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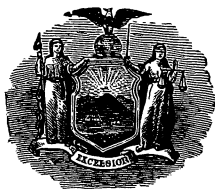
New York Agricultural Experiment Station.

GENEVA, N. Y.

MISCELLANEOUS NOTES ON INJURIOUS INSECTS.

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- II. THE FRUIT BARK-BEETLE.
- III. A MEALY-BUG ATTACKING QUINCE TREES.
- IV. TWO APPLE LEAF MINERS.
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V. H. LOWE.



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*Connected with Fertilizer Control.

†At Second Judicial Department Branch Station, Jamaica, N. Y.

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MISCELLANEOUS NOTES ON INJURIOUS
INSECTS.

V. H. LOWE.

SUMMARY.

The forest tent-caterpillars were again very abundant during the spring of 1900, causing serious injury to forest, shade, and fruit trees. Arsenite of lime, arsenate of lead and Paris green were successfully used in combating them. The application was more effectual when made soon after the caterpillars had hatched than after they had become half grown. In villages and cities they were dislodged by streams of hydrant water and prevented from returning by sticky bands or other obstructions fastened about the trunks of the trees.

In some sections of the State the fruit bark-beetle has caused serious injury by working in the bark of healthy fruit trees, especially peach, cherry and plum. The numerous punctures caused a copious exudation of sap. This injury was noticed about the first of August. Eggs and larvæ were found late in the fall in the small twigs and branches. Much can be done toward controlling the insect by applying a wash to the trunk and larger limbs late in July and trimming out and burning the infested branches during the winter.

A species of mealy-bug was found on quince trees in sufficient numbers to cause slight injury. It can be

successfully combated by applying a solution of whale oil soap, one pound to five gallons of water.

Two species of apple leaf miners were unusually common in western New York orchards but caused little injury as they do not appear until late in the season.

Peaches in an orchard near Rochester were injured by the tarnished plant-bug which sucked the juice from the young fruits, causing them to wither and become permanently distorted.

I. THE FOREST TENT-CATERPILLAR.

Clisiocampa disstria Hubn.

The forest tent-caterpillars appeared again last spring in sufficient numbers to cause much annoyance, and in some cases serious loss. The questions as to whether the caterpillars appear to be increasing or decreasing in numbers, taking the State as a whole, and whether they are becoming more destructive to orchard trees are of importance to fruit growers. To secure data bearing on these questions, circular letters were sent, as last year, to correspondents in nearly every county in the State. Summing up the reports and adding our own observations, the extent and character of the outbreak were approximately as follows: In most of the western counties the caterpillars were widely scattered, the same as last year. In Allegany and Steuben counties, they were less in numbers, as a rule, in the maple groves, woodlands and orchards that were extensively infested last year; but much more abundant in neighboring localities in which they appeared in less numbers the year previous. The reports from Cortland, Chenango, Madison, Oneida and Herkimer counties state that the caterpillars were usually more numerous in the forest trees and orchards than last year but less in numbers on shade trees. The reports from Herkimer County indicate that in that section they were somewhat less abundant in forest trees, but more numerous in orchard trees. Similar reports came from Saratoga and Washington counties and the Mohawk and Upper Hudson valleys. In the northern part of

the State, especially St. Lawrence, Franklin and Clinton counties there is a reported decline in numbers.

Destructiveness in the orchards.—Two of the questions asked in the circular letters related to the food plants of the caterpillars and the extent of their injury in the orchards. Similar questions were asked last year and the majority of the replies were to the effect that the caterpillars fed principally upon maple, basswood and elm. This year, while they have been very destructive to forest trees, there were more reports of their depredations in orchards than formerly. During the season we have also received more letters, usually accompanied by specimens, from fruit growers complaining of this insect. In the vicinity of Geneva they have been noticeably more numerous in the orchards this year than last.

There seems to be little preference as to the variety of fruit. Apple, pear, peach and plum have been attacked apparently with equal readiness.

Taking the State as a whole the reports indicate that the caterpillars were usually less destructive to shade and forest trees, but somewhat more destructive to orchard trees.

New localities reported.—The localities not recorded in our Bulletin 159 of last year but from which reports have been received this year are as follows: Niagara County, Middleport; Monroe County, Spencerport; Allegany County, Andover; Oswego County, Pulaski; Madison County, Oneida, Erieville, West Eaton, De Ruyter and Webster; Otsego County, Westford; Oneida County, Maynard; St. Lawrence County, De Kalb; Franklin County, Fay; Saratoga County, King's Station; Greene County, Coxsackie, West Coxsackie and Cornwallville; Dutchess County, Millbrook; Orange County, Montgomery and Blooming Grove; Westchester County, Bedford Station and Unionville.

Orchards easily infested.—Orchards situated near woodlands are especially in danger of becoming infested because both caterpillars and moths from the groves can easily reach them. A number of cases of this kind have come under the writer's observation. The trees in the rows nearest the woodland were so close that the caterpillars easily migrated to orchard trees from near-by forest trees which they had stripped bare.

In this connection the following extract from a letter from Mr. A. R. Eastman, of Waterville, Oneida County, who has observed this insect closely, is of interest. "The forest tent-caterpillar was far more numerous this year than last in the forests and orchards (about Waterville), not so many in the village. Last year they fed almost entirely on the maple, this year they made no distinction. All kinds of forest trees were attacked. If there were apple trees near the forest the caterpillars seemed to know it for I have seen tens of thousands of them traveling on the fences, even wire fences, leading to the orchards."

Migration in the caterpillar stage is not the only means of local distribution. Probably the species spreads more rapidly through the agency of the adults which are vigorous fliers. The eggs also may be carried long distances upon young nursery trees without injury.

Life history.—The life history of this insect is given in Bulletin 159, pages 40–50, but a brief summary will be of value here to again call attention to the principal points in its development and their relations to methods of control.

