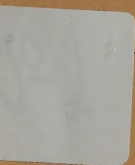


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BROTHER JONATHAN SERIES"—No. 2

TREATISE ON SPRAYING



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With Description of Insects Attacking
Apple, Peach and Strawberry, and
Treatment Recommended For
Holding Them in Check.
Formulae for Spray-
ing Mixtures.

By J. M. STEDMAN

Professor of Entomology, University of Missouri,
and Entomologist of Missouri Experiment Station.

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Brother Jonathan Series



Booklet No. 2

Preface

This little booklet is not intended to take the place of the more elaborate works upon injurious insects. It treats rather fully of the various insecticides in common use, together with the methods of making and applying the same, but discusses in a very brief way only the more common injurious insects attacking the apple, peach and strawberry plants, giving the best remedies for fighting each of these insects. By studying the first half of the booklet, one should be able to intelligently combat almost any ordinary injurious insect found on any of the common cultivated plants, even though the insect be not discussed in this work.

J. M. STEDMAN.

Entomological Laboratory, University of
Missouri, College of Agriculture and
Experiment Station, Columbia, Mo.

February, 1905.

Introduction

With very few exceptions, all insects start their existence as an egg which, as a rule, is deposited by the female upon or within some particular portion of some particular plant or animal, or other object. Some few insects bring forth living young instead of depositing eggs; as, for instance, some parasite flies and the noted San Jose Scale; but such instances are few, indeed, when compared with the vast number of insects that always deposit eggs.

The eggs of insects may be deposited singly or in rows, or in clusters of various shapes, which may be naked or covered with an excretion and form conspicuous objects. They also differ greatly in the time required for them to hatch. Some may hatch in a few days while others will not hatch for a year or more; as, for instance, Phasmidae or Walking-sticks.

Beginning with the egg, we find that insects develop to adults in two entirely different ways. It is frequently important from an economic standpoint to know by which method a particular insect develops.

In one case, known as **incomplete metamorphosis**, the egg hatches into an insect that looks very much like the adult, except it is smaller and has no wings. These young insects, known as Nymphs, feed, grow and cast their skins a number of times, each time appearing larger and more like the adult, and if they are to have wings, they become larger at each moult until the adult stage is reached, after which no insect moults again except, perhaps, Ephemeroidea. Examples of such development can be found

in grasshoppers, chinch bugs, bed bugs, plant lice and the like. By observing the Tarnished plant bug at Figs. 32, 33 and 34, one will see illustrated these incomplete stages in the method of development just described. Fig. 32, is the young nymph; Fig. 33, an intermediate stage of the nymph, and Fig. 34, the adult stage.

The important points to remember about insects developing by this method are that they feed continually from the time they hatch from the eggs until they die; that if they are sucking insects, that is take their food by piercing a plant or animal with their beaks and extracting sap or blood, or are biting insects, that is, take their food by eating away and swallowing portions of the tissue of the animal or plant, that in all cases they continue to thus take their food from the time they hatch from the eggs until they die as adults.

In the other cases, known as **complete metamorphosis**, the egg hatches into an insect that looks nothing like the adult, but resembles a worm, or grub, in appearance, and is called the larva. These larvae feed, grow and cast their skins a number of times, but still retain the worm-like appearance until they are ready to transform to the pupa stage. The pupa looks nothing like the larva or the adult, but is helpless and quite motionless, and takes no food whatever. It may be naked or enclosed in some kind of a covering or cocoon. After a time the pupa skin splits open and the adult insect emerges. Examples of such development are found in beetles, moths, flies and the like.

The important points to remember in regard to insects developing by **this method** are that, as a rule the feeding, and therefore injury, is done entirely in the larval stage, the adults rarely taking food; and



Fig. 1.—Colorado Potato Beetle. a, a, eggs; b, b, larvae; c, pupa; d, d, adult beetle.

that because the larvae usually have biting mouth parts and therefore eat away and swallow portions of the plant or animal they are feeding on, it does not follow that the adults will have the same kind of mouth parts. The larva may have biting mouth parts and the adult either biting or sucking mouth parts, according to the order to which it belongs. For example, the larva of the flat-headed apple-tree borer has biting mouth parts and the adult also, while the larva of the canker worm or the cabbage butterfly, has biting mouth parts, while the adult of each has sucking mouth parts. By observing the Colorado potato beetle in Fig. 1, one will notice the eggs, larvae in various stages, pupa and adult beetles illustrating the complete changes in the method of development just described.

INSECTICIDES.

Before one can hope to intelligently combat an insect, it is important to understand the life history and habits of that particular insect, from the depositing of the eggs to the development and natural death of the adult; and it is absolutely necessary to know the method by which the insect takes its food in all stages. In other words, it is of the utmost importance and absolutely essential to know definitely whether the insect you are to fight has biting or sucking mouth parts in the stage in which you are to combat it. On this apparently simple point depends almost entirely the method of procedure, so far as spraying or dusting is concerned, and it is right here that nine-tenths of all the failures to combat insects by methods of spraying or dusting fail.

Before you attempt to spray or dust, first determine absolutely whether or not you have a biting or a sucking insect to deal with. As it is not always an

easy matter for the horticulturist to determine this point by examining the insect through a magnifying glass he should rely, as a rule, entirely on an examination of the infested parts of the plant, where the insects are feeding. If he finds portions of the tissue removed, he knows it must have been done by a biting insect; while, if he finds no portions of the tissue removed, he knows the injury must have been caused by a sucking insect, having inserted its beak into the tissue and extracted the sap.

It is evident to all that if we cover the tissue of the plant with an arsenical poison, that just so long as that poison remains there any biting insect attacking that part of the plant will remove and swallow a portion of the tissue with its coating of poison and be killed, since a very small trace of any arsenical poison, if swallowed, is sufficient to kill most insects. On the other hand, it is equally evident to all that, no matter how much arsenical poison may be on a plant, if a sucking insect feeds there it will simply push its beak through the poison and into the tissue of the plant, suck the healthy sap below and get absolutely no poison into its body, and hence not be injured or killed. Since an arsenical poison does not injure an insect except it be swallowed by the insect, it is useless to try and kill a sucking insect with arsenical poisons, or any insect by simply covering the insect itself.

A sucking insect must be killed by some substance which will do its work when it touches the insect's body on the outside, and no arsenical poison will accomplish this purpose.

The various substances to be used in killing insects, together with the methods of preparing and applying them, are the following:

FOR BITING INSECTS.

Paris Green.

Paris green, when pure, is one of the best arsenical poisons for general purposes. It is a chemical combination of arsenic and copper and is theoretically insoluble in water. As a matter of fact, however, one finds in practice, that it usually contains a small per cent of soluble arsenic, and hence the necessity of adding lime to the spraying mixture in order to counteract the injurious effect of the trace of soluble arsenic on the foliage of many plants.

Unfortunately paris green is frequently adulterated to a greater or less degree, and hence it becomes necessary to be careful in purchasing this drug lest one fail in the result expected from its use. We have seen so-called paris green that did not contain a trace of any poison whatever, it being simply plaster of paris, colored with indigo and chrome yellow. Pure paris green should contain about 56 per cent arsenic in chemical combination with copper, and should contain little, if any, trace of soluble arsenic.

In many states laws have been passed to prevent this adulteration, the law requiring the paris green to contain 50 per cent arsenic. This law has led to another and even more serious difficulty, however, since in some instances, in order to bring the arsenic up to the standard required by law, common arsenic has been added, and as this is soluble in water, the use of such paris green has caused the death or injury of sprayed plants. Do not purchase cheap paris green, but be sure and get the best.

Test—Pure paris green will dissolve easily in strong ammonia and leave no residue, and the solu-

tion will have a deep blue color. If a residue is left, or if the solution does not look blue, adulteration may be suspected, although this test is not absolutely certain in all cases. This is the quickest and best test the general horticulturist can make.

The formula for the use of paris green is as follows:

Paris green, 1 pound.

Fresh stone lime, 3 pounds.

Water, 100 to 175 gallons.

The lime should be slaked in the usual way and added to the water, stirred and strained through cheese cloth. The paris green should be mixed with a little water to form a paste and then added to the lime water, stirring the while. The amount of water to be used will depend on the plant to be sprayed and the insect to be killed. For instance, if one is to spray only once for canker worm in an apple orchard, one pound of paris green and three pounds of lime should be added to 100 or 125 gallons of water, while if the apple orchard is to be sprayed for codling moth, which requires four sprayings, then one pound of Paris green and three pounds of lime should be added to 175 gallons of water. The different proportions to be used will be given under the discussion of each insect.

Since paris green is insoluble in water and settles to the bottom rapidly, it is absolutely essential that the liquid be kept constantly well stirred while the spraying is going on, otherwise the strength of the spray will not be constant.

If paris green is to be added to Bordeaux mixture, it should be done by regarding the Bordeaux mixture as so much water, adding the paris green and lime in the proper proportion.

Scheele's Green.

Scheele's green is an arsenate of copper that has great advantage over paris green in that it is a much finer powder and therefore remains suspended in water much longer, and does not require the constant stirring that paris green does. It will, in fact, stay suspended in water twenty-four times as long as paris green. It is to be used in the same proportion as paris green and the lime is also to be added. It can likewise be used in Bordeaux mixture, just as paris green is so used. In fact, Scheele's green is a perfect substitute for paris green as above stated.

Both paris green and Scheele's green can be applied as a liquid spray, according to the formula above indicated, either in water or in Bordeaux mixture, or they can be applied as a dry dust or powder by mixing them with lime dust or flour, as explained under the discussion "Dust Process."

Green Arsenite, or Arsenoid.

Green arsenite, or arsenoid, is a trade name given to a commercial substitute for Scheele's green and as its composition varies considerably, it is not so reliable or satisfactory to use as the original Scheele's green. It is to be used the same as paris green or Scheele's green.

London Purple.

Since London purple is a by-product from the manufacture of aniline dyes and is not made as a definite substance, its chemical composition varies from time to time, and hence cannot be relied upon to always give good or uniform results. It is an arsenite of lime, and is cheaper and remains in suspension longer than paris green, but not so long as Scheele's green. It is advisable not to use London purple when other arsenical poisons, such as good

paris green or Scheele's green, can be obtained. If it has to be used it should be mixed and applied by the same formula as given for paris green.

Arsenite of Lime.

As arsenite of lime must be made by the horticulturist by boiling arsenic and lime, and as its preparation is difficult and uncertain, and also as its use is attended with considerable risk, I will omit giving the formula for its preparation, and advise you to let it alone and to use arsenite of soda in its stead.

Arsenite of Soda.

An effort to find a cheap arsenical poison that could be relied upon not to be adulterated and that could be sprayed on plants without undue danger to the foliage, has resulted in the introduction of arsenite of soda, the formula and preparation of which is as follows:

White arsenic (powdered), 2 pounds.

Sal soda, 8 pounds.

Water, 2 gallons.

Boil 15 minutes.

The arsenic and sal soda should be added to the 2 gallons of water and a mark made on the vessel to indicate the exact position of the water. The vessel should then be placed on the fire and boiled vigorously for about 15 minutes, or until everything is dissolved. If any residue remains after 20 minutes of vigorous boiling some of the chemicals must have been impure. Remove the vessel from the fire and add water to make up the loss in boiling. Hence the necessity of having made the mark indicating the original height of the two gallons. The addition of sufficient water to make the original two gal-

ions is necessary since the solution is a concentrated one, and if less than two gallons of water is used the chemicals will crystallize out when the liquid cools, and ruin the mixture. This stock solution should now be placed in an earthen jug and properly labeled and the jug should never be used for any other purpose thereafter. This stock solution is of course deadly poison and should be kept in a safe place. It can be made up at any time, and will keep indefinitely if the jug be corked. When one wishes to use the arsenite of soda remember that two quarts of this stock solution is equivalent in poisoning properties to one pound of paris green; but unlike paris green it will injure the foliage in its present condition, and hence it is absolutely essential to slake eight pounds of fresh stone lime and add it to 100 to 175 gallons of water, stir and filter, and then add the two quarts of stock solution of arsenite of soda and stir thoroughly. There is very little danger attending the use of arsenite of soda in connection with the amount of lime indicated, because a chemical change takes place when the limewater and arsenite of soda are mixed, resulting in the production of arsenite of lime which is insoluble in water and cannot injure the foliage. This spraying mixture has no special advantage over pure paris green, except the fact that one is more certain of having pure chemicals and the proper amount of arsenic in order to kill the insects desired. If this substance is to be added to Bordeaux mixture it can be done by regarding the Bordeaux mixture as water and adding the eight pounds of fresh stone lime for every two quarts of the arsenite of soda.

Arsenate of Lead.

Arsenate of lead can be purchased in the market properly prepared under the trade name "Dispar-

ene," but commercial arsenate of lead must not be used, hence unless "Disparene" be purchased one must make his own arsenate of lead, according to the following formula:

Acetate of lead, 24 ounces.

Arsenate of soda, 8 ounces.

Water, 100 gallons.

Only the best chemicals should be used in the preparation of the arsenate of lead. First-class crystallized acetate of lead contains about 59 per cent available lead oxide, and first-class arsenate of soda should not contain more than 3 per cent chloride. The acetate of lead should be thoroughly dissolved in a half bucket of water, and the arsenate of soda thoroughly dissolved separately in still another half bucket of water. After both are thoroughly dissolved, turn them together into a receptacle, stir thoroughly, and allow it to remain over night. A chemical change takes place and there is formed arsenate of lead which will nearly fill the liquid with a white flocculent precipitate. Add all to the spraying tank containing 100 gallons of water, stir and it is ready for use.

Arsenate of lead has the following advantages over other arsenical poisons: First, it is not so liable to injure foliage, no matter how strong it be applied; secondly, it is easily prepared, does not require the use of lime and hence does not need to be strained; thirdly, it is very fine and flocculent and hence remains in suspension with very little stirring, and does not clog or stop up the spray nozzles; fourthly, it sticks much better on the foliage than any other arsenical spray, even after repeated rains, and as it is white, it is very easy to see just where and to what extent one has sprayed. I regard this

arsenate of lead as the best known arsenical poison with which to spray plants for biting insects.

Occasionally when some of the chemicals above given cannot be had nitrate of lead is used instead of acetate of lead, or arsenite of soda instead of arsenate of soda, but nitrate of lead and arsenite of soda are not used together. The formula and preparation is the same in all cases.

Powdered White Hellebore.

This substance is used as a substitute for arsenical poisons when one desires to spray plants, the fruit on which is about ripe and ready to eat, such as strawberries, raspberries and currants. It is made by pulverizing the roots of the white hellebore plant and will kill most biting insects that swallow it, provided it be fresh, but it soon loses its poisonous properties when exposed to the air on plants, and hence becomes harmless in a few days. In purchasing this powder one should be sure to purchase fresh material or at least freshly pulverized roots, otherwise it may have lost its poisonous properties before you wish to use it. It may be applied as a dry powder, dusted full strength on the plants, especially when a dew is on them, or it may be mixed with three parts of flour or air slaked lime, or it may be sprayed on the plants by mixing one pound with 50 gallons of water.

FOR SUCKING INSECTS.

Kerosene emulsion is the every-day insecticide to use in combating sucking insects, and must be made by the horticulturist at the time, or soon before the time, he wishes to do the spraying. The following formula for making kerosene emulsion must be followed exactly, since otherwise one will not make a complete emulsion:

Hard soap (preferably good whale-oil soap), one-half pound.

Kerosene, 2 gallons.

Water (soft), 1 gallon.

Churn ten minutes.

Add water, 19 gallons.

The hard soap should be cut up into small pieces and thoroughly dissolved in the one gallon of soft water by the use of heat. When the soap is thoroughly dissolved and the water boiling hot, remove the vessel from the fire and add two gallons of kerosene (coal oil). The receptacle should be large enough to contain about twice this amount of material. Remove the spray nozzle from the pump and churn this material thoroughly for ten minutes by pumping it back into itself. In a few minutes the material will look like milk, but one should not stop, but keep this churning up the whole time, otherwise a complete emulsion may not be formed. At the expiration of the ten minutes' churning, the material will be thick and creamy in consistency, and will now keep a long time without the kerosene separating and forming on top. When one desires to spray this stock emulsion should be added to 19 gallons of water and the whole stirred thoroughly. Should the stock emulsion be too thick and hard to mix readily with water, it can be heated slightly, but this heating should be done out doors, and one should be careful not to get the stock emulsion afire. The effectiveness of kerosene emulsion is improved by the addition of a pound of pyrethrum. In applying kerosene emulsion, pumps should be used that do not have rubber valves. If the pumps have spherical rubber valves you should remove them and substitute marbles, since the kerosene emulsion, especially when whale oil soap is used,

acts very rapidly on rubber. In making the kerosene emulsion any hard laundry soap will answer, but better results are obtained if good whale oil soap be substituted. There are a great many poor brands of whale oil soap on the market, and one will have great difficulty in making an emulsion from them. Good **Caustic Potash Whale Oil Soap** should be obtained, if possible.

Kerosene emulsion is troublesome to make, and for that reason many people do not use it when they should do so. Of recent years the better manufacturers of spray pumps have added an attachment to their pumps by means of which pure kerosene is placed in a special tank and the water or the Bordeaux mixture (either one containing arsenical poison if necessary) is placed in the barrel, and by means of an indicator the proper proportion of kerosene and water can be mixed and sprayed upon the plants. In general, the indicator should be set for ten per cent kerosene. Theoretically, this is a most excellent device, since it does away with all the trouble connected with the making of kerosene emulsion, and enables us to use the kerosene for sucking insects in connection with Bordeaux mixture and arsenical poisons, thus enabling us to spray with one operation for not only biting and sucking insects both, but for fungus diseases also. In most cases this mechanical mixture of kerosene and water kills insects much more readily than the emulsion and on most plants has no special injurious effect. Practically, however, these pumps cannot be absolutely depended upon to throw the percentage of kerosene and water indicated, nor to throw the same per cent continually. Occasionally one obtains a pump which will work satisfactorily, but more often the pumps need constant attention, lest they

spray too much kerosene or not enough. It is a good plan to thoroughly test a pump before taking it to the orchard, and even there to make a test at the end of each row to see that the pump is working properly all the time. The test is usually easily made by turning the spray into a glass jar and allowing the kerosene to separate and rise on top, when the variation from ten per cent kerosene can be easily determined. In general, pumps which have a separate pump for kerosene receptacle and another distinct pump for the liquid in the barrel, are preferable to those pumps which suck both kerosene and water through the same cylinder.

Whale Oil Soap.

