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# Agricultural Experiment Station

—OF THE—

AGRICULTURAL AND MECHANICAL COLLEGE,  
AUBURN, : : ALABAMA.

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## INJURIOUS AND BENEFICIAL INSECTS.

**Some Insect Pests of the Farm and Garden.**

J. M. STEDMAN.


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### CONTENTS.

	PAGE.
I. Introduction and General Remarks.....	3-7
II. Insecticides.....	7-11
III. Machines for Applying Poisons.....	12-21
IV. Colorado Potato Beetle.....	22-23
V. Cabbage Butterfly.....	24-27
VI. Harlequin Cabbage Bug.....	28-29
VII. Cut-Worms (Cabbage).....	29-30
VIII. Cotton Worm or Cotton-Leaf Worm.....	30-32
IX. Boll-Worm.....	32-34
X. Aphids or Lice on Cotton.....	34
XI. Cut-Worms (Corn).....	34
XII. Corn-Worm or Boll-Worm.....	35

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## INJURIOUS AND BENEFICIAL INSECTS.

SOME INSECT PESTS OF THE FARM AND GARDEN.

J. M. STEDMAN.

It is the intention of this bulletin not to discuss in a scientific way original or other observations on insects, but to put into popular language the facts already known to Entomologists, in regard to some of the insects effecting the farm and garden crops, and to do so in such a way as to be of service to the busy farmer, who has little or no time, and less inclination, to procure the necessary literature, and study out for himself the life histories and methods of attack of these insects, and of the means of destroying them or of preventing their ravages. Hence this bulletin has no claim to originality other than the form of expression. It is written expressly for the farmers of Alabama. The discussion of the life histories of the insect is given only in so far as it is important that the farmer should know it, while the methods of destroying the pests receive prominent attention.

It is our purpose to issue several small bulletins on injurious insects, taking them up in the order of their food plants, instead of grouping them together in one large bulletin that will take so much of the farmers time to read that it will be laid on the shelf, whereas a small one now and then would be read. Persons wishing these or any or all bulletins can get them free by simply sending a postal card requesting the same and giving their address to President W. L. Broun, Auburn, Ala., or simply Experiment Station, Auburn, Ala.

Bulletins on Fungus and other diseases of plants will also be issued.

## GENERAL REMARKS.

In order to arrive at the best results in combatting insects, it is important that we should understand at least the general life history of the insects in question, that we may thus know at what stage in its development means can best be taken to destroy it. Some insects can best be fought in the egg stage, others in the larva or worm stage, a few in the pupa stage, and still others in the adult stage; while many can be controlled in two or more stages. To arrive at this in a scientific way forms one of the great problems of the economic entomologist.

The larger number of our insects have four well defined stages of growth. The first is known as the *egg* state and of course in itself can do no harm. In a few cases these eggs are deposited in clusters or groups and in such a way that we can gather and destroy them, or when this is not practicable, they can be killed by spraying them with kerosene emulsion or soda and caustic soap.

Many insects winter in this egg stage as well as in the pupa or in the adult state, and since they frequent sheltered places, as leaves, rubbish and brush along fences and ditches, etc., it becomes important that all such useless material be gathered and burned every Fall, thereby destroying many insects that otherwise would appear the following Spring. Hence clean farming is one sure road to success.

The second, or *larva* or worm state is the one in which most insects do their greatest amount of injury, since it is here that most of the growth and feeding takes place. Many insects are injurious only in this larva stage, as our cotton-worm, cabbage worm, cut-worm, etc., and all other moths and butterflies. Some exceptions to this rule are to be found, as in our grasshoppers and most beetles, that do as much damage in the adult as in the larva stage in many instances. While again, the Rose-chaffer that does little or no damage in the larva stage, as an adult, does much injury to our vineyards. The larva or worm

does not resemble in the least the adult insect in most cases, and hence unless one be familiar with the subject, he cannot tell the adult insect by the larva. The caterpillar or worm changes to a butterfly or moth, the maggot to a fly, and the grub to a beetle. It is in this second stage that most insects are to be controlled.

The third, or *pupa* state is usually a quiet, inactive and perfectly harmless stage. Since many insects winter in this condition we can take advantage of it, and resort in the Fall to a general cleaning up and burning of all rubbish, leaves, etc., and to the burning over of stubble and to late plowing.

The fourth, or *adult* or imago stage is the perfect insect, such as a butterfly, moth, beetle, fly, etc., and it is in this state only that the eggs are deposited from which a new brood develops. As stated under the second or larva state, most adult insects except grasshoppers and beetles are in themselves harmless to the farm and garden crops; they deposit the eggs, however, on the respective plants on which the larvæ feed, and in view of this we can take means to prevent such a deposit and hence protect the plant. This is especially true and important in those cases where the larva is a borer and hence cannot readily be gotten at in that stage. Hence the necessity of covering up the base of peach trees with straw, cotton seed, ash, etc., to keep the adult from getting at the proper place to deposit her eggs, or of spraying apple trees with Paris green or London purple to prevent the codling moth from getting into the apple, or of covering the trunks of trees with a sticky or poisonous wash to prevent the borer from entering. All preventive applications must be made just before the adult insect appears, and must be kept up at frequent intervals as long as the adult is in a condition to lay eggs.

So far as the farmer is concerned vegetable feeding insects can be divided into three groups. I. Those insects that live, either in the young or adult stages or both, within the tissues of the plant. These are called borers. They

feed upon the juices and tissues inside the plant. II. Those that suck the juices of plants, in which case one finds no parts of the plants eaten away, but the leaves shrivel up and dry or turn another color. These are called sucking insects. They pierce the plant with their mouth-parts and simply suck the juices. III. Those that eat the parts of plants, in which case we find places eaten away, or parts eaten or cut off, as we say. These are called biting insects. They feed upon at least the outer parts of plants and in most cases the inner tissues at the same time.

REMEDIES.—From the nature of the case, it is evident that each of the three groups of insects as above described will require a different mode of treatment.

In general (special and exceptional cases will be noted under their respective heads) the best if not the only way to get rid of the borers is either to dig them out or, as has lately been successfully done in the case of the peach tree borer, pour hot water on that part of the tree that is infected. The application of chemicals after the insect is once inside the plant is of little or no use, since the plant would be killed before the insect could be reached. The application of chemicals to prevent their entering has succeeded in some cases. Paris green or London purple mixed with water (see formula under insecticides) and thrown in the form of a spray (apparatus for spraying will be explained later) on to the plant or parts of the plant liable to be infected, has resulted in lessening the attack in a number of cases where the insect or its young eat their way in through the outer tissue, but where the adult deposits its eggs inside the tissue beneath the outer layer, this method is of little value. The application of certain substances like coal tar, tobacco, etc., is sometimes used as a repellant. Methods and contrivances to keep the insect away will be noted under the special insect.