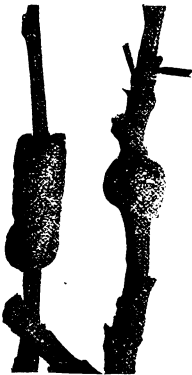


FIG. 1. EGG MASSES;
NATURAL SIZE.

This insect, like very many others, passes through four well defined stages: Egg, larva, pupa and adult. The eggs are laid in bands about the twigs (Fig. 1), during the latter part of June or early in July. They remain unhatched on the trees until the following spring when the young caterpillars appear. Toward the last of May or early in June they reach full growth, stop feeding and wander about to find a convenient place in which to spin their cocoons. Some of them are spun upon leaves, others in protected places on the trunk, in the grass, along fences or upon out-buildings. The moths appear during the latter part of June or early in July and the eggs are laid at once, thus completing the life cycle.

The larva, the pupa and the adult stages are shown in Plates I to III as follows: Plate I, figs. 1 and 2, are from photographs

from life showing dorsal and lateral views of the same caterpillar, natural size. Plate II, Fig. 1, is from another view of the same twig taken the following day. The leaves which had begun to droop were utilized in forming the cocoon. Plate III, Fig. 1, is from a photograph of the same cocoon taken the next day. The leaves have been cut away showing the cocoon. It was supported on all sides by strands of silk but did not touch the leaf at any point. The caterpillar was still working on the inside of the cocoon when this picture was taken. The picture shows the cocoon enlarged to about four times natural size, the actual length being about one inch. Plate III, Fig. 2, is from a photograph of the same cocoon taken three days later. It has been cut open showing the living chrysalis inside enlarged in the same proportion. Plate II, Figs. 1¹ and 1², are from photographs from life showing the male and female moths natural size. At Fig. 2 some of the caterpillars are shown assembled on the trunk of a plum tree. They had molted a short time before the picture was taken and their old skins are seen to the right of the group attached to the bark.

NOTES ON METHODS OF COMBATING THE FOREST TENT CATERPILLAR.

The principal methods of combating this insect are given in Bulletin 159, pages 53-56. The following notes are largely from the past season's observations.

ORCHARD TREES.

Destroying the egg masses.—This is most conveniently done while pruning the trees. In the vicinity of Geneva and in other sections of the State this method has been practiced extensively. One orchardist sent his men through a large plum orchard a second time in search for egg masses of both the forest and apple tree tent-caterpillars with the result that a large number were collected and when spring came hardly a caterpillar of either species could be found in the orchard. The year previous this orchard was badly infested with both species.

Banding the trees.—This is principally a preventive but to some extent a remedial measure. Trees that are small enough to be

jarred are banded to prevent the dislodged caterpillars from crawling back. Fruit trees located near infested forest or shade trees are also banded to prevent invasion by the caterpillars. The bands in use are of two kinds: *First*, sticky substances that will not harden too quickly. Prominent among these are a mixture of tar, one part, and raw oil, two parts; raupenleim; and a mixture of lard and sulphur, equal parts. To prevent injury to the bark these substances should be smeared on strips of tough paper a foot or more wide and tied about the trunk about midway between the ground and large limbs. Sticky fly paper is often used in a similar manner. *Second*, mechanical obstructions such as a band of cotton wool or waste, or a strip of tin fastened around the trunk so that the lower edge flares out about two inches, thus preventing the caterpillars from passing. The insect traps made on the same principle and now on the market will answer the same purpose.

Too much should not be expected of the bands as they are of value only in keeping out caterpillars which may crawl from other trees or which have been jarred out or otherwise dislodged from the tree and seek to return.

A very common mistake is to put the bands on too late in the season. If the intention is to prevent an invasion from infested trees near by the bands should be put in place not later than the middle of March.

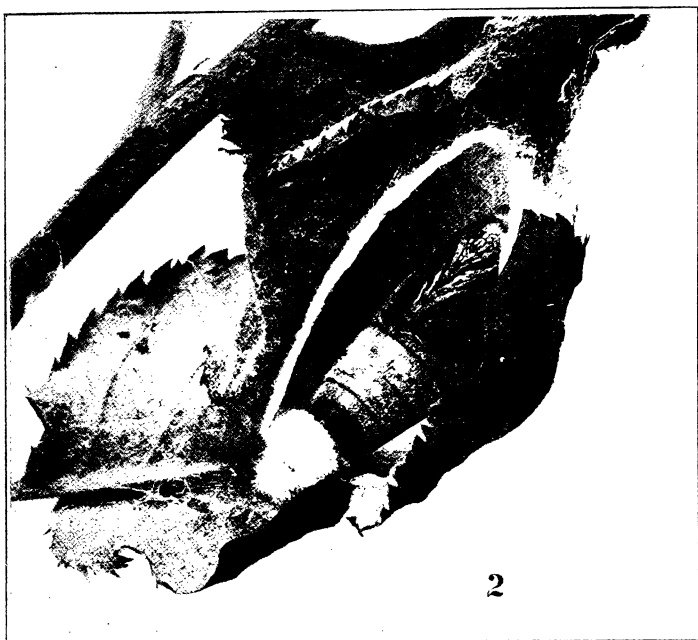
Spraying.—Thorough spraying with pure arsenicals has proven very satisfactory in cases where the poison was applied before the caterpillars were half grown. When the first application is delayed until they are past this point it seems to have much less effect. Paris green, arsenite of lime and arsenate of lead have been used. While both Paris green and arsenite of lime have been reported satisfactory, arsenate of lead has some points of especial merit. It seems to be more certain in its action and adheres to the foliage longer. This arsenical is now on the market; but can be made at home by following the directions given in Bulletin 159. It is manufactured by the Bowker Chemical Company, Boston, Mass., The Alder Color & Chemical Company, New York, and other manufacturers of arsenical compounds.



