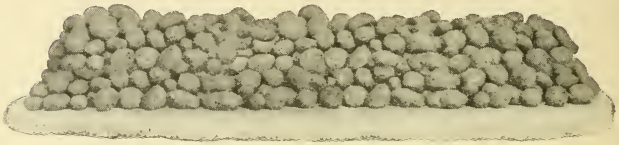
SPRAYING

FOR PROFIT

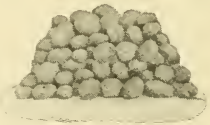
BY HOWARD EVARTS WEED

RESULTS

of Spraying Irish Potatoes at the Vermont Experiment Station



SPRAYED



UNSPRAYED

Total yield of sprayed potatoes per acre, 291 bushels
Total yield of unsprayed potatoes per acre, 99½ bushels
Profit of spraying, 191½ bushels per acre

Plate I

Spraying for Profit

A Practical Handbook

Describing Best Methods for Suppressing the More Common Injurious Insects and Fungous Diseases

"Sprayology" Simplified

By

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Revised and rewritten

1906
Horticultural Publishing Company
Rogers Park
Chicago

Booklets by the same Author

The Ornamentation of the City Lot

The Home Beautiful

The Landscape Architect and his Work

Park Cemeteries

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CHAPTER V

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FOREWORD TO REVISED EDITION

The methods of combating the ravages of injurious insects and fungous diseases have been so materially improved since the first edition of this little work in 1899, accompanied also by improvements to spraying machines themselves, that a revised and entirely rewritten work has become necessary. That the simplicity and "boiledowness" of the booklet has been appreciated by the thousands daily using spraying apparatus, is shown by the fact that twelve distinct editions of the work have heretofore been issued.

The aim in the preparation of this work has been to place before the farmer and fruit grower a practical condensed hand-book describing the how, when, and why of the application of the more common insecticides and fungicides in daily use for the destruction of injurious insects and prevention of fungous diseases. Its originality lies in its simplicity, but while the work is condensed, nothing of general importance has been omitted. Growers of special crops will need to consult the many excellent bulletins issued by the Department of Agriculture and the Agricultural Experiment Stations, relative to spraying these crops.

With the revised work has also come a change in form convenient to the coat pocket. We place a large-sized volume aside, expecting to read it tomorrow, only to find that on the morrow we have even less time for reading than today. It is hoped that the work in its present form may find a place in the pocket of every man "behind the nozzle" to

serve as a guide to the many useful purposes for which a spray pump can be used.

A careful study of each chapter is needed to give one a thorough knowledge of the science and art of Sprayology. If the first three chapters are taken up as a study, page by page, it will be found that the remaining chapters giving a summary of spraying particular plants and domestic animals can be more readily understood. In fact the last two chapters should only be consulted after a thorough understanding of the preceding chapters.

H. E. W.

Rogers Park, Chicago, October 1st, 1906.

INTRODUCTION

Estimates as to the annual loss to agriculture caused by injurious insects and fungous diseases show that the yield of all crops is lessened by them fully twenty-five per cent. This means an annual loss of more than *five hundred millions of dollars* in the United States alone. By proper spraying fully seventy-five per cent of this great loss can be prevented. This statement needs no proof, as all practical fruit growers have demonstrated time and again.

Spraying was first practiced about 1878 by the application of Paris green to potatoes for the destruction of the potato beetles. Soon thereafter it was found that for some reason the Paris green spray was also useful in preventing apples from becoming wormy, and then the entomologists gave us the life history of the apple worm which explained the how and why. It is often important that we know the life history or transformations through which an insect passes in order that we may understand the reason for spraying at some particular time. Thus in the case of the apple worm, after we know that the tiny eggs are laid in the blossom end of the young apple, we see the importance of placing a small amount of poison upon each forming apple in order to kill the young worms as they eat through the skin into the fruit.

It was not until after the establishment of the various state Agricultural Experiment Stations in 1887 that spraying came into general practice as a recognized necessity. The many experiments conducted at the Stations showed that spraying was of practically universal application for the destruction of injurious insects and the prevention of

fungous diseases. Spraying is now recognized as *the* practical method of saving crops and a spray pump of some sort is as necessary as a plow. "The man with the hoe" is closely followed by the man with the hose—and the nozzle.

But while *all admit*—for seeing is believing—the great loss caused by injurious insects and fungous diseases, only a *few realize* as yet that this loss is really a benefit to every progressive farmer. For as the loss can be prevented by intelligent effort, it is only the shiftless—the "Peter Tumble-downs"—who do not put spraying into practice. This gives the active, progressive, *thinking* farmer an immense advantage. The market demand for inferior fruit does not pay for its harvest, for it stands little chance for sale alongside the choice fruit. Select fruit must of necessity be sprayed fruit. While spraying means work, it more than pays for itself in the increased market price obtained.

Fig. 1.
The San Jose Scale.

As an example of the evolution which injurious insects and fungous diseases have brought about in farm practice, take the example of peach growing in Georgia. In former years every Georgia farmer raised peaches in plenty. Some years ago, owing to a steadily increasing demand for Georgia peaches, large additional tracts of orchards were set out. But at a time when the markets would have otherwise been glutted, the San José scale made its appearance in the orchards. This scale—shown in Fig. 1—caused the death of thousands of

trees. The average Georgia farmer became discouraged and gave us peach growing entirely. Others were not willing to let a tiny insect smaller than a pin head drive them out of peach growing, so they increased their orchards, studied the science of spraying and purchased materials and pumps. Today Georgia peach growing is in the hands of specialists whose success lies in the fact that they have become spraying experts.

However, the spraying must be done intelligently or the labor is wasted. Complaints such as the following are common: "I noticed worms on my currant bushes, so sprayed them. But it did not seem to do much good." Upon further inquiry it is usually discovered that the spraying was done after the worms had stripped the bushes of their leaves. When failure occurs it may usually be attributed to the lateness of the application. *Spray in time.* Study the subject thoroughly. Spraying is not a cure-all. It will not bring back to life a dead plant, nor restore the leaves of a tree after they have been eaten off by some caterpillar. The best results are not obtained the first year, especially when spraying for the fungous diseases. *Spraying is plant insurance.* Success lies in giving attention to details.

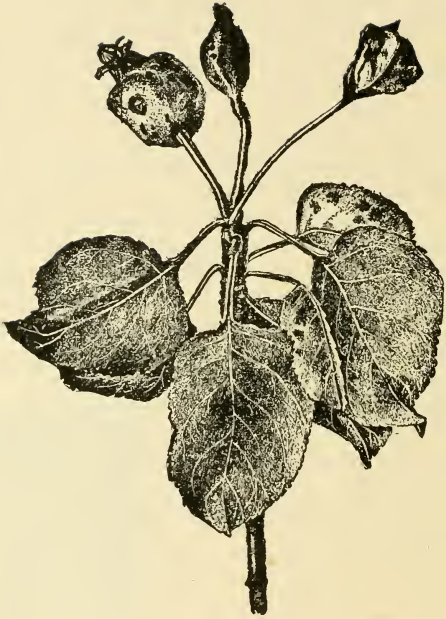

Plate II.

The Apple Scab.

CHAPTER I.

Some General Principles

Fungous Diseases—Most diseases of plants are caused by low forms of vegetable life known as fungi which live upon and within the tissues of the higher plants. They are thus parasites which obtain their nourishment by the breaking down of the cells of the plants on which they exist. The main difference, other than size, between the fungi and the higher plants is the lack of the green coloring matter so abundant in the higher order of vegetation. The methods of development in the fungi are very similar to that of higher plants, but their microscopic size renders their study more difficult. The parasitic fungi spend the winter mostly within the living and dead vegetable tissues and during the first warm days of spring send out small spores which correspond to the seeds of the higher plants. These spores are disseminated by the wind and otherwise from plant to plant. With favorable conditions as to moisture and warmth, the spores send out small branches which penetrate into the living tissues of the higher orders of growth. Here new branches are formed in immense numbers which soon sap the vitality of the plant and cause it to become diseased. New spores are developed on the exterior of the plant from time to time, but more especially in damp warm weather, and thus a fungous disease may become widely disseminated in a very short time.

