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UNIVERSITY OF MISSOURI.

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COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

Agricultural Experiment Station

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BULLETIN NO. 71.

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**THE FRUIT-TREE LEAF-ROLLER.**

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COLUMBIA, MISSOURI.

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April, 1906.

University of the State of Missouri.

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COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

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# THE FRUIT-TREE LEAF-ROLLER.

*Cacoecia argyrospila*, Walk.

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By J. M. STEDMAN.

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## SUMMARY OF RESULTS.

The results of our experiments with this insect may be briefly summarized as follows:

I. There is, in Missouri at least, only one brood of this insect each year.

II. The winter is passed only in the egg stage, as small, light gray, flat, smooth clusters on the twigs and smaller branches.

III. The larvae appear the first of May and feed upon the young leaves and buds and later also on the fruit.

IV. The larvae are somewhat protected, and therefore more difficult to combat, by their habit of fastening, to a certain extent, leaves together and also of fastening them about the fruit by means of a silken thread, and feeding largely inside of this cover.

V. The damage these larvae do depends entirely upon their abundance in the orchard or tree in that particular year, and may vary all the way from slight injury by eating the leaves to a complete defoliation of the tree, or from a slight eating and destruction of part of the fruit to the complete destruction of all the fruit on the infested trees, or to a complete destruction of both the fruit and leaves.

VI. Spraying with arsenate of lead just before the blossoms open or just after they have fallen and before the larvae have had time to fasten the leaves together to any considerable extent, is a thoroughly satisfactory and by far the best method of combating these insects.

## GENERAL REMARKS.

Fortunately for the fruit grower, both great and small, the fruit-tree leaf-roller (*Cacoecia argyrospila*, Walk.) does not occur every year in injurious numbers, although it is always found to a certain extent infesting our orchard and other trees each year. But as no one can predict when its presence will become dangerous, due to a failure of its natural insect or other enemies to do their duty, as well as to other causes which normally hold it in check, the presence of this insect always becomes a possible source of trouble and is liable at any season to destroy the entire crop of fruit, as it has done in the past in various parts of this and other states.

While conducting our experiments with this insect we visited many small orchards and many more home places where absolutely every apple, cherry, plum, pear and apricot on the premises had been destroyed within a week by the ravages of this pest. The large orchards, and especially the commercial orchards, did not suffer so complete a loss, due to the fact that the managers were accustomed to fighting insects and were prepared to spray and did so before the fruit was all ruined. But, as is the case with most injurious insects having spasmodic outbreaks, while the small growers suffered the greater percentage of the loss, their orchards in the aggregate constitute the greater percentage of the fruit in the entire state and hence the loss as a whole to the state is greatly increased.

Many letters were received last spring in regard to this insect, and a portion of three taken at random will give one some idea as to the extent of this damage.

From St. Louis County:—"We to-day send you in a small box a sample of a worm that is doing an immense amount of damage to the fruit crop in some parts of the county. This sample was obtained from near Webster Groves, about five miles from here, where fruit has already been damaged to the extent of at least 75 percent of the crop. The only thing they do not seem to hurt is the peach, but apricot, pear, apple, cherry and plum are their harbor."

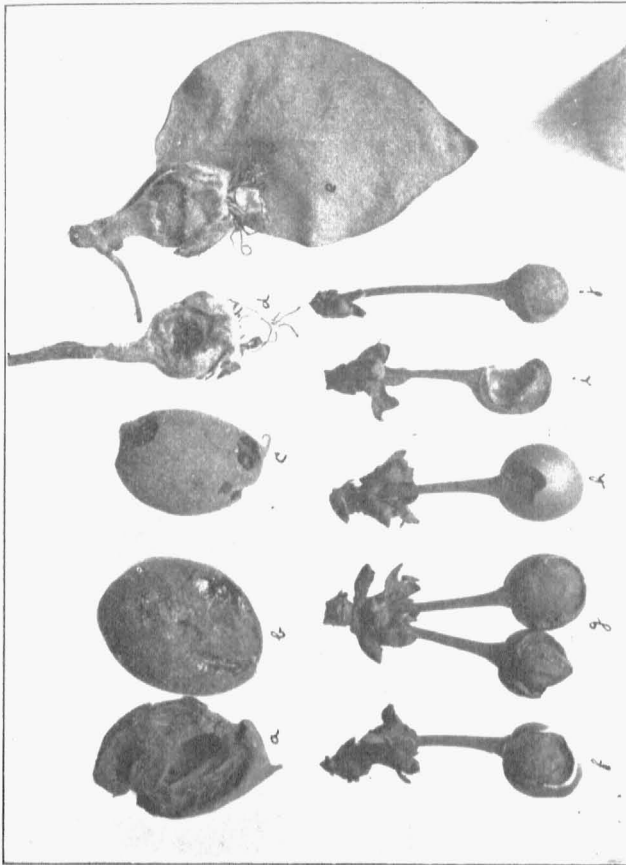


Fig. 1.—Work of the Fruit-Tree Leaf Roller, *Cacoecia argyrosbila*: a, b, c are apricots, d, e, quince, f, g, h, i, j, cherries. All photographed natural size. Original.

