trees and fruit, show better than any written proof the value of the application of fungicides for the control of the apple scab, if not so clearly for the other nuisance above referred to.

Description of Cuts.

Figure 1, p. 184, shows two rows of apple trees treated with the second and third applications above referred to.

Figure 2, page 184, is a good illustration of trees unsprayed in the adjoining rows to Figure 1. Both photographs were taken September 19th.

Figure 3, p. 184, shows average specimens collected by Mr. Clinton June 14th. Mr. Clinton had no knowledge of what the numbers referred to until after the collections were made. No. 1 shows apples from trees treated with copper sulphate April 1st, Bordeaux mixture and Paris green May 3d, 10th and 24th. No. 2, Bordeaux and Paris green May 3d and 10th. No. 3, Bordeaux and Paris green May 10th. No. 4, copper sulphate April 1st. No. 5, unsprayed. These are actual representatives of the best fruit secured by one entirely unbiased in the matter.

Figure 4, p. 186, shows trees unsprayed. Photograph taken September 19th.

Fig. 12, p 196.

Fig 13, p. 200.

Fig 14, p. 200.

Fig. 15, p. 200.

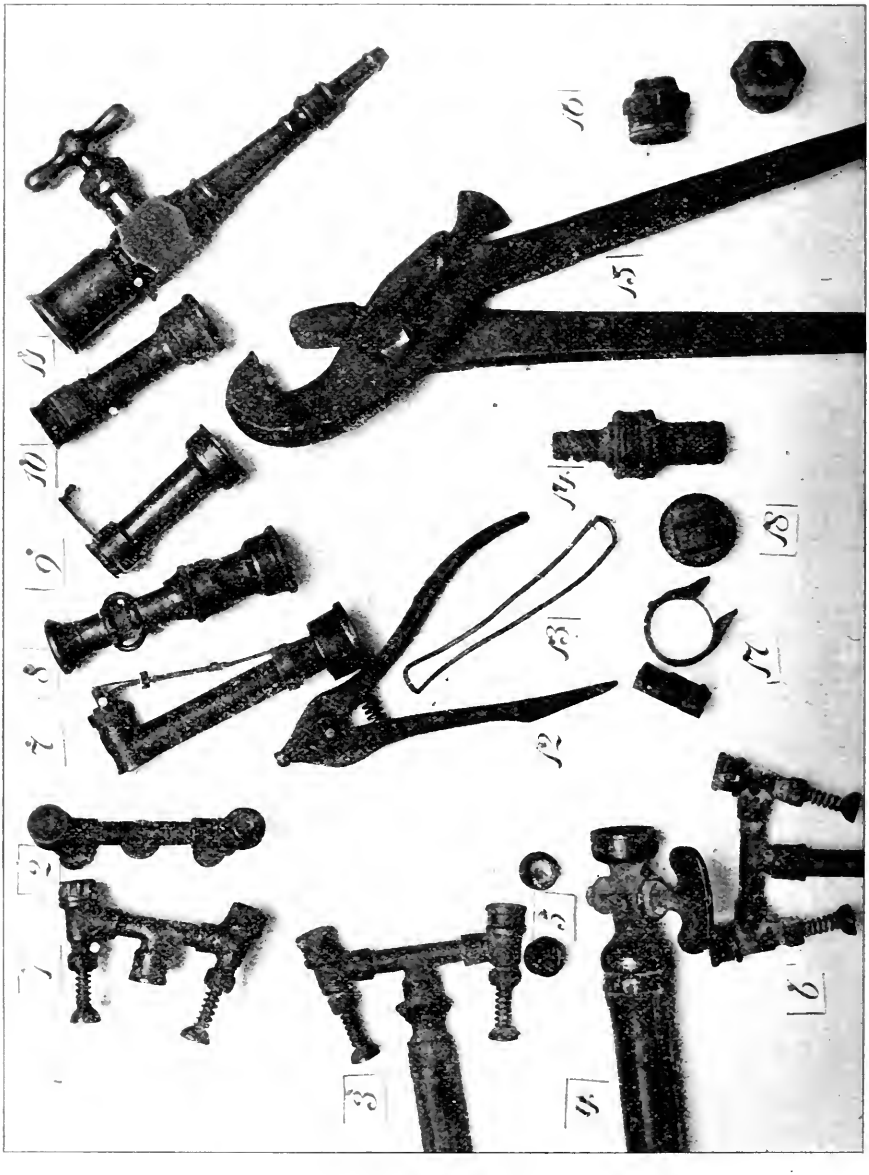

Fig. 16, p. 200.

