BULLETIN

OF THE

Ohio Agricultural Experiment Station.

SECOND SERIES.—VOLUME IV, NUMBER 2.

FEBRUARY, 1891.

Offices and Experiment Grounds on the Farm of the Ohio State University.

The Bulletin of this Station is sent free to all residents of the State who request it. Persons who receive duplicate copies of the Bulletin, or who do not care to receive any, are requested to notify the Station, as the edition is not sufficient to supply the urgent demand for it.

All correspondence should be addressed to EXPERIMENT STATION, *Columbus, Ohio.*

COLUMBUS:

THE WESTBOTE COMPANY, STATE PRINTERS.

1891.

ORGANIZATION

OF THE

OHIO AGRICULTURAL EXPERIMENT STATION.

BOARD OF CONTROL.

SETH H. ELLIS,	Springboro.
HON. JOSEPH H. BRIGHAM,	Delta.
J. L. MCILVAINE,	New Philadelphia.
THE GOVERNOR OF THE STATE, THE DIRECTOR OF THE STATION,	*Ex-Officio.*

OFFICERS OF THE BOARD.

SETH H. ELLIS,	President.
PROF. WILLIAM R. LAZENBY,	Secretary.
BERTHA E. WILDMAN,	Treasurer.

STATION STAFF.

CHARLES E. THORNE,	Director.
WILLIAM J. GREEN,	Horticulturist and Vice-Director.
J. FREMONT HICKMAM, M. A. S.,	Agriculturist.
CLARENCE M. WEED, D. Sc.,*	Entomologist and Botanist.
FRANCIS M. WEBSTER,†	Consulting Entomologist.
H. J. DETMERS, M. V. D.,	Veterinarian and Bacteriologist.
BERTHA E. WILDMAN,	Bursar.
FREDA DETMERS, B. Sc.,	Assistant Botanist.
EDWIN C. GREEN,	Foreman of the Gardens.
W. H. BAKER,	Meteorologist.

*Until April 1.

†Prof. Webster is special agent of the United States Department of Agriculture, Division of Entomology, and after July 1, 1891, will be located at this Station.

BULLETIN

OF THE

OHIO AGRICULTURAL EXPERIMENT STATION.

VOL. IV, No. 2. SECOND SERIES. FEBRUARY, 1891.

ARTICLE II.—MISCELLANEOUS EXPERIMENTS IN THE CONTROL OF INJURIOUS INSECTS.

The present article includes a number of experiments made by the Station or its correspondents that have not hitherto been reported.

Under the first and second of the following headings are reported some experiments made to determine whether certain combinations of insecticides and fungicides could be made and applied to plants without injury to their foliage. Under the third some experiments are recorded that were undertaken to determine whether Paris green or London purple is more injurious to foliage, and also to learn to what extent the addition of lime to London purple solution lessens its injurious qualities. Then follow some letters from correspondents relating experiences in lines in which the Station has been working; and the last topic deals with experiments of a very satisfactory nature in preventing insect injury in the forcing house.

THE ARSENITES AND BORDEAUX MIXTURE.

A half barrel full of Bordeaux mixture was made June 20, according to the following formula:

Lime, two pounds.
Sulphate of copper, three pounds.
Water, twenty-five gallons.

To this was added two ounces of Paris green. The combined mixture was then sprayed on the same day, between 9 and 11 A. M., upon the following plants: Two apple, two cherry, two pear, two plum and two quince trees, two grape vines, and part of a row of potatoes. A care-

ful examination of all these plants was made June 26, and in no case was there any indication of injury.

On the same date (June 20) two ounces of London purple was added to twenty five gallons Bordeaux mixture prepared as above, and between 11 and 12 A. M. was sprayed upon the following plants: Two apple, two cherry, two pear, two plum and one quince tree, and a grape vine. Examination June 27, showed no signs of injury.

CARBONATE OF COPPER AND PARIS GREEN.

A solution of carbonate of copper was made June 21, according to the following formula:

Carbonate of copper, three ounces.
Ammonia, one quart.
Water, twenty-five gallons.

The copper carbonate was dissolved in the ammonia, and the solution was then added to the water. This was then sprayed about 5 P. M. on the following plants: Apple, cherry, grape, pear, quince and potatoes. An examination June 27, showed no injury to the foliage.

In another experiment in which this solution was applied to potatoes by a machine which brought the discharge nozzles very near to the leaves, so that the solution struck them with considerable force, there was a peculiar damage evidently due to the ammonia being applied so forcibly. It only appeared on the leaves nearest the nozzles. This will be obviated where the nozzle is kept a short distance from the foliage.

We made twenty-five gallons of this same mixture June 24, and added to it two ounces of Paris green. This was sprayed about 10 A. M. upon the following plants: Cherry, grape, pear, quince, potato. The plants were examined June 27, and no injury was apparent.