From Greene County:—"I have mailed you to-day a box containing apples, plums and foliage infested with a worm which is doing great damage in our South Missouri orchards. They not only injure the foliage but also the fruit. I find they begin in the blossoms or before the apple is formed. They get in the center of the cluster of fruit and weave their web to a leaf in such a way as to protect themselves from

sight, rain, spray and even birds, and live on the leaf and fruit. They are all over the woods, attacking the oak, elm, hickory, sassafras, hazelnuts, etc., but do not hurt the peach."

From Gentry County:—"I send you by to-day's mail, under another cover, a variety of larva that is doing much damage to the apples and apple trees in this part of the country. Many trees and the whole crops are entirely ruined."

Similar letters were received from every fruit growing county in the state, which indicated a general outbreak of this pest last season.

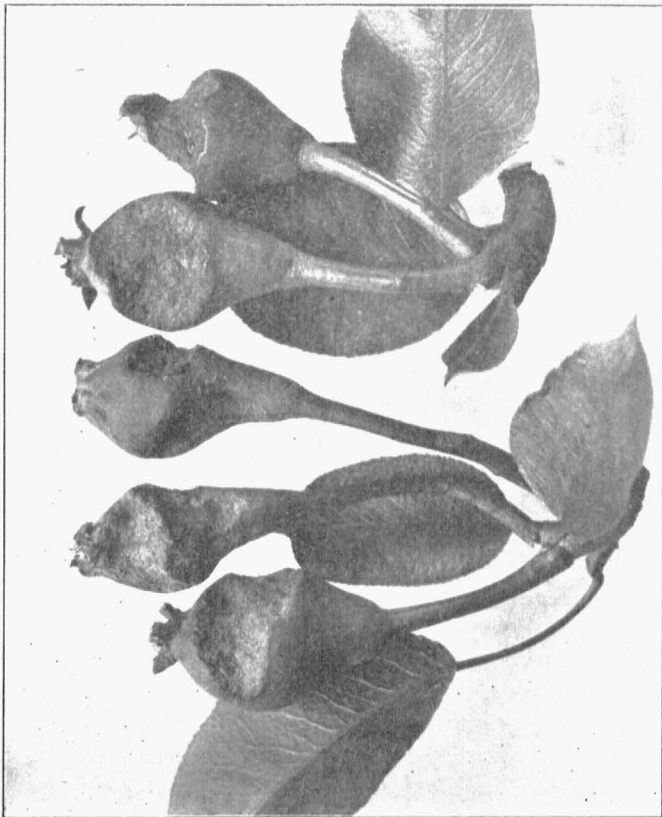


Fig. 2.—Work of the Fruit-Tree Leaf-Roller, *Cacoecia argyrospila*, in pear. Photographed natural size. Original.

## ITS DISTRIBUTION AND FOOD.

This Fruit-Tree Leaf-Roller (*Cacoecia argyrospila*, Walk) is found in damaging numbers practically all over the United States from Maine to the Gulf and westward to the Pacific Coast and up as far as Oregon. It was recognized as an injurious insect in this country and described as a new species in 1869 by Robinson, under the name of *Tortrix furvana*. In 1870 Packard described it as a new species, naming it *Tortrix v-signatana*.

This insect attracts the attention of the public by its feeding upon and injuring various fruit trees and bushes, such as apple, pear, cherry, plum, apricot, quince, rose, currant, raspberry and gooseberry, but the insect also feeds on honey locust, oak, hickory, horse-chestnut, soft maple, elm, wild cherry, osage orange, box-elder, sassafras and hazelnut. It therefore lives on such a wide range of food plants that it is not restricted by any means to fruit belts or even settled regions where fruit is to be found, but exists practically throughout the United States, except in the dry, arid areas in the Southwest and the Great Plains, but is abundant throughout the Rocky Mountain region.