PLATE I.—DORSAL AND LATERAL VIEWS OF FOREST TENT-CATERPILLAR.



PLATE II.—COCOON, MOTHS AND CLUSTERED LARVAE OF FOREST TENT-CATERPILLAR.



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PLATE III.—ENLARGED COCOON AND CHRYSALIS OF FOREST TENT-CATERPILLAR.

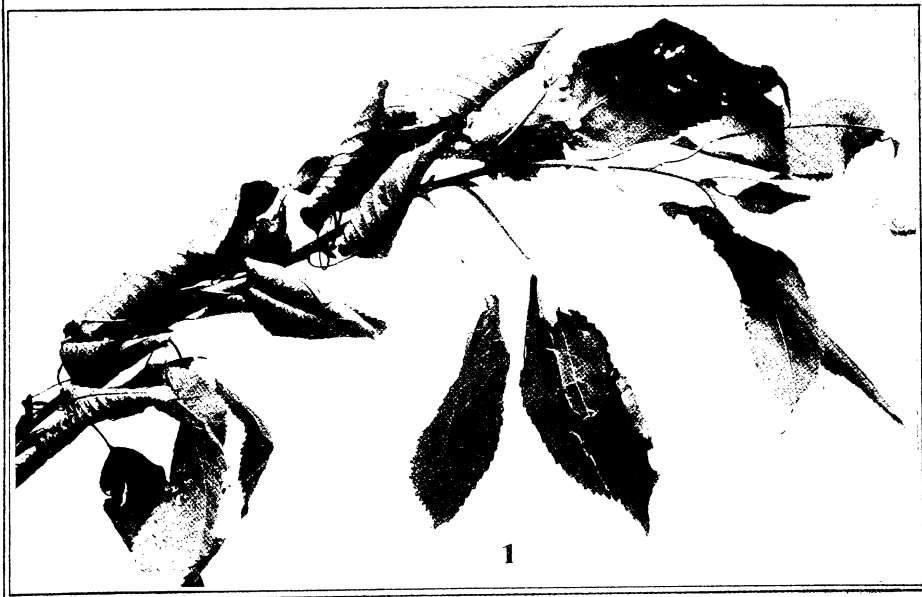
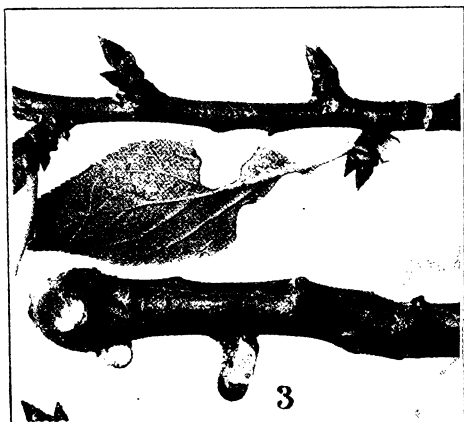
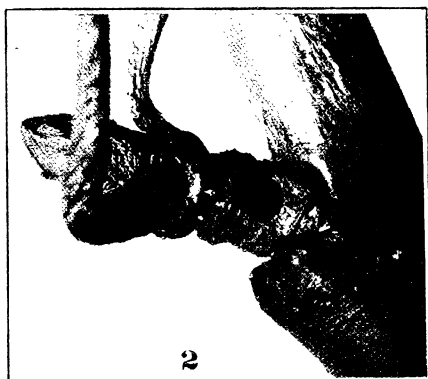
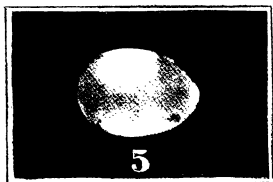


PLATE IV.—INJURY, PUNCTURE AND SAP EXUDATION CAUSED BY FRUIT BARK-BEETLE;
WITH ROW OF EGGS IN TWIG AND SINGLE ENLARGED EGG.

In a few cases where arsenical spraying had been delayed until too late for best results, kerosene oil was applied directly to the caterpillars that had assembled on the trunks and branches as shown at Plate II, Fig. 2. This treatment was resorted to in several localities in the central and eastern part of the State with satisfactory results. But very little oil should be used as there is danger of injuring the bark and but little is needed to kill the caterpillars.

SHADE TREES.

Owners of shade trees in villages and cities have successfully protected their trees by dislodging the caterpillars with streams of hydrant water and preventing their return by placing bands of cotton batting, sticky fly paper or other obstructions around the trunk. In some cases large shade trees were sprayed with arsenate of lead or Paris green by means of steam sprayers. Both are effectual if applied before the caterpillars are half-grown. Arsenate of lead is discussed more in detail under orchard treatment.

MAPLE GROVES AND FOREST TREES.

The infested maple groves and large forest trees present the most difficult problems. Probably very little can be done. In some cases, however, large numbers of the caterpillars have been killed when assembled on the trunks and lower branches by spraying or otherwise applying a small amount of kerosene oil.

The cocoons are conspicuous and easily gathered, especially where the trees have been stripped of their leaves, as most of the caterpillars desert such trees and spin their cocoons near or upon the ground. The offering of prizes to children for the greatest number of cocoons collected in a given time or the payment of a small sum per thousand has been found in some instances a cheap and easy method of securing the destruction of large numbers of cocoons. They should be gathered as soon as found after the caterpillars leave the trees. Ten days later the moths will have escaped, and hence it will not pay to gather them after that date.

As soon as gathered the cocoons should be placed in a box and covered with a coarse wire net to allow the parasites to escape.

The imprisoned moths will soon die or may be killed by sprinkling a little kerosene oil in the box.

On the whole the season's experience indicates that except of when attacking forest trees, the insect is not more difficult to control than many other noxious species. But as with other insect pests prompt and thorough treatment is necessary.

II. THE FRUIT BARK-BEETLE.

Scolytus rugulosus Ratz.