Figure 5, p. 186, shows three trees treated with one application of Bordeaux mixture and Paris green May 6th, before flower buds had expanded. Photograph taken September 19th.

Figure 6, p. 187, shows two trees treated with copper sulphate April 1st, two applications of Bordeaux mixture and Paris green May 3d and 10th, before and after blooming. Photograph taken September 19th.

Figure 7, p. 187, one tree in foreground treated with one application of copper sulphate April 1st. Photograph taken September 19th.

Figure 8, page 189, tree treated with one application of Bordeaux mixture May 10th, after the blossoms had fallen. Photograph taken September 19th.

Figure 9, page 189, shows Grimes golden trees treated with one application of copper sulphate and two of Bordeaux mixture. Photograph taken October 1st.

Figure 10, page 190, photograph of men spraying Ben Davis trees for apple scab fungus during the latter part of June. Shows the difficulties which are often met with. It is an illustration too which serves to force upon our minds the fact that the spraying and pruning of apple trees are two very closely related subjects. If the trees are not reasonably open so as to admit a free circulation of light and air the tree top will furnish an excellent breeding place for fungous diseases, and when once started the latter are impossible to get at with spraying solutions. It is almost impossible to spray such trees to advantage, and the amount of material necessary in such cases, together with time and expense, makes the matter of pruning a necessity.

Figure 11, page 190, shows specimens of the best apples from trees treated as follows: No. 1, sprayed with copper sulphate and three applications of Bordeaux mixture; No. 2, two applications of Bordeaux mixture—before and after blossoms appeared; No. 3, unsprayed.

Spraying Machinery.

We are constantly asked to give information regarding the best spray pumps and other appliances necessary for spraying; and for this reason the Station has been making a thorough test of machines sold by a few of the leading manufacturers. In looking over the machinery so far experimented with we have learned that the purchaser should bear in mind that the money invested in a pump is practically lost should the machine last no longer than one season. He wants a machine that is durable; one that will give the greatest force with the least power; and one that will be within reach of his purse. The cheap iron pumps are rarely long-lived, and are usually wholly unfit for spraying purposes. They will not stand the work, are too easily broken, or are destroyed by the action of copper sulphate. The desirable points in a pump may be summed up as follows:

All working parts should be made of brass. There should be no leather or rubber valves. There should be no stuffing-box, nor should the parts be fastened together with iron bolts or screws. In fact, the brass or alloy pumps are in the end the cheapest, since they are in every way more durable, and are not corroded by the liquids used or by simple exposure. A pump that stands above the barrel or that has any projection whatever is unsteady, especially when there is little solution in the barrel; and moreover it is likely to catch on the limbs and be a nuisance generally.

Figure 17, p. 197, shows the Eclipse pump manufactured by Morrill & Morley, of Benton Harbor, Mich. It is, according to our experience here, an ideal pump in all respects. All parts that come in contact with the liquid are brass, and there is no stuffing-box. The agitator, too, as seen in the cut, consists of a brass blade, and is a satisfactory means of agitating the liquid. List price, $10 to $18.

The Pomona pump (fig. 18, p. 197), made by the Goulds Mfg. Company, of Seneca Falls, N. Y. (Chicago Office, 22–24 N. Canal St.) is in most respects similar to the Eclipse, with the exceptions which can be seen by comparing the cuts. This is a pump which we can highly recommend, and which is listed at from $10 to $20. Figure 23 shows a good mechanical agitator which is on the market by the above named company and also by Wm. Stahl of Quincy, Ill. Mr. Stahl also has the "Excelsior spray outfit No. 22," which is similar to the Pomona, and is also recommended.

The Advance Spray pump (fig. 27, p. 199), manufactured by the Deming Company of Salem, Ohio, and for sale in Illinois by their Agents, Messrs. Henion & Hubbell, 61 N. Jefferson St., Chicago, is in every way an admirable machine, and is well spoken of by those experiment stations that have made a thorough test of it. The list price of this machine is $18.

The Kerowater pump (fig. 19, p. 198), for the mechanical mixture of water and kerosene oil, is one of the leading machines of its kind on the market, and is made by the Goulds Mfg. Co., already referred to as the makers of the Pomona pump. List price, $14 to $18.50. The Peerless kerosene sprayer (fig. 26, p. 199), made by the Deming Company, for the same purpose, is also an excellent machine. Its list price is $26 to $35.