By the application of a fungicide to a plant we destroy the spores which have found lodgment upon it and thus prevent the development of additional spores which would cause its disease. Just as long as the tissues of plants are covered with a thin even coating of a fungicide, no fungi can develop upon them. Thus if a fungicide is applied at

regular intervals of about two weeks during the spring and early summer, a plant disease may be held entirely in check.

Thus a fungicide is a *preventive,* and its application should begin long before the disease has advanced far enough to manifest itself to any extent. We should profit by the experience of former years and when our grape vines, for example, are affected with rot this year we should begin the spraying with a fungicide next year long before the time of the manifestation of the disease. It is a well-known fact also that the Bordeaux mixture has a beneficial effect upon growing plants other than its action as a fungicide. For this reason many nurserymen and others make a regular practice of its application simply to promote a healthful growth. The application of Bordeaux mixture is thus good *plant insurance.* Applied to Irish potatoes, it causes the vines to remain green much longer than would otherwise be the case, and this in turn causes the formation of larger tubers. It will thus increase the yield of potatoes more than enough to pay for its application, even though potato diseases may not be present.

Some fruits—the apple, grape, peach, and plum—are nearly always susceptible to fungus diseases and should be regularly sprayed with the Bordeaux mixture every two or three weeks during the spring and early summer. This will do much towards insuring a good crop each year.

Bacterial Diseases—Unfortunately not all diseases in plants are caused by the fungi. A few are caused by other low forms of vegetable life known as the *bacteria.* These are the "germs" which also cause so many diseases in man and the domestic animals. It will suit our purpose, in this connection, to explain the difference between the fungi and the bacteria by saying that the fungi develop their spores on the *exterior* of the host plant, while the bacteria

develop and multiply entirely *within* the plant. The application of any substance, even a fungicide, upon a plant practically does not affect the growth of the bacteria within that plant. Thus the *purely bacterial diseases* cannot be remedied with any form of spraying. About all that can be done, with our present knowledge of the subject, is to practice rotation of crops, select resistant varieties and give proper cultivation. The above explanation is made in this connection in order that it may be understood why spraying is *not a specific in all cases* of plant disease. Perhaps the best known bacterial disease is the twig blight of the apple and pear, known also as the "fire blight" of the pear.

The Leaf-eating Insects—There is a marked distinction in the manner in which insects take their food. Some *eat the leaves* while others *suck the plant juices.* Without knowing to which of these two general classes a particular insect belongs, one is unable to intelligently apply a remedy. Insects which *eat the leaves* have their mouth parts formed for biting off bits of vegetable matter and in this way eat their food in much the same manner as do the higher animals. The insects which suck the plant juices, on the other hand, have their mouth parts formed into a beak which is inserted into the plant tissues. Thus a large number of the sucking insects on a plant will soon extract so much of its vitality as to cause it to wither and die.

Some of the best known of the eating insects are the Irish potato beetle, cut-worms and the various caterpillars. While these insects can be destroyed by either an external irritant insecticide or a stomach poison insecticide, it is best to apply the last named. These are the various poisons which kill by being eaten by the insects when taken into the alimentary canal or stomach along with particles of food. We thus apply this class of insecticides to the plants,

making no effort to apply it directly to the insects. Applied to the plants upon which the insects feed, small particles of the insecticide will be taken into the system and will soon kill the insects by its action as a poison.

Cut-worms—These are the larval form of many species of moths. They attack a great variety of plants and are always more numerous upon land which has been in sod for a year or more. To destroy cut-worms moisten a quantity of corn meal or wheat bran with water, to which add and mix thoroughly a small amount of Paris green or other poison and a little molasses. Place small quantities of this in various portions of the field where the worms are at work, being careful to place the poisoned meal upon the *ridges* and not in the hollows. Of course it should not be placed where accessible to poultry.

Scale Insects—These are small sucking insects which in former years were introduced into the orchards through the nurseries. Now, however, owing to the various state laws requiring an inspection of all nursery stock by competent entomologists, this source of infection is reduced to the minimum. Unfortunately nursery inspection has only been practiced for a few years past and the various scale insects have become widely disseminated. Owing to the small size of the scale insects their presence is not generally known until the injury caused by their work becomes apparent. A main branch of a fruit tree dies back and upon examination is found to be covered with an incrustation of some sort showing many dark specks. We then find that the tree is infested with the San José scale shown in Fig. 1. While most scale insects are very small and only appear as minute specks, others are a quarter of an inch or more in diameter. An example of such is shown in Fig. 2, the Cottony Maple Scale, so common in some

years upon the soft maples.

For all scale insects we should apply a *contact* insecticide directly upon the insects. This will kill them by penetration and irritation.

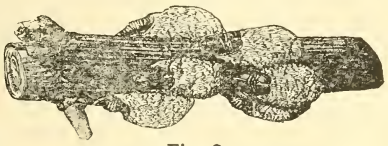

Fig. 2.
The Cottony Maple Scale.

Plant Lice—These are the lice so common upon a great variety of plants throughout the summer. They may be green in color as is the case with the lice on the underside of rose leaves and on the flowers of the common snowball in June. Some are red, a common form occurring on Rudbeckia or the Golden Glow in August. Still others are black, such as the common Cherry Aphis. Green, however, is the more prevalent color. Plant lice may or may not have wings, both forms being shown in Fig. 3. The most common form during the summer months are the wingless females which produce living young. Winged males appear in the autumn. *Some species lay eggs* in autumn which are not hatched until the following spring, *while the females of other species* are protected in winter by ants, who carry them to the interior of their nests and in the spring place them upon the proper food

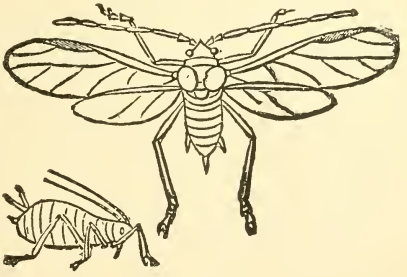

Fig. 3.
Plant Lice.

plant. The ants feed upon the "honey dew" which is no more nor less than the sap of plants pumped out by either scale insects or plant lice. Whenever large numbers of ants are seen upon a plant it is a good indication that either scale insects or plant lice are present.

The remedy for the plant lice is the same as for the scale insects—the application of an external irritant insecticide.

Lice on Domestic Animals—These exist in great variety, the different species of animals having a different kind of lice attacking them. Animals infested with lice should be sprayed or dipped in Kreso using one or two per cent solution. For lice on poultry dip thoroughly in a one per cent Kreso and for mites in poultry houses spray the houses thoroughly with a two per cent Kreso.

SOME THINGS TO REMEMBER

Spray intelligently, having a definite aim in view and knowing the results that are expected to follow.

Spray thoroughly or not at all. This can be accomplished by the application of a small amount of the spray liquid on *every part of the plant,* top, middle, and bottom. An excess of spray at any particular point is both wasteful of material and may cause injury to the foliage.

Never spray fruit trees when in bloom. The spraying is apt to wash off the pollen and when this occurs no fruit will set. The bees of the neighborhood may also be poisoned.

Label all poisons so that you will know just what they are.

Keep all poisons away from children and domestic animals.

When using a solution of a strength that may damage

foliage, spray but one or two plants at first. If no damage results after three days, it may be safely applied on a larger scale.

Never use a tin vessel in making the Bordeaux mixture or other solution containing copper.

Have a good spraying outfit, one especially adapted to the work in hand.

Spray in Time—A plant cannot be saved after it has been half destroyed by insects; nor will it fully recover after its tissues have become infested with a fungous disease.

Plate III.

Strawberry Leaf Blight.

CHAPTER II.

Materials Used in Spraying

Fungicides are substances used in destroying *fungi,* which are low vegetable organisms causing disease in plants. More correctly speaking, the fungicide acts as a preventive of plant disease by obstructing the germination of the spores of the fungi causing such disease. Since these spores grow upon the exterior portion of plants, if we cover the plants with a coating of a copper salt or other chemical deleterious to the germination of the spores, the reproduction of the fungi is held in check and thus plant disease is prevented.

Insecticides are substances used in killing insects. Those used in spraying are readily divided into two general classes: The internal poisons and the external contact irritants, known also as the internal and external contact insecticides. The internal poisons are only used for insects with biting mouth parts and they kill because of their poisonous action. The external contact insecticides act by their penetrating and irritant qualities and while more or less useful for the destruction of all insects, they are especially used against all insects whose mouth parts are formed for sucking.