Late in July of the past season Mr. F. C. Stewart of the Station staff brought into the laboratory several small branches from a healthy cherry tree showing the work of some insect. The location and extent of the injury was plainly indicated by the dead leaves. On all of the twigs from one-fourth to about three-fourths of the leaves were brown and dead—in sharp contrast to the remainder which were of normal green color. Plate IV, Fig. 1 is from a photograph of one of these branches. All of the leaves on the lower half were dead. An examination showed that in each spur bearing the dead leaves a small round hole about the size of the head of a pin had been bored as shown, enlarged about four times, at Plate IV, Fig. 2. In each case the hole opened into a short burrow in the sapwood. About forty burrows were examined at this time. All but three were empty, and in these the cause of the injury, some fruit bark-beetles, *Scolytus rugulosus*, were found still at work. Later investigations in the vicinity of Geneva and in Monroe and Niagara counties showed that this species has caused extensive injury during the past season to healthy, vigorous trees.

Although this species has been long known as an orchard pest it has been supposed to confine its attacks principally to weak, sickly trees thereby hastening their death. The fact that it will attack and greatly weaken normal trees, as shown on a subsequent page, adds much to its importance as a noxious species.

The following account of observations during the past late summer and fall is preliminary to a more complete account to be published later. Especial attention is called to the character of the insect and the injury caused by it, by which its presence can

be easily recognized, and the measures which can be taken this winter to hold it in check.

OBSERVATIONS ON THE WORK OF THE BEETLES IN HEALTHY TREES DURING LATE SUMMER AND FALL.

The work of the beetles at this time of year is of a two-fold nature. First, they make shallow holes or short galleries in the thick bark of the trunk and large limbs apparently to feed and prepare for hibernation. These injuries cause a copious exudation of sap and consequent weakening of the tree. Second, longer galleries are formed in the sapwood of the smaller limbs and twigs in which the eggs are laid. Occasionally shallow holes are also made in the branches and twigs.

Injury to the bark of the trunk and large limbs.—The most pronounced injury to the trunk and large limbs which has come under observation was in three large peach orchards near Youngstown, Niagara County. At the beginning of the season all three orchards were in a healthy, vigorous condition. Two were composed principally of Early and Late Crawford and Reeves Favorite, the third, recently come into bearing, almost entirely of Globe. About the first of August sap was seen to be exuding from many of the trees. By Sept. 20, when they were first seen by the writer, the trunks and large limbs, of many of the trees were covered with sap. Plate V will give some idea of the flow of sap from the wounds made by the beetles. This plate is from a photograph of a piece of bark cut from the trunk of one of the peach trees in the orchards above referred to. It is not an extreme case but from an average specimen.

The most extensive injury was in the Crawford and Reeves Favorite orchards. In these orchards nearly every tree was infested to an equal or greater extent than the piece of bark shown in the photograph. The Globe orchard was of especial interest as it had become infested in one corner from a nearby brush pile, in which the beetles had been breeding, and the rapid spread of the insect through the orchard was plainly indicated.

Character of the channels in the bark of the trunks and lower limbs. Feeding habits of the beetles.—On Sept. 20, pieces of bark from a number of the infested peach trees were examined. Prob-

ably owing in part to recent rains the sap was very soft. Comparatively few beetles could be found, and judging from the lack of dust, only an occasional one had been recently at work. Pieces of bark containing beetles were brought to the laboratory, some of them allowed to dry and others were kept moist for a few days. It was very noticeable that as soon as the bark became somewhat dry the beetles began feeding, while there was very little evidence of activity on the part of the beetles in the moist pieces. As soon as the pieces that had been kept moist were allowed to dry the beetles began to work. All of the mines in the bark examined Sept 20 were very irregular but with few exceptions, short.

In October the orchard was again visited. At this time the bark was comparatively dry, and most of the sap had dried down until quite brittle. All over the infested areas the red dust was in abundance, and when the bark was cut away the beetles were found at work making new galleries or extending the old ones. The galleries ran in all directions but very few of them reached the sap wood.

As on Sept. 20, large pieces of bark were brought to the laboratory and carefully examined for eggs or larvæ. Neither were found although the beetles were present in large numbers.

Very few of the small branches and twigs of any of the trees in these orchards or in nearby orchards showed the work of the insect. In every case it was confined almost entirely to the trunks and lower limbs.

Only peach trees were severely injured. Plum and apple trees in the immediate vicinity were uninjured.

Indications of injury to small branches and twigs.—Injury to the small branches and twigs was indicated in two ways: First, by the dead leaves caused by the beetles boring into the buds, Plate IV, Figs. 1 and 2; and second, by the drops of sap that exuded from the burrows in the sapwood as shown natural size at Fig. 3.

As previously stated, very few of the peach trees in the orchards near Youngstown that were infested on the trunk and branches showed any evidence of the insects' work in the smaller branches and twigs. On the contrary, the peach, plum and cherry trees examined, both in Monroe County and at Geneva and vicinity, were very slightly infested except in the small branches.

Character of the channels in the small branches.—These burrows were of two kinds, the very short ones which were mere punctures of the thin bark and the larger ones through the bark and for from half an inch to an inch in the sap wood. In some cases from two to nine punctures leading to each burrow were found. Many of these burrows opened Sept. 20 and later, were empty, others contained eggs; and in a few cases young larvæ were found.

NOTES ON LIFE HISTORY.

Observations upon the egg laying habits.—Eggs were first found Sept. 24, by Mr. P. J. Parrott while examining an infested plum tree. Upon subsequent examination of infested plum and peach twigs many of the burrows were found to contain eggs. The number of eggs varied from one to twelve. Nine was the largest number of unhatched eggs found, but in one burrow Mr. Parrott found twelve young larvæ indicating that twelve eggs had been deposited there.