Figure 12, p. 192, shows a handy arrangement for spraying purposes, and one that can be fixed up by almost any one. It consists of three barrels of a capacity of fifty gallons each, connected by hose and galvanized iron pipes fitted with stop cocks. These stop cocks enable the barrels to be separated at will, thus carrying three different solutions at one time, or allows the mixtures to drain from one barrel to another.

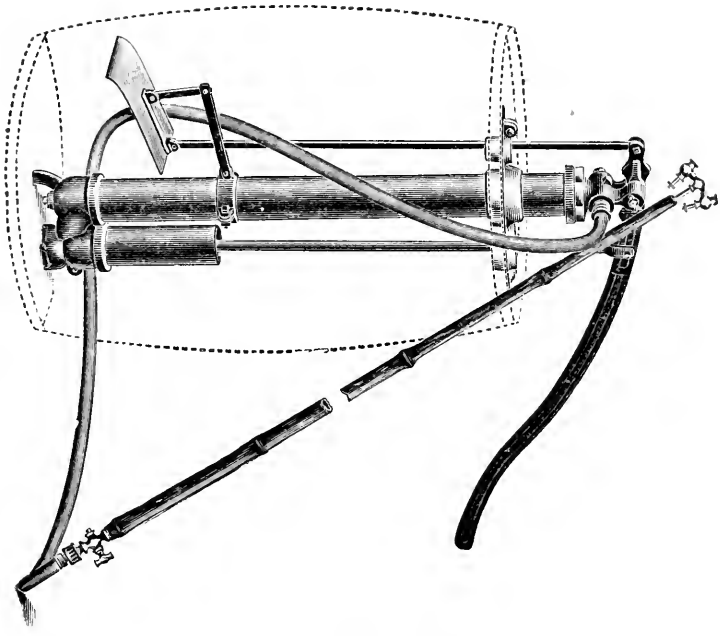

Fig. 17, p. 196.

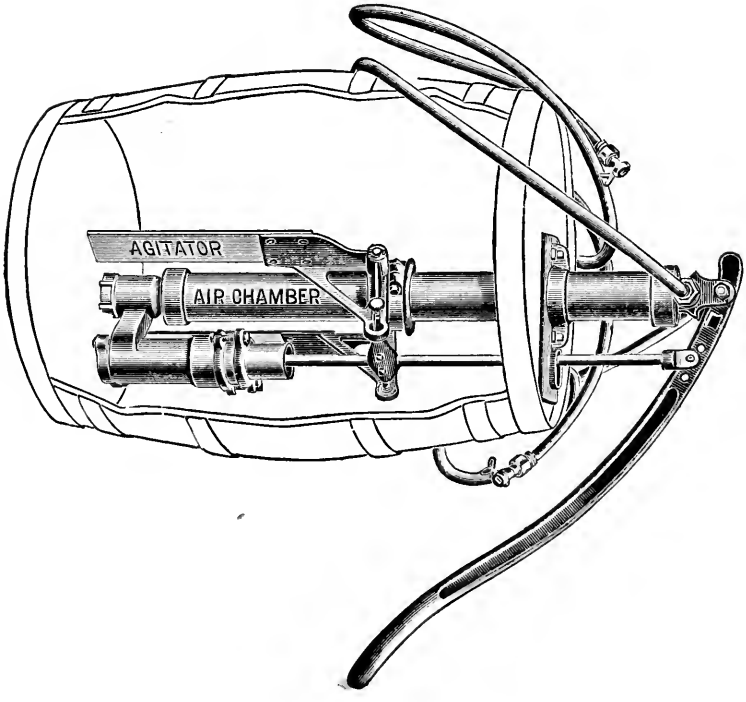

Fig. 18, p. 196.