Bordeaux Mixture—This is the *standard fungicide* and consists of a combination of copper sulphate, fresh lime and water. As it is used for the prevention of nearly all fungous diseases, its proper preparation is a matter of considerable importance. The proportions and manner in which the various ingredients are combined so largely affect the resulting mixture that it would be a difficult matter to make identically the same mixture twice in suc-

cession. The formula in most general use is the following:

Copper sulphate ..... 4 pounds.
Fresh lime ..... 4 pounds.
Water to make .....50 gallons.

For preparing on a small scale the copper sulphate should be dissolved in 25 gallons of water, using a half barrel for such purpose. To dissolve the copper sulphate readily, it should be placed in a coarse cloth bag and suspended in the water so that the sulphate is just covered. It will not dissolve readily if the copper sulphate is placed at the bottom of the vessel. The *fresh* lime should be dissolved in another vessel, using only a small amount of water at first, adding more as the process of slaking progresses. Then dilute to 25 gallons. The copper sulphate solution and the milk of lime should then be poured together into a third vessel, which may be the spray barrel. It is best to strain the materials when pouring them together. For such purpose a copper strainer of 18 or 20 meshes to the inch is best. It is important that practically equal amounts of the two solutions are poured together at the same time as illustrated in Fig. 4. Do not pour the copper sulphate into the milk of lime or vice versa, but both together into the third vessel. Otherwise the proper chemical combinations will not take place, sediment will form in the bottom of the spray barrel which will produce clogging at the nozzle and the proper results will not be obtained by the spraying.

If only a limited amount of the Bordeaux mixture is to be used, the above method of its preparation should be followed. If, however, extensive orchards are to be sprayed the following methods should be employed:

Stock Solutions of Lime and Copper Sulphate— Weigh out a given number of pounds of fresh lime and measure out the same number of gallons of water. Slake

the lime by the addition of a small amount of water at first and finally the whole amount. When this milk of lime is thoroughly stirred each gallon of the solution will contain one pound of lime. In this way a barrel of lime can be slaked at once, so that there is no loss by air slaking.

Dissolve any number of pounds of copper sulphate in a like number of gallons of water. A gallon of this solution when thoroughly stirred will contain one pound of the sulphate. Use only a copper or granite-ware measure. Both

Fig. 4.
Making Bordeaux Mixture.

of the stock solutions can be kept almost indefinitely *if* proper measures are taken to prevent evaporation of the water.

To Make Bordeaux Mixture—In making a barrel of Bordeaux mixture *from the stock solutions,* take four gallons *each* of the copper sulphate and lime and dilute to 25 gallons of water in *separate vessels.* Then pour the diluted

solutions together into a third vessel or the spray barrel as already described.

It is always advisable in extensive spraying operations to prepare the Bordeaux mixture on a raised platform conveniently arranged so that the spray mixtures can be drawn off into the spray barrels by gravity. A convenient water supply will materially aid in saving time during the busy spraying season.

A properly prepared Bordeaux mixture is of a sky blue color. With inferior or partly air slaked lime a greenish hue results. In such case the proper chemical combinations *have not* taken place and *damage* to the foliage is apt to result. Damage to foliage is the result of too little lime. A good method of testing the mixture is to dissolve an ounce of yellow prussiate of potash in five ounces of water and place in a bottle for use. After thoroughly stirring the mixture add two or three drops of the prussiate of potash. If a reddish-brown color is formed it indicates that free copper is present and more lime is needed. If no discoloration takes place it shows that sufficient lime had already been added.

In spraying peach foliage it is always advisable to have an excess of lime. In fact a mixture made with three pounds of copper sulphate, nine pounds of lime to fifty gallons of water is recommended for this special purpose. This strength is sometimes mentioned as the "Peach Bordeaux mixture."

Insecticides with Bordeaux Mixture—In spraying many varieties of fruit trees it is advisable to add some of the stomach poisons, such as Paris green or arsenate of lead, at the rate of one-quarter pound to fifty gallons of Bordeaux mixture. In this way spraying for both insects and fungi is accomplished in a single operation. The com-

bination of Bordeaux mixture with the contact insecticides, however, is not advisable, as it would lessen the adhesive properties of the Bordeaux mixture.

In the use of Bordeaux mixture the hands soon become stained. This can be removed with dilute cider vinegar or dilute acetic acid. The vinegar is also useful in cleaning the sprayer after Bordeaux mixture has been used. When applied to fruit late in the season some traces of Bordeaux mixture may remain on the fruit which will lessen its attractive appearance. To remove, dip in vinegar and then in clear water. Where much spraying is to be done, the copper sulphate should be purchased by the barrel from a wholesale druggist and should then cost not more than six cents per pound.

Ammoniacal Copper Carbonate—This is used as a fungicide when the stain of Bordeaux mixture upon maturing fruit or ornamental plants is objectionable. It is a clear light blue solution and leaves no stain. It is inferior as a fungicide, however, to Bordeaux mixture and is also more apt to cause injury to foliage. It loses strength when standing in open vessels, but may be kept indefinitely in closed Mason jars or "stoppered" bottles.

Formula for making is as follows:

Copper carbonate ..... 5 ounces.
Strong ammonia ..... 1 quart.
Water to make .....50 gallons.

Dilute the ammonia with two gallons of water. Add enough to the copper carbonate to make a thin paste, pour on about half the ammonia and stir thoroughly. Allow the mixture to settle and then pour off the top, leaving the undissolved portion behind. Repeat this operation, using small portions of the remaining ammonia until all the copper sulphate is dissolved, using no more ammonia than

is necessary to complete the solution. Then add the remainder of the required amount of water.

Lime and Sulphur Solution—This is an effective spray material being both fungicide and insecticide in its action. It originated on the Pacific coast, but in more recent years has come more extensively into general use for the destruction of scale insects and prevention of fungous diseases. It can be used only in winter or early spring, while the trees are dormant. It is most effective when applied just before the buds begin to swell. Of the many formulas used in its preparation, the following is perhaps the best:

Fresh lime .....20 pounds.
Flowers of sulphur.....15 pounds.
Salt .....10 pounds.
Water to make.....50 gallons.

If a good grade of lime is used which has not at all become air slaked, 15 pounds will probably be sufficient, but with partly air slaked lime 20 to 30 pounds will be needed, as lime absorbs an equal weight of water in becoming air slaked.

To prepare the solution, place the lime in an iron kettle, or vat if steam is used, and slake it with hot water, adding water enough to make about ten gallons. The sulphur and salt are then added and thoroughly mixed. Now boil the mixture from 40 to 60 minutes, stirring it constantly. When the sulphur is all dissolved further cooking is unnecessary. As the sulphur dissolves more readily in a concentrated mixture with lime, it is best not to have too much water during the process of boiling. The mixture, however, should not be allowed to become pasty and water should therefore be added during the boiling whenever it seems necessary. Upon the completion of the cooking process, pass the mixture through a wire strainer and dilute

to the required amount of water. It is preferable to use hot water for the dilution or else have a boiler sufficiently large to bring the mixture to a boil after the dilution.

The salt increases the adhesiveness of the mixture, but many orchardists leave it out with apparently good results. The mixture is best applied to the trees while still hot, as it is then less liable to clog the nozzle. When allowed to stand over night, reheating is necessary owing to the formation of sulphur crystals. It is therefore best to prepare the mixture only as needed for immediate application. When large quantities are wanted, arrangements should be made whereby a connection with a boiler may be had and the cooking accomplished by steam.

Kerosene—Petroleum has long been a standard as an insecticide of the external irritant class, killing by its penetrating and irritant qualities. It cannot be applied to plants, however, in an undiluted state without causing considerable injury. As it cannot be diluted with water, various other materials have been introduced to accomplish this result. The methods of dilution which have received most attention are kerosene emulsion, the kerosene-lime mixtures, and the kesosene sprayers, which automatically mix oil and water in the act of pumping.