The eggs were usually placed on end, apex down, close together but were prevented from touching by a layer of gummy shavings which extended around each egg. In every case the rows were single and extended along one or both sides of the burrows. The sticky substance which covers the eggs causes the gummy shavings to adhere to the shell and when dry to hold them firmly in place. In some cases where only three or four eggs were found, there was apparently no definite arrangement, the eggs being scattered through the gummy mass. In no cases were they found in definite pockets along the sides of the burrow. Plate IV, Fig. 4 is from a photograph of a burrow cut open showing a row of eggs along one side. Only the ends of the eggs are visible. The whole is enlarged to about three times natural size.

There is some variation in the size of the eggs. One selected as being of average size measured .564 mm. by .4 mm. They are elongate oval in outline, dull white in color with a delicate membranous shell covered with a thin coating of a transparent sticky substance. Plate IV, Fig. 5 is from a photomicrograph showing one of the eggs much enlarged.

The exact period of incubation has not been determined. A

number of eggs found in the channels Sept. 24, hatched Sept. 25.

Observations on the late broods.—The number of broods for the latitude of Western New York has not been determined. Large numbers of beetles having the reddish-brown color, characteristic of those newly hatched were found in the bark and twigs late in September. Larvæ and pupæ were also found and in one instance a number of them brought into the laboratory transformed to beetles by Oct. 15.

Laboratory and insectary observations.—A study of the life history of this insect is now being made. Trees in the laboratory, insectary and orchard are being kept under observation. Young healthy plum trees kept in the laboratory and insectary have been infested in three ways as follows: First, fourteen beetles were placed upon the trunk and allowed to crawl about. Nearly all of them selected rough places in the bark and immediately began to burrow in. Second, twenty beetles were placed near the ends of the small limbs and prevented from escaping by glass flasks placed over the ends and stopped with a plug of cotton wrapped around the limb. In most cases the bottom of the flask was broken out and a fine wire net fastened over to allow circulation of air and prevent accumulation of moisture on the inside of the glass. Third, sixty-seven beetles were confined in cells made of half inch curtain rings fastened together and to the bark by melted paraffin. When the beetles had been placed in the cells a thin cover glass, the same as used in microscopic work, was sealed on with paraffin. From one to four beetles were placed in each cell. This method, first suggested by Mr. Parrott, proved to be the most satisfactory as nearly every beetle began at once to burrow into the bark and none of them were lost. A photograph of some of the cells attached to the trunk of a young plum tree is shown at Fig. 2.

Activities of the confined beetles.—The amount of time required for the beetles to bury themselves in the bark varied from about an hour to three hours or more. Whether the beetles will deposit eggs in these young trees and beetles mature, it is too early yet to determine. On Nov. 18 some of the channels were cut open. They were very irregular and extended in all directions. No eggs or larvæ were found.

Hibernation of the beetles.—At the time of writing, Nov. 18, a large number of examinations of bark and branches have been made. As previously stated only beetles were found in the bark of the peach trees evidently preparing to hibernate. The eggs and larvæ in the twigs would indicate hibernation in the larva or adult stage.

The adult.—The adult is a beetle measuring from 1.5 to 2.2 mm. in length and varying in color from reddish-brown to nearly black. The beetles move about quite rapidly and fly readily.

TREATMENT.

Sources of infestation.

The insect breeds readily in dying and dead wood. Weakened trees, especially peach, plum and cherry, often harbor the beetles and if not removed may cause the infestation of neighboring trees. Small branches trimmed from the trees may become the sources of infestation.

A case in point is the orchard of Globe peach trees near Youngstown, previously referred to. Without doubt this orchard became infested from a

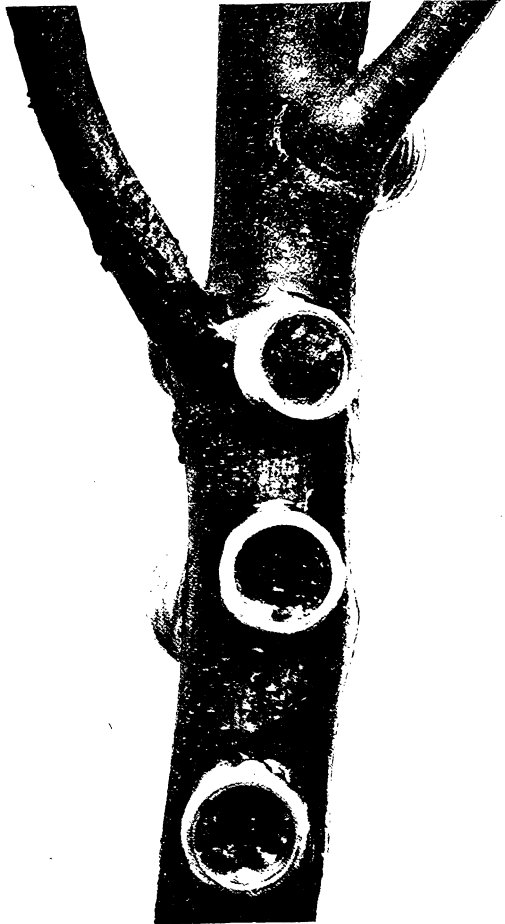


FIG. 2. CELLS ENCLOSING BEETLES ON TRUNK OF YOUNG PLUM TREE. NEGATIVE BY P. J. PARROTT.

large pile of dead branches within about a rod of the corner tree in the northwest corner of the orchard. The beetles were breeding in the branches early in the season. During August about twenty trees in the corner of the orchard nearest the brush pile were found infested, the presence of the beetles being indicated by the exudation of sap. The worst infested trees were nearest the brush pile.