The sucking insects cannot be destroyed by putting poison like Paris green on the plant, since these insects do not eat

the outside of the plant and hence not the poison. They can insert their mouth-parts through the surface of a leaf covered with Paris green, for instance, and not eat it, but suck the pure juice from the part beneath. They must be killed by simple contact with some chemicals, and a substance like Paris green, which is very poisonous to insects if it be eaten, may not affect the insect in the least to have it covered with the poison. Perhaps the most effectual substance with which to kill sucking insects is what is known as Kerosene Emulsion. (See formula under Insecticides.) This must be thrown on the plant in the form of a spray by means of some kind of a force pump. (See spraying apparatus.) Pyrethrum is an active substance in killing by contact nearly all kinds of insects, but unfortunately it is of late years so adulterated that it is almost useless for the farmer. It comes in the form of a powder and can be dusted on the plants by means of a bellows or mixed with water and thrown on in the form of a spray. (See Insecticides.)

The biting insects can be destroyed by poisoning the parts of the plants effected. To accomplish this we can resort to a large number of chemicals, compounds and patent insecticides. Some of the most useful being Paris green, London purple, White Hellebore, etc. A number of the patent insecticides (so called) that are advertised to kill *all kinds* of insect enemies are of no value to the practical farmer.

The mode of applying the different poisons to kill biting insects varies with the kind of plant infested and also with the insect. Some are simply dusted on to the plant as a powder, others sprayed on with a force pump. The methods of applying each substance will be given under their respective heads. (See Insecticides.)

## INSECTICIDES.

The various substances, compounds and mixtures used to destroy or drive away insects can be divided into three groups. First, internal poison, that kill by being eaten with

the natural food of the insect. Second, external remedies, that kill the insect by contact, either by irritating the skin, or by stopping up the breathing pores. Third, repellants, including substances that keep the insects away by offensive odors or by mechanical barriers.

#### INTERNAL POISONS.

*Paris green* is the most important insecticide of its class. It kills by virtue of the arsenic that is here in chemical combination with copper. It comes in the form of a fine powder and can be purchased at about thirty cents per pound. It can be used either as a powder to be dusted, or as a liquid to be sprayed on the plants. As a powder it is to be well mixed with from twenty to forty, and even eighty, times its bulk of flour, Plaster of Paris or air slacked lime; and can then be evenly and thoroughly dusted on to all parts of the plant by means of some kind of bellows or other powder dusting machine. (See machines for applying Insecticides.) One pound of Paris green to the acre is usually sufficient provided the dusting be done evenly and thoroughly. Paris green is sometimes used undiluted, or very slightly so (one part of Paris green to three parts of flour) as is the usual case with cotton, when the poison is placed in two heavy sacks made of some strong cloth, as 8 oz. osnaburg, and fastened to each end of a five foot pole. It is the thoroughness with which this poison is applied and not the strength that secures success. As a liquid Paris green is to be mixed with water in the proportion of one pound poison to from 150 to 200 gallons water. Paris green does not dissolve in water, and since it is very heavy and tends to settle quickly, it is very essential that the liquid be often and thoroughly stirred. It is to be sprayed on the fruit trees and other plants by means of some kind of force-pump and hose with a spraying nozzle. (See machines for applying Insecticides.) One should be exceedingly careful in spraying peach trees not to get the mixture too strong, since the



leaves of this plant are very tender and easily "burned" by Paris green or London purple. A mixture of one pound Paris green to 250 gallons of water should be used on peach trees, and that only when the leaves are young. Apple trees should be sprayed just after the flowers have fallen. Small fruits and vegetables are not easily injured, if at all, by Paris green.

*London Purple* is about as good as Paris green as an insecticide in many cases, and has this advantage, that it is much cheaper, costing about fifteen cents per pound, and is also a much finer powder and hence remains suspended in water much longer. It is to be used in the same way and in the same proportions as Paris green.

*Hellebore* (white) is a powder poison made from a plant. It kills both by being eaten and by contact. It can be used as a powder to be dusted on to the plant either full strength or diluted with flour, or as a liquid, one pound Hellebore to 40 gallons of water, to be sprayed on the plant. It costs about twenty-five cents per pound. It is used less extensively than Paris green or London purple, but is especially excellent in destroying the currant worm.

*White Arsenic* is not to be used when Paris green or London purple can be had, since it is dangerous to have about and is apt to burn the leaves.

#### EXTERNAL POISONS.

*Pyrethrum* is a powder made from the flowers of a plant and is very poisonous to insects, but is perfectly harmless to man and domestic animals. It kills insects by contact, and can be most successfully used as a powder to be dusted by means of a bellows or other powder dusting machine. Pyrethrum is hard to obtain pure or at least in a fresh condition. It loses its strength by standing, and should be kept well corked. It may be used as a spray in the proportion of one pound of Pyrethrum to 40 gallons

of water. Pyrethrum is very useful for killing the cabbage worm, or insects destroying parts of plants that are ready to be eaten by man. It is also of great use in clearing rooms of flies, mosquitoes, &c., and fleas and lice on domestic animals.

*Kerosene Emulsion* is perhaps the best substance to be used for sucking insects. It is made as follows: "Dissolve one half pound of hard soap in one gallon of boiling water, and while the liquid is still hot, but not near a fire, add two gallons of Kerosene. The whole is then violently churned until it forms a creamy mass, which will thicken into a uniform jelly-like mass on cooling, and the oil remains incorporated in the mass, and will not separate or rise to the top. The churning can best be done by means of a force pump with a small nozzle, pump the liquid back into the vessel containing the liquid. The emulsion thus obtained will keep indefinitely." When ready to use, thoroughly mix one part of the emulsion with nine parts cold water. This is to be thrown in the form of a spray on the plants by means of some kind of a force pump and spraying nozzle. (See machines.)

The kerosene emulsion will injure no foliage, and since it kills insects by contact, it is the most effectual remedy against the chinch bug, plant lice, bark lice, melon bug and other sucking insects, and also for the cabbage worm, and white grub, and will even kill eggs in some cases. It is of the greatest importance that the emulsion be forcibly, thoroughly, and evenly applied, as can be done only by the use of some force pump arrangement.

*Carbolic Acid Emulsion* is made by adding Carbolic Acid (the crude material, dry to get a good strength) one part to 5 or 7 parts of the soap solution similar to that used in making the Kerosine Emulsion. The liquid is to be churned in the same manner as the Kerosine Emulsion, to form an Emulsion.

This Carbolic Acid Emulsion is one of the best preparations to protect plants against lice and fruit trees against borers. It can be sprayed upon the trunks of fruit trees or rubbed on by means of a cloth. Every fruit tree should be treated in this way, especially the young trees, about two weeks after the trees blossom.