Kerosene emulsion was first introduced about 1878 by the making of either a milk or soap emulsion. The milk emulsion, however, was never satisfactory. Neither was the soap emulsion, for that matter, until 1904, but for twenty years past the agricultural papers and Experiment Station bulletins have repeatedly contained the directions for its preparation simply because we had nothing better to take its place as a contact insecticide. The trouble has been that the making of an emulsion has required boiling soap suds and much agitation. Hence the emulsion has never been in

general use in spite of all that has been said in its favor. In 1904, however, the writer sprayed two thousand maple trees with the emulsion, using a special soft soap containing 40 per cent naphtha and sold under the trade name of "Tak-a-nap" soap. This proved so satisfactory in making the emulsion on a large scale that no one need now hesitate in using the emulsion on account of difficulty in preparing it. Similar soaps containing a large percent naphtha will do as well.

To make a 10 per cent emulsion with the naphtha soap, dissolve one pound of the soap in two and one-half gallons of water by thoroughly stirring for a few minutes. Then pour two and one-half gallons of kerosene into the dissolved soap and mix thoroughly by pumping it twice through a bucket sprayer. Then dilute with 20 gallons of water, thus making 22½ gallons of water to 2½ gallons of kerosene or 10 per cent kerosene to the entire mixture. Any desired per cent of emulsion can be made by simply varying the amount of water used for dilution.

For a description of the special kerosene sprayers, whereby dilution is accomplished during the act of pumping, see page 37.

For two years past attention has been called to the desirability of making a kerosene-lime emulsion by means of a special grade of hydrated lime. Should this way of producing the emulsion prove what its advocates claim, it will be a very satisfactory method of making a combined spraying mixture. Different sprayologists, however, report such varying results with its use that it is doubtful if the mixture will come into general use.

Paris Green—This is the "old reliable" *insecticide* used for all insects that chew their food. But there are certain disadvantages in its use and the arsenate of lead is rapidly coming into favor as a better insecticide. The Paris green

is often adulterated. It does not remain long in suspension in water and thus requires much agitation during the process of spraying. In order to prevent injury to foliage it is always best to add a little fresh lime when spraying tender foliage like the peach. The Paris green is generally used at the rate of one-fourth pound of the green to fifty gallons of water, or a teaspoonful of the green to a bucket of water. When mixing the green with water, add only a small amount of water at first to make a paste. Or when adding the green to Bordeaux mixture make a paste first and then stir into the entire amount of Bordeaux.

Arsenate of Lead—This is a stomach poison which is rapidly taking the place of Paris green for such purpose. Its great advantages are that it adheres well to the foliage and hence the spraying does not have to be repeated as it does not readily wash off by rain. It also remains suspended well in water so that an even distribution can be obtained. It is white in color and shows just where it has been applied. But perhaps its principal advantage lies in the fact that it does not injure tender foliage. It is thus worthy of very general use. It can be purchased in the market under the trade name of "Disparene," or can be prepared by the following formula:

Arsenate of soda ..... 4 ounces.
Acetate of lead .....11 ounces.
Water .....16 gallons.

Dissolve each separately in a half gallon of warm water, mix together and add water to make sixteen gallons. The commercial arsenate of lead can be purchased ready for use from the seed stores or any dealer in other insecticides.

Other Insecticides—There are many other insecticides used in spraying but none are as good as those here given and their use is not recommended. The same may be said

regarding other fungicides. It is far better to use only a few substances and know how to use these properly than to experiment with others of less value.

Special Preparations—Many of these are upon the market and while they are not to be generally recommended, yet some of them are most excellent, especially for certain purposes. A distinction should be made between the preparations placed on the market by well established, reliable firms and the preparations put out by the firms of mushroom growth. The fact that any special preparation has been on the market for a number of years is a good indication that the article has merit. Good examples of this are shown in the merits of Disparene, Kreso and slug-shot. Disparene is simply arsenate of lead in convenient form, Kreso is a coal tar product very useful as a disinfectant as well as insecticide, while slug-shot is a mixture of gypsum and other chemicals which has been on the market for many years.

Liquid or Dry Application?—The application of fungicides and insecticides in dry form is more easily accomplished than in the liquid form. The results obtained, however, are rarely satisfactory, as the material used will not stay upon the foliage. At best it can only be applied to the upper surface of the leaves. There are cases, however, as on hillsides where dry application may be advisable. In case of some low growing plants, especially the cabbage, dry application is very convenient. The best machine for dry application to low growing plants is shown in Fig. 5.

Fig. 5.
Dry Powder Distributor.

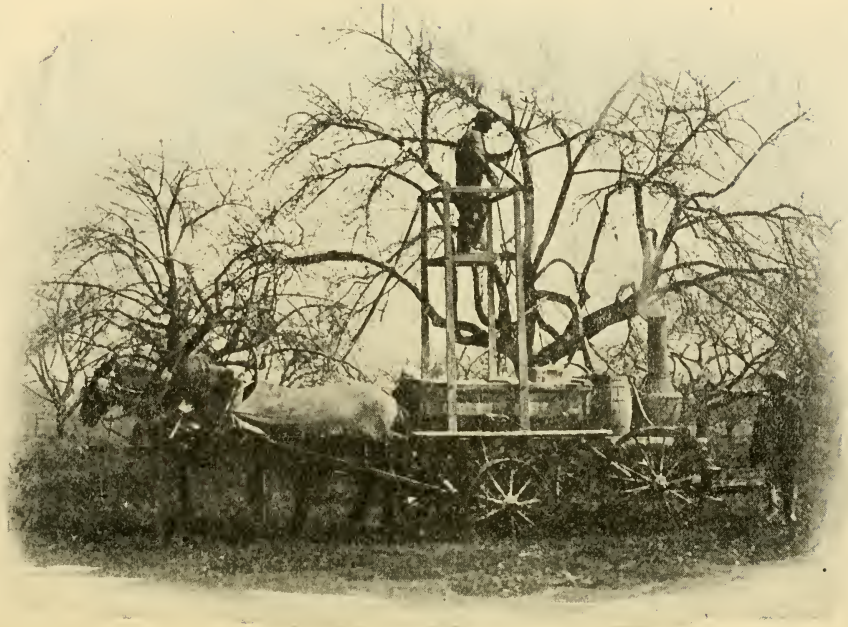

Plate IV.
Power Sprayer.

CHAPTER III.

Spray Pumps and Outfits

Best Outfits Only—It does not pay to waste time in the use of poor outfits. A pump that is continually getting out of order had better be thrown away. All working parts should be made of brass. Iron soon corrodes by the action of the spray chemicals. A rubber valve is soon swelled by kerosene. Use only an outfit suited for the purpose in hand and have several outfits where necessary.

Fig. 6.
Spray Bellows.

Spray Bellows and Atomizers—Fig. 6 shows a form of bellows quite popular some years ago. It is a convenient form for greenhouse work, but in general use becomes very tiresome. These cost from one to two dollars. Fig. 7 shows an atomizer which has the advantage of making the spray solution cover foliage without any waste of materials. For spraying on a small scale, with a few low plants, flowers, or rose bushes, they do very well if nothing better is at hand. They are not adapted for tree spraying and cost from $1.00 to $2.50, depending on the material of their construction. Those made of tin last only a few weeks as only copper or brass will stand the corrosive action of the chemicals.

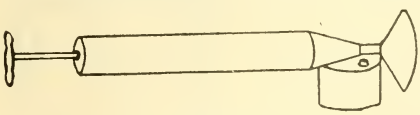

Fig. 7.
Spray Atomizer.

Bucket Spray Pumps—One of the many styles of this class of sprayers is shown in Fig. 8. These cost from $1.00 to $5.00, the cheaper ones being made of tin, with either a

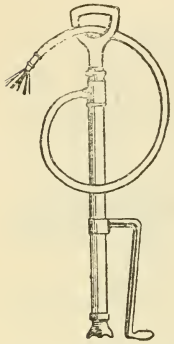

Fig. 8.
Bucket Sprayer.

tin nozzle or none at all. A good bucket sprayer, with a proper nozzle and made with all brass working parts, is a very useful and convenient apparatus. They are useful in all spraying operations on a small scale and also useful in washing buggies, whitewashing, and for fighting fire. A nozzle which throws a solid stream is the best for this style of sprayers.

Knapsack Sprayers—Some years ago the knapsack sprayer was more popular than at present, as operators have found it tiresome to carry five gallons of spray liquid on the back. To lessen these objections the author has suggested certain improvements, the result being shown in the pattern illustrated in Fig. 9. This form of knapsack sprayer can be readily changed into a bucket sprayer by removing the lever and long handle and substituting the handle shown in the dotted lines. The cost of a knapsack sprayer with copper tank is from $8.00 to $10.00, depending on the *construction* and *quality of material.* They are of special use in spraying small vineyards, garden vegetables and potatoes.