## THE WORK OF THIS INSECT.

As soon as the larvae hatch, which they do about the first of May, they eat their way out of the coating which the female placed over the mass of eggs, and scatter over the tree and at once begin to feed upon the developing and expanding leaves and also more or less down into the buds. They soon spin a few silken threads from leaf to leaf and thus gradually fold a few leaves over more or less and fasten them together in a loose cluster, and inside of this retreat they feed upon the leaves venturing out only occasionally for other food. The young larvae are now very active creatures, of a cream color, with a faint trace of greenish and with a dark head and thoracic shield, and when disturbed too much, will wriggle out and drop a short distance, suspended in the air by means of a silken thread, and when everything is quiet, will crawl up again and go to work.

When the larvae become older and larger, they change to a decided green color, and the head and the thoracic shield to a lighter or brown color.

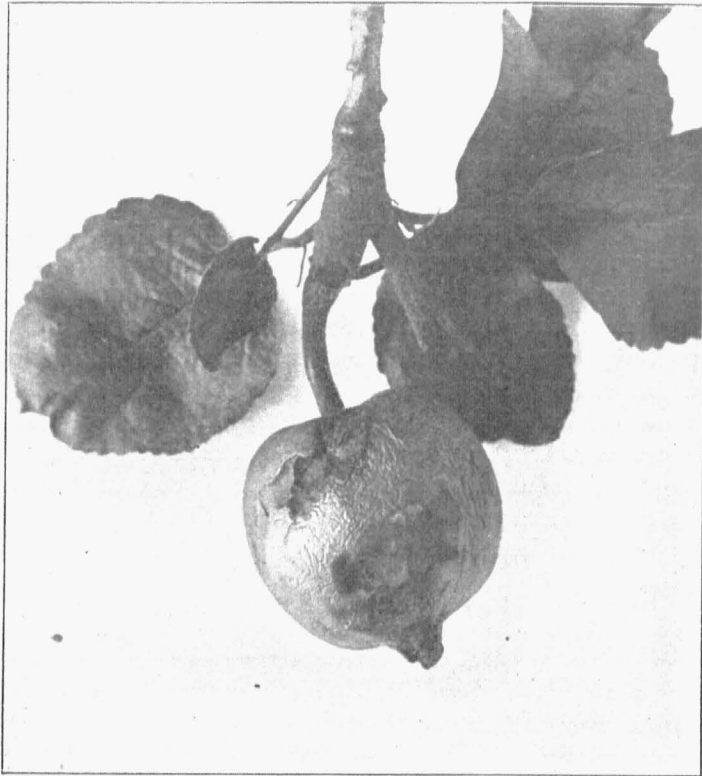


Fig. 3.—Work of the Fruit-Tree Leaf Roller, *Cacoccia argyrosbila*, in the apple. Photograph natural size. Original.

After the blossoms have fallen and the young fruit has set, the larvae loosely fasten some of the leaves to the fruit and under cover of the leaf, feed upon the young fruit, eating off the skin and devouring the pulp and even the now soft, developing seed, as in the case of plums and cherries. It is in this stage that the greatest amount of damage is done, as very little feeding on a young fruit at this time ab-



solutely ruins it. By referring to a photograph taken natural size and shown in figure 1, one will be better able to appreciate the work of this insect and the extent of the injury they can quickly cause; *a*, *b*, and *c*, are apricots; *d* and *e*, quince; *f*, *g*, *h*, *i*, and *j*, are cherries. It will be noticed that the larvae have eaten about half of the developing and, at this time, soft stone of the apricot at *a*, and all of the seed within, as well as about half the pulp, and at *i*, the same result as regards the cherry is observable; in most cases, however, they leave the cherry stone untouched, eating only of the skin and pulp, as is shown at *f*, *g*, *j*. By referring to the natural size photograph shown in figure 2, an accurate idea of the injury these larvae cause to young pear may be obtained, and in figure 3, the damage they do even to a good sized young apple, which is also photographed natural size. Of course, all such apples and other fruit are absolutely ruined and can never develop, while the younger and smaller ones are more fully devoured.