*Tobacco Decoction* is made by adding refuse tobacco, which can be obtained at small cost from tobacco factories, to boiling water, in the proportion of one pound of tobacco to two or three gallons of boiling water. As soon as the water has cooled, strain out the tobacco, and the decoction is then ready to use. It is to be sprayed upon the leaves, and is an effectual remedy against the striped flea beetle, and the cucumber, watermelon and squash flea beetles. It will also drive away some bugs from similar plants. It is also valuable as an insecticide against lice and ticks upon domestic animals, and has the advantage over Kerosene Emulsion in that it leaves the hair in a better condition.

*Bisulphide of Carbon* is a liquid that is of great use in destroying the Phylloxera of grape, ants, insects in stored grain, and other insects which can be reached by means of a vapor. For Phylloxera and ants it is to be poured upon the top of the ground above them.

For grain insects and insects affecting clothing, it is placed in shallow dishes and kept in the closed room. The vapor from this liquid is extremely explosive, and must not be used in a room or near the least trace of fire, even a lighted cigarette may cause a great explosion. Bisulphide of Carbon can be had from the manufacturer for from 10 to 12 cents per pound in 50 pound cans.

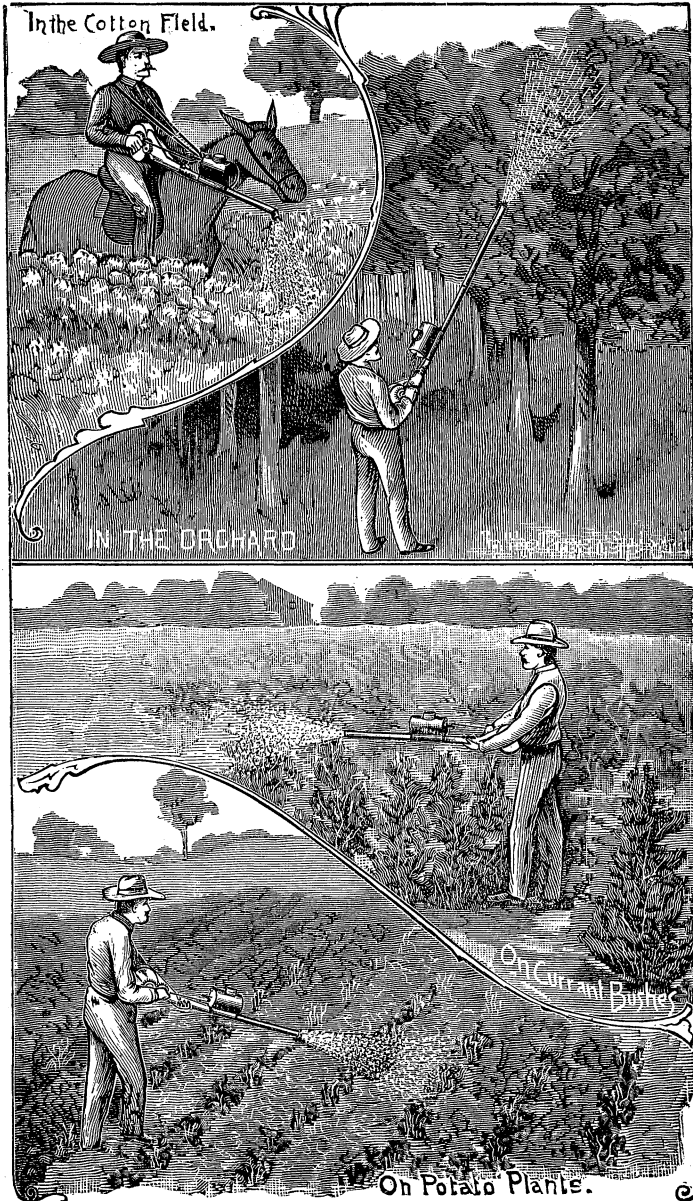
#### MECHANICAL ARRANGEMENTS.

These are intended to act as barriers to keep away insects, or as traps to capture them. They will be described under the special insect which can thus be best treated.

## MACHINES FOR APPLYING POISONS.

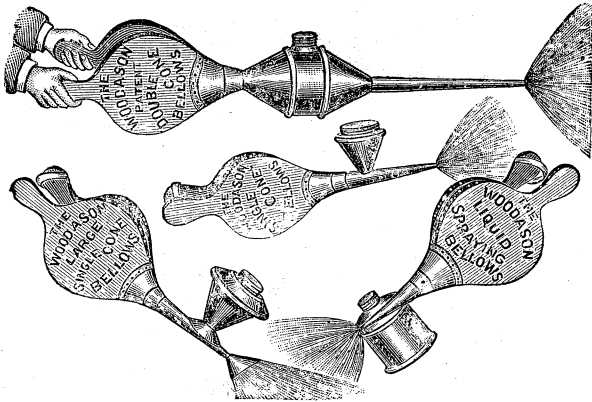
There are a great many kinds of machines and devices manufactured and sold by dealers for applying insecticides and fungicides, some of which are very good, and every farmer, fruit grower and gardener should have at least one. In order to save the purchaser time and trouble in making a selection, a few of the more important machines are here figured, together with the price and manufacturers address.

It is of course important, whenever possible, that one provide himself with two machines, one for using a powder, the other for spraying a liquid; but in case only one can be purchased, a force pump and spraying nozzle should be selected, since one can often mix the powder with the water and apply it in this way.



LEGGETT BROS. POWDER-GUN.

One of the best machines for dusting a powder on plants is Leggett's Powder-gun. It works by turning a crank, and throws the powder in a fine dust constantly and evenly, and the supply can be easily regulated so that one or one half pound of Paris green or London purple can be evenly distributed over an acre. This instrument has been highly recommended by all who have tried it. The price of this gun delivered complete with four extra tubes, shoulder strap and oil can is six dollars. This machine can be purchased from the makers, Leggett & Bros., 301 Pearl St., New York.

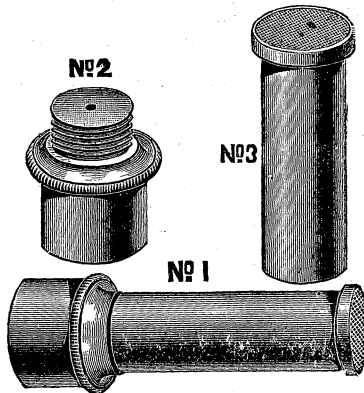


Another very simple and effective machine is Woodason's Liquid and Powder Spraying Bellows, of which four styles are made. The Double Cone Bellows for dusting Paris green, London purple or Pyrethrum, can be purchased for \$3.00, and will be found a very simple and economic machine. The liquid spraying bellows can be had for two dollars.