THE ARSENITES AND LIME.

In 1888 we sprayed a number of pear trees with London purple in the proportion of eight ounces to fifty gallons of water. At the same time other trees were sprayed with the same mixture except that a half peck of fresh slaked lime was added. It was then found that while the trees sprayed with London purple alone had their foliage decidedly injured by the application, those sprayed with the lime and London purple were not affected. Similar results were obtained in 1889. The present season a series of definite experiments to determine to what xtent this is true were planned, and at the same time a test of the

comparative effect of London purple and Paris green, as regards injury to foliage was made.*

Six pear trees were divided into three sets of two each, and each set was sprayed June 19, with the following combinations:

First set. Paris green, eight ounces; water, fifty gallons.
Second set. London purple, eight ounces; water, fifty gallons.
Third set. London purple, eight ounces; lime, two pounds; water, fifty gallons.

The first set was sprayed at 10 A. M., June 19, the second at 3 P. M., and the third at 5 P. M., on the same day. The spraying was done by an experienced assistant, with a Nixon cart and No. 3 Climax nozzle. The trees were sprayed until the foliage began to drip. A week later, June 26, the trees were examined to determine the amount of injury to foliage with the results indicated in the following table:

	Per cent. of leaves badly damaged.			Per cent. of leaves slightly spotted.		
	Paris green.	London purple.	Lime and London purple.	Paris green.	London purple.	Lime and London purple.
First tree		80		5		
Second tree		75		10		
Total		155		15		
Average per cent.		77.5		7.5		

This table shows that the two pear trees sprayed with Paris green were very little damaged by the application so far as one could judge a week after the spraying; that nearly eighty per cent. of the foliage on the two trees sprayed with London was badly damaged, and that the addition of lime to the London purple solution entirely prevented this great injury, as was shown by two trees sprayed with London purple and lime.

The same experiments on a more extensive scale were conducted upon apples. Eighteen Ben Davis trees were divided into three sets of six each, the first set being sprayed with Paris green, eight ounces to fifty gallons water; the second with London purple in the same pro-

*A brief account of the lime and London purple experiment, in which the saving effect of the lime is noticed, will be found in the report of this Station for 1888, p. 145, and in the Proceedings of the Society for the Promotion of Agricultural Science for 1888, p. 94. A mention of the work of 1889 was made in a paper read before the Ohio State Horticultural Society, Dec 11, 1889, and published in the Journal of the Columbus Horticultural Society, vol. IV, p. 100.

portion, and the third with the London purple solution, plus two pounds freshly slaked lime. A week later (June 26) the trees were examined to determine the amount of injury, the results being indicated in the following table:

	Per cent. of leaves badly damaged.			Per cent. of leaves slightly spotted.		
	Paris green.	London purple.	Lime and London purple.	Paris green.	London purple.	Lime and London purple.
First tree	5	25	.....	30	60	75
Second tree	5	50	5	25	30	75
Third tree	3	20	2	20	50	70
Fourth tree	2	20	3	40	50	60
Fifth tree	5	20	10	30	50	75
Sixth tree	5	20	5	40	50	60
Average	4	26	4	30	47	70

The first thing this table shows is that the Paris green was much less injurious to the foliage than London purple. The second is that addition of lime to the London purple mixture very largely prevented the injury to the foliage. These results agree with those obtained the past season at several other experiment stations.

SPRAYING FOR THE PLUM CURCULIO.

We have received from Mr. G. B. Strong, of Cuyahoga county, Ohio, an account of his experience in spraying plum trees the past season. He sprayed forty trees with London purple, at the rate of one pound to 150 gallons of water. Three applications were made, the first one being applied when the fruit was about the size of a small pea. The spray was put on until the leaves began to drip. Twenty-five bushels of plums were gathered from the forty trees, and not one per cent. of the crop was stung. Two trees in the vicinity that were not sprayed had all their fruit stung. The foliage was injured somewhat, so that Mr. Strong says that the solution was too strong, and that hereafter he will use one pound London purple to 200 gallons water, spraying more lightly, and applying only twice unless a third application becomes necessary.

It is probable that Paris green would be better for spraying plum

trees than London purple, as it usually contains less soluble arsenic, and consequently, is less liable to injure delicate foliage. It may be used at the rate of three ounces to fifty gallons water.

Some spraying experiments were also made by Mr. Wm. Miller, a leading fruit grower of Ottawa county, Ohio. Having two pear orchards several rods apart, the fruit of which has for some years been greatly injured by the Plum Curculio, he determined to try spraying one of them. The larger orchard, containing several hundred trees, was accordingly sprayed twice with London purple—four ounces to fifty gallons water. The fruit on this orchard was very much less injured by the Curculio and other insects, than that on the other orchard which had not been sprayed. Mr. Miller also found the spraying machine a decided help in fighting the Curculio in his plum orchard, although he did not rely upon it altogether, but used the jarring method part of the time.