#### ITS LIFE HISTORY.

*The Adult*.—The adult stage of the fruit-tree leaf-roller (*Cacoecia argyrospila*, Walk.) is a small, rather pretty, moth, measuring from eleven-sixteenths to fourteen-sixteenths of

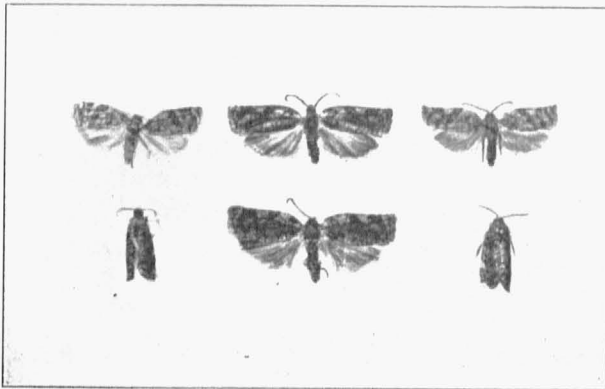


Fig. 4.—Adult Moths of the Fruit-Tree Leaf-Roller, *Cacoecia argyrospila*, Walk. Photographed natural size. Original.

an inch across its expanded wings. They are quiet variable in size, as well as in color, as can be seen by looking at the photograph shown in figure 4, which represents the moths natural size—four of them with the wings expanded and two with the wings closed. Figure 5, is a photograph showing two moths magnified three diameters, and will therefore give one a better idea of the general shape and markings. The general color of the front wings varies from a light rust to a dark rust brown, according to the individual specimen, and the markings also vary from a decided

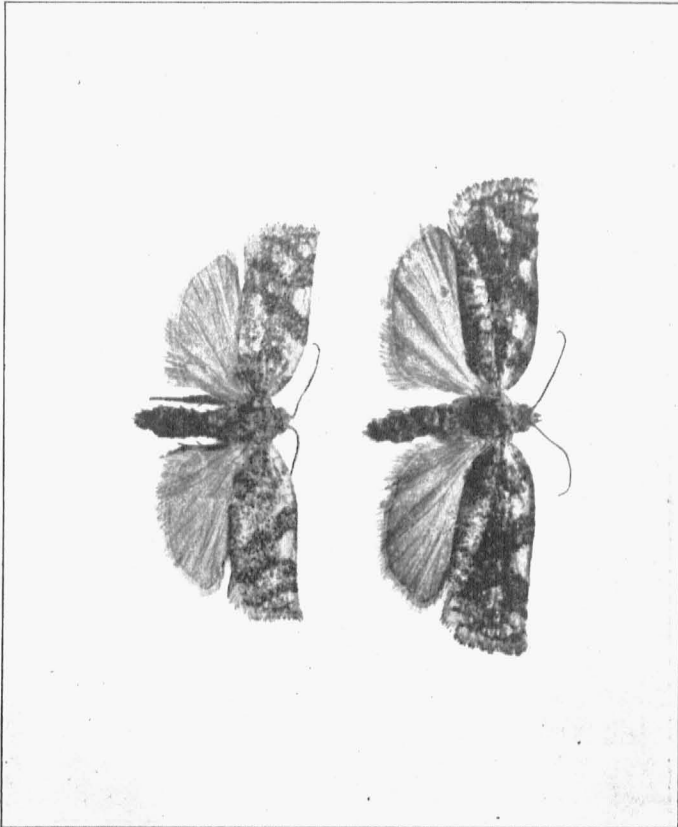


Fig. .—Adult moths of the Fruit-Tree Leaf-Roller, *Cacoecia argyrospila*, Walk. Magnified 3 diameters. Photograph. Original.

yellow to an almost white. It will not be at all necessary to describe the markings, as a reference to the photograph will give one at a glance more information on this subject than any amount of description can do. The hind wings are of a uniformly light slate color. A reference to the photographs of the adult moths, especially the two enlarged ones in figure 5, will give one a good idea of the variation to be found in the color and markings among the individuals of this species.

These adult moths emerge from the pupa stage and first make their appearance from the first to the tenth of June in this state, at least this was the duration of those bred last season in the breeding cages in the insectary, and the field observations coincided with it. These adult moths come into our open windows and fly about the lights at night in great numbers, appearing to be more attracted by light than most other insects that frequent such places. By the middle of June last year, these moths were extremely numerous in infested orchards and swarmed about our trap lanterns which we were running that year as an experiment. But let it be distinctly understood in this connection that in spite of the fact that these moths are readily attracted by light and can therefore be caught in such vast numbers in our badly infested orchards at the proper time, nevertheless, our experiments show emphatically the folly of ever using this as a method of combating these insects, because, in the first place, most of the moths so caught were males and the females had already deposited their eggs before they would come to light, and, in the second place, because we thus caught and killed the natural insect enemies of this pest, which, as Ichneumon-flies, were even more readily attracted to light and caught than the leaf-rollers. Hence we were doing vastly more harm than good even during the two weeks while the adult fruit-tree leaf-roller moths were flying about.