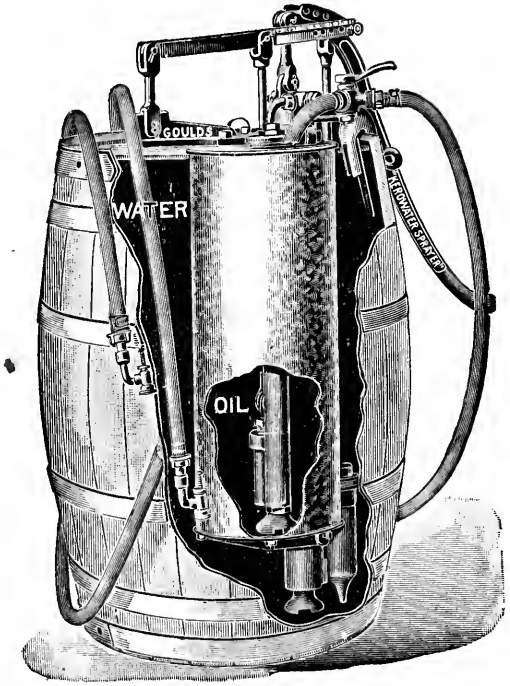

Fig. 19, pp. 196 and 202.

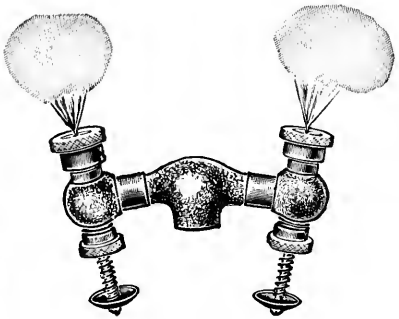

Fig. 20, p. 200.

Fig. 21, p. 200.

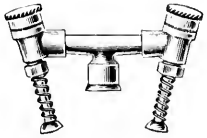

Fig. 22, p. 200.

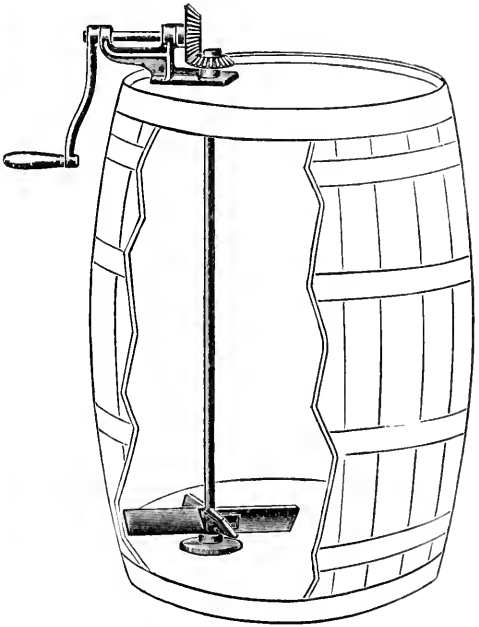

Fig. 23, p. 200.

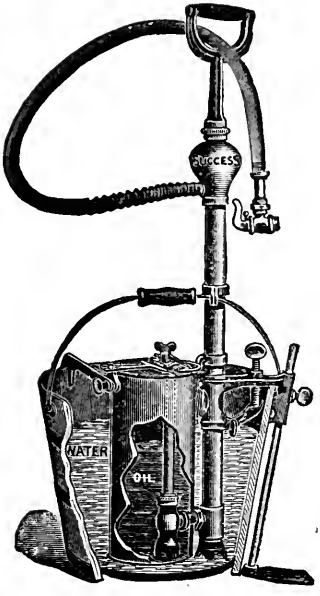

Fig. 24, p. 201.

Fig. 25, p. 201.

Fig. 26, p. 196.

Fig. 27, p. 196.

All can be drained dry, especially if the front wheels of the wagon are allowed to stand for a few minutes in a slight depression of the ground. The pump used here is the Eclipse seen at fig. 17, p. 197. The truck is the Farmer's Handy Wagon, manufactured by the Farmer's Handy Wagon Co., of Saginaw, E. S., Michigan. The low wheels of this wagon together with the one agitator give sufficient motion to the wagon to keep the solutions agitated. Otherwise the second and third barrels should each be fitted with an agitator as seen in fig. 23, p. 198.

Fig. 13. p. 192, shows the three barrels and their couplings, together with hose and bamboo extensions at nearer range. Fig. 14, p. 193, is the Eclipse pump mounted on an Eclipse special tank manufactured by Morrill & Morley, Benton Harbor, Mich. This tank is sufficient to hold 250 gallons, and as seen in the figure is mounted on a Farmer's Handy Wagon. This is the machine used by Mr. H. M. Dunlap, of Savoy.