It is frequently much quicker and handier to use whale oil soap than to make kerosene emulsion or to use the kerosene and water mixing pump. Soft bodied insects such as plant lice or aphids can be readily killed by a spray made by dissolving one pound of caustic potash whale oil soap in seven gallons of water. Here, again, it is important that the best whale oil soap be used. Many of the brands now on the market are practically useless. Whale oil soap used in the proportion I have just indicated is cheap and easily prepared and does not injure any of our ordinary plants. In spraying for the San Jose scale, whale oil soap is used in the proportion of two pounds of soap to one gallon of water. This proportion becomes quite expensive for a large orchard, although where only a few trees are to be sprayed it is not excessive. In order to dissolve the two pounds of whale oil soap in one gallon of water and keep it in the form of a liquid it is necessary to do the spraying while the solution is hot, and this is liable to eat up the rubber hose or any other rubber coming in contact with the same.

Tobacco Tea.

It is sometimes convenient to use tobacco tea for sucking insects instead of the kerosene emulsion or of the kerosene and water mixture, or even of the whale oil soap, although the tobacco tea does not give as good results in all cases. It is an excellent spray for plant lice, especially on small plants, and as it is easily prepared, it becomes useful where one does not have enough spraying to warrant the preparation of the kerosene emulsion. Any refuse tobacco, preferably the strippings or stems, should be used for this purpose, and in the following proportion:

Tobacco, 1 pound.

Water, 2 gallons.

The tobacco should be placed in cold water and the same boiled for a few minutes, after which it can be strained and the liquid or tea sprayed upon the plants. When one is using a large quantity of this material its killing properties can be increased by the addition of one pound of caustic potash whale oil soap to each fifty gallons of the tobacco tea. Tobacco tea as an insecticide for sucking insects should be used in preference to the kerosene preparations where one wishes to spray plants the fruit on which is nearly full grown or the leaves of which we are to eat, since the tobacco tea will not taint the leaves or the fruit, while kerosene emulsion or kerosene and water mechanically mixed will taint them so as to render them unfit for food.

Tobacco tea is an excellent thing for such plants as strawberries, raspberries, blackberries and the like, when the fruit is nearly grown.

Lime, Sulphur and Salt.

There are several different formulae used by fruit-growers and experiment stations combining lime,

sulphur and salt, or caustic soda, only two of which will be given here. The first one requires boiling by artificial heat and is as follows:

Lime, 15 pounds.
Sulphur, 15 pounds.
Salt, 15 pounds.
Water, 50 gallons.

The above mixture is prepared by slaking the lime to a thin whitewash and then adding the sulphur (which has previously been made into a paste by means of hot water), the whole is then stirred, and the salt (dissolved in enough water to readily dissolve it) is then added and the entire mixture boiled for two hours. After boiling for a sufficient length of time, enough hot water is added to bring the entire mixture up to fifty gallons. This spray is more effectual when applied hot. The time and method of applying will be given under "The San Jose Scale."

Experiments recently conducted at the Geneva, N. Y., Experiment Station go to show that the use of salt in connection with the lime and sulphur has no insecticidal effect whatever. They have, therefore, omitted the salt in the above formula and found that it killed the San Jose scale as effectually and as thoroughly and with no more injurious effect upon the trees than from those washes containing the salt. The method of preparation is the same as above given with the omission of the salt. Experiments conducted at the New Jersey Experiment Station, however, seem to indicate that the presence of salt has an advantage.

The second formula is as follows:

Lime, Sulphur and Soda.

Lime, 30 pounds.

Sulphur, 15 pounds.

Caustic soda, 6 pounds.

Water, 50 gallons.

As this mixture is prepared without artificial heat, the chemical heat of the mixture being depended upon entirely to convert the substance to the proper union, a somewhat different method of procedure becomes necessary. The lime should be placed in the proper tank and about six gallons of hot water turned over it. The sulphur is now made into a thin paste by means of hot water and as soon as the lime commences to slake the sulphur paste should be turned over it and the whole thoroughly and continually mixed. As soon as the lime is nearly slaked the caustic soda should be added and also hot water as needed to keep the material from becoming too hard or the stirring too difficult. It is also important that the mixture be stirred thoroughly during the boiling process after the caustic soda has been added. As soon as the chemical action has ceased the proper amount of hot water should be added to make the fifty gallons, and the whole thoroughly mixed. It is then ready to apply. This formula and the method of making the mixture without artificial heat originated with the Geneva, New York, Experiment Station. In some of my experiments and those of other experiment stations the self-boiled mixture has not always killed all the San Jose scale, while no difficulty of this nature has been experienced with the mixture requiring artificial boiling. The best fresh stone lime and the best caustic soda should be used in order to obtain the best results.

FOR BOTH BITING AND SUCKING INSECTS.

Pyrethrum.

Pyrethrum is a yellow colored powder made by pulverizing the flowers of the pyrethrum plant, and is one of our best insecticides. It undoubtedly owes its poisonous properties to a volatile oil, and while deadly poison to all kinds of insects,—especially when enclosed in a room or box,—it is absolutely harmless to man and all kinds of domesticated animals. It is absolutely essential in order to have success in the use of this material that one obtain absolutely fresh material, and also material that is pure. Pyrethrum powder loses its poisonous properties in a very short time, and hence cannot be kept over from one season to another, even in an air-tight jar. It is better to order this material as needed from some reliable wholesale drug house. It cannot be purchased for less than forty cents per pound, plus the carriage. There are on the market many insect powders of various names, which are nothing more nor less than pyrethrum adulterated with flour or other substances. These various powders should not be used by the horticulturist, and he should be careful in regard to adulteration, since pyrethrum is frequently mixed with flour, colored with chrome yellow, and an enormous profit made. Fresh pyrethrum powder can be applied as a dry powder either unadulterated or mixed with common flour in the proportion of one pound of pyrethrum to three pounds of flour, or it can be sprayed on the plants by mixing a pound of pyrethrum in three gallons of water. Pyrethrum has no injurious effects whatever on any plant. It is used more especially on strawberries and other small fruits when the same are ripening.

Carbon Bisulphide.

Carbon bisulphide is a clear liquid looking much like water, but it is very much heavier and evaporates immediately on exposure to the air. The fumes are heavier than the air and therefore settle to the bottom of the room, bin or box, and will not be disseminated through the same like gas. The fumes of bisulphide of carbon are deadly to all kinds of insect life, provided the air contains a sufficient quantity and the insects be confined, such as would be the case under ground or in a room or box. Bisulphide of carbon is one of the best insecticides we can use when the insects are thus confined in a closed place. The only precaution to be taken in the use of bisulphide of carbon is not to go into the room containing the fumes of this material with a lighted pipe or lantern, or any trace of a fire, or to handle or use bisulphide of carbon when a light of any kind is near; since an explosion may thereby occur. Bisulphide will not explode from handling.

It is well to know that bisulphide of carbon can be obtained from the manufacturers for ten cents a pound in fifty-pound drums. So far as the horticulturist is concerned, bisulphide of carbon is used principally for subterranean insects.

Where one wishes to kill the insects in a room or box, two pounds of the bisulphide of carbon should be placed in the **upper part** of the same for every one thousand cubic feet of room space, regardless of the amount of material to be fumigated. This can be done by saturating rags or by placing the liquid in shallow dishes. It will do no good to put the same on the floor. The room or box should be closed up for two to three days, and then opened up and allowed to air out thoroughly. All cracks

and crevices should be stopped up so far as possible in order not to have a circulation of air.

Hydrocyanic Acid Gas.

This is the most poisonous substance known, and great caution should be taken in regard to its use. The formula is as follows:

Sulphuric acid, 1-2 pound.

Water, 1 1-2 pounds.

Cyanide of potassium, 1-4 pound.

The amount above given is sufficient for six hundred cubic feet of room space, and more or less should be used according to the size of the room. The amount of material to be fumigated should not be taken into account in figuring the cubic contents of the room. The gas should be allowed to act from thirty to forty-five minutes, after which the fumigating chamber should be aired thoroughly before one enters the same. The better plan to follow is to place the water in a large, deep earthen vessel, such as a crock, then turn in the sulphuric acid slowly stirring the while, and when everything is all ready drop in the proper amount of cyanide of potassium and get out immediately, closing the room up tightly. Hydrocyanic acid gas is used more especially for fumigating nursery stock, small plants, greenhouses and the like.

METHODS OF APPLICATION OF INSECTICIDES. LIQUID PROCESS.

In most instances insecticides cannot be applied full strength either because of injury to the plants or because of undue waste of material. Therefore water has been used and is still generally used as a carrier for these substances, and, in most cases, is the best carrier known. It has some disadvantages, notably the great weight that must be carried about.

The water, however, can be managed perfectly under practically all conditions of weather, and can be thrown as a fine or coarse spray at will; it has the advantage of sticking upon the foliage of most plants, therefore causing the insecticide to remain fastened to the plant. Many insecticides cannot be applied to plants by any other carrier than water, and in nearly all cases water gives the most satisfactory results, although in a few instances it is not as convenient as dust.

THE DUST PROCESS.

Of recent years dust as a carrier for various insecticides has been used, especially in Missouri, and a vast amount of discussion has arisen in regard to the effectiveness of this process as compared with the liquid process. Air slaked lime in a finely powdered condition is the usual substance used as a carrier in the dust process, although for small plants flour or finely sifted wood ashes can be used.

The dust process cannot take the place of the liquid process for applying insecticides in all cases, but in many instances it is just as effectual, while in a few it seems to be more so. Where one has a number of small plants, such as cabbages, strawberries and the like, it frequently happens that the dust process is more effectual than the liquid, and also has an advantage over the liquid process in that it is much more easily handled. On the other hand, in spraying large orchard trees it is not so effectual, especially for the codling moth, as is the liquid process. However, there are a number of instances where it is practically impossible for the orchardist to spray the orchard at the proper time if compelled to use the liquid process. For instance, many orchards are located on steep hillsides, where it is

practically impossible for a team to draw a heavy load of water. The ground in other orchards is so soft during the spring that it is practically impossible to draw a heavily loaded water tank through the orchard. In still other orchards the location is such that it is impossible to obtain sufficient water for the spraying. In such instances, it becomes a matter of using the dust process or none at all. It is advisable, therefore, that this dust process be used in all such cases. The dust has a decided advantage over the liquid process in that it does not require anything like the bulk and weight to be carried through the orchard. In the garden this becomes unusually apparent where a person cannot readily use a barrel mounted on a cart. The dust process is so much lighter that a person can readily carry the machine and do the dusting that would require a barrel of water in case of the liquid process. The dust process also has an advantage in that, in many instances, it is much more readily made up, and many people will use a small hand dust machine where they will not go to the trouble of using a liquid one.

There are some precautions, however, in the use of the dust process that do not enter into the liquid. The paris green or other arsenical poisons used in the dust machines readily float in the air, and are blown a considerable distance by the wind, so that in dusting the trees one should be careful to see that the dust does not blow in the face, otherwise one is apt to inhale too much arsenical poison. The horses should also be kept away from the dust.

It is advisable in the use of dust to apply it early in the morning while the dew is on the plants, or soon after a rain, and it is also well to apply the dust when there is a slight breeze. The wind will carry the dust through the tree, so that it will not

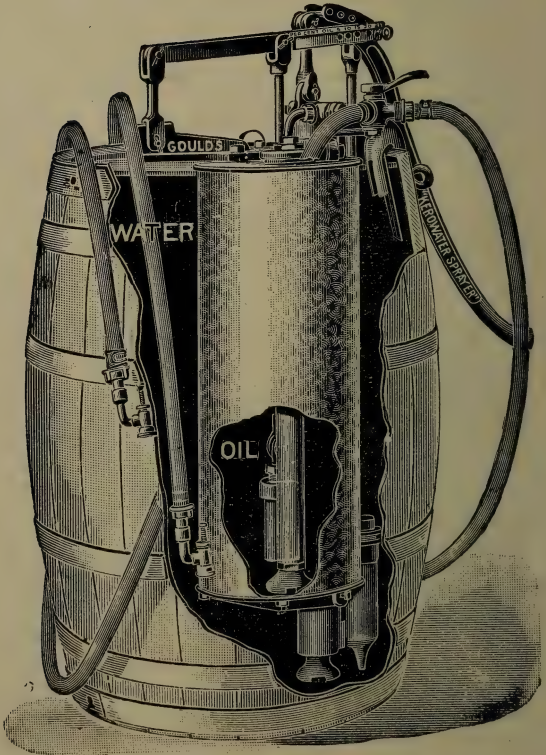


FIG. 2. Spray pump with kerosene attachment.

be necessary in all instances to dust from two sides. The dust, when properly made and applied, has a tendency to cover more surface than the liquid process with the same amount of work, but unless the plants be somewhat damp the dust has a less tendency to remain on them.

In making the various insecticides for dust machines it is advisable to use finely powdered lime as a carrier for the poison, although it is possible, especially with small plants, to use common flour, or finely sifted wood ashes.

In making the powdered lime, it is well to do so in the following way: Take ten pounds of fresh stone lime and break up the lumps so that they will be about the size of a hen's egg. Place these in a sieve, the bottom of which should be made of common wire mosquito netting, and sprinkle water slowly over this so that the lime will take up all the water. When it begins to slake stop pouring, and begin again when it becomes necessary to keep up the slaking; the idea being not to allow the water to drop down through the sieve, or to put on enough water to cause the lime to become putty. With very little experience one will soon learn to slake this lime in such a way as to cause the fine particles to drop down through the sieve as fine slake into the box underneath, and yet not wet the powdered lime that has fallen through. It is well to stir the lime in the sieve occasionally. About three quarts of water is required to properly slake the ten pounds of lime. After the lime is all slaked, and has been sifted through, cover the box over and allow it to heat for a time. If this process be properly conducted there will be no further need of sifting the lime, as it will all be in a fine, dry powder. This may now be kept indefinitely in a dry place.

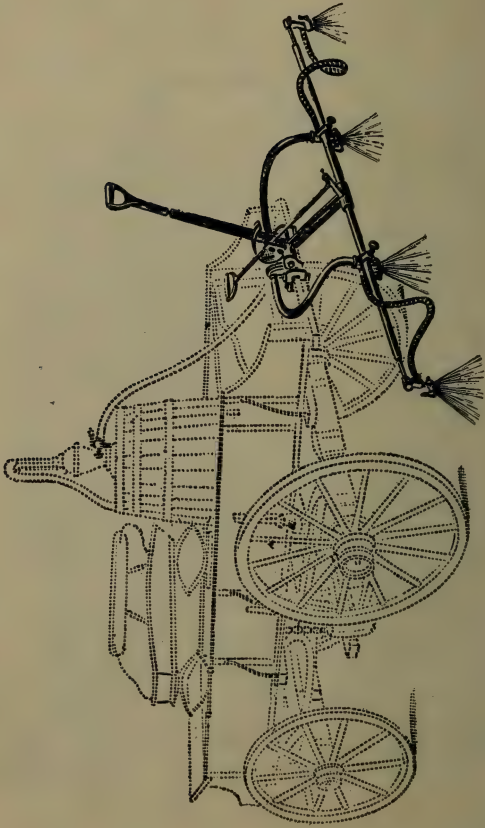


FIG. 3. The Field Sprayer, attachable to any wagon and used in connection with any force pump. For low plants such as strawberries.

When one wishes to spray for a biting insect, all that is necessary is to thoroughly mix a pound of paris green or Scheele's green with twenty to forty pounds of powdered lime, fill the machine and apply. It is possible with some machines to make this mixture twice as strong and yet not waste the insecticide, because of the fact that they can be so regulated as to allow but a certain amount to be applied. In the case of cabbage and potatoes, paris green or Scheele's green can be put into the machine without lime, and the machine so set as to dust one pound to the acre, but even here it is advisable to mix the insecticide with a few pounds of lime or flour.

One disadvantage in the use of dust sprays is that we are restricted in the use of insecticides to those that can be powdered. So far as my experiments go, I have not been able to use arsenate of lead or arsenite of soda with as little trouble as we can paris green or Scheele's green, and yet, in many instances, it is advisable to use the arsenite of soda or the arsenate of lead.

In the use of the dust process for sucking insects I have not had anything like as good success as can be obtained by the liquid process. It is possible to dissolve concentrated lye in the water that is to be used for slaking the lime, and thereby render the lime caustic enough to kill many insects by contact; but it does not have the wide killing power found in the use of kerosene, either as an emulsion or as a ten per cent mixture in water by means of the new spray pumps.

It will be seen from the above that the dust process has advantages, as well as disadvantages, over the liquid process, and that it cannot take the place of the liquid process in all cases in combating

the various insects. I advise all fruit-growers, agriculturists and especially gardeners to obtain at least a hand dust machine for use in connection with the liquid sprays. There are several machines now manufactured for the distribution of dust. Some of them

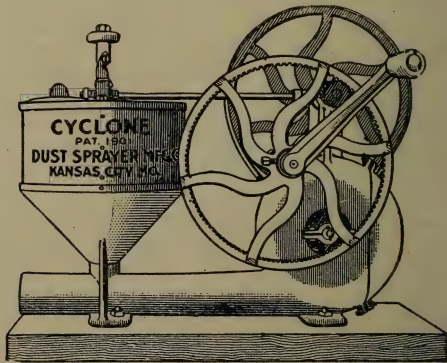


FIG. 4. Dust spray Machine.

have advantages over others, but, as a rule, the machines that use a crank power are better than those that use other methods of generating the air blast.

APPLICATION.