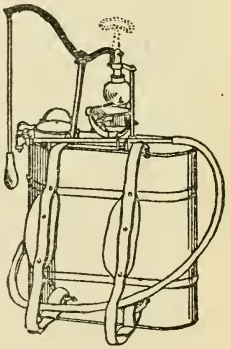

Fig. 9.
Knapsack Sprayer.

Barrel Spray Pumps—These are force pumps fastened to the side or end of an oil or whisky barrel. Of the many styles on the

market those with a submerged cylinder, as shown in Fig. 10, are perhaps preferable. A good mechanical agitator is absolutely essential in a barrel sprayer. For the best work three persons are necessary in operating the outfit, one to drive and pump and one each to operate the two sections of hose. The hose sections should be of varying length, depending upon the work to be done. When the spraying is done by the operators standing in the wagon 10 to 12 foot sections are sufficient, but with large trees where the operators work from the ground, longer hose is essential. Every barrel sprayer, or any other outfit with two sections of hose, should be provided with a three-way cock. This will enable the spray to be shut off from either one or both hose sections and there is thus no waste of materials. The cost of a barrel spraying outfit ranges from $5.00 to $20.00.

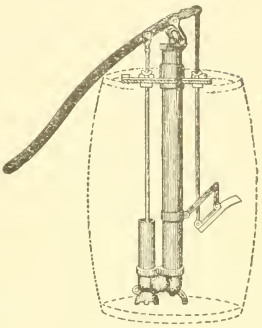

Fig. 10.
Barrel Sprayer.

Compressed Air Outfits—The general character of these sprayers is shown in Fig. 11. With them the work of pumping is exceedingly easy. The outfits consist of an air-tight receptacle and an air pump. They are convenient

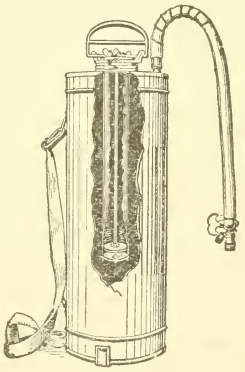

Fig. 11.
Compressed Air Sprayer.

for small work, but lack agitators so that unless the tanks are kept constantly shaken an uneven and ineffective spraying is done. With good agitators they would be worthy of more general use.

Another style of sprayers similar to these is the "Gas" sprayer wherein the power for spraying is obtained by liquefied carbonic gas. They are made from 50 to 200 gallons in capacity and cost from $75.00 to $200.00.

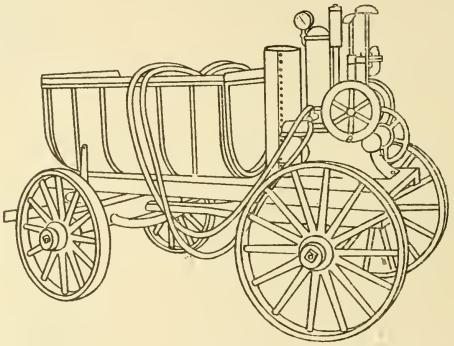

Fig. 12.
Power Sprayer.

Power Sprayers—Steam engine outfits have been used to some extent but the cost of fuel and labor as well as loss of time in starting give the gasoline outfits the advantage. A steam power sprayer is shown in Plate IV. Gasoline sprayers where the power is furnished by a gasoline engine of about one and one-half to three horse power are now becoming quite popular in all large spraying operations. Spraying is such an essential practice in parks and large orchards, that the first cost of an outfit is not nearly so important as the saving of time in labor, and the convenience which is

obtained with a gasoline sprayer. The general character of these outfits is shown in Fig. 12. A special spray tank is provided and four leads of hose can be operated at once. The cost of these outfits ranges from $100.00 to $300.00, the last named being for complete outfits, including wagon truck, tank, hose, etc.

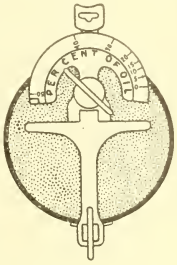

Fig. 13.
Kerosene Indicator.

The Kerosene Sprayers—These consist of a kerosene attachment to the bucket and knapsack sprayers, whereby kerosene and water are mixed in the act of pumping. The kerosene is placed in a separate tank which connects with the pump cylinder by means of a suction pipe. The regular reservoir is filled with water, and by this means both kerosene and water are forced through the pump at each stroke of the plunger. The mixture of the two liquids takes place partly in the pump but more especially at the nozzle, where they are divided into very fine particles. The proportions of oil are controlled by means of a valve which is connected to an indicator on top of the kerosene tank as shown in Fig. 13. The knapsack style of these sprayers is shown in Fig. 14. The kerosene tanks are readily detached when the sprayers are wanted for applying other liquids and they then become the same as the ordinary bucket or knapsack sprayers.

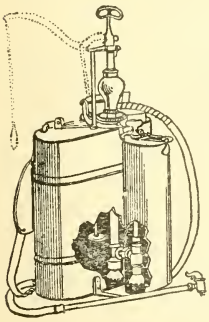

Fig. 14.
Knapsack Kerosene Sprayer.

Extensions—In spraying trees, especially where the hose is operated

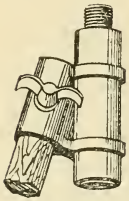

Fig. 15. Pole Connection.

from the ground, some arrangement is necessary whereby the nozzle is held near the foliage or branches. This may be accomplished either by means of an extension pipe, or an extra section of hose and pole connection. An extension pipe should consist of a quarter inch brass tube inside of a bamboo pole. This will be found to be much lighter and more easily handled than an ordinary iron pipe. With an extra section of hose and pole connection such as shown in Fig. 15, the same object of holding the nozzle near the foliage is also accomplished.

Field Sprayers—In spraying low growing crops on a large scale it is quite important to have an outfit arranged with several nozzles adjustable in position so that several rows of potatoes or other crops can be sprayed at a time. Such an outfit is shown in Fig. 16. Generally all that is needed is the regular barrel sprayer placed in a wagon and arranged with several leads of hose and nozzles. Special outfits of this nature are on the market.

Nozzles—The nozzle is perhaps the most important feature of a spray outfit. What is wanted in all spraying operations is the application of a *fine mist* and not *drops* of the liquid. A *perfect* nozzle would be one where the liquid is thrown a considerable distance in a fine mist-like spray, *without waste* of materials, and one that could be changed to throw a coarser spray or a solid stream. Unfortunately a *perfect* nozzle has not yet been in-

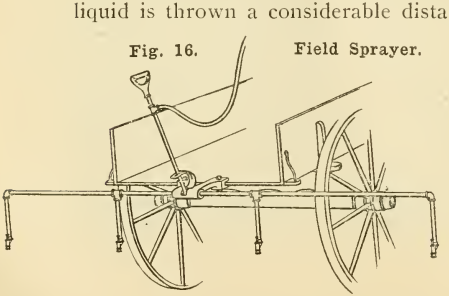

Fig. 16. Field Sprayer.

vented, although the Bordeaux nozzle is close to perfection. The three best known nozzles are as follows:

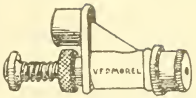

Fig. 17.
Vermorel Nozzle.

The *Vermorel* is shown in Fig. 17 and undoubtedly throws the finest spray of any. In its use the nozzle should be held quite near the foliage or branches as the liquid is not thrown out with much force.

The *Bordeaux*, shown in Fig. 18, is the best all-around nozzle, and where but one is used this style should be the pattern selected. The Bordeaux has the advantage over all other spray nozzles in that the character of the spray is readily changed from a solid stream to a mist-like fan-shaped spray. Should there be any clogging of the nozzles with the spray material, it is easily remedied by turning the handle.

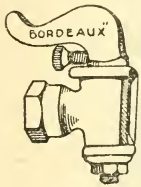

Fig. 18.
Bordeaux Nozzle.

The *Cyclone*, shown in Fig. 19, has been largely used for some years but it does not have the advantages of a disgorging device. The spray is conical-shaped, similar to the Vermorel.