Fig. 15, p. 193, shows the apparatus and one barrel seen in figures 12 and 13 mounted on a cart made from two wheels from an old seed drill provided with axle platform and shafts. This can be made by any fruit grower for himself, and is a very serviceable outfit, not only for orchards but for other fruits as well.

Fig. 16, p. 194, shows the following nozzles and other appliances:

No. 1. Double Vermorel nozzle (showing side).
No. 2. " " " (" end).
No. 3. " " " on bamboo extension.
No. 4. Shut-off on bamboo.
No. 5. Inner and outer views of reducing caps for Vermorels.
No. 6. Vermorel nozzle attached to brass extension rod.

These Vermorels, all things considered, are the best of all nozzles. They throw a double, round, misty spray, and are provided with lances for cleaning should they become clogged. This cleaning is done by tapping the lance on a limb. They should always be mounted on a bamboo extension pole, since the spray does not reach any great distance. Figs. 20 and 22, p. 198, show two styles of the double Vermorel nozzle. Fig. 21, p. 198, shows a single Vermorel nozzle.

No. 7 shows a McGowen nozzle, which is one of the very best nozzles manufactured, and is made by John G. McGowen, of Ithaca, N. Y. It is provided with a piston which is easily regulated by spring, and is in no danger of becoming clogged as will sometimes happen with the Vermorel. It has also a greater carrying power than the Vermorel.

No. 8. A Gem nozzle, not so good as the former.

Nos. 9 and 10 show the Calla nozzle, which has a great carrying power, and is also quite reliable, but is not considered so good as either the Vermorel or McGowen.

No. 11, is the Fuller nozzle, which has a greater carrying power than any other make, but is too wasteful of material to be recommended.

No. 12, shows the pliers used for putting in place the brass hose coupling No. 13.

No. 14. Iron couplers to which the hose is attached when a coupling is desired.

No. 15. A pair of pipe tongs, which are very serviceable for tightening hose couplings, especially where the union is made to the pump.

No. 16. Two reducers, used for attaching either ⅜ or ¼ in. nozzle to hose or rod.

No. 17. Two views of a very handy and easily adjusted hose clamp.

No. 18. Plug used when one attachment only of hose to pump is desired.

Fig. 24, p. 199, shows the Success kerosene sprayer, manufactured by the Deming Company, Salem, O., and is a very serviceable pump for kerosene and water when treating small trees infested with scale insects. Price $10.00.

Fig. 25, p. 199, shows the copper strainer, 12 in. in diameter with brass wire cloth mesh, manufactured by Morrill & Morley, Benton Harbor, Mich. Price, $1.50. This is one of the indispensable pieces of apparatus used in connection with spraying. Burlap or other cloth strainers should not be depended upon for straining Bordeaux mixture, since lint is almost sure to get into the solution and clog the nozzle.

The bamboo extensions, such as are seen in Fig. 13, p. 192, are for the purpose of carrying the nozzle up into the tops of the trees, thereby ensuring a more thorough job than could be otherwise done. These are lined with copper tubing, which makes them durable, and are in every way a satisfactory and quite indispensable acquisition to spraying apparatus.

In regard to hose. We find that the ⅜ in. rubber tubing is in every way the most satisfactory hose to use, on account of its lightness and durability. It can be procured for six cents a foot from most dealers. The ¼ in. hose as seen in Fig. 13, p. 192, is too heavy for ordinary use, but is the most durable, especially when wrapped with wire as seen in the cut. Another objection to this hose is the fact that that found on the market for less than 12 to 20 cents per foot is too short-lived to be recommended. The cheaper grades of hose should never be purchased for spraying purposes, as they will prove the more expensive in the long run.

Spraying Solutions.

A.

For controlling insects which chew their food, such as the codling-moth, canker-worm, bud-moth, case-bearer and tent caterpillar, use the following:

1.—Paris green, 1 lb.; 150–250 gallons of water.

Never put the dry Paris green powder into a quantity of water expecting thoroughly to mix it therein. Put say one pound into a gallon jug, then fill the same two-thirds full of water. Cork and churn violently for a few moments, when every part of the powder will be in contact with water. Add this concentrated solution in such proportion as to give the desired amount to the larger quantity of liquid, with which it will readily and thoroughly mix.

2.—London purple, 1 lb.; 150–250 gallons of water.

Prepare same as above. We prefer Paris green, because it is less variable in composition than the London purple, and also less caustic in its action.

B.