Suggestions for late summer and winter treatment.—The habits of the beetles when attacking normal trees, suggest two methods of treatment. First, the liberal application, about the middle of July, of some caustic wash such as a solution of whale oil soap, two pounds to the gallon of water, with the addition of crude carbolic acid, two ounces to the gallon of the soap solution. The whole should be well stirred before using as otherwise the carbolic acid and soap solution will not mix well. Probably two applications about ten days apart will be sufficient. The object of the applications at this time is to prevent the beetles from going into the bark. Second, severe winter pruning. This is to destroy the eggs and hibernating larvæ and beetles in the twigs. The infested branches can be distinguished by the exudation of sap as shown at Plate IV, Fig. 3. The pruned branches should be burned.

III. A MEALY-BUG ATTACKING QUINCE TREES.

Dactylopius sp.

Late in April of last season a quince twig infested with a species of *Dactylopius* was brought into the laboratory. The bearer stated that the insect was first noticed about three weeks previous. On April 27, the orchard was examined. It is one of the largest bearing quince orchards in the vicinity of Geneva, and is situated in an exposed position on the west shore of Seneca Lake. Nearly all of the trees were infested, especially those along the north side, but none of them sufficiently to show injurious effects.

Notes on life history and habits.—On the date above given the mealy bugs were crawling about on the small branches and twigs or had settled down in protected places in the angles or near the

buds. Most of them were from one-third to two-thirds grown. A few adults were found under the loose bark of the trunk and large limbs, but no eggs.

June 28, the orchard was again visited. The twigs were infested about as in April. On this date however, large numbers of adults were found under the loose bark making cocoons and laying eggs. As a rule they were in groups of from two to six or eight as shown at Plate VI, Fig. 1. This picture is from a photograph from life showing the insects enlarged to about four times natural size. Some of them are partially covered by their cocoons. A few eggs are scattered about. From this date until the middle of August there was little change in the numbers. From the middle to the latter part of August there was a decided decrease in numbers. By the first of September very few were left on the twigs. Nearly all of those that remained sought shelter under the loose bark. By Sept. 26, the numbers had diminished materially. Those remaining were from half to two-thirds grown. A few larvæ were found.

October 26, which was an unusually bright, warm day for that season of year, the mealy bugs were crawling about freely. Some of them still remained inactive under the bark. Careful search was made for eggs with the result that one cocoon containing eight eggs was found. Four of the eggs hatched in the laboratory, November 19; the remainder did not mature.

The egg.—The eggs are at first nearly white but finally change to a deep pink. The shell is membranous and covered with a white powder. An egg of average size measured .47 mm. by .23 mm. In shape they are oblong, slightly oval and broadly rounded at both ends.

The eggs are laid in cocoons of coarse silk placed under the loose bark. There is apparently no regularity in their arrangement in the cocoons. An abundance of white powder covers each one and may prevent their touching.

The egg cocoon consists of two distinct parts, an outer coarse tent-like structure of coarse strands of white silk loosely woven and an inner cocoon-like structure more closely woven. The two are connected only by loose strands of silk. The inner structure is oval in shape and contains the eggs. It varies in size but meas-

ures on the average about 2 mm. by 5 mm. The cocoon is at first pure white and a beautiful object, but exposure to the weather finally changes it to a dull slate color. The average number of eggs in a cocoon was not determined. One examined contained eight. A cocoon showing inner and part of outer structure is shown natural size and enlarged at Plate VI, Fig. 2.

The larva and adult.—The larvæ closely resemble the adults. When first hatched they are deep pink and within a few days become covered with a white powder. They are very active and move readily about on the bark. In all stages the insect feeds by sucking the sap from the bark. None were found on the leaves, either in the larva or adult stages.

The adults are active, soft-bodied insects measuring 3.5 by 2 mm. The color of the living adult is a dull dark green, covered with white powder similar to the larva. As with other species of this genus the margins of the body are irregular, each segment bearing short irregular projections. Plate VI, Fig. 3 is from photographs from life showing a single individual enlarged and a group natural size.

Economic importance.—Mealy bugs are capable of inflicting injury to the host plant in a manner similar to scale insects by sucking the sap from the bark and leaves. A number of species work upon the roots of plants. In the infested quince orchard some injury was undoubtedly done as the insects sucked the sap from the limbs and twigs often from near the base of the buds. In this case the amount of injury is only a question of numbers.

Treatment.—As the insect is soft bodied similar to the plant lice and during the spring and early summer lives openly on the twigs, one or two applications, of whale oil soap, one pound to five gallons of water, would quickly check it. Scraping the trunk and large limbs during the winter where there is loose bark and painting with a strong solution of whale oil soap, one pound to the gallon of water, would have a similiar effect.

IV. TWO APPLE LEAF MINERS.

The minute caterpillars that mine into leaves are among the most common of the insect pests. A number of species work in the foliage of apple trees but seldom in sufficient numbers to do serious injury. The past season, however, has been an exception in Western New York with at least three species two of which are briefly discussed here. The two species have occurred in sufficient numbers to cause apprehension on the part of fruit-growers in the western part of the State. Fortunately they do not appear in very large numbers until late summer or fall when most of the leaves are mature, thus making less injurious the work of the caterpillars.

ORNIX PRUNIVORELLA Cham.

ORDER *Lepidoptera*. FAMILY *Tineidæ*.

This species is probably widely distributed in Western New York, but judging from the few references in the literature of economic entomology seldom occurs in sufficient numbers to attract much attention. One of the earliest references is by Brunn¹ who in 1883 found it in apple leaves in Tompkins County, but not in sufficient numbers to do material injury. During the past season we have received specimens from Monroe and Orleans counties. Its distribution in the United States is indicated by Forbes'² report in which he states that it is widely distributed in Illinois, and in addition to New York is found in Colorado, Kentucky, Michigan and Massachusetts.