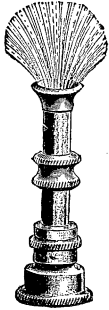
These machines will be found very useful, and are highly recommended. They are manufactured by Thomas Woodson, 2900 D. St., Philadelphia, Penn., or they can be purchased of H. A. Kuhus, Atlanta, Ga.

In the purchasing of machines for spraying liquids, three things should be taken into account. The pump should be made of such materials as will not be easily affected by the chemicals used, there should be some automatic device for keeping the liquid constantly stirred, and the spraying nozzle should be one that is not easily clogged and one that will throw a fine and uniform spray. There are many nozzles manufactured for this purpose, almost any of which can be purchased from a dealer in force pumps.

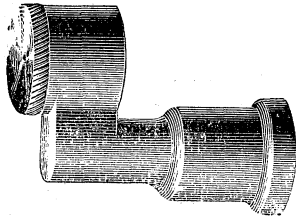
The names of some of the different spraying nozzles are "Masson," "Cyclone," "Vermorel," "Boss," "Graduating," and "Climax." Some of these nozzles, such as the "Boss" and the "Graduating," can be made to throw a fine or coarse spray, or a solid stream. They are all of value and range in price from a dollar to a dollar and a quarter.



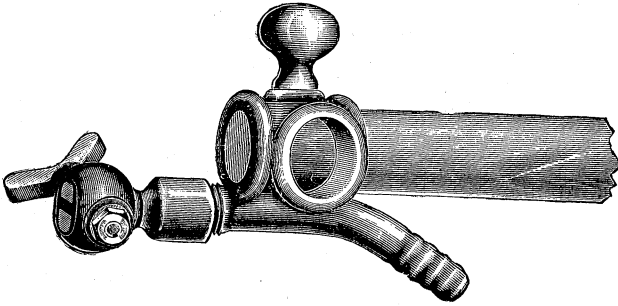
CLIMAX NOZZLE



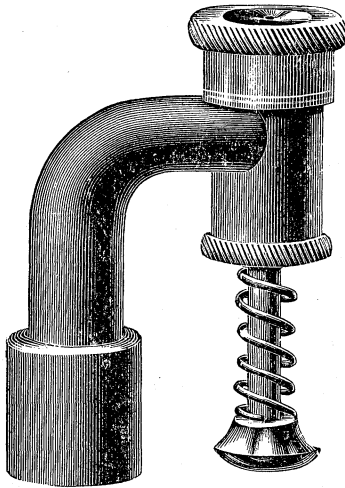
GRADUATING NOZZLE.



CYCLONE NOZZLE.



MASON NOZZLE.



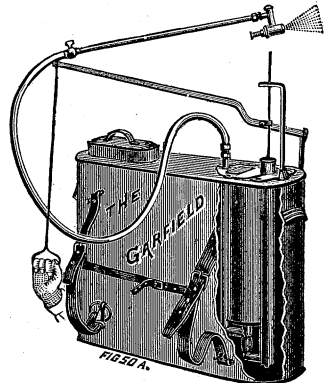
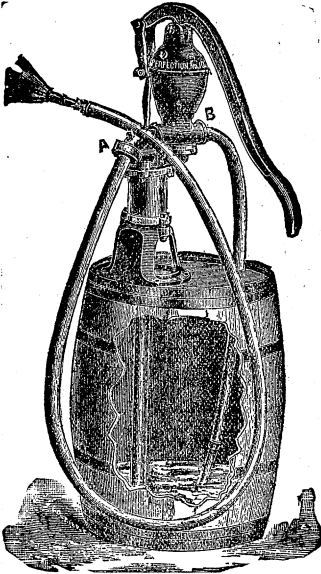
VERMOREL NOZZLE.





CLIMAX AUTOMATIC AGITATOR PUMP.

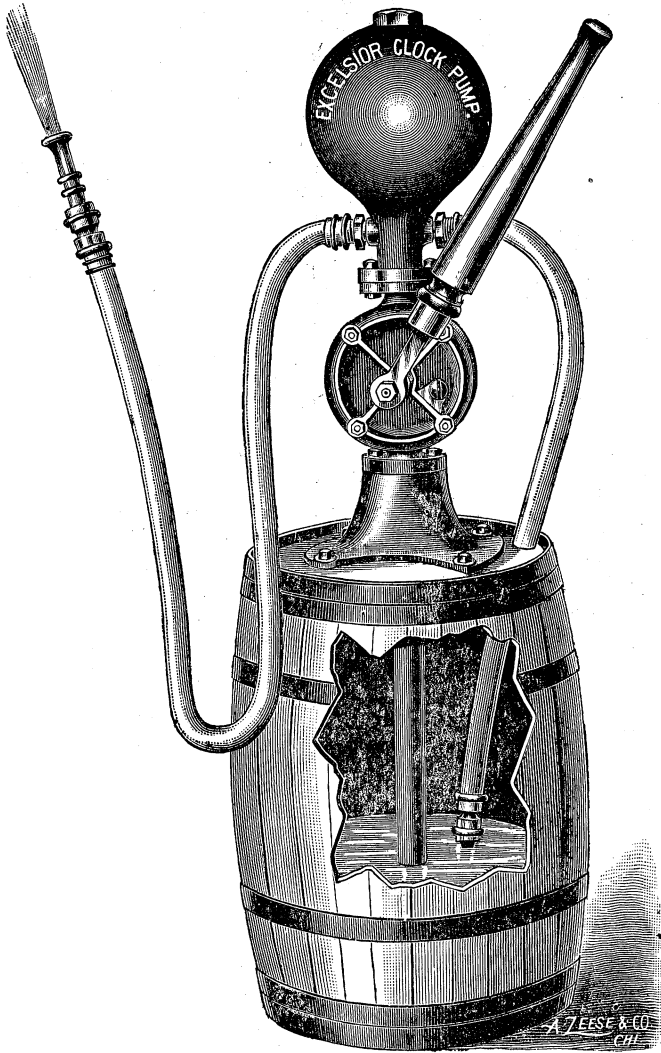
The "Climax Automatic Agitator Pump," manufactured by the Nixon Nozzle and Machine Co., Dayton, O., is an excellent machine for spraying Paris green or London purple in water, since it has an automatic device for keeping the liquid constantly stirred. The price of the pump, however, is a little high, being \$15.00.

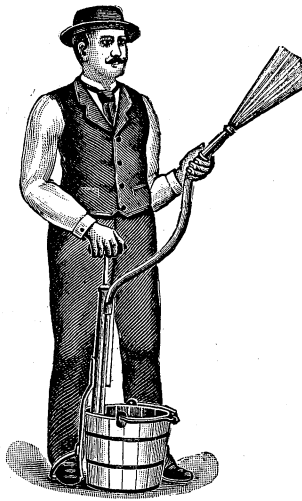


FIELD FORCE PUMP CO.