Whether one be using the liquid process or the dust process, thoroughness of work is of the first importance. This is especially the case where a liquid spray is being used to combat sucking insects, because here one must touch each insect itself in order to kill it, and nothing short of the most thorough work will accomplish the best result. In using the liquid process one should exert as much pressure

as possible in order to throw as fine a spray and with as much force as can be accomplished by a hand machine. It is impossible for hand spray pumps to spray as fine a spray and to throw the

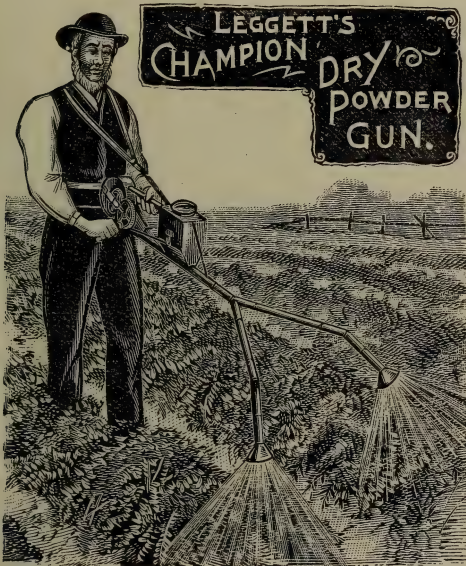


FIG. 5. Hand Dust Spray Machine.

same with as much force, as automatic or gasoline machine; but one should keep as much pressure in the pump as possible. It is a well known fact that the finer the spray the more evenly distributed will be the insecticide, and, other things being equal, the

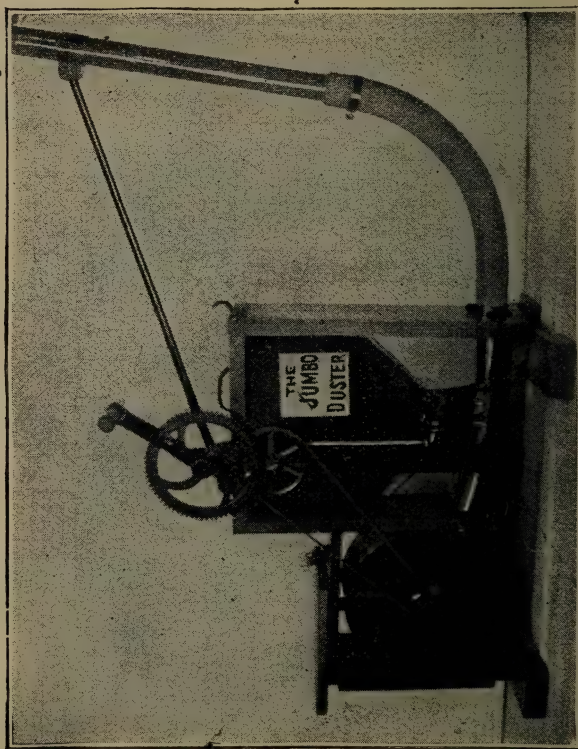


FIG. 6. Large Orchard Dust Spray Machine.

more thorough the work; and it is also a well known fact that the finer the spray the more insecticide one can cause to remain on the plant, provided one does not spray long enough to cause the material to

form in drops and run off the leaves. It is, therefore, always advisable not to spray a plant until the liquid runs off on the ground, but to stop just before the accumulation in large drops occurs.

Of course this does not apply to the dust process. It is also important in using most insecticides with the liquid process to keep the material constantly well stirred during the entire spraying operation, otherwise some of the material will settle to the bottom, and the spray will not be uniform or give satisfactory results. This is especially the case in using paris green or London purple.

MACHINES FOR APPLYING INSECTICIDES.

There are a great many different machines on the market for applying various insecticides, either liquid or dust, and the price is as varied as the machines. It is always advisable to purchase the best makes of pumps or machines, since in the long run they are very much cheaper, will cause less annoyance and delay and bring you in better returns in the end. There are a number of different manufacturers making excellent pumps or machines, any one of which is about as good as the other. One should, in buying a pump, obtain one that has metal valves, and all parts of the pump in which the liquid comes in contact made of brass. The so-called rotary or clock pumps are not as satisfactory as others. One should write to a number of the better manufacturers and obtain their catalogues and make his own selection, regardless of price. Pumps for applying liquid sprays are shown in Figs. 2 and 3; and machines for applying dust are shown in Figs. 4, 5 and 6.

INSECTS INJURIOUS TO THE APPLE.
ATTACKING THE ROOTS.

WOOLLY APHIS.

Schizoneura lanigera, (Hausm.)

This insect is so well known to all apple growers that it needs no scientific description. A very brief statement of its life history may, however, be useful. The adult insects are found in two forms, as can be seen by carefully examining a colony late in the summer. One form has wings and does not excrete the downy matter (See Fig. 7 A), while the other and more numerous form has no wings and excretes from the pores on its abdomen the bluish-white downy or cottony matter that covers the insect and renders it so conspicuous (See Fig. 7 C). If this downy substance be touched it will be easily removed from the insect, which will immediately excrete more. Figure 7A represents a winged form, which is an agamic female; B, a wingless, or apterous, form, with the downy matter removed; and C, one with a small amount attached. Both B and C are apterous agamic females. All three of these figures represent the females magnified, while the hair lines under the winged and between the wingless forms represent the natural size of each respectively.

The solitary eggs of this woolly aphid may be found during the winter in the crevices of the bark at or near the base of the tree, where they are usually seen completely enveloped in the dead skin of the mother, who lays a single egg. In the spring these eggs hatch into wingless agamic females, like the ones figured at B and C. These females then bring forth living young rapidly and without males—parthenogenetically. These young are always

wingless agamic females. Their offspring do likewise. This is continued during the summer, each generation being apterous agamic females only. Towards the latter part of the summer winged agamic females are developed (see Fig. 7A). Some of the winged forms leave the infested tree and fly to

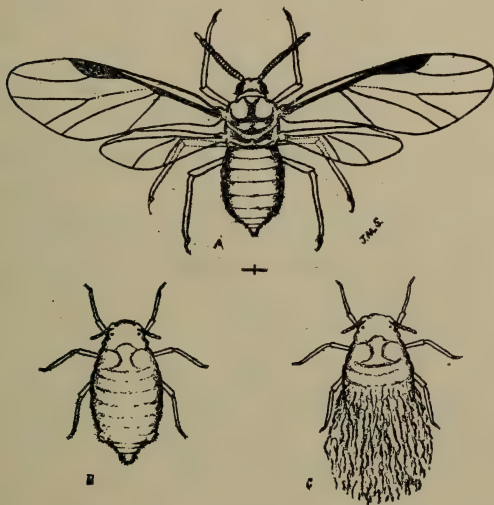


FIG. 7. Woolly-Aphis of the apple, *Schizoneura lanigera*, magnified; a, winged agamic female; b, c, apterous or wingless agamic females. (Stedman.)

other trees, where they establish another colony by bringing forth living young. Late in the fall, towards the approach of cold weather, some of the agamic females bring forth living wingless and mouthless true males and females. These pair, and

the females each develop a single fertilized egg and perish.

Each aphid, whether winged or wingless, is independent and derives its nourishment by piercing the bark with its long beak or mouth parts and sucking the sap below.

North of the Missouri river most of the woolly aphid perish during the severe cold of winter, and the eggs are frequently the only means of continuing the species the following summer. South of the Missouri river, however, the aphids themselves are usually able to hibernate in large numbers, and hence it is that we find this pest so much more numerous in the southern half of the United States. Each hibernating aphid commences to bring forth living apterous agamic females just as soon as warm weather is established and as hundreds of them may hibernate on the roots of a single tree, it is readily understood why this insect is so much more numerous south of the Missouri river.

The woolly aphid is found not only infesting the roots, but may occur also on the trunk or limbs where its presence is readily detected by the bluish-white cottony or downy looking substance that is excreted and covers the greater part of each wingless aphid; and since these insects live in clusters or colonies, the patches of white matter are very conspicuous, and can scarcely escape the notice of even the most casual observer. In the central part of the United States the woolly aphid occurs more especially and does its greatest damage by infesting the roots, while in some of the eastern states, and especially in Europe and Australia, the presence of these insects above the ground frequently kills the trees outright. The woolly aphid is frequently artificially induced to attack the trunk by mulching or by using wrappers around the base of the tree as

a protection against borers and rabbits. But whatever may be the cause of their presence above the ground, the result is the same, viz., to cause an abnormal growth of the infested portion, resulting in the formation of a rough and pitted surface known as a gall.

The presence of the root-inhabiting form is readily detected by removing the earth from the roots of the infested tree. The appearance of the bluish-white or mildew-looking substance, or of knotty and distorted roots, will indicate its presence. It is this root or subterranean form that causes so much damage to the apple orchards throughout the greater part of the United States, and also to apple nursery stock.

The woolly aphid sucking the juices from the roots of the apple tree causes an abnormal growth of the attacked portion of the roots, resulting in the formation of gall-like swellings or excrescence. These swellings are usually irregular and knotty in appearance, and sometimes attain considerable size, while that portion of the roots between the excrescences is frequently undeveloped. Fig. 8, which is a photograph of two such roots, will give one a good idea of the attacked portion. The woolly aphid and the dirt were removed in order to show the exact condition of the roots themselves.

The woolly aphid will be found in large numbers and in clusters over the surface of the swellings, and especially between them in the numerous crevices that the larger excrescences contain. The roots thus attacked, distorted and swollen, soon begin to decompose. Saprophytic fungi and bacteria enter the dead and decaying portions and help to hasten the work, and soon that portion of the root perishes. Sometimes the roots seem to be killed outright by



FIG. 8. Roots from a two-year-old apple tree, showing the abnormal growths and knotty excrescence caused by the Woolly-Aphis. (Stedman.)

the immense numbers of aphid sucking the sap and causing the abnormal growth. As the woolly aphid attacks in immense numbers the main roots at or near the trunk, and as these roots are usually eventually killed and then rapidly decay, the tree loses its support and falls with the first wind.

The infested apple tree appears sickly, it does not grow as it should. Its leaves are less numerous, and they have more of a pale green or yellowish color than is natural, and finally the tree dies outright or is blown over with the first wind. In nursery stock the damage usually comes directly from the excrescences or galls that are formed upon the roots, and which makes such trees unsalable, although they may not contain aphids or their eggs. No variety of apple tree seems to be exempt from the attack of the woolly aphid, nor does the age of the tree make any difference. It attacks and injures alike, seedlings, nursery stock, young and old bearing trees, although old trees appear to withstand this pest much better than young ones.

Remedies.—The aerial form of the woolly aphid can be easily killed by one or two thorough sprayings with kerosene emulsion. If these aphids are on the trunk only, as frequently happens when the wooden wrappers are used against the attack of borers, they can be killed by washing the trunk with the emulsion by means of a whitewash brush.

The root inhabiting form can be killed by removing the earth from about the trunk of the tree for some two feet and about four inches in depth, and filling this space in with a liberal supply of tobacco dust, then covering it over with the earth again. The rains will wash the nicotine down about the roots and kill the aphids and prevent others from entering. It is important that ground tobacco or tobacco dust be used for this purpose, since chopped up stems and refuse tobacco not in a finely divided state will not answer the purpose. While this powdered tobacco should be placed about the tree, as suggested, as soon as indications of injury appear, nevertheless the best results are obtained by put-

ting this tobacco dust about the trees, as indicated, early in the summer, when the first settled warm weather appears. One will thus kill the hibernating aphids, or the young that may hatch, before a colony has been established and more or less injury accomplished.

In sections of the country where the woolly aphid is extremely troublesome, it is always a good plan to put a liberal supply of tobacco dust about the roots of the young trees while setting them out, and then each spring to place about the trees in the manner suggested a liberal supply of tobacco dust, especially if any indications appear of an undue number of aphids. The tobacco dust not only kills the aphid and prevents others from attacking the trees that year, but it also acts as an excellent fertilizer. The use of bisulphide of carbon injected into the ground a foot and a half away from the trunk and main roots will kill the woolly aphid, but will not prevent others from reinfesting the tree in a short time; hence it is advisable to resort to the use of tobacco dust in the first place. The use of hot water or kerosene emulsion turned about the roots is not advisable. From my experiments with this insect I can say that the use of tobacco dust as above indicated is far superior to any other or all methods.

ATTACKING THE TRUNK, LIMBS AND STEMS. ROUND-HEADED APPLE TREE BORER.

Saperda candida, Fab.

The adult of the round-headed apple tree borer is a beautiful long-horned beetle. It is from three-fourths to nearly an inch in length, and with the antennae or feelers nearly as long as the body. The under surface of the body is silvery white, while the

upper surface is light brown with two white stripes running from the head to the tip of the wing covers; the legs and antennae are gray. A picture of one of these adult beetles is shown in Fig. 9c, natural size.

The adult beetles emerge about the last of May as a rule, but vary a month or so in emerging, and as a result they are nearly two months in depositing their eggs. The eggs are deposited at night, usually in the bark of the trunk near the base, but may sometimes be deposited higher up, and even in the

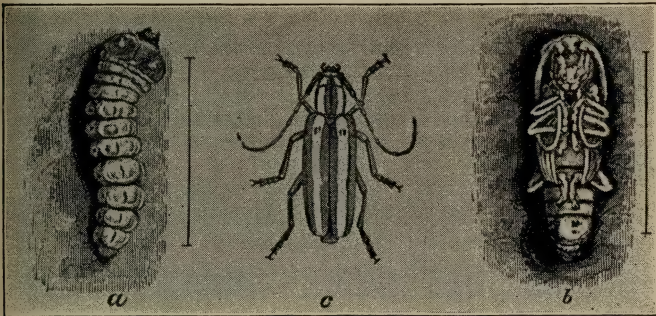


FIG. 9. Round-Headed Apple-tree borer, *Saperda candida* Fab.; a, larva; b, pupa; c, adult.

limbs. The larvae or borers on hatching burrow in the sap wood for the first season, and, if the tree be young or there be several in the tree, they may girdle it. The second year the borers usually work more or less into the heart wood, and the third year they gnaw out towards the bark, where a cocoon is made within the tunnel out of their excrement

and gnawings, and within this the pupa stage is passed. The adults on hatching eat their way out and escape. One can tell whether a round-headed or a flat-headed apple tree borer be in the tree by the presence of gnawings or droppings that accumulate about the base of the infested tree, and by digging into the tree, or by observing the holes out of which the adults emerge, one can determine which of these two borers he has to deal with; the round-headed borer, both in the adult and larval condition, makes a round hole, while the flat-headed borer, both in the adult and larval condition, makes an oblong burrow.

Thus it will be seen that it requires three years from the time the egg is deposited until the adult round-headed apple tree borer appears, the borer being within the tree all this time. Fig. 9a shows a picture of the larva of the round-headed borer, natural size, and figure 9b a picture of the pupa, natural size.

The round-headed apple tree borer also works in the pear and quince, and in fact in nearly all members of the family Pomaceae.

Remedies.—The methods of combating the round-headed apple tree borer may be divided into three classes, viz., destroying the borers, mechanical barriers, protective washes. In no case should one rely upon any one of these methods, and especially where the borers are very troublesome, all three methods should be resorted to.

Every year about the last of August or during the first of September one should go through the orchard and by means of a sharp knife dig out and kill the borers before they have mined too far or have done much damage; sometimes a wire will be useful. Kerosene gradually turned into their holes

is sometimes successful, especially where capillary attraction will carry the oil through the castings which fill up the burrows and thereby reach the larva and kill it.

Wire gauze or mosquito netting or thin wooden wrappers are of value, and should be placed about the base of the trunk in the early spring before the adults emerge. The wooden wrappers are satisfactory, and, as they can be purchased for about three dollars per thousand from box and basket makers, they are now the most economical. They should be pushed down into the ground so that the adults cannot burrow under to deposit their eggs, and the tops should be stopped up with cotton wool in order to prevent them from entering there. Young trees should be thus protected. These wrappers are also of value in preventing "sun scald" during the summer, and in the winter they will keep rabbits away.

Protective washes of various kinds are used to a great extent. There are many patent washes on the market, some of which are of value, but the great bulk of which are useless, and all of them are expensive. I have found that the following wash is as effectual as any, and is extremely cheap, and one can do no better than to use this mixture in preference to any patent wash yet placed upon the market, regardless of price:

Dissolve as much common washing soda as possible in six gallons of water; then dissolve one gallon of ordinary soft soap in the above; slake a quantity of lime to a thick paste and add enough of this to the above mixture to make a thick white-wash, which will stay upon the trees an eighth of an inch or so in thickness. It is better to scrape off all the loose bark possible from the trunks and main limbs of the trees, and also remove the earth

from the base and scrape the loose bark from this. Apply the wash liberally from the main limbs to the ground, covering all portions of the bark. The dirt can then be placed about the base of the tree as before. The use of powdered sulphur has no effect whatever as regards insects, and hence can just as well be omitted from these washes.

It must be understood that these washes have no effect upon the borers once they are under the bark; they act as repellants and prevent the adults from depositing their eggs. Washes must be applied in the spring before the adults appear, and again in about three weeks or oftener if necessary; the application should be made by means of a white-wash brush. All cracks and crevices in the bark must be filled and the bark thoroughly and completely covered.

THE FLAT-HEADED APPLE TREE BORER.

Chrysobothris femorata, Fab.

The adult of the flat-headed apple tree borer is a beetle measuring about one-half an inch in length; the upper surface is of a dark, metallic brown color, and the under surface is of a coppery brown color. A picture of one of these adult beetles is shown in Fig. 10d; at a, the larva or borer, and at b, the pupa.

The adults appear in the spring at practically the same time as those of the round-headed borer, but differ much from them in their habits. The beetles deposit their eggs during the daytime upon the bark and limbs of trees; the larva and borers usually mining and feeding in the sap wood. They hibernate on the approach of cold weather, and the next spring make their pupae within the infested tree, and the adults ultimately emerge by eating their

way out. Both the larvae and the adults make an oblong shaped burrow in cross section. Thus it will be seen the flat-headed borer lives only one year within the tree. It is usually not as destructive an insect as the round-headed borer, and is largely found in the limbs, sometimes in considerable numbers; and is more apt to attack injured and dying than perfectly healthy trees. Its range of food plants is quite large, including besides the apple, the

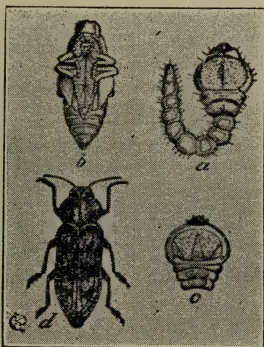


FIG. 10. Flat-Headed Apple-Tree Borer, *Chrysobothris femorata* Fab.; a, larva; b, pupa; d, adult, natural size.

peach, plum, pear, oak, hickory, chestnut, maple, box elder, sycamore, linden and willow.

Remedies.—While the life history and habits of this insect differ considerably from those of the round-headed apple tree borer, the methods of fighting it and the remedies are the same. These are given under the round-headed apple tree borer.

FRUIT TREE BARK-BEETLE.

Scolytus rugulosus, Ratz.

The fruit tree bark-beetle was introduced into the United States from Europe about 1870, and it has since spread over the eastern portion of the United States from Kansas to Massachusetts, and from Michigan to Alabama. The beetle attacks the plum, cherry, apricot, nectarine, peach, apple, pear and quince, but the greatest amount of injury seems to be done in the apple orchard, probably because it is the more abundant fruit.