*The Egg.*—Soon after emerging, the moths pair and deposit their eggs and in about two weeks begin to perish, so that they soon disappear again, and hence in Missouri the adult moths are rarely seen after July 1st. Each female

moth deposits her entire supply of eggs in a single, irregular, flat mass, upon a twig or small limb of the proper tree, and then smears over this mass of eggs a gummy substance which completely covers them, and becomes smooth and of a light brown color and is impervious to water. Each mass contains about one hundred and fifty eggs. A photograph of two such masses of eggs is shown natural size in figure 6,

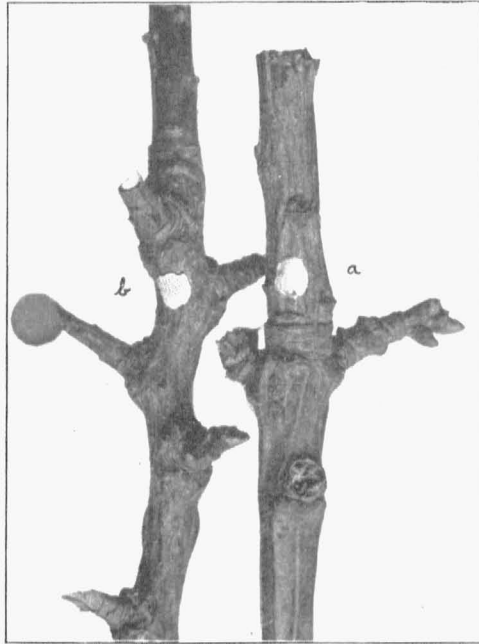


Fig. 6.—Egg masses of the Fruit-Tree Leaf Roller, *Cacoecia argyrospila*: a, unhatched, b, partly hatched. Photographed natural size. Original.

and enlarged two diameters in figure 7. At *a*, the eggs have not yet hatched, while at *b*, some of the eggs have hatched, and the holes in the gummy substance covering the mass of eggs can be seen where the young larvae ate their way out.

These egg masses are deposited during June in this state, and they remain on the limbs and twigs without hatch-

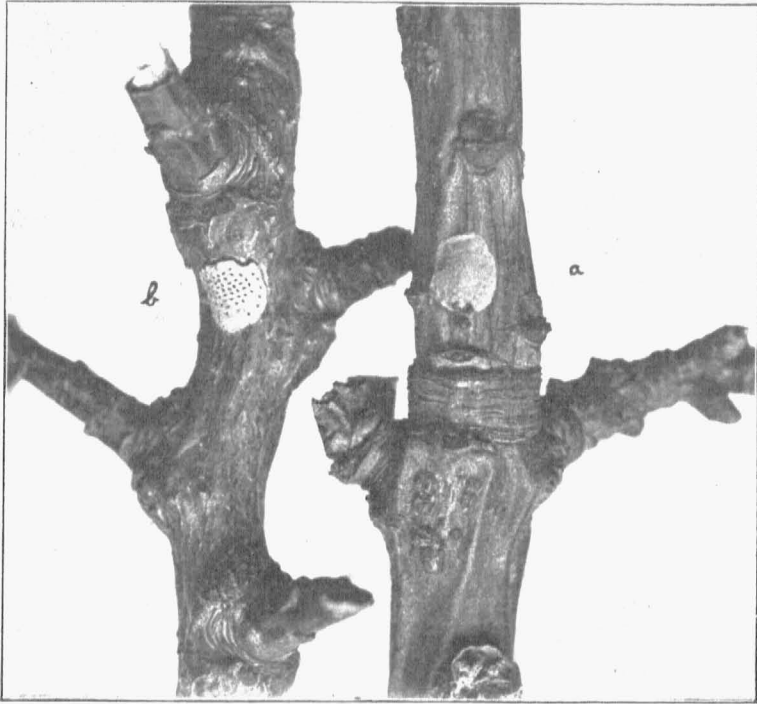


Fig. 7.—Egg masses of the Fruit-Tree Leaf-Roller, *Cacoecia argyrosplia*: a, eggs unhatched, b, partly hatched. Magnified two diameters. Photograph. Original

ing during the entire summer, fall and winter, and hatch the following spring, the latter part of April and the first part of May. There can therefore be but one brood of these insects each year in this state. These facts were determined by both laboratory or insectary and field observations and there can be no doubt about it. The fact that some observers have described two broods of these insects each year is easily explained by the fact that this species so closely resembles both the common apple leaf-roller (*Cacoecia rosana*) and the common cherry leaf-roller (*Cacoecia cerasivorana*), not only in the val but also in the adult stage, that these three insects have become greatly mixed in their minds and they have not made accurate determination of the species.