Appearance in Western New York in 1900.—This species was first brought to the writer's attention early in October when some infested leaves were received from Brockport. The correspondent stated that nearly all the apple orchards in the vicinity of Brockport were badly infested. October 29 an infested apple orchard at Albion was examined. On nearly every tree two-thirds or more of the leaves were distorted by the mines of the larvæ. In many of the leaves from two to four mines were

¹ Cornell Univ. Agr. Exp. Sta., Second Ann. Rept. (1883), pp. 155-157.

² Fifteenth Ann. Rept. State Ent. Ill. p. 59.

found. Most of them were old, indicating that the larvæ had been working in the leaves several weeks. The owner of the orchard stated that he had first noticed them about the middle of October. In the vicinity of Geneva a number of apple orchards were mildly infested, but no case of serious infestation was found.

Notes on life history and habits of the larvæ.—The life history of this species has not been fully determined. Probably the most complete account is by Forbes,³ who states that the eggs are laid on the leaves, and that the young caterpillars feed on the parenchyma. When full grown they leave their old mines and form new ones in which to pupate and pass the winter. No description of the egg is given, and the time of egg laying is not stated. No eggs were found on the branches received, and, although a careful search was made, none in the orchards at Albion or Geneva. Some indication of the time of egg laying were given by the evident age of some of the larvæ found October 29. An occasional one less than half grown was found, but most of them were full grown, and a number had transformed to pupæ.

The mine.—The young larvæ feed upon the parenchyma usually in the upper side of the leaf. The skin is left intact. The final result is a tentiform mine which distorts the leaf as shown at Plate VI, Fig. 4. In this mine the larva lives and feeds until full grown. Evidently no attempt is made to keep it clean, as the droppings were always found scattered about, as shown at Plate VI, Fig. 2. This picture shows one of the mines cut open and much enlarged.

When full grown they leave the old mine to prepare for pupation. The manner of doing this is shown by a number of full grown caterpillars which were placed on fresh leaves in the laboratory October 31. They did not mine into the tissue but selecting the slightly curled edges of the leaves and placing the body in a position nearly parallel to the side and far enough away so that by bending the anterior two-thirds of the body the head would touch the point of one of the serrations, begin to spin strands of silk from this point to the main body of the leaf.

³ Fifteenth Ann. Rept. State Ent. Ill., p. 57.



PLATE V.—EXUDED PEACH SAP FROM PUNCTURES OF FRUIT BARK-BEETLE.

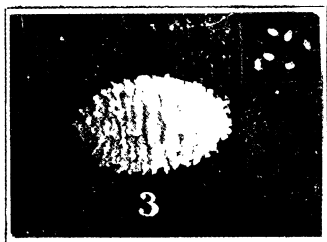
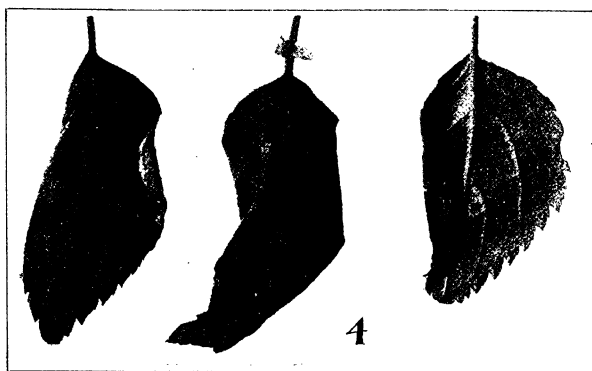


PLATE VI. — 1 AND 3, QUINCE MEALY-BUGS; 2, EGG-COCOON OF SAME.
4 AND 5, WORK OF *Ornix prunivorella* ON APPLES.



PLATE VII.—METHOD OF LEAF-FOLDING AND COCOON-MAKING OF *Ornix prunivorella*, WITH LARVA.