The beetle prefers and will attack first of all those trees or parts of trees that are injured, weakened or dying from any cause whatever. I have, however, seen many trees infested with this insect that were apparently as healthy and sound as any tree could be; but the insect undoubtedly prefers unhealthy trees to healthy ones, attacking the perfectly healthy trees only when the insects become unduly numerous. It matters not what causes the injury to the tree, as long as it is not in a perfectly healthy condition the insects readily attack it. This is the case with neglected orchards, where the trees are weakened from undue attacks from borers or woolly aphis, or a lack of cultivation and fertilization, or from severe drought. A perfectly healthy and vigorous tree will frequently repel the attacks of the fruit tree bark-beetle by the copious flow and exudation of sap. This is especially the case with the stone fruits, where the beetles appear to be driven away by this means, and are unable to burrow to any considerable distance below the bark and deposit their eggs.

When the beetles attack a comparatively small limb, perhaps the first indication will be a wither-

ing of the leaves, while a closer examination will show the bark to be more or less shriveled, as can be seen by referring to the photograph in Fig. 11; and later, when the adult beetles emerge, by the small "shot holes," which will be conspicuous. If the beetles attack a large limb or trunk, the work may go on for some time before it is observed; but usually one will detect the flow of sap, especially if it be a stone fruit-tree, where the exudation of drops of gum will be sure to attract attention, and may



FIG. 11. Photograph of a portion of an apple-tree twig infested with the fruit-tree bark-beetle, showing the "pin holes" or "shot holes" and the shriveled bark. Natural size. (Stedman.)

even be very conspicuous and run down the tree to the ground.

The fruit-tree bark beetle is a small, cylindrical beetle about one-tenth of an inch in length and one-third as wide as it is long; nearly or quite black in color, with the very tips of the elytra or wing covers and portions of the legs reddish brown. Under a hand lens one can make out the peculiar markings

on the back, and the short hairs on the head and wing covers. A fair idea of the general appearance of these beetles as seen under a lens can be had by observing the drawing of one magnified in Fig. 12a, while a side view outline is shown in Fig. 12b.

The adult beetles begin to emerge about the last of March in most seasons, and may soon begin to feed by eating small round holes through the bark of the tree. These holes are usually made near the base of the larger limbs and about forks and old scars or lateral spurs, but are also common on the smaller limbs, and even on the smaller twigs; while

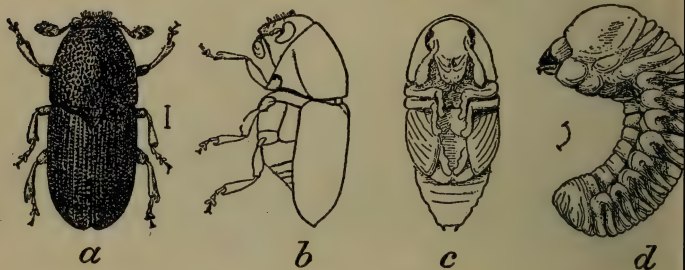


FIG. 12. The Fruit-Tree Bark-Beetle, *Scolytus rugulosus* Ratz, a, adult beetle; b, same in profile; c, pupa; d, larva. All magnified about ten times. (From Chittenden, Circular 29, Div. Entomology, U. S. Dept. of Agriculture.)

in badly infested trees they may occur on the trunk as far down as to within a short distance of the ground. The holes through the bark are small, not much larger than the cross section of a large pin, or about one-eighteenth of an inch in diameter; and for this reason are frequently spoken of as "pin holes," and the beetles are the "pin-hole beetle." Where these holes are very numerous they give the limbs the appearance of having been shot, or pep-

pered full of holes with fine bird shot, and this again has led to another common name for the beetles—"shot hole borers." Fig. 11 shows the appearance of a twig, natural size, infested with these beetles, and the holes and shriveling of the bark can be seen fairly well.

The first holes are made by the adult beetles that eat directly through the bark until they reach the wood; then they tunnel between the bark and the wood, making a hole from an inch to an inch and a half in length and slightly larger than the insect. This burrow is almost invariably in the direction of the long axis of the limb, or very slightly oblique, and is made in the cambium layer, including a little of the wood on one side and a little of the bark on the other. As the female makes this burrow, which is known as the brood chamber, she deposits her eggs to the right and left along its course.

The minute grubs hatching from these eggs eat little tunnels or side galleries at right angles to the brood chamber, likewise keeping in the cambium layer and including a little of the wood and a little of the bark. As they increase in size they make the burrows larger in size accordingly, and soon begin to turn the tunnels in the direction of the long axis of the limb and parallel to the brood chamber. These side galleries are lengthened as the larvae feed until they are about as long as the brood chamber, or possibly longer, by which time the grubs have become full grown larvae. They are small, white, footless grubs, with brown heads, one of which is represented magnified in Fig. 12d. They then eat a little deeper into the wood and thus make a small chamber, known as the pupal chamber, stopping up the entrance with pieces of wood, and

there change to pupae. A pupae is represented magnified in Fig. 12c.

When the adult beetles emerge they simply eat through the bark and escape. Thus it is that the limbs become so full of small holes through the bark; and as each female deposits about eighty eggs, as can be readily determined by counting the side galleries of the brood chambers, one can readily imagine the result when the adults emerge. From a short section of a limb, one-half of which is photographed in Fig. 11, there emerged one hundred and sixty-seven adult beetles of one brood.

As the great bulk of the young beetles soon attack the same tree from which they emerged, and eat holes through the bark and burrow in order to deposit their eggs for another brood, it can be readily understood that it does not require much time before these insects have completely undermined the bark, and by destroying the cambium layer, have killed the limb above the infested place.

By removing the bark from an infested limb one can readily see the shape of the burrows engraved upon the limb and upon the bark; and where the limb is badly infested one will find the galleries so close together and so interwoven that it is difficult to trace the work of a single family.

This beetle has three and sometimes four broods during a season, each brood requiring on an average five weeks for its completion; but as the beetles do not all emerge at once, and vary considerably in a single tree, the result is the different broods tend to overlap somewhat. The beetles all perish in the fall, the winter being passed by the larva stage within the infested trees, and this, no doubt, is the key to successful combating this pest. These hibernating larvae transform to pupae early in the

spring and emerge from the tree as adult beetles about the latter part of March.

Remedies.—The fruit-tree bark-beetle is more difficult to control than other fruit-tree borers. From the habits of the insects one can readily see that the most essential thing to be done is to keep the trees in a perfectly healthy and vigorous condition, and free from any injury or weakness, or from injured, weakened or dying parts. This can be done by careful cultivation and fertilization and by clean culture. Although this pest will infest perfectly healthy trees, especially when the insects are in undue numbers, nevertheless it is so much more liable to attack weakened or dying trees, that it becomes important that clean culture be practiced, at least insofar as to remove from the orchard and burn all dead and dying trees or portions of trees. The sooner this can be done the better. If for any reason it has not been done during the summer it must certainly be done during the winter; and all such limbs and trees burned before March, thereby destroying the insects before they emerge. When a tree or a portion of a tree is seen to be dying from the attack of these insects, it is useless to try and save it, and it should be removed and burned at once.

While the cutting out and burning of unhealthy and attacked trees or portions of trees is of the greatest importance and the best method of combating these insects, nevertheless I have used a wash in many instances with good results in keeping the beetles away from the unattacked and healthy portions of trees. The cheapest and best wash is made by dissolving as much common washing soda as possible in six gallons of soft water; then dissolve one gallon of ordinary soft soap in the above; and after

slaking lime to a thick paste, add enough lime to the soda and soap water to make a thick wash. This is to be applied to the main limbs and to the trunk, after having removed the loose bark as much as possible. This wash should not be relied upon to keep these insects out of the trees, but should be used in connection with the cutting out and burning of infested and diseased trees and portions of trees. The above wash has been successfully applied to trees about the last of March by means of a force pump, but in this instance the wash cannot be applied in as thick a condition as with a white-wash brush, and the mixture must, therefore, be thinned with water and strained through cheese cloth or gunny sack, otherwise it will stop up the spray nozzles. This method of spraying the trees is a vigorous and expensive one, and should not be resorted to except in extreme cases. Should one discover that the beetles have just attacked a tree where one can get at it, they may be killed by touching their entrances with a sponge or rag saturated with a mixture of creosote oil one part, turpentine two parts.

TWIG PRUNER.

Elaphidion villosum, Fabr.

This insect, in the adult condition, is a long-horned beetle, about three-fourths of an inch in length; of a long, cylindrical shape and of a dull, dark-brown color. While these beetles breed normally in oak trees, sometimes in overwhelming numbers, they also do considerable damage in the apple orchard, especially where the orchard be near infested forests.

The female beetle lays her egg in the axil of a leaf, on a young twig. When the egg hatches, the larva bores into the young twig and down the center of the same towards the main twig, after reaching which it bores down the main twig, feeding upon the wood as it goes, and enlarging its burrow as the larva increases in size. When the larva is nearly full grown, by which time it has probably mined nine inches or so down the stem, it then suddenly enlarges its burrow, eating away the wood fibers to the bark, or in some cases leaving a few wood fibers, and then crawls up its burrow and stops up the entrance by means of its gnawings of wood. The larva then feeds in the upper part of the burrow for some time. The first good wind causes the twig to break off and drop to the ground.

By fall the larva becomes full grown, and may then either hibernate in its burrow, or may transform to a pupa in the same and pass the winter in that stage. As a rule, however, the larva hibernates and transforms to a pupa in the spring, the adult emerging in June.

Remedies.—As this is one of the many insects normally living in the forests, and attacking orchard trees in damaging numbers only when the same are near forests, and as it is difficult for us to fight this insect in any other way than to pick up the fallen twigs containing the insects in the larval or pupal condition and destroy the same by burning, it becomes a serious matter to try and fight this insect, because of the fact that the forests near by are so overwhelmingly full of these insects that anything you can do along this line is of very little use. The insects come right over into our orchards from the forests and it is impossible for us to fight them there. Where these insects become trouble-

some in orchards away from forests, or away from numbers of oak trees, then the picking up and burning of fallen twigs will do a great amount of good. Many species of birds, especially the wood peckers, sap suckers and the like, dig out and devour great numbers of these insects, especially in the forests.

TWIG GIRDLER.

Oncideres cingulatus, Say.

This insect, in the adult condition, is a long-horned beetle about a half inch in length, and of a brownish-gray color. Like the twig-pruner, this insect is also normally found in the forests where it feeds upon dead hickory limbs. And again, where the orchards are near forests, this beetle gets into them in undue numbers and causes injury by likewise severely pruning the apple trees.

This pruning process, however, is quite different from that described under the twig-pruner. The female twig-girdler deposits her eggs through the bark of the twigs, and then, knowing that the larvae must have dead wood upon which to feed, she goes down some distance below the eggs, and by means of her mandibles, girdles the twig completely, by eating through the bark and into the wood. This not only kills the twig above, thus giving the larvae dead wood to feed upon, which they do by mining the twig and passing their transformations in the same, but the first good wind breaks the twigs off so that they fall to the ground.

Remedies.—The same statements as given under the remedies for the twig-pruner apply here to the twig-girdler. Only when the orchards are some distance from forests do we find any satisfaction in trying to fight these insects.

NEW YORK WEEVIL.

Ithycerus noveboracensis, Forster.

This insect, in the adult condition, is a snout-beetle or curculio, about one-half inch in length, of an ash-gray color, marked with black. These beetles in the adult condition get into our orchards during May and June especially, and injure the trees by eating the buds and also the bark off the tender shoots, thus killing them. Later they eat the young leaves entirely off just at their base and feed upon the terminal shoot. This insect also attacks the peach, plum, cherry and pear. It also gets into nurseries, where it does considerable damage by preventing the proper growth of the trees. The larval stage of this insect is found in the bur-oak and pig-nut hickory.

Remedies.—One of the first things to do, where this insect is troubling the orchard, is to cut down and destroy the bur-oak and pig-nut hickory about the premises, so as to do away with the breeding places of these insects. Where the trees are small, one can place sheets under them early in the morning while it is still cool, and by jarring the trees with a sudden stroke, the insects will feign death and drop to the ground, where they can be destroyed. In large trees, thorough spraying with arsenate of lead before the leaves are fully developed will kill these beetles.

IMBRICATED SNOOT-BEETLE.

Epicaerus imbricatus, Say.

The adult of this insect is also a snout-beetle or curculio, about one-half an inch in length, of a silvery-white color with dark markings. This beetle

also normally lives in the forest, but gets into the orchards that are near them, and cause the same kind of trouble as given under the New York weevil. The two beetles frequently work together, and it is practically impossible to separate the work of each. The life history of this beetle is not known, and hence no suggestions can be given as to the destruction of its breeding places.

Remedies.—The methods of fighting this insect are the same as those for the New York weevil.

BUFFALO TREE-HOPPER.

Ceresa bubalus, Fabr.

The adult of this insect is about one-third of an inch in length, of a light grass-green or yellowish-brown color, according to age. In looking down on the insect it has a triangular shape. In front there is on each side a projecting horn which suggests the name of the insect. Those familiar with the beech-nut will be struck with the similarity between this nut and the insect, the body being three-sided. The mouth parts of this insect are formed for sucking, and consist of a rather long, sharp beak, by means of which the creature sucks the sap from various plants.

The adult female alights upon the apple trees in the latter part of the summer and deposits her eggs in the twigs by pushing her ovipositor through the bark into the wood, thus causing a slit which does not readily heal over and leaves a scar; and as many of these are placed rather close together on a twig, it tends to either kill or greatly injure the twig beyond the egg punctures. Where these insects are extremely numerous, this egg-depositing process

may injure the trees severely. The only damage these insects do to the orchard is in this process of laying eggs. In the spring, when the eggs hatch, the young nymphs, which are light grass-green in color like the adults, may feed upon the trees by sucking the sap from the leaves and tender shoots, but are more apt to leave the tree and get upon various weeds about the orchard or neighboring fields, and there feed by sucking the sap from those plants, until they are ready to deposit their eggs. They then fly to the orchard in order to do so in the twigs of the trees.

Remedies.—The only successful method of fighting these insects is to destroy and prevent the growth of weeds of various kinds about the orchard and neighboring fields. There is no successful way of fighting these insects in the orchard trees, and when the eggs are deposited the injury is accomplished.

OYSTER-SHELL BARK-LOUSE.

Mytilaspis pomorum, Bouche.

The oyster-shell bark-louse is perhaps the most common scale insect on the apple tree, and is also found on the pear. While it is not regarded as a very injurious insect, it may become so in time if the infested trees are neglected. The insects that we see normally upon the bark are the females, which are covered with a dark brown or grayish colored scale, shaped somewhat like an oyster shell, and hence the name. The scales are about one-sixth of an inch in length and usually somewhat curved, and remain attached to the twigs or limbs and cannot move. The males, which are probably never

seen by the horticulturist, have wings and are able to fly about from place to place. A picture showing the oyster-shell bark-lice, natural size, is given in Fig. 13.

It frequently happens where trees are neglected for some time that these lice occur in such overwhelming numbers upon the twigs and branches as to overlap one another and completely cover the bark. When this is the case the insects may greatly



FIG. 13. Oyster-shell Bark-lice.

injure the trees. Ordinarily, however, trees are not neglected to this extent, and while the scales are quite numerous, they do no great amount of harm, especially on the older bearing trees.

Along in the latter part of August the females deposit their eggs under the scales. These eggs remain over winter and during the latter part of May hatch into small, lice-like insects, which crawl out from the scales and move slowly over the bark, inserting their beaks here and there and extracting the sap, apparently trying to find a suitable place for the rest of their existence. In two or three days the lice insert their beaks and shed their skins, shedding with them their legs, eyes and antennae, but not their mouth parts, which are still retained in the tissue of the twigs and from which they now have no power of withdrawing. A shell is now excreted about the body, completely covering it and extending beyond so as to be when fully developed much longer than the insect itself. These females

never leave this situation. The males, however, develop wings and move about as before stated. The females begin to develop their eggs and lay them under the shell again the latter part of August.

Since there are rarely more than one hundred eggs deposited by a single female, and since there is only one brood of these insects each year, you readily see why it is that these scale insects require so long a time in order to absolutely cover the bark of the twigs and limbs of infested trees.

The insects are carried from one tree to another by birds and insects, on the feet and body of which the young lice may crawl while they are on infested trees, but where trees touch one another the young lice will crawl from one to the other, although it is very doubtful whether they would be able to leave one tree and crawl on the ground to another. In nurseries, these insects, of course, have no difficulty in passing from one tree to another, since they always overlap.

Remedies.—The oyster-shell bark-louse is easily killed and held in check by one or two thorough sprayings with kerosene emulsion during May and June. The sooner the tree is sprayed after the young lice appear the better, as they are easier reached at this time. As these insects are confined more especially on the twigs and branches, it is somewhat difficult to reach them with a spray when the trees are fully leaved out.

SCURFY SCALE.

Chionaspis furfurus, Fitch.

The scurfy scale infests the apple, pear and mountain ash, and also some other plants, and is nearly as common in the apple orchard as the oyster-shell

bark-louse, but is more easily detected because it is of a light grayish-white color, which makes it more conspicuous on the bark than the oyster-shell bark-louse which so nearly resembles the bark in color. The scurfy scale not only differs in color, but it also differs in shape from the oyster-shell bark-louse, it being somewhat triangular with the insect at the smaller end.

As these insects develop somewhat slower than the oyster-shell bark-louse they are not as apt to cover the bark, and neither are they as injurious to the tree. The male scales are long and narrow, but when the males are fully matured, they leave these scales and fly about from place to place. The winter is passed in the egg stage under the female scales, and the young lice hatch out in the spring, about the latter part of May, and crawl about for a few days before they insert their beaks and become motionless and develop a scale over their bodies. The eggs do not appear until September. A fairly good idea of the appearance of the scurfy scale upon a twig can be had by referring to Fig. 14, 1., which represents them natural size. At 1c is shown a female scale magnified, and at 1d a male scale magnified.