*The Larva.*—As soon as the young larvae hatch (the last of April) they eat their way through the gummy substance which the female deposited over the mass of eggs as

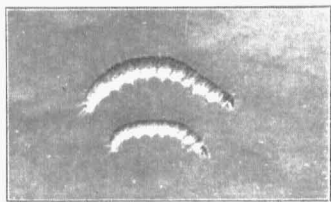


Fig. 8.—Larvae of the Fruit-Tree Leaf-Roller, *Cacoecia argyrospila*, Walk. Photographed natural size. Original.

a protection from the weather and also from numerous parasitic and predacious insects, birds and other animals, and at once scatter over the limbs and begin to feed upon the young developing leaves. They may crawl down into the bud and feed there also. A few silken threads are then spun from leaf to leaf by each larva, which thus unites a few leaves, causing

some to curl or fold, and inside of this shelter or protection the larva does most of its feeding. The young larva is of a light straw color, with a darker, sometimes almost black, head and thoracic shield. Each larva spins a thread wherever it goes, and they are very active. When disturbed too much by pulling apart their loosely united leaves, they will wriggle out and drop a short distance and hang suspended in the air by means of a silken thread, climbing up and feeding as soon as everything is quiet again. When the young fruit sets, the larvae fasten a leaf or two to a cluster or to a single one, as the case may be, and under protection of the leaf, feed upon the fruit and ruin it as previously described.

From the time the larva hatches until it becomes a full grown larva requires from eighteen to twenty days. When full grown, it is about seven-eighths of an inch in length and has changed its color somewhat from what it was when young; Its head is now brown to dark brown or blackish and the prothoracic shield is dark brown on the lateral part; the first pair of true or thoracic legs are dark brown, the second pair lighter, and the third pair, still lighter brown; the prolegs are of the same color as the body, the body being yellowish green to light green, with a translucent line down the back, which may be either yellow or green according to the

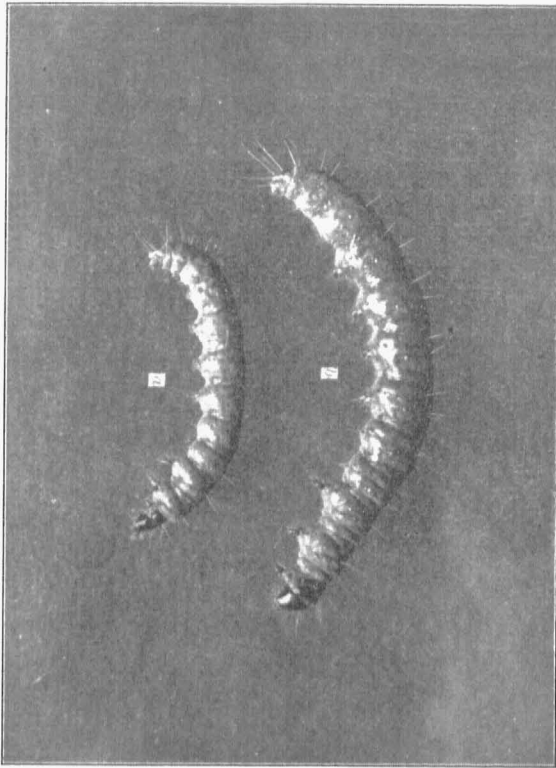


Fig. 9.—Larvae of the Fruit-Tree Leaf-Roller, *Cacocia argyropila*; Magnified 3 diameters. Photograph. Original.

food in the alimentary canal. The body is very sparsely covered with a very few light colored, short hairs, rising from very minute tubercles. Figure 8, is a photograph showing two larvae natural size, the larger one being a full grown larvae. Figure 9, is a photograph of these same two larvae magnified three diameters, and taken with a dark background so as to bring out the hairs, while figure 10, is the same, except that this photograph was taken on a white background and hence the light colored hairs do not appear, but the surface of the body is brought out more in detail. It might be well to add here that all the illustrations

in this bulletin, were made by photographing the actual specimen and that in no instance was the negative or the print retouched, as is so often done.