The Field Force Pump Company, Lockport, New York, manufacture a pump that can be mounted on a barrel, and has a second hose reaching to the bottom of the barrel, which keeps the liquid constantly stirred by forcing part of it back into the barrel. These pumps are comparatively cheap, and can be had for \$10.00.

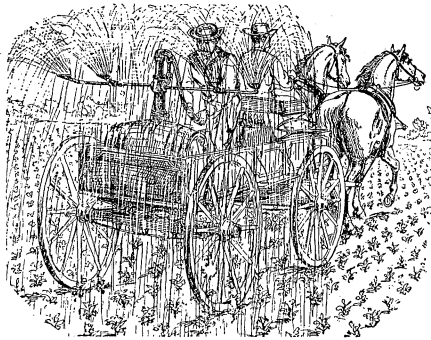
The same company also manufacture a knapsack sprayer, known as the Garfield. This machine is to be carried upon the back, while the person pumps with one hand and holds the nozzle with the other. This pump is very convenient, and costs but \$12.00.

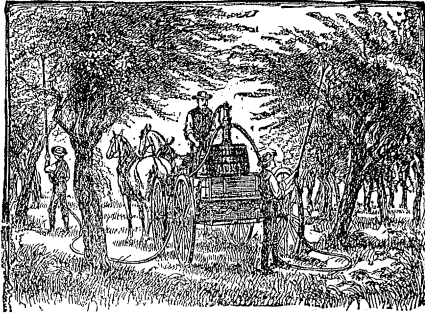




EXCELSIOR No. 8

William Stahl, Quincy, Ill., also manufactures a number of different styles of pumps, including a knapsack pump. The Excelsior Spraying Outfit No. 8, which costs but \$2.50, consists of a pump and hose that can be used in a pail; they also manufacture more durable and more costly machines for use in a similar way. They manufacture an Excelsior Clock Pump that is extremely useful, since it can be mounted upon a barrel and has a second hose extending down to the bottom, which keeps the liquid well stirred, while the lever handle can be used at any angle. The price of this pump is \$13.00.





The Goulds M'fg., Co., Seneca Falls, New York, are the manufacturers of a large number of pumps similar to the above, including the Knapsack Sprayer. The method of using some of their pumps for orchard and field work is shown in the above cuts.



Adam Weaber & Son, Vineland, N. J., are also the makers of some excellent spraying machines. One of their nozzles that will be found convenient to use in connection with a number of machines of various makers, is shown in the above cut.

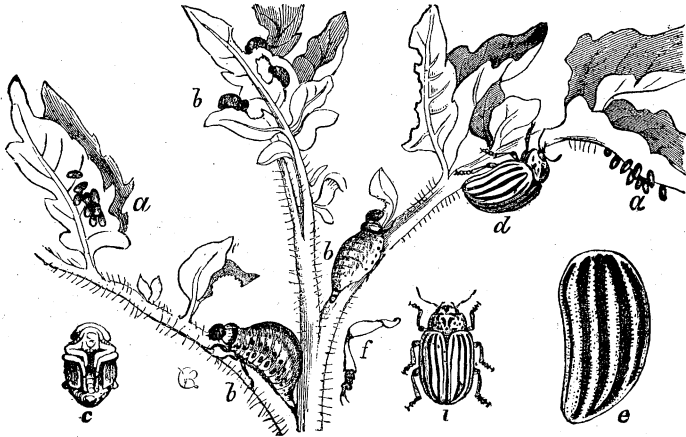
I wish to acknowledge the kindness of the various firms above mentioned, in loaning us the cuts here used to illustrate machines.

## INSECTS.

## THE POTATO PLANT.

## COLORADO POTATO BEETLE.

The Colorado Potato-Beetle has appeared in Alabama this year for the first time. This insect has occurred in immense numbers throughout the northern and eastern parts of the United States, having originally come from the west. It has done immense damage to the potato crop, and when not kept in check it will strip the plants completely of their leaves.



COLORADO POTATO BEETLE.—*a*, eggs; *b*, larvæ; *c*, pupa; *d*, *d*, adult beetles; *e*, enlarged wing cover of beetle.

The adult insect is a beetle nearly one-half inch in length, of a yellow color, with dark longitudinal stripes and orange legs and belly. It deposits its eggs in clusters, usually on the underside of the leaf; these hatch in about a week into small grub like larvæ, at first of a light yellow color, but changing to orange or red with a few black spots along the side, as they grow larger. They eat almost continually and with great rapidity, and keep their bodies distended with

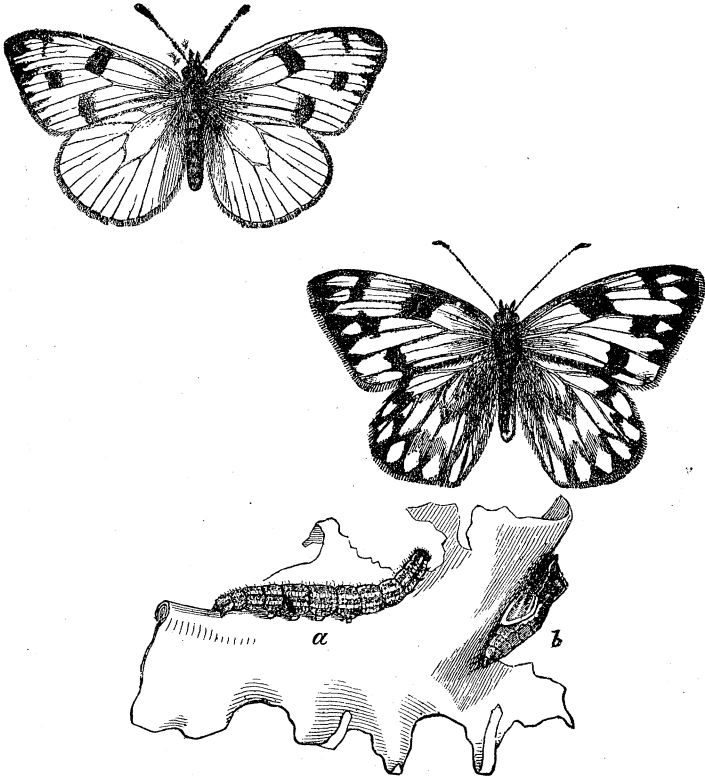
food. In a few weeks they become full grown and descend just beneath the surface of the ground, where they transform to the pupa stage. They remain in the pupa stage about ten days, and then come forth as a perfect insect. These then pair and the female soon deposits her eggs, and another brood follows with the work of destruction. There are about four broods in a season, and unless they are held in check, it is easy to see that they increase in numbers with great rapidity. The adult beetle, only, lives through the winter, secluded under rubbish, leaves, etc., and comes out in the Spring to deposit eggs.