As these insects are almost white and therefore attract attention, they become very conspicuous objects on nursery stock and are frequently mistaken for the San Jose scale. The nursery seems to be the great place in which the trees become infested with this scurfy scale, but no one need worry about the presence of a few of these scales on nursery trees, since they are not dangerous, nor are they

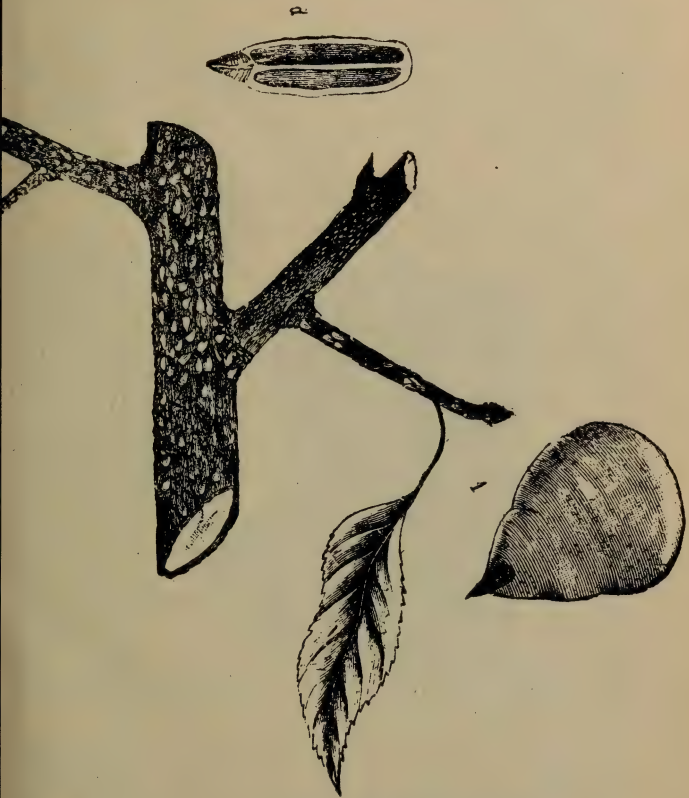


FIG. 14. The Scurfy Scale. (*Chionacpis furfurus*.)

especially injurious, and are easily held in check or killed.

Remedies.—The same methods I have given for fighting the oyster-shell bark-lice apply to this insect; viz., thorough spraying in the spring and early summer with kerosene emulsion.

SAN JOSE SCALE.

Aspidiotus perniciosus, Comst.

The San Jose scale is one of our most injurious and dangerous insects, and unlike the oyster-shell bark-louse, or the scurfy scale, the insect seems to poison fruit trees upon which it may be feeding. And also unlike the two previous scale insects, the San Jose scale multiplies with great rapidity. In fact this insect multiplies faster than any other known insect, the result of a single female amounting in a year to three billion, two hundred and sixteen million, eighty thousand insects (3,216,080,000). It must be understood that this does not mean that a single female actually produces this number of young, but that the result of her producing young will amount to the above sum in one year, since the young that are produced very soon produce other young, and these again others, and so on with great rapidity, there being many broods a year. This rapid method of development is helped by the fact that these insects bring forth living young and are never known to lay eggs.

The San Jose scale is much smaller than the two previous scale insects, and differs from them in the fact that the scales are circular, the insect itself being in the center of the scale. They are of an ash gray color, sometimes decidedly dark, and resemble

the bark on the stems as closely as do the oyster-shell bark-lice. As these insects multiply so rapidly, they soon literally cover a tree, so that the scales overlap one another, and in many badly infested trees, it is almost impossible to see the bark itself. Such trees have the appearance of having been covered



FIG. 15. San Jose Scale. Apple branch with scales in situ—natural size; enlarged scales above, at left.

with wood ashes. A good idea of the general appearance of these insects can be had by referring to Fig. 15, in which the scales are represented natural size on the large twig and magnified on the piece of bark at the side.

By looking at an infested tree under a hand lens during the summer, one can see the San Jose scales in all stages of development, from the little lice-like creatures that move about for a day or two to the full-grown female scales. Unlike the two previous scales, the San Jose scale passes the winter as hibernating females. Like the oyster-shell bark-louse, the San Jose scale is an imported insect and has now spread over the greater part of the United States and Canada. It is carried from place to place on nursery stock, the nurseries being the main centers of distribution. When once in an orchard, the San Jose scale passes from tree to tree by the young lice getting on the feet of insects and birds that get upon the trees or by the trees overlapping or touching one another, or by people taking scions or buds from infested trees.

The San Jose scale, unlike most insects, feeds upon an immense variety of plants. It is known to infest practically all deciduous fruit trees and bushes, and also many forest and shade trees, and small plants. But it seems to be especially injurious to the orchard fruit trees, where the insect, in sucking the sap from the plant, appears to poison the cambium layer, so that when the tree becomes badly infested, it is liable to be killed. Very frequently orchard trees are killed outright within three years from the first attack. Such is not the case with the forest and shade trees, and in fact with most plants that the San Jose scale attacks. It frequently happens that predacious insects, such as lady-bug beetles, or some other causes, prevent the San Jose scale from developing and spreading as rapidly as it normally would do.

Since the San Jose scale is such a dangerous insect, and since the nurseries are the great centers of

distribution, it behooves one to be especially cautious where they purchase nursery stock. It is always a good plan to have nursery stock purchased from regions known to contain San Jose scale fumigated with hydrocyanic acid gas before the trees are set out.

Remedies.—Hydrocyanic acid gas, made according to the formula given under Insecticides, for both Biting and Sucking insects, in the fore part of this booklet, is the best remedy we can use to kill the San Jose scale on infested nursery stock, but it is not practical to use this on large trees in the orchard. Most nurseries will now fumigate stock when so ordered by the purchaser, and unless you know the nursery it is well to have the stock fumigated before you receive it, or to fumigate it yourself before it is planted.

Should the orchard become infested with San Jose scale, one should prune back severely the infested trees and spray all trees in the orchard with the lime, sulphur and salt wash, the formula and method of making which will be found in the fore part of this booklet under the heading Insecticides for Sucking Insects. This spraying should be done early in the spring before the buds swell, and the work should be done thoroughly, since it is absolutely necessary to touch each scale in order to kill it. It is always a good plan to scrape the loose bark off the main limbs and trunk before applying this spray, because many scales will get behind buds or under loose bark, or in cracks and crevices where it is almost impossible to reach them, and a single scale escaping destruction on a tree is sufficient to reinfest that tree with an immense number of scales in a very short time. If one cannot spray all the trees at the time suggested, they may be sprayed in

the fall sometime after all the leaves have fallen, but the spring spraying is usually preferred. This spraying may injure some of the fruit buds, but the trees will make a more vigorous growth than they otherwise would, and of course if we neglect to treat infested trees they will die as the result of the presence of these insects. It is also well to prune rather severely all infested trees before applying the spray and to burn the brush.

ATTACKING THE LEAVES.

APPLE APHIS.

Aphis pomi, DeG.

These plant lice are the common aphids found in the spring of the year upon the apple leaves and buds. They are about one-tenth of an inch in length and of a yellowish green color. The winter is passed in the egg condition, and one can see these eggs very readily on the twigs during winter, where they appear as minute, oval and glossy black specks, usually deposited about the base of the bud or in the cracks and crevices of the bark on the smaller twigs.

In the spring of the year, at about the time the buds begin to open and show the little green leaves below, these eggs hatch into wingless agamic females in all cases. These begin at once to stick their beaks through the tissues of the unfolding leaves and extract the sap. In about five days they become full grown and begin to bring forth living young at the rate of two each day, and keep this up for about three weeks. The young also reach maturity in five days and likewise begin to bring forth living young with the same rapidity and for

the same length of time. As this process of multiplication is more rapid than that by the process of laying eggs, one can very readily see why it is that in a very few days from the time the buds begin to open, in favorable seasons, nearly every bud and unfolding leaf will be literally covered with these plant lice. The presence of these insects feeding on the leaves causes them to turn, or fold, over backwards, and thus form a protection over the colony of aphids which are sucking the sap from the leaves inside the folded portion.

Later in the season some winged agamic females are produced, and these fly from the tree to other trees and reinfest them by bringing forth living wingless agamic females again. In this way the insects are distributed from tree to tree and from field to field. Towards the latter part of summer, after these insects have brought forth living young generation after generation without males, the males are produced. These male insects have wings and are therefore able to fly about. They fertilize the females, which later deposit the eggs on the twigs and then perish. By cold weather all of the aphids have died and the eggs alone remain to carry the species over winter.

By examining these aphids carefully under a magnifying glass one will detect two little tubes projecting out from the back part of the abdomen known as the honey tube. There is excreted in drops from the ends of these tubes a sweet, honey-like substance known as honey-dew, which falls upon the leaves and gives them the appearance of having been covered with varnish. This honeydew also gets upon the twigs, and a little black fungus is apt to grow here in great profusion, giving the twigs the appearance of having been covered with smut.

Many species of ants are very fond of this honeydew and visit the colonies of aphids in order to feed upon it. An ant will approach an aphid and, if there is no honeydew on the end of the tubes, it will stroke the aphids with its antennae, when a drop will be excreted at once for the benefit of the ant. In seasons when the flow of nectar is scarce, honey bees will gather this sweet excretion and store it in their combs.

These plant lice are very common in all apple orchards every spring, but it is only occasionally that they succeed in multiplying to such numbers as to literally cover the developing leaves, predacious and beneficial insects keeping them in check to a large extent. When they do occur in large numbers, they cause serious trouble by injuring the flower and causing the tree to shed the flowers or young fruit, or prevent the development of flowers at all by getting upon the flower buds while they are opening.

Remedies.—It is a very simple matter to kill these aphids, or to hold them in check, if one will spray the trees thoroughly as soon as the buds begin to open nicely with kerosene emulsion, made according to the formula given under Insecticides for Sucking insects. If one is going to spray for fungus diseases and for biting insects at the same time, these aphids can be killed also by using the kerosene attachment on the new pumps, placing the kerosene in the special reservoir for that purpose and the Bordeaux mixture, with some arsenical poison, in the barrel and setting the indicator at 10 per cent kerosene.

LESSER APPLE LEAF FOLDER.

Teras minuta, Rob.

This insect in the adult condition is a moth about two-thirds of an inch across its expanded wings.

There are three broods of these moths each year. The first two broods are orange colored, while the third brood is ash gray. The moths of the third brood appear the last of August, or the fore part of September, and, at the approach of cold weather, seek hibernating quarters.

In the spring these moths come out, and as soon as the leaves begin to unfold on the apple trees they deposit their eggs there. The eggs hatch into active larvae in a very few days, and these larvae feed

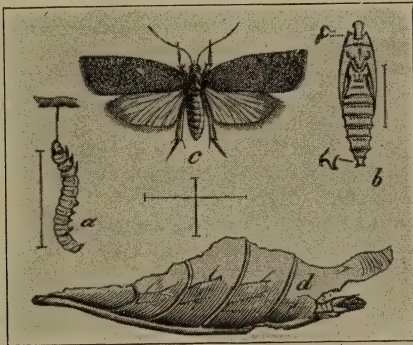


FIG. 16. The Lesser Apple Leaf Folder, *Teras minuta*, Rob. Adult enlarged twice natural size at c; at a, the larva; at b, the pupa twice natural size.

upon the developing and unfolding leaves and spin a web over the same, thus preventing them from unfolding as they otherwise would do.

As the leaves push out they spin more webs, preventing the leaves from unfolding, until finally the tree looks as though a fire had injured it. In about three weeks these larvae become full grown and then make their pupae inside of the bunch of folded

leaves, and in about a week come out as adult moths, which pair at once and lay eggs for a second brood. This second brood behaves exactly as the first, but usually occurs in greatly increased numbers. Inside of a month the adults of the second brood appear, which lay eggs for the third. Fig. 16 shows this insect in all its stages.

If these insects occur in undue numbers for the first brood they will succeed in preventing the trees from making any growth whatever that year, because every terminal bud will contain one or more larvae which will absolutely prevent that from growing as it should. These insects do damage more especially to nursery stock and to young orchards, in many instances preventing the trees from making any growth at all for that year. I have seen blocks of two-year-old nursery apple trees that were still yearlings in appearance, caused by undue numbers of these insects.

Remedies.—These insects can be readily held in check by thorough spraying with any of the arsenical poisons, provided the same be applied before the larvae have obtained any considerable growth and have, therefore, folded up the leaves so as to be practically impossible to reach them with a spray. In using paris green or Scheele's green for this purpose, one pound of the poison and three pounds of lime in one hundred and twenty-five gallons of water should be used; or if arsenate of lead be used, it should be made according to the formula given under Insecticides for Biting Insects. Usually one does not notice the presence of these insects until the first brood has appeared and is too old to spray for successfully. In this case, it is better to wait until one notices the orange colored moths, which are easily determined by passing through the trees and

jarring them, when the moths will fly up before one. The presence of the moths means that they are laying their eggs for another brood of larvae, and one should then begin to spray at once in order to poison the leaves before the eggs hatch and the larvae fold them up.

LEAF CRUMPLER.

Phycis indiginella, Zeller.

The adult of this insect is also a moth about six-eighths of an inch across its expanded wings. The fore wings are ash gray in color with brown markings, while the hind wings are of a uniform dusky gray color. These moths emerge the last of June and the first of July and deposit their eggs in the terminal shoots of apple, plum, cherry and peach trees. The moths are some time in depositing their eggs.

The larvae hatch in about a week after the eggs are deposited. They begin to feed upon the young leaves as soon as they hatch and make a covering, or tube, about their bodies by spinning silk, weaving in it their excrement and other material. This case is then neatly lined with silk. It is horn-shaped, with the opening at the large end, and gradually tapering to a point at the other, and is usually somewhat curved, or twisted. The larvae carry this case with them wherever they go, enlarging it as they grow in size.

They do not eat rapidly or ravenously and are somewhat shy, except at night, and withdraw in their cases when disturbed. They have the habit of drawing two or three leaves together and fastening them with silk, feeding there somewhat protected.

At the approach of cold weather the larvae fasten their cases securely to a twig by means of silken threads, and then gather a number of leaves about the same and fasten them by means of silken

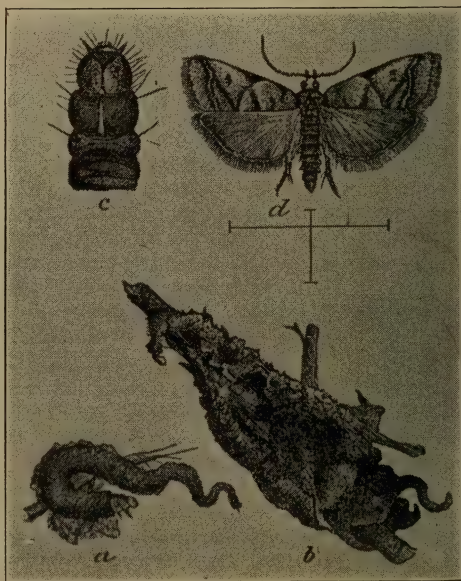


FIG. 17. The Leaf Crumpler. a, larva case; b, crumpled leaves; c, head end of larva enlarged; d, adult moth enlarged.

threads. They then retreat within their cases and hibernate as about two-thirds grown larvae. Fig. 17 shows an adult moth, at d, magnified somewhat; at a, a larva projecting from the end of its case:

and at b, a bunch of crumpled leaves in which the larva inside its case hibernates during the winter.

When the leaves fall from the trees these crumpled up and dead bunches of leaves fastened here and there upon the trees become conspicuous objects. In the spring, when the buds begin to open and the leaves appear, these larvae come out from their hibernating quarters and feed upon the unfolding leaves. This is the time when the damage is done, since they feed more ravenously at this period, and every mouthful counts for more as the leaves are unfolding. After feeding for about two weeks in this way the larvae transform to pupae, coming out about the latter part of June as adults. Hence you will see there is only one brood each year, the damage being done by the larvae coming out from hibernating quarters and feeding in the spring.

Remedies.—Where the trees are small, so that one can readily reach all parts without the use of a ladder, the best method of fighting these insects is to go through the orchard in the winter, when the crumpled leaves are easily detected, and pick off the leaves, with their contined cornucopia-shaped cases, in which the hibernating larvae are found, and burn them. As the crumpled leaves come off very much easier than the cases themselves, one should be careful or he will simply remove the leaves and leave the cases remaining on the twigs. Where the trees are large or where one has neglected to pick off the insects during winter, they can be killed by thorough spraying with any of the arsenical poisons in the spring of the year, as soon as the leaves begin to appear nicely.

CANKER WORM.

Anisopteryx vernata, Peck.

There are two species of canker worms which look so near alike that it will be impossible for the ordinary observer to distinguish them, and as they differ in habits only in the time of emergence of the adults, one species emerging in the fall and the other in the spring, and as the larvae of each species work together on the trees at the same time, we will discuss them together.

The male and female adult moths differ greatly in appearance. The males have well developed wings and look like ordinary moths, about an inch and a third across their extended wings and of a light-gray color. The females, on the other hand, have no wings at all and the body is short and thick set.



FIG. 18. Canker-worm—a, male moth; b, female.

Fig. 18 shows a male and a female adult canker worm—a, the male; b, the female; both natural size.

In all cases it is necessary, in order that a tree become infested with the canker worm, that these wingless female insects crawl up the tree and lay their eggs on the stems. One species hatches out in the adult condition in the fall, and the females crawl up the trees from the first of September until cold weather. The other species hatches out in the spring, and the females do likewise, but some of

them may begin to hatch out whenever we have a few consecutive warm days during January or any time thereafter, although the great bulk of them do not hatch until early spring.

In all cases, the eggs are deposited on the twigs and do not hatch until the tree begins to leave out. The larvae then appear and feed ravenously upon the unfolding leaves. The amount of food that these larvae can consume in a single day is surprising. Their presence can now be detected by the leaves which they partly devour, and by the fact that when one jars the tree or the limb these larvae will suspend themselves in the air about a foot by means of a silken thread, and in a little while crawl up again and go to work. In moving they crawl by a loop, or



FIG. 19. Canker-worm, eggs and larva.

measuring, motion. These larvae become full grown in from two to three weeks, by which time they are dark-colored larvae, about an inch or an inch and a quarter in length. They then crawl down the tree or drop down by means of their silken threads, and seek some sheltered place under stones, rubbish or matted grass, and there spin cocoons and transform to the pupa stage, remaining in this condition until fall, or until spring, according to the species.

Figure 19 shows a larva canker worm and eggs, natural size.

The presence of these canker worm larvae devouring the leaves frequently strips the tree entirely, or does so to the extent of causing the tree to shed its

bloom, and therefore ruin the prospective crop of fruit. These insects also attack and strip the leaves from the elm trees and various other forest, shade and orchard trees, but the great damage seems to be done in the apple orchards.

Remedies.—The best method of fighting this insect is to take advantage of the fact that the females are wingless; that they hatch on the ground and must crawl up the tree in order to deposit their eggs on the twigs, otherwise the tree will not become infested with these insects. It is a comparatively easy matter to prevent these insects from crawling up the tree in the following way: Scrape the loose bark from around the trunk at a convenient distance from the ground, cut a band of wire mosquito netting four inches in width and long enough to go around the tree and lap six or nine inches, then cut down one edge an inch and a half, at intervals of two inches, and overlap these cuts, driving a tack through into the tree where the loose bark has been scraped away, when around the tree fasten the two ends by means of a wire. The cutting and overlapping of the upper edge will cause the lower edge to flare out away from the tree. If any holes are left between the wire netting and the bark, or in the wire netting itself, they should be stopped up by means of cotton. The female canker worm motins will crawl up the tree as far as this wire netting and cannot pass it.