The Proper Outfit—The particular outfit to be selected will depend altogether upon the amount and character of the work to be done. For spraying on a small scale the bucket or knapsack pattern, with extension hose, will be all that is needed. For orchard work a barrel sprayer is essential. In large orchards or public parks, the power sprayers should be used. No one outfit can be expected to suit all the varying conditions of spraying. That style should be selected which is best suited

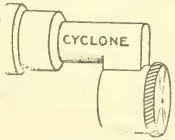

Fig. 19.
Cyclone Nozzle.

for the work in hand. The more expensive outfits are often the cheapest in the end for they are the most saving of labor. In large operations an elevated platform upon the spray wagon, such as shown in Fig. 20, may be used.

Care of an Outfit—A spray pump, like any machine, will do good work and last in proportion to its care. When an outfit is first received, it should be carefully studied, that its working principles may be thoroughly understood by the person using it. When a pump does not work prop-

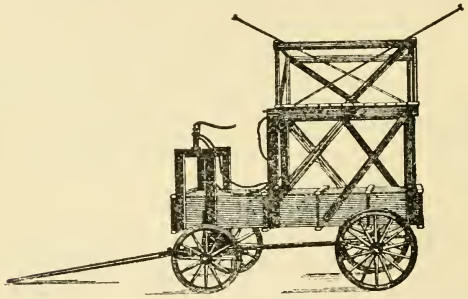

Fig. 20.
Showing Elevated Platform.

erly, the cause of the trouble should be ascertained at once and remedied, otherwise permanent damage may result. After using Bordeaux mixture clear water should be run through the sprayer to remove any sediment that might otherwise remain. When the spraying is over for the season, the pump should be thoroughly cleaned, using vinegar to remove traces of Bordeaux. With proper care the pump proper will last several years. The hose, however, will probably have to be replaced after one or two seasons' use.

Graded Apples from Three Trees Sprayed Six Times.

Graded Apples from Three Trees not Sprayed.

Plate V.

CHAPTER IV.

Summary of Spraying Plants

APPLE

Summary of Treatment—Practically all of the many insect and fungous enemies of the apple can be remedied by three or four sprayings during each spring. The first spraying should be given just before the buds swell in March, followed by a second spraying just after the blossoms fall. The third spraying should be given three weeks later and still a fourth spraying three weeks afterwards. The spraying should consist of the Bordeaux mixture, with arsenate of lead or Paris green added. If scale insects are present the first spraying should consist of the sulphur and lime wash. Each tree should be looked over carefully during the winter and all dried up fruit removed, the loose bark scraped off, and any old leaves still adhering carefully picked off and burned.

Borers in Trunk—Go over the trees in autumn and with a knife remove any borers which may be just starting their work. In spraying with Bordeaux and arsenate of lead make application upon the trunk as well as upon the branches. If borers are numerous apply in spring a whitewash containing soft soap and crude carbolic acid. Fig. 21 shows a common form of the apple tree borer.

Fig. 21.
Apple Tree Borer.

Scale Insects—The most common are the oyster-shell bark louse, the scurfy scale and the San José scale. The first is elongated, much resembling in form an oyster shell, but of a dark color. The last two are very similar to

each other in appearance, both forming a grayish incrustation upon the bark. The scurfy scale is somewhat triangular in appearance, however, while the San José is somewhat circular with a prominent raised portion in the center. It is important to know what scale is present, for the oyster-shell scale and the scurfy scale are both very easily treated, while the San José scale is a more serious pest in that it cannot be so readily exterminated. In fact, if the San José is present on only a few trees, it is best to cut these down and burn them in order that the scale may not be spread to an entire orchard.

To kill the oyster-shell or scurfy scale, spray the trunk and larger branches in May or June about the time the leaves are coming out, with 10 per cent kerosene emulsion. At this season the young are just hatching and appear as minute light colored specks upon the bark. To keep the San José scale in check, spray early in the spring with the lime and sulphur solution.

The Woolly Aphis—This insect, shown in Fig. 22, works on both the roots and trunk and larger branches. When new trees are set out they should be carefully examined for this insect, and if present dip the roots in a 10 per cent kerosene emulsion. If present upon the trunk or branches, first scrape off all loose bark and spray with 10 per cent kerosene emulsion. There is both a winged and wingless form and the insect may be readily distinguished by the white down somewhat resembling cotton upon the abdomen.

Fig. 22.
Apple Aphis.

Bud Worms—These are small caterpillars which eat the leaves before they open in the early spring. They may be destroyed by spraying with arsenate of lead before the leaves open. Where the trees are sprayed with Bordeaux mixture and the arsenate of lead for a general treatment, special treatment is not necessary.

Leaf Crumpler—This insect passes the winter upon the trees, securely fastened between two leaves which generally adhere to the branches. Go over the trees in winter and pick off all remaining leaves and burn. Where this has been neglected, spray with arsenate of lead in June for the destruction of the caterpillars.

Canker Worms—These are the "measuring worms" so common at times in the spring. A spraying with arsenate of lead will promptly kill the caterpillars.

The Codling Moth—This is perhaps the principal insect enemy of the apple, being the cause of wormy apples and pears, and is shown in Fig. 23. The eggs are laid in the blossom end of the young apples and later a second brood of moths lay their eggs upon the growing fruit. The trees should be sprayed with arsenate of lead just after the blossoms have fallen and again three weeks later.

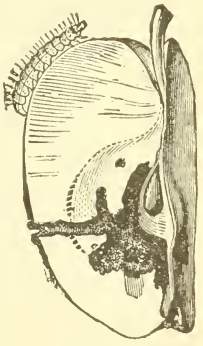

Fig. 23.
The Codling Moth.

Apple Scab—This is a widespread disease which shows itself on both the fruit and leaves in the form of

dark colored spots as shown in Plate II. It is always more or less prevalent and can be prevented by spraying with Bordeaux mixture. Make the first application ten days before the buds open, followed by three other applications at intervals of two weeks.

The Bitter Rot—This disease causes the fruit to rot before ripening. It can be prevented by five applications of Bordeaux mixture at intervals of two weeks, making the first application four weeks after the fruit has set.

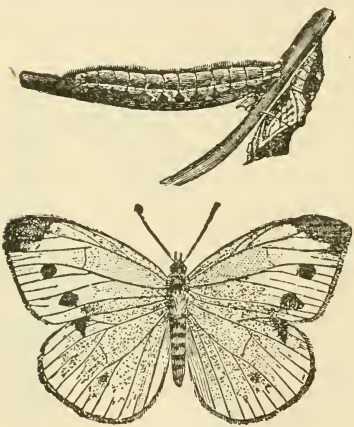

Fig. 24.
Cabbage Worm and Butterfly.

Sooty Fungus—This causes a blackened, spotty appearance on the fruit of some varieties, especially the early kinds. One application of Bordeaux mixture in June will prevent its appearance.

Twig Blight — See Fire Blight of Pear.

Other Diseases of the apple include black rot, leaf blight, fly speak, powdery mildew and rust. The application of Bordeaux mixture as given under the head of general treatment for the apple will prevent all these diseases.

BEAN

Anthracnose—This is a disease causing brown spots on the pods. Spray with Bordeaux mixture three times, mak-

ing the first application when the plants are about five inches high, and repeat at intervals of two weeks.

BLACKBERRY

Same as Raspberry, which see.

CABBAGE

Caterpillars—There are several species, the most common of which is the green worm which hatches into a white butterfly. This is shown in Fig. 24. There are several methods used for the destruction of these insects, the best being spraying with either kerosene emulsion, or hot water. Use a 10 per cent emulsion. If boiling water is placed in the sprayer, it will be none too hot by the time it comes out of the nozzle. When the plants are young, arsenate of lead can be used to advantage but in no event should this be used after the heads begin to form.

Cabbage Aphis—These are the small green lice quite common on the cabbage. To destroy, spray the plants with 15 per cent kerosene emulsion.

Harlequin Cabbage Bug—Use a trap crop of mustard planted in November and in bloom in March. Destroy the insects in March by spraying with pure kerosene. If all the bugs which live over winter are then destroyed, the cabbage crop will be saved.

CELERY

Caterpillars—A green, black and yellow worm which feeds on the leaves. Spray the plants with arsenate of lead.

Blight—There are two diseases which attack the celery plant, causing the leaves and stems to become discolored, thus lessening the market value of the product. The plants in the seed-bed should be sprayed with Bordeaux mixture as soon as they are up and continued at intervals of two

weeks until transplanted, or longer if indications of disease are present.