For controlling such insects as the woolly aphis, plant louse, oyster-shell bark louse, scurfy bark louse, and San José scale, all of which are sucking insects, use the following:

1.—Kerosene emulsion.

This solution is made by dissolving ½ lb. of hard soap in one gallon of hot water, and to this adding two gallons of kerosene oil. Emulsify thoroughly by driving this solution repeatedly through a force pump or any spray pump back into the vessel originally containing it. Dilute each gallon of this emulsion with 15 to 30 gallons of water for the aphides and plant lice above referred to. For San José scale dilute each gallon with five gallons of water and apply on the dormant wood only. For oyster-shell bark louse and scurfy bark louse, in making application after leaves of tree have expanded, use the dilute solution, or when treating dormant trees, use the concentrated solution as in the case of the San José scale.

2.—Kerosene and water applied by means of the "Kerowater" pump (fig. 19, p. 198), or "Peerless Kerosene Sprayer" (fig. 26, p. 199).

For the scale insects above described use a 30 per cent. to 40 per cent. mixture when applying to dormant wood. After leaves have expanded use from a 5 per cent. to 10 per cent. mixture. A 50 per cent. mixture of kerosene and water may be applied with impunity to apple trees. Although there has been some difference of opinion in regard to the use of strong mixtures of kerosene and water on fruit trees, it is now a settled fact that pure kerosene alone may be sprayed and brushed on the limbs and trunks of apple trees during dry days without any injury whatever. We have repeatedly made such applications, not only to apple but also to pear trees. This mixture, however, should be used with caution, and preferably during weather when evaporation takes place rapidly. Especial care should be used in applying kerosene and water to peach trees, as, when used on them, many disastrous results have been reported.

3.—Whale oil soap, 2 lb. to one gallon water.

This solution is in high favor for the control of the San José and other scale insects.

C.

For controlling fungous diseases, such as apple scab, rot, rust and mildews, use the following:

1.—Copper sulphate, 1 lb. to 15 gallons of water. To be used on dormant wood only.

The object of this solution is to kill the spores of the apple scab fungus and of other diseases which may be present before the buds expand. Put the desired quantity of copper sulphate in a coarse bag and suspend it in the water near the surface. In a few hours the sulphate will be entirely dissolved. A more expeditious method, should a stock solution not be desired, is to dissolve the required quantity of sulphate in hot water.

2.—Bordeaux mixture. 6 lb. copper sulphate, 4 to 6 lb. quicklime, 50 gallons water.

Dissolve the copper sulphate in the manner described under 1: slack the desired quantity of lime in a sufficient quantity of water; then mix the two solutions, carefully strain through the wire sieve (fig. 25), and to this add water to make quantity given above. This is one of the best fungicides, and rarely will it be found to injure foliage. Should it do so, however, add a greater quantity of lime, which will lessen the the caustic effect of the copper sulphate. It is a solution, however, which stains fruit, and, consequently, later in the season the following mixture is in high favor.

3—Ammoniacal carbonate of copper solution. Copper carbonate, 1 oz.; enough ammonia to dissolve the copper carbonate; 9 gallons water.

Before making the solution, the ammonia should be prepared as follows: dilute the ammonia with 7 or 8 volumes of water, using ammonia of about 26 per cent. strength. Gradually add this to the copper carbonate until the latter is entirely dissolved.

D. Stock solutions.

Where a great deal of spraying is to be done it is often more convenient to keep stock solutions of copper sulphate and lime on hand for the more expeditious preparation of the spraying mixtures when wanted. They may be prepared in the following manner:

Lime:—Keep the lime in a barrel partially sunk in the ground, where it will keep indefinitely in the form of paste if the surface is kept covered with water.

Copper sulphate:—Dissolve the copper sulphate in water, two pounds of copper sulphate to one gallon of water. Two gallons of the

solution then will contain the required amount of copper sulphate for a barrel of Bordeaux mixture.

E. Cautions.

Be sure you know what you want to spray for before commencing the operation. Be prompt: be thorough: be persistent. Use fresh Bordeaux mixture, and not that which has been standing for some time after mixing. Keep the ammonia and copper carbonate mixture in glass-stoppered bottles, thoroughly corked, when not needed.

JOSEPH CULLEN BLAIR,
Assistant Horticulturist.

UNIVERSITY OF ILLINOIS-URBANA
Q.630.7IL6B C001
BULLETIN. URBANA
49-60 1898-00
3 0112 019528709