*The Pupa.*—When a larva becomes full grown, it spins a delicate silken web inside of the loosely united leaves, or between the fruit and united leaves, and within this loosely woven cocoon, transforms to the pupa stage. This transformation takes place usually during the last week of May in this state. In from six to eight days after the pupa is formed, it wriggles its way out of the cocoon, and hangs suspended by

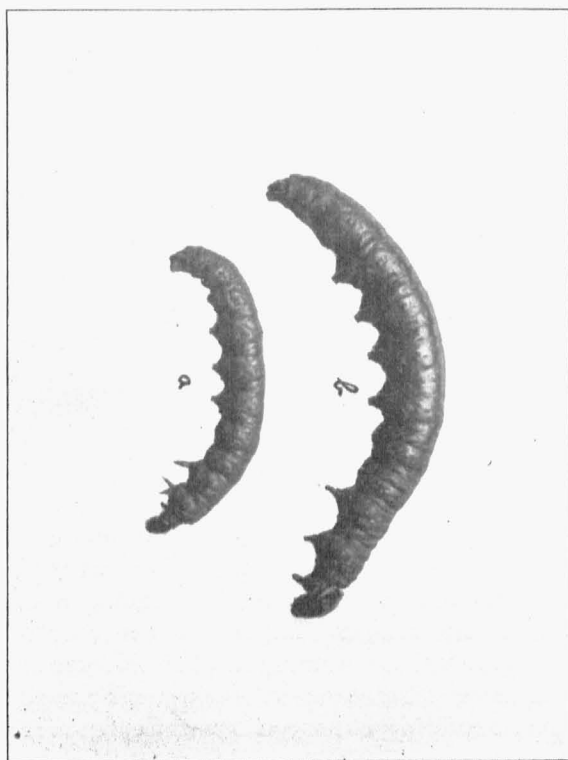


Fig. 10.—Larvae of the Fruit-Tree Leaf-Roller, *Cacoecia argyrospila*: magnified 3 diameters. Photograph. Original.



means of several hooks with which the posterior end of the pupa is provided and which catch in the silken threads and hold it securely. Figure 11, is a photograph natural size of one of these pupae suspended from a portion of its cocoon, and figure 12, is a photograph of the same pupa magnified three diameters; figure 13, is a photograph of a pupa magnified four diameters, so as to show the position and arrangement of the posterior hooks.

As soon as the pupa is out of the cocoon and hangs suspended, its skin splits open along the anterior third and the adult moth emerges, and soon expands and dries its wings and flies away. Figure 14, is a photograph of the cast pupa skin, magnified three diameters.

It will thus be seen from the description of the life history of this insect, that there is but one brood each year; that the adult appears during the fore part of June and deposits her eggs, which do not hatch until the following spring, about the last of April; that the larval stage lasts about two and one-half or three weeks, and the pupa stage about one week.

#### REMEDIES.

While the most serious damage by this insect is due to its habit of feeding upon the young fruit and thereby absolutely destroying it, nevertheless, it sometimes causes very serious damage when unusually numerous by completely defoliating the trees, so much so that in several instances not a trace of a green leaf remained on an entire orchard, the work of defoliation being as complete as the most serious outbreak of the canker worm. To be sure, such complete defoliation does not, as a rule, take place until after the larvae have already destroyed all fruit by eating it, but such a defoliation of the trees at that season of the year means that, although under ordinary climatic conditions the trees will leave out again,

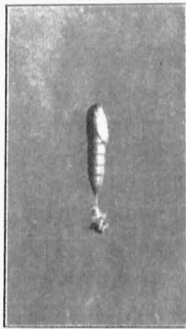


Fig. 11.—Pupa of the Fruit-Tree Leaf-Roller, *Cacoecia argyrospila*. Photographed natural size. Original.

they will not make fruit buds for the following year's crop, and if we happen to have an unusually dry spell at that time, the trees are liable to be killed outright, or at least greatly injured. It is therefore important for all fruit growers, as well as for every one having a home with a few trees in the backyard, to know the habits and life history of this insect and the methods of controlling it.

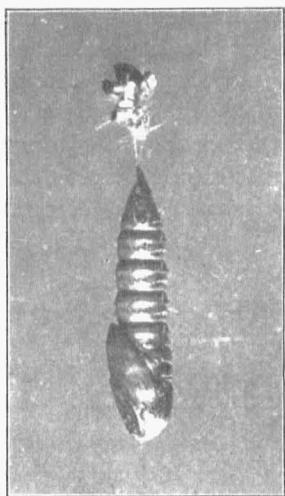


Fig. 12.—Pupa of the Fruit-Tree Leaf-Roller, *Cacoecia argyrospila*; Magnified 3 diameters. Photograph, Original.

An experienced observer, or, in fact, any person with good sharp eyes and a little practice and pains, can easily examine his fruit trees and locate the little egg patches (see figures 6 and 7) and then cut them out or kill them by crushing.

Then again, trees that have received a thorough coating of lime or whitewash in the spring before the buds opened are not liable to be injured by this insect, because of the fact that where the lime covers the egg clusters completely and remains there until the young larvae hatch, they all die in attempting to eat their way through this lime coating.