This netting should be placed around the trees by the first of October, or at least during January, where only the spring canker worm is found. But as you will not be able to determine the difference between the spring and the fall canker worms, it is always advisable to place these bands about the trees by the beginning of October. They will re-

main on the trees without injuring them until the trees grow so as to form places of escape for the females, or outgrows the band itself. If left on the trees more than one year one should go through and repair these bands the second fall.

Another method of banding the tree to prevent the female canker worms from crawling over is to scrape the loose bark off at a suitable height and tie a band of cotton wool around at this point, the string or wire being placed at the bottom of the band, after which the top is pulled down over the bottom, thus inverting it and forming a fluffy, cottony band, around which the insects cannot crawl, since they become entangled in the fibers of the cotton. These bands, however, become matted and out of place by severe storms, and are not as satisfactory as the bands made of mosquito netting.

Where one is troubled with the canker worm in large elm trees or other large trees the bands will be found far superior to any other method of fighting the insect.

In the orchard, where the trees are not too large to spray thoroughly, one can kill the canker worm by spraying as soon as they are noticed, with any of the arsenical poisons. Usually one thorough spraying is sufficient, but sometimes two sprayings are necessary. This second spraying, however, is only necessary when the first spraying was not done thoroughly, or the poison not made strong enough. In using paris green or Scheele's green one pound of the poison and three pounds of lime should be used for every one hundred gallons of water. But where arsenate of lead is used, the formula given under Insecticides for Biting Insects should be employed.

APPLE TREE TENT-CATERPILLAR.***Clisiocampa Americana*, Harris.**

The adult of the apple-tree tent-caterpillar is a reddish-brown colored moth with two oblique light-colored lines across the front wings. The females measure a little over an inch and a half across their expanded wings and the males a little over an inch. The moths appear during the fore part of July and soon deposit their eggs on the twigs of apple and cherry trees especially. These eggs are deposited in a bunch of about three hundred, which surrounds the twig completely, and is then smeared over with a gummy substance. These eggs remain throughout the summer and winter and hatch the next spring, about the last of April or the first of May, usually at the time the buds begin to open.

The young larvae feed at first upon the gummy substance which the mother has placed about the clusters of eggs, and then begin to feed upon the opening buds and the unfolding leaves. They work together in colonies, and pass down the twigs to a fork and there spin a silken web about the same. Inside of this silken web the larvae collect during the night and during stormy weather, crawling out and feeding upon the leaves during the day time. As the larvae grow they enlarge this web, or tent, as it is sometimes called.

These larvae are quite ravenous feeders and soon defoliate the leaves from the limb upon which the nest is situated. In about six weeks the larvae become full grown, and then leave the tree and seek a suitable place in which to spin cocoons and transform to the pupa stage. In about three weeks the adults appear. These adults soon lay eggs as

described above for another brood. Hence there is but one brood of these insects each year.

Remedies.—During the winter, while the leaves are off the trees the clusters of eggs are quite conspicuous and easily found, when they may be removed and destroyed. In the spring of the year, after larvae have hatched and have made their webs, they may be easily destroyed early in the morning or late in the evening, while the larvae are gathered inside their tents, by pushing a forked stick in the same and revolving it, thus winding up web, larvae and all, where they may be stepped upon and killed. The larvae can also be readily killed by spraying the infested limb with any of the arsenical poisons.

OTHER INSECTS.

There are a great many insects which feed upon the leaves of the apple tree in the larval condition and which we have not space to discuss. In all cases, however, when these insects become troublesome, as is the case with the Yellow-Necked Caterpillar, or the Red-Humped Caterpillar, and many others, they can be readily killed by spraying with any of the arsenical poisons.

ATTACKING THE FRUIT.

Codling Moth.

Carpocapsa pomonella, Linn.

The adult of the codling moth is about five-eighths of an inch across its expanded wings. They are of a gray-chocolate color, marked with alternate, irregular, transverse, wavy streaks of ash-gray and brown. The lower angle at the tip of the front

wings has a large, tawny brown spot, with glossy streaks of light bronze or copper color, arranged nearly in the form of a horseshoe. The hind wings are light yellowish-brown, with the luster of satin. Figure 20, f and g, shows the codling moth's natural size.

The moths first appear in the spring at about the time the apple trees bloom and continue to emerge for about three weeks. They begin to deposit their

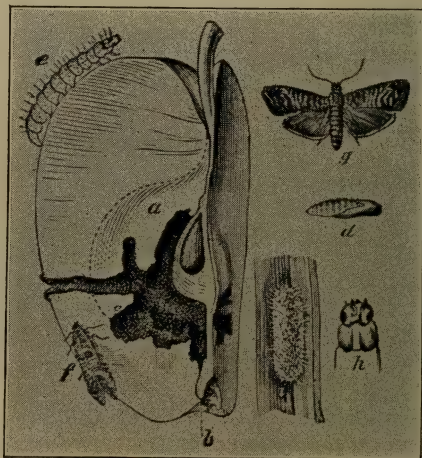


FIG. 20. The Codling moth.

eggs soon after the blossoms (petals) fall, and at this time usually deposit the eggs in the blossom end of the young apple. Later in the season they may deposit their eggs at various places on the

apple and, even in some instances, on the leaves. The moths deposit their eggs at night, and are quite slow in doing so, rarely depositing more than one egg on an apple, and occupying from two to three weeks in the process of laying all their eggs. It will thus be seen that the egg-laying season of the first brood of moths extends over a period of about six weeks.

The eggs hatch in a few days after being deposited and the young larvae may eat of the blossom end of the apple for a short time, usually not more than a day or two at most, and then eat their way through the skin into the pulp and down to the core, around which they feed until full grown larvae. Figure 20, e, shows a full grown larva, and a, the work of the same in the apple; d is the pupae and i, the cocoon.

Whether or not these apples prematurely ripen and fall to the ground, the larvae, as soon as full grown, leave the apple by eating a hole through to the outside and then crawl down the tree in search of a suitable place in which to spin their cocoons, inside of which they transform to the pupa stage. They do so under all kinds of rubbish or under the loose bark of the tree.

From the time the egg is deposited until the adult moth emerges requires about six weeks.

As soon as the adults appear they immediately pair and lay eggs for the second brood. In depositing these eggs, the females usually do so at any place on the apple. There are only two broods of the codling moth each year; but as the first brood of moths is so long in appearing and take so much time in depositing their eggs, the last of them are not through by the time the first moths of the second brood appear. Hence we have these moths depositing their eggs on the apples continually from

the time the blossoms fall until the apples are full grown. While the larvae of the second brood should be full grown by fall, and should leave the apples and make their cocoons, and pass the winter as pupae, or as hibernating larvae, it frequently happens that many of them are too late to do this, and hence pass the winter as nearly full grown larvae inside of the apples.

Remedies.—In that part of the United States east of the great plains the codling moth can be controlled very readily by spraying with the arsenites. This has been done repeatedly, and we are now familiar with the numerous conditions which render it a success or a failure. The object in spraying is to poison the apple so that the larva, as soon as it hatches and starts to feed, will get some poison with its first meal and be killed before it has time to eat its way into the apple, where it will be beyond our reach. We desire to kill all the larvae of the first brood, and thus do away with the necessity of trying to spray for the second brood. In order to do this it is essential that the spraying be done at the proper time, and the proper number of times, and that the work be done thoroughly.

The first spraying, which is the most important, should be done thoroughly in order to cover the blossom end of each apple before the same has turned down. The first spraying should be made in about five days after the blossoms (petals) have fallen. In eight or ten days after this spraying, another spraying should be given the trees and this should be repeated in eight or ten days again, and this repeated for four sprayings. If at any time within four days after a spraying heavy rains occur the spraying should be repeated, and this not counted as one of the four.

If paris green or Scheele's green is to be used, one pound of the same should be taken in connection with three pounds of lime and one hundred and seventy-five gallons of water. If arsenate of lead is to be used (and I advise the use of this in place of other arsenical poisons for this purpose), the same should be used according to the formula given under Insecticides for Biting Insects.

It is important that one make the four sprayings as above suggested, otherwise it will be impossible to kill the great bulk of the codling moth larvae. We must keep the blossom end of the apple and, in fact, the entire apple, covered with an arsenical poison during the entire time that the larvae of the first brood are hatching, and nothing short of the four sprayings above indicated will accomplish this. It is also essential that the first spraying be done within five days after the blossoms fall.

It is a good plan, in connection with the spraying to scrape the loose bark away from the limbs and trunk, and to place a band of burlap around the trunk, removing this once a week and killing the larvae and pupae that will collect under the same in place of getting under rubbish on the ground. If the loose bark is not removed, many larvae will spin their cocoons under it.

The destruction of wind-falls will also greatly lessen the number of codling moths, since wormy apples have a tendency to drop prematurely; and as each one contains one or more larvae which will soon leave the apple and seek sheltered places in which to make their cocoons, the destruction of these windfalls every two or three days will prevent the contained larvae from transforming.

If one attends to the orchard as above indicated he will have a very few codling moths, provided his

orchard is a large one and some distance away from neighbors who do not attend to theirs. But if one's orchard be near a neighbor's orchard which is neglected, no matter how thoroughly one may attend to his orchard, even if he should kill all of the larvae of the first brood, moths of the second brood from the neighbor's orchard will come over and deposit their eggs on his perfect apples, and he will later have wormy apples in spite of his efforts to prevent it. Of course, if one could keep up the spraying and fighting throughout the entire season the neighbor's orchard would do no special harm, but it is too expensive to try and fight the codling moth throughout the entire season. The best we can do is to fight this insect during the first brood, otherwise it becomes too expensive. Hence it is of the first importance where orchards are near together to see that one's neighbors fight these insects also.

PLUM CURCULIO.

Conotrachelus nenuphar, Hbst.

The common plum curculio in many instances does as much damage to the apples as does the notorious codling moth. This is especially the case with the commercial orchard, where the apples are frequently all reduced from what would otherwise be number ones to number twos and threes and even culls.

The plum curculio is the insect which causes the "sting" in the apple. Figure 21 shows one of these beetles magnified five diameters.

The insect is so well known that it does not need description, but the life history of the insect in the apple will be given very briefly.

The adult beetles appear during August and begin

at once to "sting" the apples by feeding upon them. In doing this they eat small holes through the skin and into the pulp. These holes are usually about one-tenth of an inch in diameter and about the same in depth, and the pulp may be eaten away for a short distance back under the skin. These holes cause the apples to decay at these places and render them unfit for storage purposes. At the approach of cold weather the beetles seek some sheltered place in order to hibernate, getting under rubbish or matted grass, or even entering the ground.



FIG. 21. The Plum Curculio; adult magnified five diameters.

In the spring the beetles come out from their hibernating quarters and begin to feed upon the young developing leaves, and later upon the petals of the flowers, and still later upon the young apples. Both the male and female beetles make these feeding punctures in the apples, but later the females also make punctures for the purpose of depositing eggs. In this instance the female eats a hole through the skin and into the pulp, and then turns around and

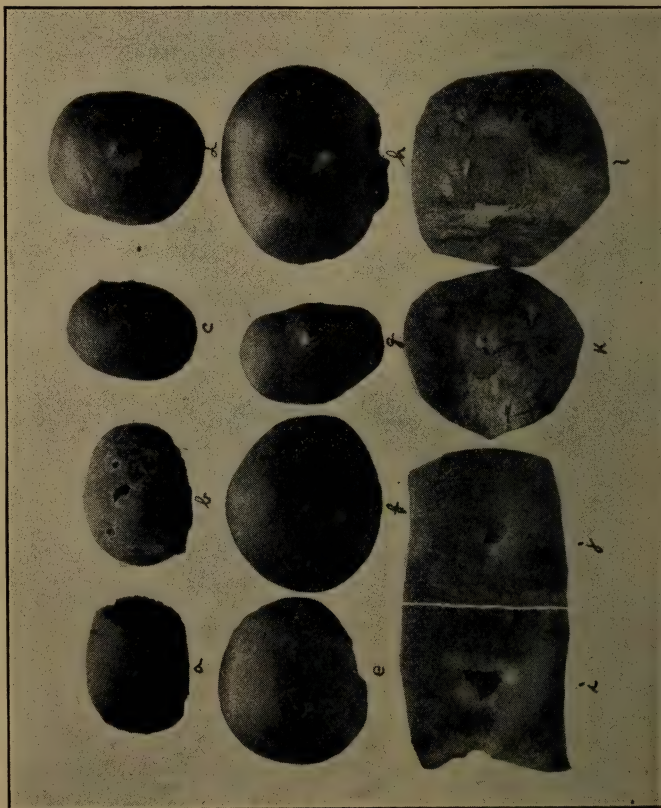


FIG. 22. Portions of apples showing "stings" and scars, a, b, c, e, f, g.—egg-depositing punctures; d, k.—scars showing where the apple is recovering as the egg did not hatch; h, i, j.—scars in depressions showing the apple recovering after the larva had mined a short distance in the pulp and then died; l.—scar showing the apple recovering from a feeding puncture. Natural size. (Stedman.)

pushes an egg into it. Having accomplished this, she eats a crescent-shaped cut through the skin, partially surrounding and partially undermining the egg. These punctures for the purpose of depositing eggs and also the feeding punctures are called "stings" by the horticulturist.

A photograph showing the "stung" portions of apples cut away with the various "stings" in different stages, can be seen in Fig. 22. When the apple is comparatively small it tends to outgrow these "stings," and will usually do so, leaving only a scar, provided fungoid and other diseases do not enter at this point. Such scars are shown in Fig. 22, at I, J, K, L. If the egg hatches and the larva eats its way into the pulp a short distance and then dies the apple may recover from this, but will leave a scar situated in a depression as shown in Fig. 22, H. This depression is due to the fact that the tissue where the larva has eaten becomes hard and does not grow to the extent the surrounding tissue does, and if cut into will appear as a short, dark-colored, hard thread which is bitter to the taste. In this way the great bulk of our knotty and gnarly apples are produced.

If the apple in which the young larva is feeding falls to the ground the larva will continue to feed upon the pulp, mining in a zigzag direction through it towards the core, and when full grown will leave the apple and enter the ground about two inches in depth, pack the earth away from its body so as to make a small earthen cell, inside of which it will transform to a pupa. If, however, the apples containing the young larvae fail to fall by the time the larvae are half grown, the larvae appear to all perish.

Fortunately, comparatively few eggs deposited in

apples ever succeed in hatching, and of those that do hatch into larvae, very few ever succeed in reaching the full grown larval condition.

The larva requires about three weeks to reach maturity, and the pupa requires a little over two weeks before the adult hatches; but as the larva usually remains in the ground about ten days before it transforms to a pupa, and as the adult after it hatches usually remains in the ground about ten days before coming out we find that this insect passes fully as much time in the ground as it does out of it, from the time the egg is deposited until the larva enters the ground.

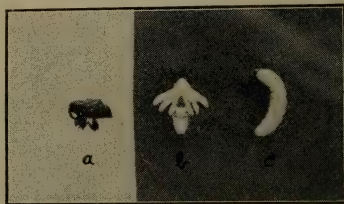


FIG. 23. The Plum Curculio; a.—adult; b.—pupa; c.—larva.
Natural size. (Stedman.)

As the female beetles that have hibernated over winter begin to deposit their eggs in the young apples about the middle of May, when the apples are about the size of hazelnuts, and as they are a long time in depositing their two hundred and fifty to four hundred eggs, doing so during the latter half of May and all of June and the first half of July, and as the first adult beetles begin to emerge the latter half of July and during all of August, and at once begin to "sting" the apples for feeding purposes,

one can readily see that the apples are being "stung" continually throughout the entire season, that the larvae can be found in them until the fore part of August, and that the pupae will therefore be found in the ground from the fore part of July to the fore part of September. The fact that the first of the young adult beetles begin to emerge and "sting" the apples before the last of the old beetles are through "stinging" them, has led some to suppose there is more than one brood of these beetles each year, but you can readily see from what I have given of their life history, that there is but one brood each year. The old beetles die at the approach of cold weather and the young beetles hibernate over winter under rubbish of all kinds, and do not deposit their eggs until the next spring and summer, although they "sting" the fall apples for feeding purposes only.

Figure 23 shows a photograph of the adult plum curculio at a, and the pupa at b, and at c, the full grown larva, all natural size.

Remedies.—It is possible to kill many of the adult beetles in the spring of the year while they are feeding upon the unfolding leaves, provided one sprays thoroughly twice before the blossoms open with any of the arsenical poisons.

It is also possible to kill great numbers of the pupae and of the young adults in the ground before they emerge, provided one will plow the orchard shallow and immediately and thoroughly harrow the same the middle of July and then harrow thoroughly again the first and again the fifteenth of August. The plowing and harrowing breaks the earthen cells in which the pupae are situated and kills the great bulk of them, and the middle of July until the middle of August covers the period in which the pupae are found in the ground.

The best single method, however, of fighting these insects is to take advantage of the fact that the larvae will die by the time they are about half grown unless the apples fall to the ground. Hence, if we will pick up once each week and destroy by burning or by feeding to stock windfalls, or will turn hogs or other stock into the orchard so that they will eat up the apples as fast as they fall, we can thus prevent the development of adults, which would come out and reinfest our orchard. It must be understood that the spraying in the spring of the year is the only method that will greatly lessen the number of "stings" in the early apples that particular year. The destruction of windfalls and the cultivation of the orchard lessening the number of "stings" for the next year, more especially, and also lessening the late "stings." If the above directions be followed, one can, in a year or two, so rid his orchard of these insects that the "sting" will be practically prevented.

INSECTS INJURIOUS TO THE PEACH.

ATTACKING THE ROOTS.

BLACK PEACH APHIS.

Aphis persicae-niger.

These aphids are almost black in color and are found principally upon the roots of the peach tree, although they sometimes get on the leaves. The insect exists in two forms—one wingless, agamic females, and the other, winged agamic females. The eggs are deposited in the fall of the year by the true females, and they pass the winter on the roots or on the stems, according to the place the aphids happen to be when the eggs were deposited. In the

spring of the year these eggs hatch into wingless, agamic females in all cases, which immediately begin to insert their beaks into the tissues of the plant and extract its sap. They bring forth living young, which are also wingless, agamic females, and they in turn do likewise in a few days, so that a colony is established very soon.