WHITEWASHING THE ROSE BUG.

In the report of this Station for 1888 I recorded an experiment made at my suggestion by Mr. E. A. Dunbar, of Ashtabula county, Ohio, in which peach trees and grape vines were sprayed with a dilute whitewash (made by adding a peck of fresh slaked lime to forty gallons of water) to prevent the injuries of the "Rose Bug" or Rose Chafer (*Macrodactylus supspinosus*). The experiment was made on a large scale and was entirely successful, the insects leaving the sprayed trees and vines for others not sprayed.

In a letter dated March 17, 1890, Mr. Dunbar writes that he repeated the experiment in 1889, "applying a good whitewash to what I wanted to save from the Rose Bugs and they staid away."

At a meeting of the Ohio State Horticultural Society, June 11, 1890, Mr. F. C. Miller reported that in 1889 he whitewashed in this way a three-acre peach orchard, and a plum orchard of 300 trees, but without success. The insects remained in spite of the thick coating of lime and ruined the crop. Mr. Miller did not leave any untreated trees for them to migrate to, which may possibly account in part for his failure.*

A somewhat similar failure has been reported from New Jersey where the Rose Chafer is extremely injurious. Prof. J. B. Smith, of the Experiment Station of that State, reports having tried this preventive on grapes without successful results.†

---

*Report Ohio State Horticultural Society, 1889-90, pp. 281-282.

†Insect Life, v. III, p. 114, Bull. 75, N. J. Expt. Station, p. 28.

That the remedy is not altogether useless, however, is shown by the following experience of Mr. S. Justus, of Lake county, Ohio, contained in a recent letter received from him:

The past season has been rather a sorry one in our section as regards our fruit crop. First of all we have lost nearly all of our fruit, excepting berries and grapes, and some have lost all their grapes, because of the Rose Bug or Brown Rot. We had a fine prospect at blossoming time, but when Mr. Rose Bug put in his appearance he made us sick. He came in such force that many fruit growers made no effort to save their crop. The insects cleaned out several vineyards of four or five acres. My son and myself had some twenty acres to fight on, and had nothing ready to fight with. I went five miles and hired a spraying pump, and purchased a quantity of lime and carbolic acid. On some vines we used dry lime, but on most we used the liquid in very strong solution. We used one bushel of good fresh unslaked lime, and one quart of crude carbolic acid to fifty gallons water. The lime was dissolved and strained through a seive. We sprayed on freely. Our vines looked white when we were over them. It took us four days to cover nineteen acres. We lost no grapes by bugs after getting the lime on them. It is as sure death to them as a ball is to a squirrel.

There is no need to fear injury from the lime. In my experience it has never killed a vine It is also a good fertilizer.

I think I had the best test that could have been given. Had three vineyards to operate upon, with drives between them. In the middle of one of them there was an acre of mixed grapes, with pear trees and current bushes set among the vines so that we could not drive the spraying machine through. As a consequence we lost the entire crop. It was set as full of fruit as any. Right across the drive way where the lime was used, the vines were full of fruit. So I know the solution killed them when used strong enough.

I have tried Paris green and London purple for the Rose Bug, thoroughly, but without benefit. I think the lime shuts off their breathing apparatus. The trouble with dry lime is that the wind blows it off. We only went over ours once. Shall begin sooner another season and go over them twice, and use the sulphate of copper in connection with the lime to prevent the Brown Rot. The bug does his damage inside of one week, and when in blossom. In our experiment, I use five barrels of fresh lime. I also had similar results on cherries; saved a good crop on half of the orchard which was sprayed, and lost, within three days, all on those not sprayed.

This experience is a valuable one, and shows that there is virtue in the method, notwithstanding the adverse accounts concerning it. Probably the number of the chafers present and the leaving of untreated trees and vines are important factors in determining success or failure. The addition of crude carbolic acid to the mixture, and the use of freshly slaked lime probably also render success more certain. It will be noticed that Mr. Justus is decidedly of the opinion that the insects were killed outright by the application.

As to the combination of the sulphate of copper with the lime opinions are likely to differ. The experience recorded in another part of this Bulletin indicates that Eau Celeste is the most desirable fungicide for the prevention of Brown Rot, and that the first application should be made some days before the blossoming period, which

would usually be too early to take effect on the Rose Bugs. Hence it seems likely that it will be best to fight the two enemies separately.

STRIPED CUCUMBER BEETLE REMEDIES.