CHERRY

Aphis—The black plant-lice on the cherry leaves are perhaps the hardest to kill of any of the plant lice. It requires a kerosene emulsion of 20 per cent to destroy them.

Slug—Shown in Fig. 25. Spray with arsenate of lead.

CORN

Chinch Bug—In former years this was a very injurious pest, but is not now so common. Can be destroyed by spraying with 10 per cent kerosene emulsion.

Other Corn Insects—Corn should be planted on land which has been plowed the fall previous. It should not be planted on sod land, especially when the sod is turned under in the spring of the year. These precautions will prevent the work of cutworms and many other insects which attack the plant.

Fig. 25.
Cherry Slug.

COTTON

Cotton Army Worm—This insect has done no particular damage in recent years, and does not appear in such large numbers as formerly. In some particular sections, however, it is present in small numbers. It may be easily destroyed by spraying the plants with arsenate of lead.

Cotton Boll Worm—If the plants are sprayed three or four times at intervals of four weeks during the summer, the destruction caused by this insect will be greatly lessened.

Fungous Affections—There are several diseases affecting the cotton plant, known mostly under the name of leaf rust and blight. Three or four applications of Bordeaux mixture at intervals of three weeks, beginning the first week in June, will do much towards lessening the damage done. Arsenate of lead should be added to destroy any leaf-eating insects which may be present.

CUCUMBER

Same as Melons, which see.

CURRANT

Worm—To destroy, spray with arsenate of lead. As the worm will entirely strip the bushes of leaves in a few days the plants should be closely watched early in the spring and the applications made just as soon as the worms are noticed.

FLOWERS

Caterpillars—A great variety of leaf-eating caterpillars occur upon all kinds of ornamental flowering plants. They may all be killed by spraying with arsenate of lead.

Scale, Plant Lice and Mealy Bugs—These occur quite often in hothouses, especially where plants have been neglected. All affected plants should be sprayed with 10 per cent kerosene emulsion. Where hothouse plants are specially tender, try the 10 per cent emulsion on a small scale at first, before making any general application.

Plant Diseases—In greenhouses these are numerous and varied. Their presence generally indicates a lack of careful attention and ventilation. When new plants are set fresh soil should be used. Spray all infested plants with Bordeaux mixture every ten days.

GOOSEBERRY

Leaf-spot and Worm—Same as on Currant, which see.

GRAPE

The Black Rot, Downy Mildew, Powdery Mildew and Anthracnose—Four distinct diseases attack the grape, the effects of which are very much the same. The remedies also are practically the same. The vines should be given a thorough spraying with Bordeaux mixture before the buds swell in the early spring. The Bordeaux mixture should then be applied every two weeks until the fruit begins to ripen.

GRASS

Caterpillars—Various leaf-eating caterpillars, especially the army worm, shown in Fig. 25, feed upon grass. Grasshoppers are also at times quite abundant. To destroy, spray with arsenate of lead.

Fig. 26.
The Army Worm.

MELON

Plant Lice—Found mostly on the underside of the leaves. Spray with 10 per cent kerosene emulsion, using an under-sprayer for this work.

Striped Beetle and Flea Beetles—Fresh powdered tobacco applied around the base of the young plants will prevent the work of these insects.

Worms—These eat both the leaves and fruit and are common only in the South. Spray infested plants with arsenate of lead as soon as any worms are noticed.

Cucumber Mildew—A fungous affection causing the leaves to turn yellow or brown in spots. Spray with Bordeaux mixture three or four times at intervals of two

weeks, making the first application when the vines are nearly half grown.

The Melon Blight—A disease common in the South, caused by *bacteria*. No remedy is known for this disease. Do not plant melons on the same land year after year and do not have melons follow potatoes or tomatoes.

ORANGE

Scale Insects—There is probably no plant so susceptible to the attack of scale insects as is the orange. A grove will soon become infested with many species of scale insects unless regularly sprayed with kerosene emulsion. It is much easier to give regular spraying of kerosene emulsion whenever any scales are noticed than it is to clean up the trees of a grove after they have become thoroughly infested with the scales.

Sooty Mould—A black film which forms on the upper side of the leaves and fruit. This fungus lives on the sweet secretions of the "white fly," the small white insects so common on most orange trees. Kill the white fly by a spray of 10 per cent kerosene emulsion and the sooty mould will disappear.

PEACH

Scale Insects—The peach is attacked by a great variety of scale insects, the worst of which is the San José scale. An orchard should be thoroughly examined at least once a year, and if any scale insects are present all infested trees should be sprayed with the lime and sulphur solution. If found only on a few trees of an orchard, dig out and burn. The lime and sulphur solution is most effective if applied just before the buds swell in the spring.

Peach Tree Borer—A small worm which works within the bark, at or near the soil surface. The borers should

tion of whitewash, to which has been added crude carbolic acid and arsenate of lead should be made.

Curculio—Same as on Plum, which see.

Peach Aphis—Same as Cherry Aphis, which see.

Leaf Curl—A curling of the peach leaves, such as is shown in Fig. 27, is quite common after wet springs. The curled leaves fall off after some time and new leaves put forth, which necessarily weakens the vitality of the tree. A single spraying of Bordeaux mixture will prevent this disease. Where the lime and sulphur solution is used for a winter treatment for scale insects, this disease will also be prevented.

The Brown Rot—This disease attacks all the stone

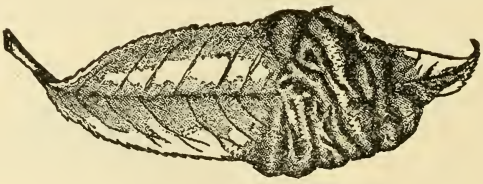

Fig. 27.

Peach Leaf Curl.

fruits and is a serious and widespread fungous affection. It causes the fruit, or part of it, to rot before ripening and, like most fungous diseases, does its greatest damage during wet seasons. As the disease is more or less present in peach and plum orchards at all times, their regular treatment with Bordeaux mixture is a matter of considerable importance. A familiar sight in the winter months in most peach and plum orchards is the "mummied" fruit which still adheres to the branches. As the disease is present in this mummied fruit, the first step in the treat-

ment of an orchard should be the burning of all such diseased fruit. The mummies should not simply be picked and thrown to the ground, but they should be *burned*. At least once during the winter the trees should be thoroughly sprayed with a copper sulphate solution—4 ounces of the sulphate to 50 gallons of water. This is the Bordeaux mixture without the lime. If, however, scale insects are present, the lime and sulphur solution should be used for the winter treatment instead of the copper solution. Six or seven sprayings with the "Peach Bordeaux Mixture" should be given at intervals of two weeks, the first application being made before the buds swell. Arsenate of lead should be added to Bordeaux mixture to destroy the curculio. Spraying peach orchards so many times as here recommended means work, but the results will justify such treatment.

PEAR

Codling Moth, Bud Moth and Scab—Same as Apple, which see.

Pear-leaf Blight—This is a fungous affection which yields readily to Bordeaux mixture. Spray early in the spring, making two or three applications.

Pear Blight—This is a widespread disease which occurs especially in the South. It is caused by bacteria which work entirely within the tree and no spray application will do any good whatever. The bearing trees should be made to grow as slowly as possible. Prune only in summer. Winter pruning promotes growth, while summer pruning retards it. Cut off affected limbs considerably below point of infection and dip the pruning tools in a bichloride of mercury anticeptic solution after each operation. Any pruning without this precaution will tend to spread rather than lessen the disease.

PLUM

Curculio—This insect, shown in Fig. 28, is common in every State east of the Rocky Mountains. The adults eat the tender foliage for some time before the fruit is "stung" and owing to this fact we have a good remedy in arsenate of lead. The trees should be sprayed three or four times at intervals of ten days, making the first application before the buds have opened. In large orchards spraying will prevent injury to a great extent, as great numbers of the adult insects will be killed before the fruit is stung. Where only a few trees are sprayed the effect of the insecticide will be the same in killing the adult insects, but as others will come from surrounding trees which are not sprayed and will sting the fruit on the sprayed trees, the latter will still lose a good per cent of their fruit. *Spray the trees of an entire orchard, not simply a few of them.* In spraying for the curculio it is only necessary to add the arsenate of lead to Bordeaux mixture when spraying for the brown rot.