REMEDIES.—Fortunately this insect can be readily held in check by sprinkling or dusting the plants with Paris green or London Purple, used either as a powder or in a liquid state. In using these remedies as a powder, the poison can be diluted by mixing with four times its bulk of flour. This can then be applied by means of a dusting machine or powder gun, or it can be sifted on by means of a tin can with a few small holes in the bottom. It is better to dust the plants early in the morning when the dew is on them. In using the poisons as a liquid, 1 pound of the poison to 50 gallons of water, can be sprayed upon the plants by means of some spraying machine, or the liquid can be carried in a pail and sprinkled on the plants by means of a brush-broom. It is important that the liquid be frequently stirred, otherwise the poison will settle to the bottom, especially Paris green. Fortunately the larvæ as well as the adults are destroyed by these remedies. It is important that the application be made as soon as the insects appear, and should be kept up as often as they appear in damaging numbers. This is especially true with the young potato plants, since they will eat every leaf in a remarkably short time.

## CABBAGE PLANT.

## CABBAGE BUTTERFLY.

There are two species of the common cabbage butterfly in Alabama. One known as the southern cabbage worm is a native of this country. The other known as the imported cabbage worm was introduced from Europe about 1857, and has since spread nearly all over the United States and Canada, and has almost exterminated the native species. The life histories and habits of these two insects are so nearly alike that, for our present purposes, a description of those of the imported cabbage worm will answer for both.



SOUTHERN CABBAGE BUTTERFLY :—Adult male and female.  
*a*, larva ; *b*, pupa.



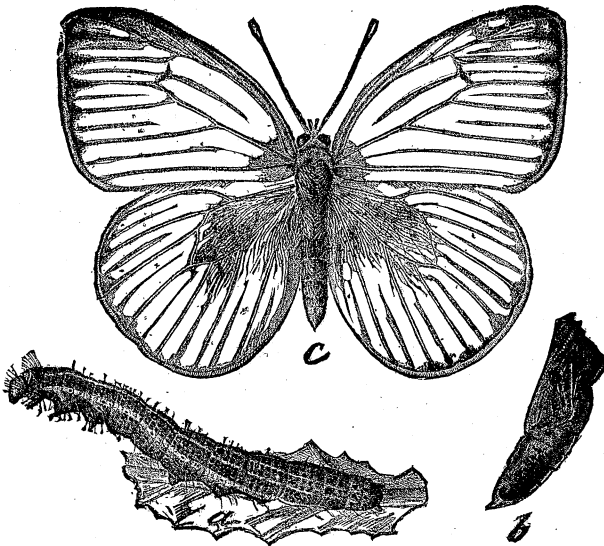
The adult butterfly is so common and well known to every gardener and farmer, that a description of it is unnecessary, suffice to say it is a small white butterfly, with a few black spots near the margin of the wings, which measure about two inches in expanse. The female butterfly deposits her small yellowish eggs upon the leaves of the cabbage plant. In a few days the little green larvæ hatch and immediately begin to feed upon the foliage. They eat with considerable rapidity, and become full grown in about two weeks. As a rule the larvæ then leave the cabbage plants and seek some sheltered place, and change to pupæ, which are naked and without a cocoon. Occasionally the pupæ will be found on the cabbage plants. They remain in the pupa state about ten days, and then the adult butterfly comes forth ready to deposit eggs, which soon hatch into another brood of worms. There are several generations each year, and it can be readily seen that if left to themselves, they will increase in number with great rapidity. This insect passes the winter in the pupa state.

Fortunately these insects have a number of natural enemies that tend to keep them in check. The adult butterflies fall a prey to birds, and a bug that catches them and sucks their juices. The larvæ and pupæ fall a prey to birds, and are greatly subject to the attack of certain insects both predaceous and parasitic. The larvæ are also sometimes killed in great numbers by a certain disease.

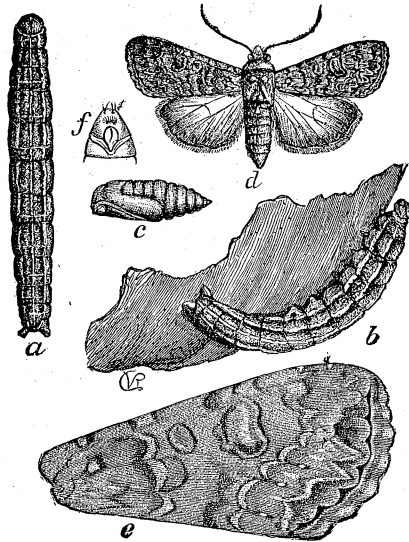
REMEDIES.—The cabbage worms are readily killed by a number of easily applied remedies. When the plants are very young Paris green or London purple can be applied without danger. It may be used either as a powder or mixed with water. When the plants are of any considerable size Pyrethrum either mixed with five times its bulk of flour and, dusted on the plants, or mixed with water and sprayed upon them, will prove an excellent remedy, provided the Pyrethrum is good. Kerosene emulsion will kill them, but when the plants are nearly headed, it may taint the leaves.

Dr. C. V. Riley says that the cabbage worm can be killed by the use of hot water sprinkled upon the plant by means of an ordinary sprinkling pot. If the water be boiling in the pot, it will kill the worms and yet not be too hot to kill the leaves by the time it reaches them. It is essential whatever remedy you use, that it be applied at frequent intervals, as new broods come on every few days. There need be no fear about the use of Pyrethrum, since it is not poisonous to man. As regards the use of Paris green, there need be little or no fear if it be used properly, that is, reduced to the proper strength and put upon the plants evenly. The worms will be killed by a very small amount that would not affect man, and the first rain will wash the most of it off.

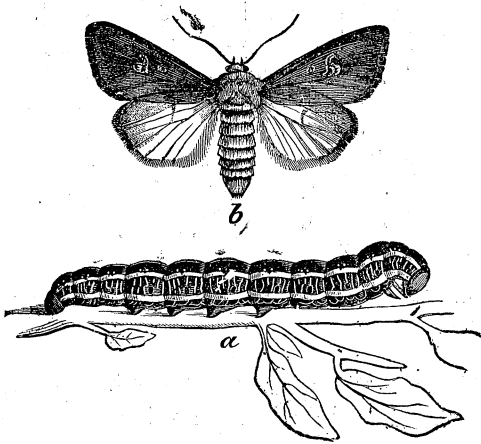
OTHER CABBAGE WORMS.



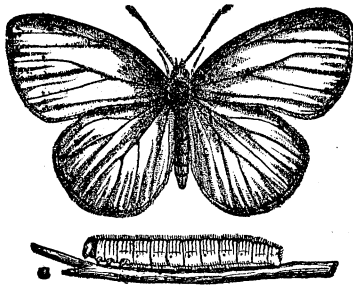
CABBAGE WORM.—*a*, larva ; *b*, pupa ; *c*, adult.