The publication of the Striped Cucumber Beetle article in the September Bulletin, has led Messrs. W. F. Shuman, of Seneca county, Ohio, and Marion Foster, of Wayne county, Illinois, to send accounts of their methods of fighting this insect. Mr. Shuman writes:

I have had considerable experience in raising melons for market, and have tried many remedies for destroying the common Striped Bug. The past season I planted two and one-half acres, and before planting used a certain amount of phosphate mixed in with fine well rotted barnyard manure. A small shovelfull of this mixture, well mixed into the soil of each hill, gave me but little trouble with the pests, and the finest and most profitable crop I ever raised.

Mr. Foster writes:

I wish to give you my remedy for the Striped Cucumber Beetle. Take one-half gallon of fresh hen manure, put it in a four-gallon vessel and add to this one and a half gallons of boiling water. Stir thoroughly, and let it stand till cold. Then add one and one-half gallons cold water. Then springle the plants with it. This has proved to be the best remedy that I have found.

Several letters were also received after the publication of the 1889 Bulletin, giving an account of the Striped Beetle experiments of that season. One is from Mr. F. C. Miller, a well known Ohio fruit-grower, who writes:

With us the beetle does its greatest injury by eating the stem under the ground. Our remedy for this is to mulch the hill of plants, not less than one inch in depth, with clean, dry sand. The beetle will not disturb the stem under ground, as the sand will follow him under ground and drown him out. The sand also acts as a warm mulch for the young plants. Try it with some of the offensive odor protections—I like cow manure as well as any—or slug shot and sand will fill the pickle barrel.

Mr. W. P. T. Coal, of Meadows, Illinois, writes:

When I lived in Ohio, forty years ago, and almost every year since, I have had occasion to combat the Striped Cucumber Beetle, (*Diabrotica Vittata*) and I think I never saw them more numerous than this year. They came early when the cucumber seed was just bursting through the surface of the ground, and they came late when the Possum Nose squash was beginning to ripen. At this time "fencing out" was impracticable, but the arsenites (I prefer London purple) are always practicable, and always effectual. I dissolve it in water and apply *liberally* so that it will run down the stems of the plants, and wet the ground to the roots. It is so sure, and cheap, and easily applied a remedy, that time is wasted (at least I formerly wasted time) in trying others.

I think the aqueous solution of London purple much better than a dry application, for the latter will not go below the surface of the ground, and the stem down to the roots needs protection as much as the leaves. If you try this insecticide I think you will be satisfied with the result, and if the pest returns, as perhaps he will after rains and dews and winds and sun have destroyed the poison, apply it again.

I do not make the solution as strong as for the potato beetle, and put more of it on the vines.

Mr. W. B. Hoisington, of Champaign county, Ohio, writes:

My remedy for the Striped Cucumber Beetle is to put ashes or air-slaked lime under the leaves and around the stems to prevent the beetles from girdling them. If they can not get at the stem they will not trouble the leaves much, consequently I seldom put any thing on the latter.

Mr. A. Newton, of Madison county, Ohio, writes:

I have my remedy for the Striped Bug. I take cow manure soon after it is dropped, scoop it up in a bucket and add water. This is then sprayed on the plants with an old broom. I never have injured the vines by putting it on thick, nor have I applied it so thin that it did not save the plant.

Mr. Isaac Wolf, of Loudonville, Ohio, writes:

I take one tablespoonfull of turpentine and about one quart of land plaster and mix together and dust the vines and repeat after rains if necessary.

These methods are given on the strength of the experience of the authors. They have not been tested at the Station, although it is hoped that they may be in future years.

My attention has been called to a slip in the report of experiments with this insect in the Bulletin for September, 1890, page 231. The phrase "about sixteen inches square" occurring in the ninth line of the second paragraph should read "about sixteen by twenty-seven inches."

TOBACCO AS AN INSECTICIDE.

For several seasons the horticultural department of this Station has been annoyed in raising lettuce in the forcing house by the presence of Aphides or plant lice, that developed in among the leaves where it was difficult to reach them with insecticides. This is a very common trouble with market gardeners who raise lettuce under glass. The writer has frequently seen in the houses of commercial growers fine crops of lettuce ruined because of the presence of these pests.

We have lately avoided trouble of this kind by the frequent application of tobacco powder to the growing crop. As soon as any lice appeared upon the young plants, or even before, the benches were thoroughly dusted with the powder, so that both the soil and plants were more or less coated. We have used the ordinary refuse tobacco powder of the cigar factories, obtainable usually for little or nothing, and also the "Egyptian Bug Killer," an insecticide composed principally of tobacco and manufactured by the Egyptian Insecticide Co., St. Louis, Mo., and the X. O. Dust, also composed largely of tobacco, manufactured at Baltimore, Md.