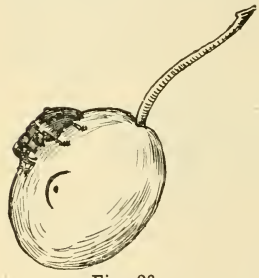

Fig. 28.
Plum Curculio.

Brown Rot—The same disease as in the Peach, which see.

The Plum-leaf Blight—This is a disease causing dark spots on the leaves and is especially prevalent in nursery rows. It is readily held in check with three or four applications of Bordeaux mixture.

Black Knot—This disease forms knotty excrescences on the twigs and small branches. Cut off and burn them as they appear.

POTATO (Irish)

Potato Beetle—Spray with arsenate of lead when the beetles appear in the spring, which will generally be as soon as the plants are out of the ground. If the first brood were destroyed in a neighborhood there would be few or no second broods.

Potato Blight—There are two fungous affections of the potato, known as the early and late blight, but the treatment for both diseases is the same. The Bordeaux mixture should be applied as soon as the vines are nearly half grown and other applications made as soon as the first applications are washed off by rain. The vines thus treated will remain green and healthy long after the others have died. As the tubers do not begin to form until after the plants have blossomed, it is readily seen that vines treated with Bordeaux mixture will have a longer period of growth, and thus yield much more than others. Arsenate of lead should be added to the Bordeaux mixture when the beetles are present. To increase the yield, potatoes should be sprayed with the Bordeaux mixture, whether potato diseases are present or not. Plate I shows the results of spraying Irish potatoes at the Vermont Experiment Station.

Scab—This causes the rough and uneven surface on the tubers and greatly lessens their market value. It may be prevented by treating the seed potatoes as follows: Dissolve 1 ounce of bichloride of mercury (corrosive sublimate) in 30 gallons of water. Put the seed potatoes in a coarse sack and immerse in the solution for two hours. The same solution may be used over and over again. It should be remembered that the bichloride is a violent poison, and precautions must be taken accordingly. *Do not place the solution in a metallic vessel.*

QUINCE

Fungous Disease—The quince is attacked by black rot, rust, leaf blight and fruit spot. These may be prevented by three applications of Bordeaux mixture at intervals of two or three weeks, making the first application early in May.

RASPBERRY

Anthracnose—This is a very serious disease, and causes the leaves to be much smaller than normal and the fruit to shrivel so much as to be worthless. The plants should receive three sprayings of Bordeaux mixture of one-half the usual strength; that is, with double the usual amount of water. The first application should be made before the leaves open and the others at intervals of two weeks.

The Orange Rust—The red, or orange powder, found on the plants early in the season is quite familiar to most growers. Where the plants are sprayed as given above for the anthracnose the orange rust will do but little, if any, damage.

ROSE

Aphis—Where many of these are present they materially check the development of the buds. Spray with 10 per cent kerosene emulsion, taking care to reach the under surface of the leaves.

Thrips—These are the small insects which feed on the buds before opening and are generally numerous in the spring. As the insects are largely concealed they are hard to reach with insecticides, but a spraying of kerosene emulsion will kill many of these tiny pests.

Slug—Spray with arsenate of lead.

Mildew—A common disease in greenhouses, especially where plants do not receive proper attention in the matter

of ventilation and water. Florists generally use sulphur fumigations twice a week. Spraying with Bordeaux mixture is also effective.

Rust—The rose rust causes dark spots upon the leaves, and plants affected with the disease do not thrive well, and have a sickly appearance. In spraying a large number of roses in New Orleans, in 1897, the author found that the regular application of Bordeaux mixture every three weeks entirely prevented the rust, and the treated plants appeared much more vigorous and healthy than others.

STRAWBERRY

Slug—Pale green worms which eat the leaves, especially on young plants. To destroy these worms spray with arsenate of lead. This, of course, should not be done during the bearing season.

Leaf Blight—This is a common diseased condition of the leaves, as shown in Plate III. It rarely attacks new and thrifty beds. The plants should be sprayed three or four times a year with Bordeaux mixture, making at least one application before the blossoms open.

SHADE TREES

Beetles and Caterpillars—A great variety of these leaf-eating insects attack various shade trees. Whenever present the trees should be sprayed with arsenate of lead.

Scale Insects—The shade trees of our large cities are rapidly becoming infested with various scale insects, the most injurious of which is the San José scale. All infested trees should be sprayed with kerosene emulsion or the winter treatment of lime and sulphur solution.

Fungous Diseases—There are many plant diseases which affect shade trees, but few of them do serious dam-

age. Affected trees should be sprayed with Bordeaux mixture.

SQUASH

Bug—This insect sucks the plant juice and is a very serious pest to squash growers. The young may be destroyed by the application of 10 per cent kerosene emulsion. The squash is a tender plant, and care should be exercised in the application of the oil. The adult bugs should be picked off and killed. A little careful attention at the right time will prevent damage.

TOBACCO

Horn Worm—This insect is quite prevalent and is very familiar to tobacco and tomato growers. The plants should be sprayed with arsenate of lead as soon as any worms are noticed. Several applications may be necessary during the season, and a knapsack is the most useful outfit for the purpose.

TOMATO

Horn Worm—This is the same as on the tobacco.

Rot—This disease first shows itself on the blossom end of the fruit when about half grown. Three or four applications of Bordeaux mixture should be made at intervals of two weeks, making the first application as soon as the fruit begins to set.

The Blight—This is a disease quite common in the lower South. It produces a wilting of the plants and is caused by bacteria—not fungi. No remedy for this disease is known. Tomatoes should not follow potatoes, melons, or tomatoes on the same land in case any wilting of any of these crops manifests itself.

CHAPTER V.

Summary of Spraying Domestic Animals

General Recommendations—Animals which are allowed to become infested with insects soon become weakened and emaciated. It should be remembered that insects upon domestic animals are *parasites,* which suck the life blood of the animal. The prevention of these insects is much better than a cure and on this account regular spraying of kennels, poultry houses and stables with some good disinfectant such as Kreso or similar products, which can be obtained at any drug store, is recommended.

CATTLE

Lice—Spray infested animals thoroughly with a one per cent solution of Kreso. Where a large number of cattle are to be treated a large vat in which to "dip" the animal can be used. Experiments have been made with large spraying machines, the cattle being driven through a covered way, spraying from all sides.

Ticks—These are very common pests in the South, and are the carriers of the Texas or "acclimation" fever. The infested animals should be sprayed with one per cent Kreso, care being taken to reach all parts of the hind quarters where the pests are most common.

Horn Flies—These pests are distributed over the entire United States. They are not so numerous now, however, as they were shortly after being introduced from Europe some twenty years ago, but there are always enough of them in a dairy herd to warrant a spray treatment. If the cattle are sprayed at milking time daily for six days with one per cent Kreso, the number of flies will

greatly decrease. The spray should be directed upon the flies and they will be killed as soon as the solution strikes them. The object of spraying on consecutive days is to kill the new flies which hatch from day to day, so that no new eggs will be laid. If several such consecutive treatments are given during the season, the number of flies about the animals will be greatly lessened; therefore no dairyman can afford to neglect this work.

CATS

Fleas—Spray or dip the animal, using two per cent solution of Kreso.

DOGS

Fleas—Same remedy as cats.

HOGS

Lice—There are several species attacking hogs, all of which may be readily killed by a spray of two per cent Kreso, or similar preparation of equal strength.

Fig. 29. Chicken Louse.

HORSES

Lice—There are several species which occur on horses and are to be found especially about the mane. Spray with one per cent Kreso.

POULTRY

Lice and Mites—The common poultry louse is shown in Fig. 29. It is quite easy to distinguish between the mites and the lice. The mites get on the hands of a person when working around a poultry house. They are lively little creatures and are constantly "on the go." The lice, however, are rarely seen unless looked for among the feathers. About nine-tenths of poultry diseases are pri-

marily caused by the mites and lice, so that the best method of keeping them under control is a matter of considerable importance. It is much easier to prevent mites and lice than it is to get rid of them after they once become abundant. The manure under the roosts should be removed about twice a month. Spray the poultry houses thoroughly once a month with a two per cent solution of Kreso or similar preparation. This treatment will prevent or destroy the chicken mites. Where the animals are at all infested with lice spray or dip thoroughly in a one per cent solution of Kreso or similar material.