CABBAGE WORM.—*a, b*, larva; *c*, pupa; *k*, adult.



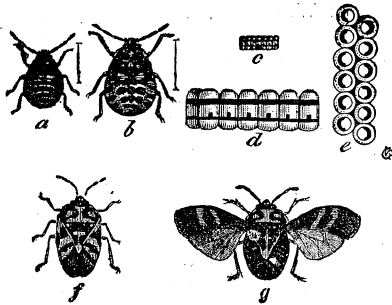
ZEBRA CABBAGE WORM.—*a*, larva; *b*, adult.



CABBAGE WORM.—larva and adult.

## HARLEQUIN CABBAGE BUG.

This is a small sucking insect of a dark color with orange yellow markings. It is not confined to the cabbage plant alone, but feeds upon a number of cruciferous plants. The adult lives through the winter, and deposits its eggs upon the



HARLEQUIN CABBAGE BUG.—*a*, *b*, young; *c*, *d*, *e*, eggs; *f*, *g*, adult natural size.

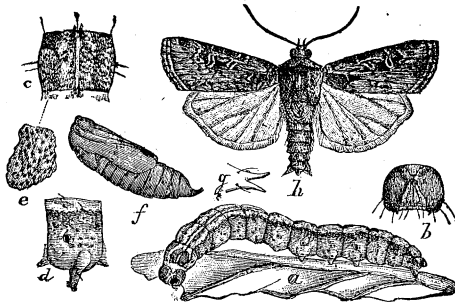
young plants as soon as they are set out. The eggs hatch in about a week or less into a minute insect resembling very much the adult, except that it is smaller and has no wings. The insect pierces the plants by means of its mouth parts and sucks the juices. It develops in a little less than two weeks into an adult insect. This insect does not pass through the inactive pupa stage of most insects, but feeds continu-

ally from the time it hatches, and is extremely destructive to the cabbage plant. A few of these insects will kill a plant in a single day. There are several broods each season.

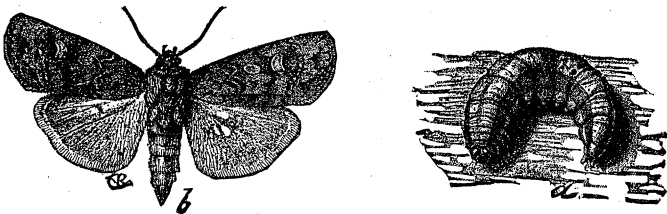
REMEDIES.—It is of the greatest importance that this insect be fought as soon as it appears in the Spring, otherwise they will increase beyond our control. The same substances which are used to combat the cabbage worm, with the exception of Paris green, viz: Kerosine Emulsion, Pyrethrum and hot water, are used to kill these insects.

#### CUT WORMS.

There are about ten different species of cut-worms that attack the cabbage. The habits and life histories are so nearly alike that for our purposes we can treat of them in general.



CUT WORM.—*a*, larva; *f*, pupa; *h*, adult.



CUT WORM.—*a*, larva; *b*, adult.

The adult is a small nocturnal moth, with an expanse of wings of about  $1\frac{1}{2}$  inches. The female deposits her eggs usually upon the branches of bushes. As soon as the eggs hatch, the larvæ descend to the ground and feed while young upon various plants, usually grass. They are about half-grown when winter comes, and they then seek shelter by crawling under some object or burrowing in the ground. They pass the winter in this condition and come forth in the Spring in search of food. They now attack a large variety of plants. Nearly all garden vegetables are attacked by them. They soon become full grown, and in early Spring enter the ground, and just below the surface turn to the pupa stage. In three to four weeks they turn to the adult and emerge as a moth, the female then depositing eggs for another brood. Some species of cut worms have more than one brood in a year.

REMEDIES.—One of the best methods to kill the cut worms is to place clover, cabbage or other leaves upon the soil before the garden is planted; these leaves to be poisoned with Paris green or London purple, either by dusting with the powder or dipping them in a solution of the poison. The worms crawl about in search of food, eat the leaves, and are killed before the cabbage or other plants are up. The cut worms are easily trapped by placing boards on the ground between the rows of vegetables, and killing in the morning the worms that get beneath them during the night. Occasionally the worms can be successfully fought by digging them out of the ground.

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## COTTON PLANT.

### COTTON WORM OR COTTON LEAF WORM.

This insect is too well known throughout the cotton growing States to need any description, either of the adult, its habits or its life history.

REMEDIES.—The cotton insect is easily destroyed and its ravages prevented by the use of Paris green or London purple. The larva or worm stage is the best one in which to fight this insect. We simply have to poison the leaves on which they feed, in order to kill them, and it is surprising what a small amount of either of the above poisons is necessary. The amount of poison used is of little value provided it is so distributed as to cover every leaf. The application of the poison should be made just as soon as the worms appear, and if well done there need be no damage resulting from these worms.

One pound of Paris green or London purple to the acre is sufficient. It is sometimes used undiluted, but more often it is mixed with from three to five times its bulk of flour. The cheapest method of application is as follows: Make two sacks of some heavy cloth, 8 oz. osnaburg if the undiluted poison is to be used, but thinner cloth if diluted; these sacks should be about one foot long and four or five inches in diameter; leave it open along the whole length of one side; sew up both ends firmly. Get a hard wood stick five feet long and about  $1\frac{1}{2}$  inches thick and 2 inches wide, and bore an inch hole near each end. Firmly tack a bag to each end of this stick in such a way that the stick will form the upper portion of the bag; the bag will have its length in the direction of the stick, and there will be but one opening into the bag, viz: the hole in the stick. The bags can now be filled, by means of a funnel, with pure Paris green or London purple, or that thoroughly mixed with about three times its bulk of flour.

The pole is to be carried by the man on horseback, who rides between the rows, holding the pole across the horse, and shakes or taps the pole with a stick, thus causing the powder to sift through the sacks on the plants. It is essential that the sacks do not touch the leaves or become wet in any way, otherwise the powder will not sift through. The

workman should keep out of the dust as much as possible, and should dust his clothes and take a bath at the close of his work; it is well also to brush or wash the mule. The above apparatus can be made in a short time by any farmer, and the poison and flour will cost him no more than 50 cents per acre, and money can be made by having these ready for use at a moment's notice before the cotton is up.

It is of the greatest importance that the poison be applied just as soon as the worms first make their appearance, since every day that is neglected may cost a great many dollars. A single application of the poison, if not followed by a heavy rain, is usually all that is necessary to protect the crop. With the above precautions, and especially that of promptness and thoroughness in the application of the remedy, no farmer need fear trouble from the cotton worm.