All of these forms of tobacco were found effectual. The application was repeated as often as necessary, usually about once in three weeks,

and has proven an entirely satisfactory remedy. In applying the powder we usually use Leggett's Paris Green Gun. This is the only really satisfactory appliance I have ever found for the application of insecticides or fungicides in a powdered form. It consists of a rotary bellows worked by a cog-wheel, which throws the powder out of the long tube with great force. We have used it in our experiments the past season whenever we desired to apply any of these substances in the form of a dry powder. It is manufactured by Leggett & Bro., 301 Pearl street, New York City. We have repeatedly cleared rose bushes and ornamental plants in the green-houses of these Aphides or "green-fly," by first spraying them with clear water, and then dusting them with powder by means of this "gun."

CLARENCE M. WEED,
Entomologist and Botanist.

ARTICLE III.—SOME COMMON CABBAGE INSECTS.

THE IMPORTED CABBAGE WORM.

Pieris rapæ.

This insect was imported into America from Europe about 1857, since when it has become exceedingly destructive over a large portion of the United States and Canada. The adult is a common white butterfly, the female of which has two black spots upon each of the front wings (Fig. 1, *c*), while the male (Fig. 2) has but one. The former deposit, singly or in clusters of two or three each, small, fusiform, yellowish eggs upon the cabbage leaves, which soon hatch into little, green larvæ that feed upon the substance of the foliage. In about two weeks they become full grown (Fig. 1, *a*), when they generally leave the cabbage

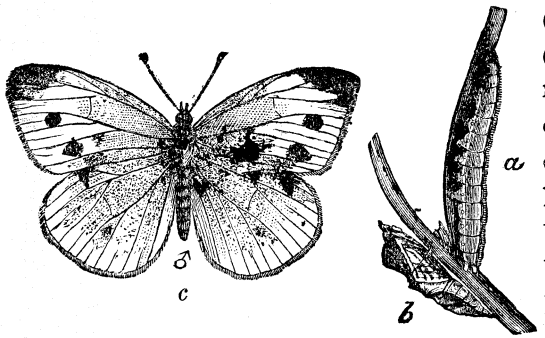

Fig. 1. Imported Cabbage Worm: *a*, larvæ; *b*, chrysalis; *c*, female butterfly. [After Riley.]

plants, and finding some suitable shelter—beneath a board or under the coping of a fence—change to chrysalids (Fig. 1, *b*). They remain in this condition about ten days, when they emerge as butterflies, to lay eggs for another brood of worms. The winter is passed in the chrysalis state. There are several generations of larvæ each season, the number varying with the climate and latitude.

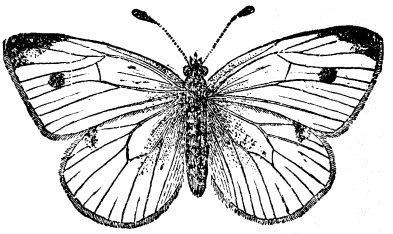

Fig. 2. Imported Cabbage Butterfly. Male. [After Riley.]

This insect has numerous natural enemies with which to contend. The larvæ and pupæ are preyed upon by certain parasitic and predaceous insects, and the butterflies are often captured by insectivorous birds, as well as by a predaceous bug, known to entomologists as *Phymata wolffii*. The larvæ are often destroyed by thousands by a bacterial disease—a sort of insect cholera—that has lately aided greatly in checking the injuries of this pest.

There are two or three species of native cabbage worms—notably the Southern Cabbage Butterfly (*Pieris protodice*) and the Potherb Butterfly (*P. oleracea*)—closely related and similar to this Imported worm, that were formerly quite injurious to cabbage, but since the introduction of the alien species they have been largely crowded to the wall, and are seldom destructive.

Remedies.—Pyrethrum (insect powder or buhach), hot water, and kerosene emulsion are the substances that can most successfully be used in fighting the Imported Cabbage Worm. The insect powder may be diluted with six or eight times its bulk of flour, and dusted on with a powder-gun or bellows, or it may be mixed with water in the proportion of one ounce to four or five gallons of water, and sprayed upon the plants. Dr. Riley gives preference to hot water as a remedy for this insect. He states that "every worm visible upon the cabbages may be killed by the use of hot water at the temperature of 130° Fahrenheit. The water may be boiling hot when put in the watering-can, but it will not be too hot when it reaches the cabbage leaves." Kerosene emulsion can advantageously be used when the plants are young, though there would appear to be danger of tainting the heads if applied to the fully developed plants. Whichever method of treatment is adopted, it should be carried into practice at frequent intervals, thus keeping the worms well in check. If the plants are dusted with insect powder once a week during the time that the worms are present, they will cause little or no trouble. For applying the water mixtures of pyrethrum, or kero-

sene emulsion, either the Excelsior or Field knapsack sprayers appear to be well adapted; while on a larger scale the Nixon potato sprayer might be utilized.

THE CABBAGE PLUSIA.

Plusia brassicæ.