But the most satisfactory and successful method of combating these insects is to thoroughly spray the trees just as soon as the first indication of the presence of these insects manifests itself, and to use for this spray arsenate of lead. It is very rare indeed that a second spraying is necessary. The most important points are to use arsenate of lead and to use it as soon as possible, because the longer one delays this spraying the more difficult becomes the task of reaching and therefore poisoning all the leaves, because of the fact that the larvae fold them up and fasten them together more and more as they grow and thus form an enclosure within which it is difficult, and in

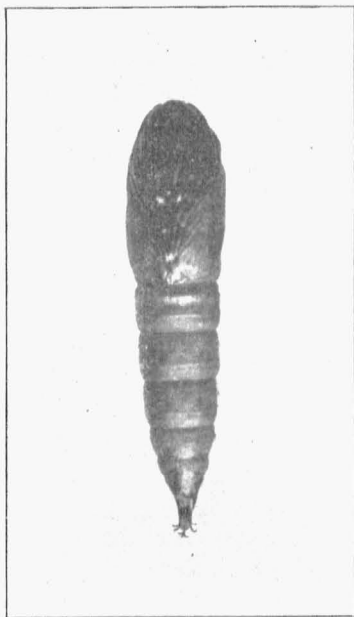


Fig. 13.—Pupa of the Fruit-Tree Leaf-Roller, *Cacoecia argyrosbila*: Magnified 4 diameters in order to show looks at caudal end. Photograph. Original.

many cases, impossible, to drive a spray and poison the leaves or the fruit on which the larvae feed. It is for this reason that one is sometimes forced to make a second application of the spray. The reason one should use arsenate of lead instead of Paris green or Scheele's green or other arsenical poison for this insect, is that this arsenate of lead can be placed on such trees as plum and cherry without danger of injuring the leaves, whereas there is great danger in spraying these trees with any other arsenical poison when made strong enough to successfully kill the in-

sects. Of course, this does not apply so much to the spraying of apple or pear trees, which will stand a Paris green or Scheele's green spray much better.

Let it be distinctly understood that commercial arsenate of lead should never be used. By this we mean the chemical substance sold in drug stores under the name of arsenate of lead. The fruit grower must either make his own arsenate of lead according to the formula given below, or else purchase it already properly made and sold under the trade name of "Disparene." But of course it is cheaper to make it yourself, especially if a large amount is needed.

Arsenate of lead is made as follows:

Acetate of lead	. . .	24 oz.
Arsenate of soda	. . .	8 oz.
Water	. . .	75 gal.

Only the best chemicals should be used in the preparation of arsenate of lead. First class

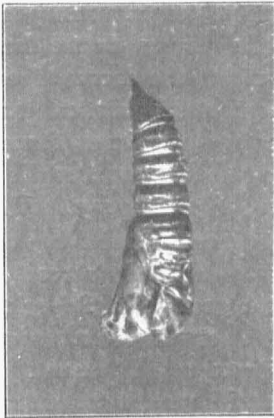


Fig. 14.—Cast Pupa skin of the Fruit-Tree Leaf-Roller, *Caecilia agyrosphila*; magnified three diameters. Photograph. Original.

crystalized acetate of lead contains about 59 percent of available lead oxide, and first class arsenate of soda should not contain more than 3 percent 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 75 gallons of water, stir and it is ready for use.

You will notice that the arsenate of lead as here advised is to be used stronger than we normally use this substance for ordinary biting insects. Ordinarily, we use the amount above given in 100 gallons of water, but in such instances we do not have as difficult insects to kill, or we are making several applications from necessity, on account of the length of the period of the hatching of the larvae. Such is the case with the codling moth. It is always advisable, therefore, to follow the directions here given for the fruit-tree leaf-roller, and use the arsenate of lead stronger than is ordinarily the case. 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. Where one has to spray apple trees only, Paris green or Scheele's green can be used in the proportion of one pound of the poison, three pounds of fresh stone lime, in 125 gallons of water; but such a spray will be almost sure to injure cherry, plum, apricot, etc., when applied sufficiently strong to kill these insects successfully. By following the above directions, one need not suffer serious loss by the fruit-tree leaf-roller.

We are indebted to the following railroads for numerous courtesies and material assistance in giving us passes in order to conduct the field experiments in various orchards along their respective lines: The St. Louis & San Francisco Railroad Co.; Missouri, Kansas & Texas Railroad Co.; Missouri Pacific & Iron Mountain Railroad Company.