Later, winged, agamic females are developed, and these fly to other trees, bringing forth another colony without the presence of males. Later in the season the true males and females are produced, and after pairing, the females lay the eggs as above stated.

These insects do considerable injury to the peach where they occur in sufficient quantities, and give the tree a sickly appearance, which is frequently mistaken for the yellows.

Remedies.—The methods of fighting the black peach aphid on the roots are the same as those given for fighting the woolly aphid of the apple; viz., the removing of the dirt about the tree, filling in with powdered tobacco and covering the same over again with the earth. The reader is referred to the remedies given under the discussion of the Woolly Aphid, which also apply for the black peach aphid and is given there more in detail.

ATTACKING THE TRUNK, LIMBS AND STEMS.

THE PEACH-TREE BORER.

Sannina exitiosa, Say.

The adult peach tree borer is a moth that differs from most moths in that its wings are more or less transparent and shaped somewhat like the wings of wasps; in fact, the casual observer is very apt to

mistake these moths for wasps as they are flying about in the sunshine and depositing their eggs. The male measures about one inch from tip to tip



FIG. 24. Adult Peach-Tree Borer. The upper one is the male; the lower one is the female.

of the expanded wings, and the females about one and one-half inches. The two sexes differ so much in general appearance that one would scarcely be-

lieve them to be the same species. The general color of these moths is a deep steel blue, while the female has a conspicuous orange band across the abdomen. One may obtain a fair idea of the general appearance of these adults by observing Fig. 24, which represents them enlarged; the upper figure being the male and the lower figure the female.

The adult moths begin to emerge in the spring, usually in May, and continue to emerge until well in July, for, unfortunately, they do not reach maturity together. Hence it is that they are found depositing eggs for so long a time. There is but one brood each year, however. The eggs are deposited, as a rule, on the bark at or near the surface of the ground, although they will sometimes deposit them up the trunk and even on the larger limbs. The young larvae, or borers, are active and soon eat their way through the bark to the sap-wood, usually entering where there is a crack or crevice. They feed in the cambium layer, enlarging their tunnels as they grow, and if the tree be a small one, or if there be several larvae in the same tree, they may girdle and kill it, or greatly weaken and injure it. When cold weather appears the larvae hibernate in their burrows, and in the spring after they have fed for a time and become full grown, they make an oblong cocoon by fastening their excrement and gnawings together by means of a little silken thread and gum which exudes from the tree. This cocoon is usually near the surface of the bark and more or less surrounded by the exudation from the tree. Within this cocoon the larvae, or borer, transforms to the pupa stage, and shortly emerges as an adult moth.

As is well known to all the presence of the borer within a tree is easily detected by the gummy exu-

dations, usually mixed with more or less excrement and borings; but as this may be just below the surface of the ground, it may escape notice for some time, unless the earth be removed from about the base down to the large roots.

The peach tree borer will also attack the plum tree.

Remedies.—As the methods of combating this borer are the same as those for the apple tree borers, with the exception that wrappers should not be used on the peach tree, the reader is referred to the remedies given under Round-Headed Apple-Tree Borer.

PEACH-TREE BARK-LOUSE, OR PEACH LECANIUM.

Lecanium nigrofasciatum, Perg.

These scale insects are about one-eighth of an inch in diameter, of a somewhat circular form, and very hemispherical, and the color varies from a bright red through reddish-brown to almost black. They are very conspicuous objects on the smaller twigs, where the bark is smooth, as they project up above the twig and are easily detected.

The eggs will be found during the early spring massed together under these scales. They hatch about the first of June into minute, lice-like creatures that crawl about the twigs, inserting their beaks here and there, but finally finding a suitable place, insert their beaks and remain attached to the twig in this place during the rest of their existence, if they be females. They then begin to excrete the shellac shell over their bodies, which is so familiar

to the peach-grower. The males finally develop wings and fly about.

Ordinarily these insects are not found in overwhelming numbers on the peach tree, but occasionally occur in such numbers as to greatly injure the vitality of the tree. They do not multiply as rapidly as some other scale insects, and rarely occur in sufficient quantities to completely cover the bark of the infested twig.

Remedies.—The best method of fighting the insects is to spray the infested trees with kerosene emulsion twice during the fore part of June, or before the leaves on the trees have become full grown, after which it is very difficult to touch these insects with the spray, since the leaves catch practically all of it.

OTHER INSECTS.

The Fruit-Tree Bark-Beetle sometimes attacks the peach trees and does a great amount of damage, especially where the trees are neglected and have become weak from any cause. Their presence is easily detected in the peach tree on account of the exudation of gum from their burrows, and where a limb is very badly infested, drops of gum will be found projecting out from the bark wherever these perforations are made. Since this insect was discussed under the apple, the reader is referred to it for a discussion of the insect and for the remedies.

The New York Weevil and the Imbricated Snout Beetle both do damage to peach trees by eating the buds and also the bark from the tender shoots, and the reader is likewise referred to the discussion of these insects under the apple.

ATTACKING THE LEAVES.

PEACH-TREE APHIS.

Myzus persicae, Sulzer.

This is also a dark colored plant louse, resembling somewhat the black peach aphid, and this fact has led many people to erroneously suppose they are one and the same insect.

The small glossy, black eggs of these insects are deposited on the limbs in the fall of the year, and as soon as the buds begin to open the following spring and show the little green leaves, they hatch into wingless, agamic females, which begin at once to suck the sap from the unfolding leaves and to multiply in a similar manner to the black peach aphid. It frequently happens, where conditions are favorable, that these insects multiply to such an extent as to completely cover each developing leaf; but as these insects are preyed upon by a number of predacious and parasitic insects they are usually held more or less in check. When the leaves are about full grown, the presence of these aphids sucking the sap from them causes the development of little elevated places, which become reddish on the side opposite the plant lice. These leaves then give the tree a sickly appearance, and is frequently mistaken for peach yellows. The general life history of these aphids follows that given for the black-peach aphids.

Remedies.—These insects are very easily held in check by one or two thorough sprayings with kerosene emulsion, which is better applied early and before the leaves are fully developed.

OBLIQUE-BANDED LEAF-ROLLER.

Cacoecia rosaceana, Harris.

The adult insect is a moth nearly an inch across the expanded wings. The front wings are of a light cinnamon-brown color, crossed with little wavy, dark-brown lines and with three broad, oblique, dark-brown bands, one of which covers the base of the wings. The hind wings are ocher-yellow, with the folded part next to the body blackish.

These moths deposit their eggs upon the trees. they hatch in the spring into small, greenish-yellow larvae that attack the developing leaves soon after they have unfolded. The larvae feed upon the leaves, first drawing them together and fastening them by means of silken threads. As many of these larvae work together at a colony they soon succeed in drawing all the leaves on a young branch close together, thus forming a nest inside of which they continue to feed until full grown. They make their pupae inside of the web and enclosed leaves. In about two weeks the pupae work their way partly out of the web, their skin splits open and the adult moths appear. This usually takes place the latter part of June. This web, or nest of curled-up leaves, forms such a protection for the larvae that it is practically impossible to reach them by any of our ordinary sprays.

The larvae may feed on the young fruit by eating the skin and pulp, especially when the fruit is included in the nest.

Remedies.—The best plan to fight these insects is to cut off the twig containing the nest of folded and enclosed leaves and destroy them. It is rare that these insects occur in large quantities, and hence this removing of the few infested twigs will cause no loss whatever.

FRUIT-TREE LEAF-ROLLER.

Cacoecia argyrospila, Walker.

The adult of this insect is also a small moth about three-fourths or seven-eighths of an inch across its expanded wings, and is bell-shape when the wings are closed. The front wings are yellowish-brown, mottled with darker and lighter colors, and the hind wings are light grayish-brown color. They lay their eggs in the fall of the year in a mass upon the twigs of the trees, and smear them over with an excretion from the bodies.

In the spring, soon after the leaves appear, these eggs hatch, and the larvae feed upon the leaves, sometimes drawing two or three together by means of silken threads and also spinning a slight silken web over the partially folded leaf. They also fasten the leaves to the young fruit and in that protected position feed upon the fruit. Where the larvae are very numerous they may ruin the entire crop of fruit by eating the skin off and also more or less of the pulp, and in some cases devouring the entire fruit and even eating into the seed, while the same is in a soft condition. When full grown the larvae transforms to pupae inside of the slight web which they have spun over the folded leaves, and later come out as moths, which deposit their eggs on the twigs as before stated, where they remain over winter.

Remedies.—Thorough spraying with arsenate of lead as soon as the larvae first appear and before they have become sheltered will kill them.

BAG WORM.

Thyridopteryx ephemeraeformis, Haw.

During the winter, while the leaves are off the trees, one frequently notices little oblong bags, made

of silk and portions of the leaves of the tree, hanging suspended from the twigs. If these are opened one will find inside some of them a mass of eggs, within what appears to be the pupa stage. These are the females, one of which is shown in Fig. 25, c. The males are moths with rather transparent wings and of the general size and shape showing in Fig. 25, d.

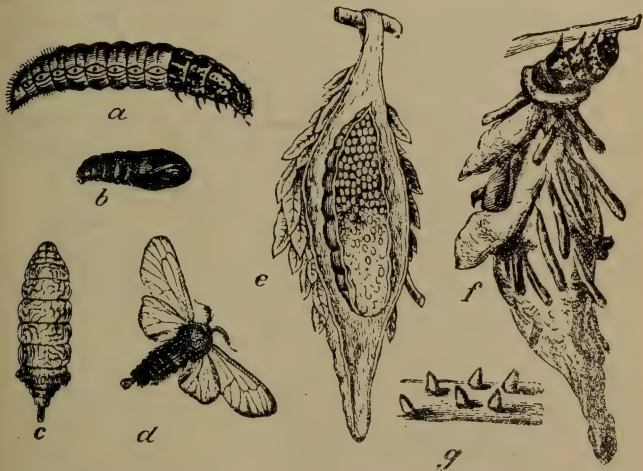


FIG. 25. The Bag-worm; a, caterpillar removed from the bag; b, male chrysalis; c, wingless and legless female moth; d, male moth; e, bag cut open showing female chrysalis and eggs; f, caterpillar in the bag; g, cones made by young larvae.

These eggs hatch in the spring after the tree leaves out, and the larvae feed upon the leaves. They soon make a case about their bodies composed of silk and portions of the leaves upon which they are feeding, and enlarge it as they grow. They

carry this case about with them wherever they go. When they become full grown, which is towards the latter part of summer, they fasten these cases to the twigs by means of bands of silk, and inside of it transform to the pupa stage. These insects feed upon a great variety of shade, as well as orchard trees and some ornamentals. A full grown larva within its case, or bag, is shown in Fig. 25, f.

Remedies.—These insects are readily killed by spraying the trees thoroughly with arsenate of lead made twice as strong as that given in the formula under Insecticides for Biting Insects. As these insects are somewhat hard to kill, especially when more than one-third grown, it is well to spray just as soon as the larvae appear, and to use the spray of double strength and to spray thoroughly. As it is not advisable to spray a peach tree under ordinary conditions, one should not spray the trees that are not badly infested and should never use anything but the arsenate of lead. Even then, under some conditions, which we do not understand, peach trees are occasionally injured by the spray.

If the peach trees are small so that they can be reached without the use of a ladder, one can go through the orchard in the winter and pick these bags off, thus removing the female bags with their eggs.

OTHER INSECTS.

The Leaf Crumpler and the Apple-Tree Tent-Caterpillar, also attack the peach and cause more or less trouble, but the reader is referred to the discussion of these insects and their remedies under the Apple.

The Tarnished Plant Bug also attacks the peach

trees early in the spring and causes damage by sucking the sap from the expanding leaf and flower buds, thus causing them to turn dark, and frequently killing the flower buds. The reader is referred to the description and life history of this insect, as given under the Strawberry. The insect is killed in the peach trees by spraying with kerosene emulsion early in the morning, while the insects are sluggish and will not readily fly away from the spray.

ATTACKING THE FRUIT.

ASH-GRAY PINION.

Lithophone antennata, Walker.

The adult of this insect is a dull, ash-gray colored moth, about an inch and a half across its expanded wings, and with the fore wings variegated with grayish-brown. An adult moth is shown, natural size, in Fig. 26, b. These moths appear in the latter part of the summer, when they may be seen flying about the orchard.

In the spring, shortly after the trees shed their blossoms, the eggs hatch into larvae which feed upon the fruit by eating holes into it and mining out the inside, not only the pulp, but while the peaches are young, eating the tender, developing kernel and seed. These larvae are of a pale-green color, with cream colored spots and a broad band of the same color along each side. A larva just leaving a peach is seen at a, in Fig. 26. When full grown larvae, they leave the fruit and crawl down the tree and enter the ground a short distance. They then pack the earth away from their bodies and spin a light, silky cocoon, inside of which they transform to the pupa stage.

Where these insects are not numerous the real damage is very slight, because a certain thinning of the peaches is advisable where they are numerous upon the tree, but when, as sometimes happens, these insects become unduly numerous, they devour



FIG. 26. Ash-gray Pinion. a, larva; b, adult moth; both natural size.

more than their share of fruit. Each peach attacked by one of these larvae is, of course, ruined.

Remedies.—As the peach does not readily fall to the ground when attacked by these insects we have only two methods of fighting them—one of which is to spray the trees with arsenate of lead two or three times, beginning when the peaches are about the size of cherries and keeping this up at intervals of two weeks. It is advisable, of course, to make a test on a few trees for the first year in order to determine whether or not the peaches in that particular place will be injured by the spray before one attempts to apply it to the whole orchard. The other method of fighting these insects is to harrow the orchard thoroughly about the first of August, and thus destroy the pupae before the adults have time to emerge.

INDIAN CETONIA.

Euphoria inda, Linn.

The adult of this insect is a beetle a little more than one-half inch in length, and of an oblong shape and quite robust. The head and thorax are dark colored, or almost black with a copper luster, and thickly covered with short, greenish-yellow hairs. The wing covers are light yellowish-brown, mottled with black spots. The under side of the body is nearly black and covered with hairs, and the legs are reddish.

These beetles appear early in the spring and fly about the orchards on sunny days, making a buzzing noise very much like bees. They can be found sucking the sap from the wounded portions of the trees. Later in the season the adult beetles do injury to the peach by eating holes into the ripening fruit. The larval stage of these insects is not known.

Remedies.—As these insects attack the fruit when it is nearly ripe, or ready to pick, it is a very difficult matter to suggest any remedy for them, since it would not be advisable to try and spray at this time. Where they are unduly numerous, one can readily catch them with a net and thus prevent a great amount of injury which would otherwise follow.

PLUM CURCULIO.

Conotrachelus nenuphar, Herbst.

The plum curculio was so thoroughly discussed, both in regard to its habits and life history and methods of fighting it, under the apple insects, that it will not be necessary to repeat it here; and the reader is therefore referred to the discussion of this insect there given.

The plum curculio attacks the peach with more freedom than it does the apple, and it also breeds much more rapidly in the peach than it does in the apple. The peach does not readily drop to the ground when infested by these insects, but tends to remain upon the tree. It is a common occurrence to find practically every peach on the tree infested with one or more of the larva of the plum curculio, sometimes as many as eight in a single young peach.

The presence of these larvae feeding in the pulp causes a gummy exudation to appear on the outside of the fruit, which may extend down in little threads from a quarter to a half inch, and one may imagine the fruit to be entirely ruined. However, in a great many cases, even where the fruit is badly attacked, it will remain upon the trees after the larvae have become full grown and have left it, and it will frequently recover and make a fairly good peach. Hence from a commercial standpoint, this insect does not do the immense amount of damage in the peach that it does in the apple, although it breeds much more readily and is much more numerous in the peach orchard. The peculiar rough and fuzzy skin of the peach probably has more or less to do with this, also the exudation of gum which protects the opening from the attack of diseases, and also the rapid growth of the peach resulting in a rapid healing of the wound.

OTHER INSECTS.

The Peach Gouger and the Fruit-Tree Leaf-Roller also attack the fruit of the peach tree by eating the skin and pulp, thus ruining the peach that is eaten to any considerable extent. The Fruit-Tree Leaf-Roller has been discussed and the reader is therefore referred to the same under Insects Attacking

the Leaves of the Peach Tree. The Peach Gouger is a curculio beetle which, as an adult, eats through the skin and into the pulp, sometimes doing considerable damage. Both of these insects, when in undue numbers, can be held in check by spraying thoroughly two or three times with arsenate of lead.

INSECTS INJURIOUS TO THE STRAWBERRY. ATTACKING THE ROOTS.

MAY BEETLE, OR WHITE GRUB.

Lachnosterna fusca, Frohl.

The adult of the white grub is known by the common name of May Beetle, and is familiar to all as the dark, chestnut-brown, thick-bodied beetle, about seven-eighths of an inch in length, which appears during May and June, and flies about our houses, bumping against the same and getting into our rooms at night, being attracted by the light. These beetles remain more or less quiet during the daytime and become active and fly about at dusk and during the night. Figure 27 shows two of these beetles, natural size.

They feed upon the leaves of various fruit trees, especially the cherry and plum, and the female deposits her eggs in the ground. The larvae, on hatching, feeding upon the roots of various plants, and burrowing through the earth from plant to plant. They require several years to reach the full-grown larval condition, and during this time may feed upon the roots of a great variety of plants, doing more or less damage, according to the number of larvae present. When full grown these larvae, which are known as white grubs, are about an inch and a half in length, of a light color, somewhat

transparent, with a thick, juicy body about the size of a man's little finger. The body is bent so that the abdomen and the head almost come together. Figure 27 shows one of these larvae, natural size, at 2.

When the larvae become full grown they transform to the pupa stage in the ground about the roots of the plant upon which they happen to be feeding at that time, and the adult beetles emerge

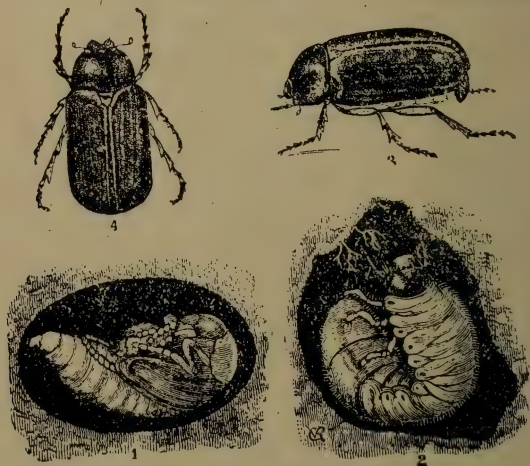


FIG. 27. May Beetle; 3 and 4, adult beetles; 1, pupa; 2, larva or white grub. All natural size.

during May and June. As these beetles usually deposit their eggs in grass fields, it very frequently happens that when such a field is plowed and strawberries set out, these grubs, finding themselves deprived of the great quantity of roots upon which they have previously been feeding, attack the roots

of the strawberry and kill the plants. Where these insects are not numerous the injury is of course slight, but where they are extremely numerous, as sometimes happens, each spadeful of earth containing one or more white grubs, the strawberry plants are almost sure to be ruined.