The Paris green or London purple may also be applied by mixing it with water in the proportion of one pound of poison to a barrel of water, and spraying it upon the plants by means of a force pump and spraying nozzle. There are many machines for this purpose. (See machines for applying insecticides.) Where a farmer has a large crop of cotton every year, it will be to his advantage to purchase a spraying machine that can be used with a mule.

The adult moth of the cotton-leaf-worm can be trapped by placing a shallow basin of kerosine, molasses, or even water upon poles at intervals about the cotton-field, and putting a lantern just above or in the basin. The moths are attracted at night by the light and fall into the oil or molasses from which they cannot escape. This method has proved very successful in many localities.

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#### BOLL WORM.

The boll-worm like the cotton-worm needs no description to a farmer living in the Southern States. (For figure of boll-worm see corn-worm under corn-plant.)



As is no doubt generally known, the boll-worm is the same thing as the corn-worm. It often migrates from the corn-field to the cotton field, as soon as the ears of corn begin to harden, and then eats its way into the cotton boll. In migrating it frequently also eats the leaves of the cotton to a slight extent.

The adult moth deposits here eggs upon the leaves of the cotton plant, and the young crawl to the bolls into which they eat their way, but frequently in doing so, they eat of the leaves. It has often been said that the boll-worm feeding upon the inside of the boll, as it principally does, cannot be poisoned by ordinary means. However, from what has been said, one can easily see that if there be poison upon the leaves of the cotton-plant when the boll-worm migrates to it from the corn, or when the young are hatched from the eggs laid upon the cotton leaf, that those worms that do eat of the leaf, will be poisoned. Hence the poisoning of the leaves for the cotton-leaf-worm will also greatly lessen the number of boll worms; and an application of the poison at a time just before or as soon as the boll-worm begins to migrate from the corn, will save much money. The poisoning for the third brood of the cotton worm and of the boll worm may be done simultaneously. The application of the poison for the boll-worm is accomplished in the same way as given for the cotton-worm.

Perhaps the most widely used method of destroying the boll-worm is to trap the adult moth. The moth is not only attracted by light, but is also attracted by sweets. Hence the placing of lanterns in basins of some liquid about the field, or the placing of simply basins containing molasses and vinegar in the proportion of 4 parts of vinegar to 1 part of molasses, will catch large numbers of the moths. They are attracted by the odor of the mixture, and in trying to sip it, they fall into the liquid and cannot escape. Since

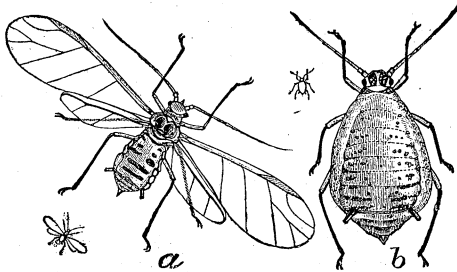
the moths fly only at night, the basin should be visited every evening, the moths taken out and the liquid replenished.

From what has been said in regard to the cotton-worm and boll-worm, it will be seen that we can fight both worms by the same remedies and at the same time.

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#### APHIDS ON COTTON.

Aphids, or plant lice, as they are commonly called, are small, usually wingless insects, frequently of a green color. They pierce the leaves of the cotton-plant and suck its juices. Since they are not biting insects and do not eat the tissues, they cannot be killed by the use of the poisons applied to destroy the cotton worm or boll worm.



PLANT LICE OR APHIDS.—*a*, male; *b*, female.

The cotton-plant louse is not as common or destructive an insect except in extreme cases, as the boll worm and cotton-worm. Whenever the plant louse does occur to a threatening extent it is easily destroyed by the use of Kerosine Emulsion. (See Insecticides.)

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#### THE CORN PLANT.

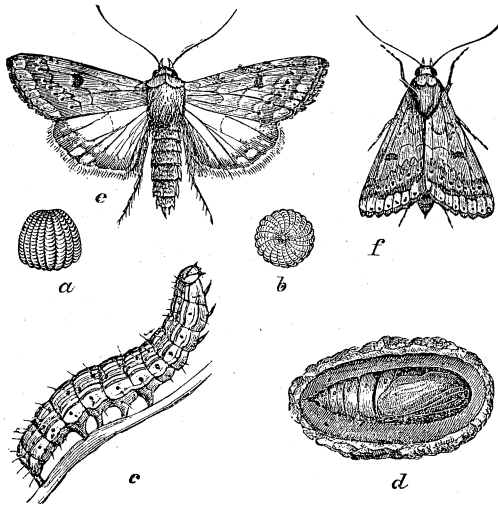
##### CUT WORMS.

The cut-worm has been already described as affecting cabbage. They are also very destructive to corn, often necessitating re-planting. It is not necessary to describe them

again. The remedies to be used in the case of their attacking corn are the same as those to be used in the case of cotton. (See cut worms under the cabbage plant.)

CORN-WORM OR BOLL-WORM.

This is perhaps the most destructive insect affecting corn, especially the roasting ears. The worm is the same that attacks the cotton bolls, but prefers the corn while it is soft to cotton, and only migrates to the latter when the corn becomes too hard.



CORN-WORM OR BOLL-WORM.—*a, b*, eggs greatly enlarged; *c*, larva; *d*, pupa; *e, f*, adulta.

The female moth deposits her eggs among the silks of the young ears. As soon as the larvæ hatch they eat their way into the ear, and feed upon the young kernels of the corn. They remain here eating the corn for several weeks, and sometimes eat the entire length of the ear, although they usually confine their depredations to the extremity. If the corn becomes too hard before the worms are full grown, they migrate to the cotton plant and enter the boll; otherwise they simply leave the corn, and burrow just beneath the ground, where they make a frail cocoon of silk and sand, within

which they change to a pupa. In about two weeks they come forth as adult moths. There are four or five broods during the summer. The first broods attack the corn, as a rule, the latter broods attacking the cotton bolls, the corn at this season of the year being too hard for them to eat.

The cotton or boll worm winters in the pupa stage.

REMEDIES.—Owing to the peculiar habits of the corn worm, no successful means has yet been devised to control them on a large scale against attacking corn. The only remedy is hand picking. The ends of the ears can be opened and the worms picked out and destroyed. Their presence can usually be told by a premature ripening of the silk. Trapping the moths as suggested under the cotton plant can be used to a good advantage.

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I wish to acknowledge the kindness of Dr. C. V. Riley, and also of the U. S. Department of Agriculture through Dr. Riley, for the cuts of the insects used to illustrate this Bulletin.

It is hoped that whenever a fungus or other disease, or an insect attacks a plant in sufficient quantities to attract attention, that the person will send a note and a sample or specimen of the same to J. M. Stedman, Biologist, A. & M. College, Auburn, Ala.