This insect, illustrated in its three later stages at Fig. 3, has been known for years to do serious injury to a number of garden crops. While it is especially injurious to cabbage, it also attacks celery, turnip, tomato, clover, cauliflower, lettuce, dandelion, dock, and several other plants. The adult (shown at upper part of Fig. 3) is a handsome, dark-grey moth, with a silvery spot near the middle of each front wing. The females deposit their pale, greenish-yellow eggs, singly or in clusters, on the cabbage leaves, usually on the upper surface. The larvæ soon hatch and devour the leaves as they develop, boring small, irregular holes in the cabbage head. When full grown (*a*), they are about an inch long, of a general pale-green color, with longitudinal lighter stripes; the head is small, and the body gradually enlarges from the front backward. In motion the body assumes a looping position, as shown in the figure. The full grown larva spins a slight, white, silken cocoon on the cabbage leaf, generally on the lower surface, and within this changes to a brownish pupa, (*b*). In a short time it emerges as a moth. At the South, where this insect is ordinarily more destructive than at the North, there are several broods each season. The moths are nocturnal or crepuscular, but in cloudy weather are sometimes seen flying during the day.

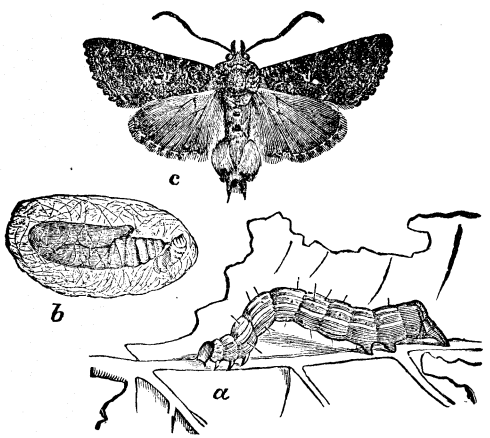

Fig. 3. Cabbage Plusia: *a*, larva; *b*, pupa in cocoon; *c*, moth. [After Riley.]

The larvæ of the Cabbage Plusia are subject to the attacks of many enemies: They are devoured by birds, destroyed by certain parasitic insects, and often become the victims of a fungous disease.

Remedies.—This insect is more difficult to destroy than the Imported Cabbage Worm, but it will succumb to pyrethrum if not diluted with

more than three times its bulk of flour, and may also be killed with the kerosene emulsion applied in a spray.

THE ZEBRA CATERPILLAR.

Ceramica picta.

This caterpillar is at once distinguished from other larvæ feeding upon cabbage by the brilliant yellow and black markings upon its body. It originates from small, spherical eggs, laid in clusters upon the cabbage leaves by a handsome, purplish-brown moth (Fig. 4, *b*), that appears early in summer. At first the larvæ are very dark, and feed together gregariously, but as they develope they become lighter colored, and disperse over the plant. When disturbed they roll up and drop to the ground. They become full grown (*a*) in three or four weeks, when they are about two inches long, with a wide, longitudinal, velvet-black stripe upon the middle of the back, and two bright yellow stripes upon each side, which are connected by fine, yellow, transverse lines. The caterpillars now construct, slightly beneath the soil surface, loose cocoons composed of particles of earth fastened together by silken threads, within which they change to pupæ. About a fortnight later the moths emerge, and deposit eggs for a second brood of larvæ, which develop early in autumn, pupating before winter, and hibernating within their cocoons.

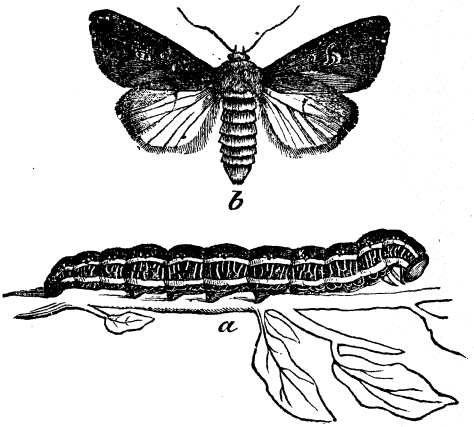

Fig. 4. Zebra Caterpillar: *a*, larva; *b*, moth. [After Riley.]

Remedies.—When young the larvæ are congregated together upon one or a few leaves, and may then easily be checked by hand-picking. Later they are open to destruction by the application of hot water, insect powder, or kerosene emulsion.

THE WAVY-STRIPED FLEA-BEETLE.

Phyllotreta vittata.