Remedies.—Where these insects are extremely numerous in a young strawberry bed, there is no remedy you can use that will prevent the destruction of the same, and one should plow under the bed and plant the field to some crop upon which these insects will not feed. After starving these insects in this way, one can then set out the strawberry plants without danger of injury from these insects. Where one wishes to set out a strawberry bed in a field previously occupied as a pasture or some crop containing a large amount of grass, it is always advisable to turn over a few spadeful of sod in order to see whether or not these insects are there in sufficient quantities to seriously injure strawberry beds. In that case, one of the best methods is to turn hogs into the field in order to allow them to root up the grubs and feed upon them, and to plant in the field for the first year some crop requiring cultivation and upon the roots of which these grubs will not feed, and the next year plant the strawberries. Do not put the infested field in wheat or corn.

ATTACKING THE STEMS.

CUTWORMS.

There are several species of cutworms, the habits of which are similar and the insects closely related, so that it is not necessary to describe each of them, and we will therefore refer to them as a group. The adults are moths about an inch and a half

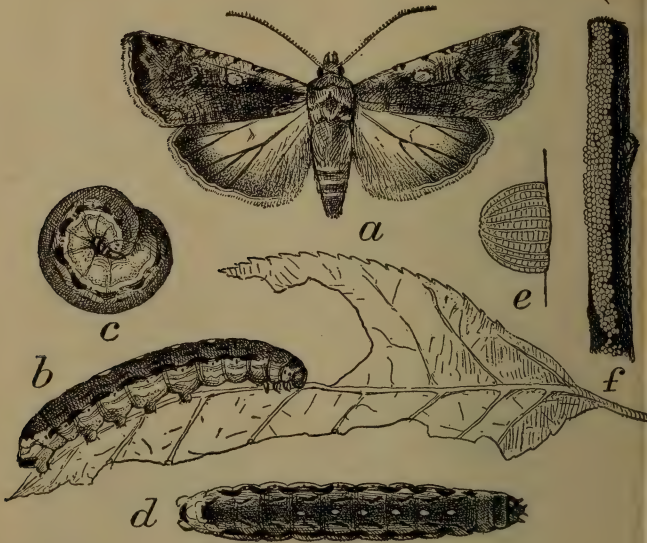


FIG. 28. Variegated Cut-worm. a, adult; b, c, d, larva; e, egg, magnified; f, eggs on a stem, natural size.

across their expanded wings, most of them being of a dirty brown color. They deposit their eggs at the base of grass during the summer, and the larvae on hatching burrow in the ground and feed upon the roots of grass, becoming nearly full grown larvae by the approach of cold weather. They then hibernate over winter and the next spring when settled warm weather appears they change their

food habits entirely, ceasing to feed upon the roots of grass as heretofore.

They now come out from the ground during the night and crawl about in search of some green vegetable matter upon which to feed, and do so by cutting down the strawberry plant and a great variety of other garden and field crops. They seem to feed on a plant only long enough to cut the same off near the ground, and then pass on to another, doing the same work. In this way a single larva may do considerable damage in one night.

At the approach of day these cutworms crawl into the ground or under rubbish and there remain until the following night, when they come out to continue their depredations. This method of feeding and injuring plants goes on for about two weeks, when the insects become full grown larvae and enter the ground an inch or two, and make little earthen cocoons inside of which they transform to pupae, the adults emerging along the middle of the summer. The Variegated Cut Worm in its various stages is shown in Fig. 28.

Remedies.—There are two ways by which we can fight the cutworms in the strawberry patch. If the field be a small one, such as a little home garden patch, one can place shingles or boards about the patch, and every morning go through and turn these boards over and step upon the larvae or cutworms that will collect under the same instead of going to the trouble of entering the ground. It will be but a few days before the patch will be rid of these pests.

Where the strawberry patch is a large one, the better plan would be to poison the cutworms in the following way: Take a bushel of bran and mix with

it thoroughly while dry two pounds of paris green or Scheele's green, or one pound of powdered white arsenic, then make a dough out of the same by means of sweetened water, using a quart of molasses or sorghum for each three quarts of water. Scatter handful of this poisoned bran here and there about the field. The cutworms during the night will feed upon this in preference to the plants. Of course one should be cautious and not allow poultry or livestock of any kind to have access to this poisoned field until the poisoned bran has disappeared, which it will do in time by repeated rains.

CROWN BORER.

Tyloderma fragariae, Riley.



FIG. 29. Crown Borer; a, larva; b, c, adult beetles. All magnified. Hair lines at side of each figure represents natural size.

The adult of this insect is a small curculio beetle about three-sixteenths of an inch in length, and of a dark brown color. The beetles appear the latter part of June or the fore part of July and deposit their eggs in the crown of the strawberry plant. These eggs soon hatch into larvae or grubs, which eat their way down into the crown and there feed

upon the same, mining it out more or less. Sometimes a crown will contain two or three of these larvae, in which case the crown may be entirely excavated and the plant killed. When the larvae become full grown they transform inside the crown, the adult beetles emerging later. Fig. 29 shows two adult beetles and a larva, all magnified.

Remedies.—As these beetles do not tend to migrate far, and rarely infest a new bed in sufficient quantities to cause serious trouble, but occur in sufficient quantities in beds three years or more old, and as it is impossible to kill these insects by means of sprays, the only successful method of fighting them is to take the young plants from the old bed, being sure that the same are not infested, and with them to set out a new bed some little distance from the old one, plowing under the old bed and using the field for some other crop for a year or two.

ATTACKING THE LEAVES.

STRAWBERRY LEAF-ROLLER.

Phoxopterus comptana, Frohl.

The adult of this insect is a small moth about a half inch across its expended wings. The front wings are reddish brown, streaked and spotted with black and white, while the hind wings are dusky. One of these moths is shown in Fig. 30, natural size and also magnified.

The adult moths appear in the spring and deposit their eggs on the leaves of the strawberry plant; the larvae when hatched feed upon the same, and at once fold the leaves over and fasten them by means of silken threads, thus protecting the larvae, since they do not eat through the outer epidermis.

This injures the plants, and where numerous causes the bed to appear as if a fire had passed over it. When the larvae have become full grown they transform to pupae within the folded leaves, and in a couple of weeks transform to adult insects, which immediately pair and lay eggs for another brood. The pupae of the second brood remain over winter as such. The first brood appears before the strawberries blossom and the second brood after the strawberries have been gathered.



FIG. 30. Adult Strawberry Leaf-Roller. The upper figure enlarged, the lower figure natural size.

Remedies.—While it is possible to spray the strawberry plants before the fruit is one-half grown with any of the arsenical poisons and kill these insects before they have folded up the leaves and become protected from any spray, nevertheless this is not as successful a method as to wait until the strawberries have been gathered, and then mow the plants and allow them to dry, then set fire to them when the wind is in a favorable direction and burn over the entire patch. If the plants are not thick enough to burn well by themselves, straw may be

spread over to help in this process. This burning of the plants at this time will not injure them in the least, even though it be a dry season.

FALSE-WORM.

Harpiphorus maculatus, Nort.

The adult insect is a hymenopterous saw-fly, a little less than one-fourth of an inch in length and about one-half inch across its expended wings. An enlarged picture of one is shown in Fig. 31.

The adult insects appear early in the spring, either the latter part of April or the first of May, and begin at once to deposit their eggs on the leaves



FIG. 31. Adult Strawberry False-Worm; enlarged. (Stedman.)

of the strawberry plant by pushing the eggs through the epidermis of the leaf. In about two weeks the eggs hatch and the larvae, which are slug-like, begin at once to feed upon the leaves by eating small holes through them, leaving the main ribs of the leaves untouched. The larvae require about five weeks in order to become full grown, by which time they have stripped the plants of their leaves or greatly injured them. When the larvae are full grown they enter the ground a short distance and make a fragile cocoon, inside of which they remain

during the rest of the summer and over winter, transforming to the pupa stage the next spring.

Remedies.—As this insect feeds upon the exposed leaf, it is a simple matter to kill them by spraying the plants thoroughly with any of the arsenical poisons; or, if the plants be in bloom, or fruit be upon them, it is better to use powdered white hellebore in place of the arsenical poisons, at the rate of one pound of the powdered white hellebore in three gallons of water. Or the white hellebore may be placed upon the plants as a powder, by mixing equal parts of the powdered white hellebore and flour, and dusting the same upon the plants early in the morning while the dew is on them.

**ATTACKING THE FRUIT.
TARNISHED PLANT-BUG.**

Lygus pratensis, Linn.



FIG. 32. Young Tarnished Plant Bug; second stage, X9 diam.
(Stedman.)

The tarnished plant bug is a small sucking insect of an elliptical shape, somewhat flattened, about one-fifth of an inch in length and about half as wide. Its color varies considerably, ranging from a

dark brown through light brown to yellowish or yellowish-green, with darker and lighter markings, which in some instances are more or less obscured. Fig. 34 shows an enlarged drawing of one of these insects, and Fig. 32 and Fig. 33 enlarged drawings of two of the young stages of the insects.



FIG. 33. Young Tarnished Plant Bug; third stage, X9 diam
(Stedman.)

The tarnished plant bug hibernates during winter under rubbish of all kinds, such as is usually found along fences or along the edges of timber, or wherever there is any matted grass or weeds. Early in the spring as soon as the buds begin to swell, these insects come out and begin at once to suck the sap from the expanding buds, both leaf and flower, of various fruit trees and bushes, especially the peach. The insects insert their beaks through the tissues of the bud and extract the sap, introducing involuntarily a little poison which causes the bud to turn dark, and where badly injured may kill the same.

When the flowers appear these insects pierce them as well, and likewise cause them to turn dark

and greatly injure them, or kill them if the injury is sufficient. These insects attack not only the orchard fruits, but also the small fruits, such as rasp-



FIG. 34. Adult Tarnished Plant Bug; X6 diam. (Stedman.)

berry, blackberry and especially strawberry, when the blossoms are appearing.

The tarnished plant bug does its greatest amount of damage, perhaps, in the strawberry patch when the same is in bloom, since wherever these insects suck the sap from the flower or the developing berry it causes that portion to cease growing, and may kill it outright or will cause an uneven growth or a complete "buttoning" of the berry. While this is not the only cause of "buttoning," it is usually the principal cause, and it is also the principal cause of the buds, flowers and young fruit "blighting," as it is called.

The tarnished plant bug deposits her egg in the spring singly on the plants upon which it is feeding, and the young bugs hatching from these eggs begin to suck the sap in a manner similar to the

adults; so that later in the season these insects may be found in various stages of development on the plant.

Remedies.—In the orchard the best plan of fighting these insects is to spray the trees early in the morning while it is yet cool with kerosene emulsion. If one waits until the sun is up well and the atmosphere warm, these insects are so active that they will fly away from the tree before the spray can reach them. In the strawberry patch, however, as these insects are there feeding upon the flowers and developing berries, it is not advisable to use the kerosene emulsion because the same will taint the berries and the emulsion may interfere with pollination. Hence in the strawberry patch one should dust the plants early in the morning with fresh and pure pyrethrum, one pound of which should be mixed with two or three pounds of common flour, and the same applied by means of any of the numerous dust applying machines. Pyrethrum can also be sprayed upon the plants by mixing a pound of the pyrethrum with three gallons of warm water.

Another excellent method of fighting these insects is to spray the plants with a patent extract of tobacco known as "rose-leaf extract." One gallon of this extract in fifty gallons of water will give excellent results. I have tried making an extract of tobacco, or tobacco tea, myself, but have never been able to reach anything like the good results with it that can be obtained with the patent extract given above.

THRIPS.

These insects are so small that they escape the notice of most people who have not sharp eyes.

They are about one-fifteenth of an inch in length, very long and narrow, and agile, moving about and flying at the least provocation. They may be found in the blossoms of the strawberry, where they sometimes occur in such numbers as to prevent the



FIG. 35. Thrips, greatly magnified. (Stedman.)

development of the berries. By jarring a few flowers and picking them to pieces over a white paper one can sometimes catch great numbers of these insects, where they can be seen under a magnifying glass to be quite interesting little creatures. Fig. 35 shows a picture of one of these insects greatly magnified.

Remedies.—The same remedies as given above for the tarnished plant bug apply equally for the destruction of this insect.

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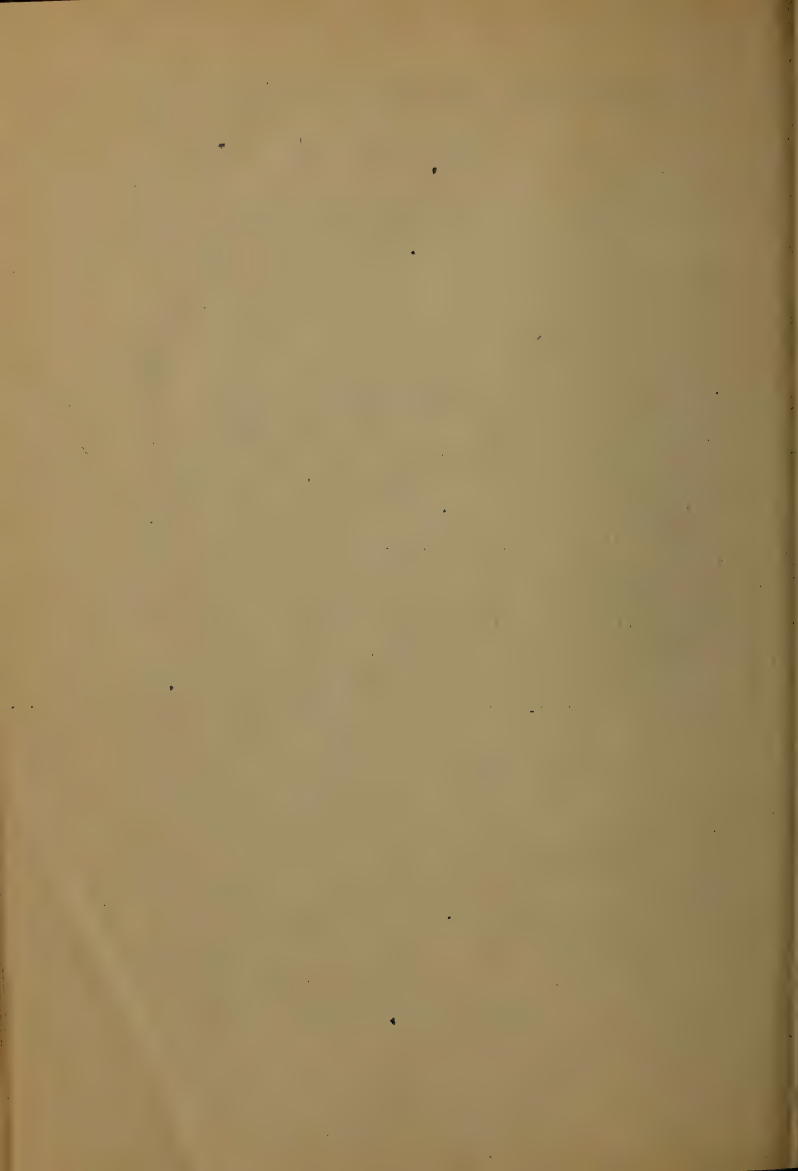
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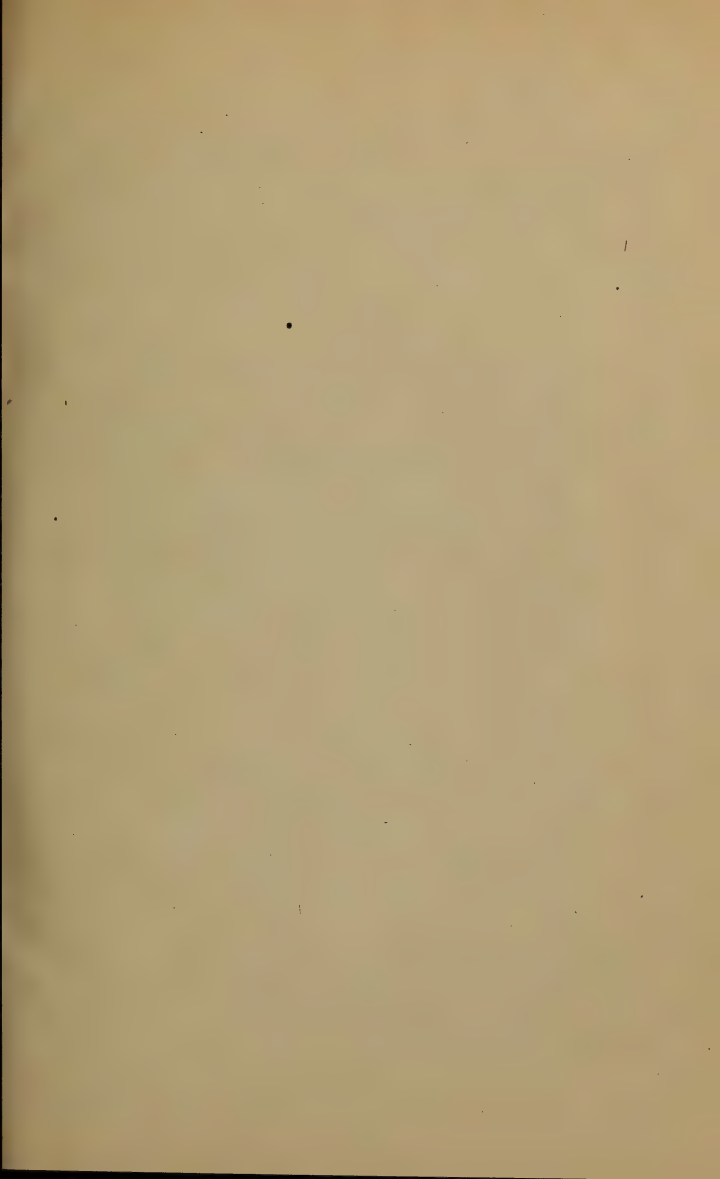
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THE FRUIT-GROWER

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