This little pest does not by any means confine its depredations to the cabbage, but attacks turnip, mustard, radish, and various other plants as well. It is represented magnified at Fig. 5, *b*, and is a small,

shining black beetle, one-tenth of an inch long, with a broad, yellow wavy, longitudinal stripe on each wing-cover. It feeds upon the surface of the leaf, gnawing out little pits. The females deposit their minute, oval, whitish eggs upon the roots of various cruciferous plants, such as radish, cabbage, turnip, etc., and the larvæ which hatch from them feed upon these roots, sometimes doing serious damage in this way. The full grown larva (Fig. 5, *a*) is about one-fourth of an inch long, with a yellowish-white body, and brown head. There appear to be two or more broods each season.

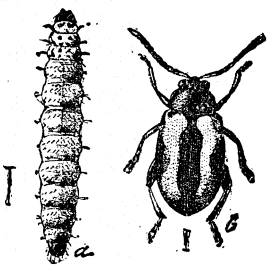

Fig. 5. Wavy-striped Flea-beetle: *a*, larva; *b*, beetle. [After Riley.]

Remedies.—Tobacco powder is the best remedy for these little pests. If applied freely to the plants, it will drive them away. In seasons when the beetles are not too thick, dusting the plants with dry, unleached wood ashes, or lime or plaster, will also keep them off, and tobacco decoction is a good remedy.

CABBAGE CUT-WORMS.

The cabbage is subject to attack by nearly a dozen species of cut-worms, nearly all of which, however, are similar in habits and history, and may well be treated of collectively. They are all larvæ of medium-sized, night-flying moths, and are rather thick, naked worms of the general form of Fig. 6, *a*. They curl up when disturbed. The eggs are deposited generally on the branches of trees and shrubs, the larvæ descending to the ground in search of food as soon as hatched. Most of them feed upon grass or clover when young, becoming about half grown by winter time, when they seek the shelter of some log or stone, or burrow into the soil. Here they hibernate, and in spring come forth in search of food. They now attack a variety of young plants, biting off the stems and feeding upon the leaves. Cabbages, tomatoes, turnips, squashes, melons, and various other garden vegetables are all liable to their attacks. They become full grown in spring or early summer, when they pupate beneath the soil surface, and three or four weeks later emerge as moths. The larva (*a*) and moth (*b*) of the Variegated Cut-worm (*Agrotis saucia*)

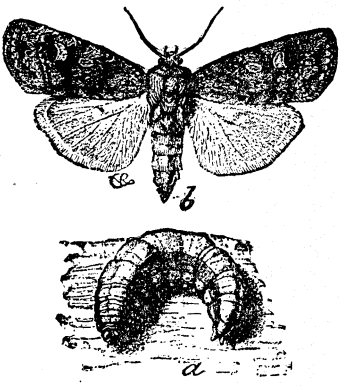

Fig. 6. Variegated Cut-worm. *a*, larva; *b*, moth. [After Riley.]

are represented, natural size, at Fig. 6. Some species have two or more broods each season, while others have but one.

Cut-worms are especially likely to do damage in fields and gardens close to grass-lands, and to crops immediately following grass.

Remedies.—Of the dozens of methods of destroying cut-worms, there are three which are of special merit. They are:

(1). *The poison method.* This consists in killing off the worms before the crops are planted, by strewing over the soil bunches of fresh clover or cabbage leaves, which have been treated with Paris green or London purple, either by dipping into a solution of the poison, or dusting it on dry. The half grown worms prowling about in search of food eat of the baits thus set, and are destroyed before doing any harm. This method has proved a practical success with many gardeners; and is well worth trying where there is likely to be trouble from these pests. Of course care must be taken that chickens or stock do not get at the poisoned leaves.

(2). *Using boards as traps.* This method consists in placing boards on the ground in and about the garden, and collecting in the morning, the worms that will congregate beneath them during the night.

(3). *Digging out the worms* where plants have been cut off. This is practicable in most gardens, and is well worth doing, thus preventing further damage.

CLARENCE M. WEED,
Entomologist and Botanist.

ARTICLE IV.—THREE IMPORTANT CLOVER INSECTS.

THE CLOVER ROOT-BORER.

Hylastes trifolii.

This insect was originally a native of Europe, from whence it was introduced into America not very many years ago. The adult is a small, brownish-black, punctate beetle (Fig. 7, *d*), not quite one-tenth of an inch long It deposits eggs during spring in the crown of the clover plant, four or five eggs being laid on each plant. Shortly afterwards the larvæ hatch and burrow downward through the larger roots (*a*, *a*), feeding upon the inner substance, and filling the galleries behind them with their sawdust-like excrement. Late in summer the larvæ become fully grown (*b*), when they are one-eighth of an inch long, with a whitish body and yellow head. They change to pupæ (*c*) within the tunneled roots (*a*, *a*), and shortly afterwards emerge as adult beetles. The species generally passes the winter in the beetle state, but occasionally hibernates as a larva or pupa.

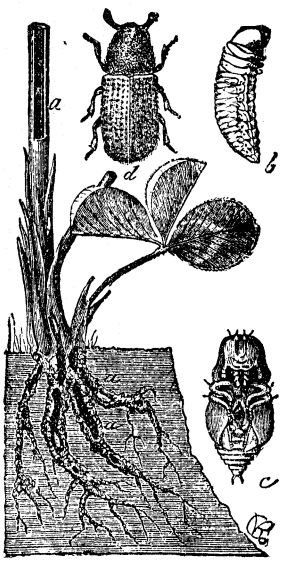

Fig. 7. Clover Root-borer: *a*, infested plant; *b*, larva; *c*, pupa; *d*, beetle; *b*, *c*, *d*, magnified. [After Riley.]

The injuries of this insect are frequently very serious, whole fields of clover often being destroyed. Fortunately its ravages are as yet confined to a comparatively few States, but it is likely to spread over a large portion of the country.

Remedies.—In regions infested by this insect it has been found necessary to rotate the clover crop more frequently than before, mowing the seeded land but once, and pasturing or plowing under the abundant second growth. In this way the crop is turned under before the injuries of the borer become manifest. According to many of the most successful farmers, this frequent rotation is deemed desirable anyhow, so that the insect, in their opinion, is a means of compelling the adoption of an improvement in farm management.

THE CLOVER SEED-MIDGE.

Cecidomyia leguminicola.

The Clover Seed-midge is a small, orange-colored maggot that develops in the clover heads at the expense of the young seeds. It hatches from eggs laid by a very small, two-winged fly (Fig. 8, *a*), similar to the Hessian Fly in appearance. The female is provided with a long ovipositor with which she pushes her eggs in among the young flowers. When the larva is full grown (*b*) it wriggles its way out of the head and falls to the ground, where at or just beneath the soil surface, it forms a slight cocoon, within which it changes to the pupa state. About ten days later the flies emerge to lay eggs for another brood. In the Northern States there are two broods each season, while at the South there are at least three, and possibly more. Clover fields infested by this insect are at once distinguished by the unnatural condition of the heads at time of blossoming; instead of being red with bloom, the heads are green and dwarfed on account of the undeveloped florets.

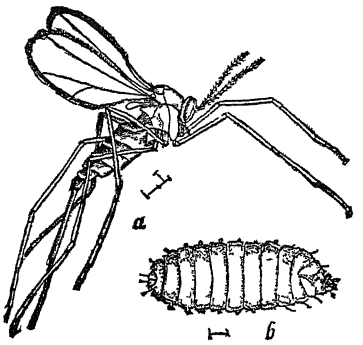

Fig. 8. Clover Seed-midge: *a*, fly; *b*, larva. Magnified. [After Riley.]

Remedies.—The best preventive of the injuries of this insect yet suggested is that of mowing the field about the middle of May (in the latitude of central Ohio) when the green heads are just forming, and leaving the partial crop thus cut on the ground as a mulch and fertilizer. A new crop of blossoms is then produced, which comes between the regular crops, and also between the two broods of the Midge. This method has been tried for several years by some of the best farmers of Ohio, with excellent results. The other remedies ordinarily recommended are early cutting of the first crop—about ten days earlier than usual—and pasturing the fields in spring. But there are serious objections to both these methods.

THE CLOVER HAY-WORM.

Asopia costatis.

Clover hay that has been standing in the mow or stack for some time, is often infested by numerous small brown worms which web the dried

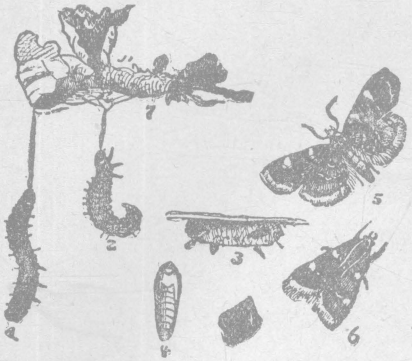

Fig. 9. Clover Hay-worm: 1, 2, larva; 3, cocoon; 4, pupa; 5, 6, moth. [After Riley.]

stems and leaves together and feed upon them. This is the insect named above, and its various stages are represented, natural size, at Fig. 9. The adult is a very pretty little purple and golden moth (5, 6) which deposits eggs upon such clover hay as it has access to. The eggs soon hatch into small brown worms that become full grown (1, 2) in a few weeks. They then spin silken cocoons (3) within which they change to chrysalis (4), to emerge soon after as adult moths. There are two or more broods each season.

Remedies.—It will readily be seen that these insects are more likely to prove troublesome when old hay is left over from season to season for them to breed in. Consequently hay mows should be thoroughly cleaned out each summer, and new stacks should not be put on old foundations until all of the leavings of the previous season are removed. Hay which is thickly infested by the worms should be burned.

CLARENCE M. WEED,
Entomologist and Botanist.