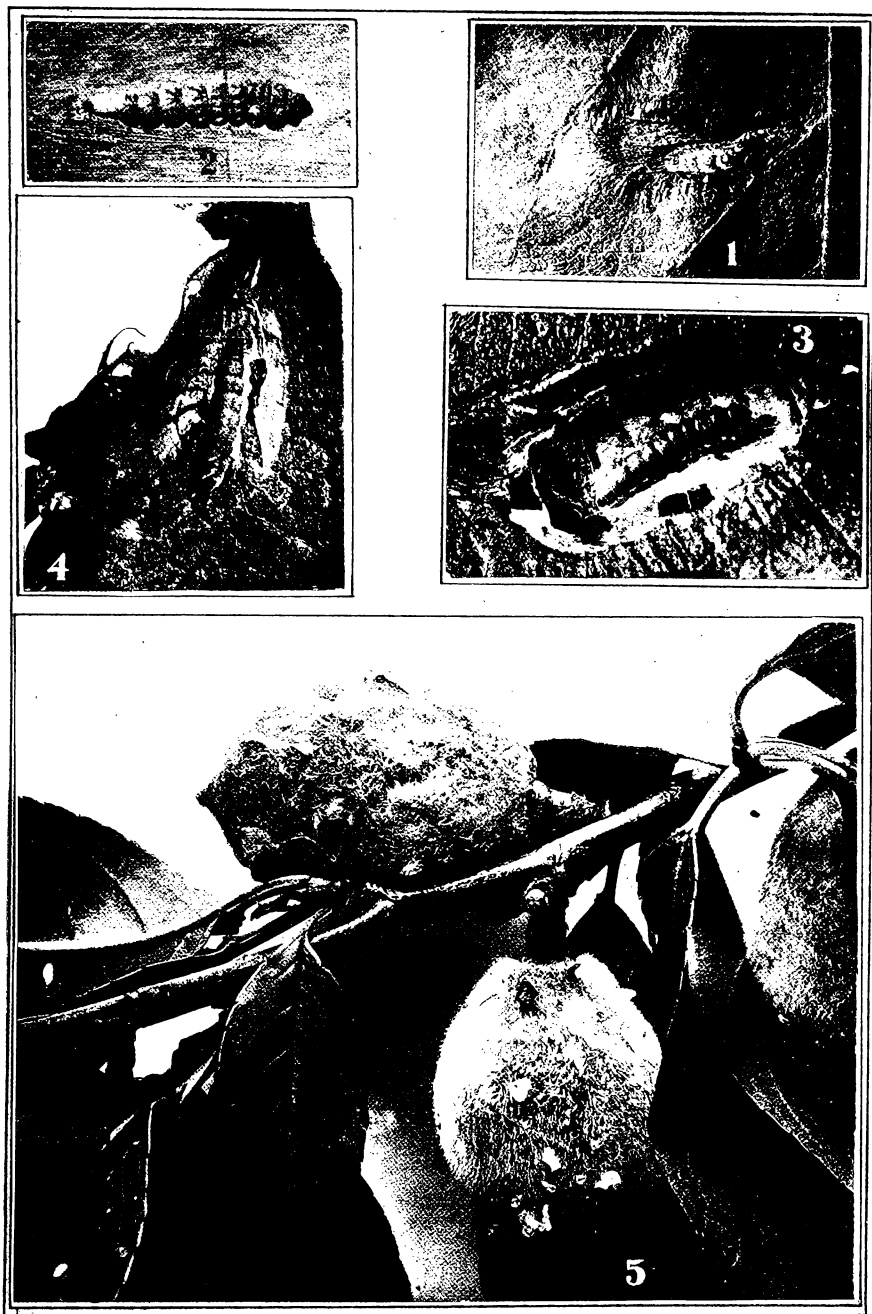


PLATE VIII.—1-4, MINE AND LARVA OF *Tischeria malifoliella*,
5, PRACHES INJURED BY TARNISHED PLANT BUG.

There were eight caterpillars, and all of them followed this plan. At Plate VII, fig. 1, a single point is shown, much enlarged, held by the threads. The larvæ worked very rapidly. In about half an hour most of them had made a net work of silk extending about half an inch along the sides of the leaves. They then began to work from the under side of the silk, and as they clung to it began to spin as before. Brunn⁴ suggests that the weight of the caterpillar's body causes the margin of the leaf to bend over. This undoubtedly has some effect, but as the caterpillars feed on the parenchyma under the tent the withering tissues may play an important part in producing the desired result. In about three hours most of the tents had the appearance of the one shown at Plate VII, Fig. 2, and by the second day all were drawn over as shown at Fig. 3. The caterpillars thus roll the leaves in a manner somewhat similar to a true leaf roller. They evidently feed for a time in these retreats before pupating, as out of a large number examined the parenchyma on the upper side was entirely eaten away.

Before pupating the caterpillars line their retreats heavily with white closely woven silk. Every one examined both in the laboratory and in the orchard was lined in this way. The silk is not closely attached to the leaf except at the edges which are fastened together and to the leaf tissue. Within this snug retreat the chrysalis is formed. At Plate VII, Fig. 4 the edges of the leaf that were drawn together have been pulled apart exposing the white, cocoon-like covering of the chrysalis. In this stage the insect evidently passes the winter, although it is probable that some of the larvæ hibernate; as Forbes⁵ states he has found them as late as the middle of November. Our own observations are similar to those of Forbes as we found hibernating larvæ Dec. 1.

The full grown caterpillar.—A full grown caterpillar is shown much enlarged at Plate VII, Fig. 5. The following description is a modification of that by Brunn.⁶

⁵ Fifteenth Ann. Rept. State Ent. Ill., p. 57.

⁶ Second Report Cornell Univ. Agr. Exp. Sta. p. 153.

⁴ Second Report Cornell Univ. Agr. Exp. Sta., p. 151.

Length 5.5 mm. to 7 mm. General color light greenish drab to slate. With the exception of the first, each segment has eight dull white slightly raised blotches, four on each side of the median line. Each bears one or two slender white hairs. Head half as broad as first segment, light yellowish green to light brown. Mouth parts brown. Along the posterior margin of the head is a row of six large deep black irregular spots. The two end spots are sub-marginal, triangular and slightly larger than the others. There is also a somewhat paler spot at the base of each mandible. A row of four similar spots extends across the first segment midway between the anterior and posterior margins. The spots are larger than those on the head. Thoracic, abdominal, and anal legs well developed. Outer surface of thoracic legs black and smooth. Inner surface same color as ventral surface of body and sparsely furnished with hairs.

Detailed descriptions of the other stages are reserved for a future publication.

Treatment.—As the insect works within the leaf arsenical or other sprays would have little if any effect. The only vulnerable point seems to be in the method of passing the winter. By destroying the fallen leaves, as by plowing them under, the insects within them will be destroyed and thus the species held in check.

TISCHERIA MALIFOLIELLA Colem.

ORDER *Lepidoptera*. FAMILY *Tineidae*.

The mines of this species were very common in the leaves in the apple orchards examined at Albion and Geneva and were received from Brockport. At Albion at least forty per cent. of the leaves were infested.

The mines are in the upper side of the leaf and are somewhat trumpet shaped. The small end is often curved and marked with crescents of white. The dead and dried leaf tissue turns reddish brown in sharp contrast to the green color of the healthy leaf. At Plate VIII, Fig. 1 an external view of a mine enlarged to twice natural size is shown.

The caterpillars feed and pupate in the same mine. Brunn⁷ states that this species probably passes the winter within the mine in the larva state. Our observations were similar except in one case when on Oct. 29 a larva was found evidently about to pass to the chrysalis stage as shown

⁷ Cornell Univ. Agr. Exp. Sta., 2d Rept., p. 156.

much enlarged at Plate VIII, Fig. 4. At Fig. 3 one of the mines cut open exposing the caterpillar is shown and at Fig. 4 a single caterpillar. Both are much enlarged. But little is known of the life history of this species and the pupa has not been described. In this State we have found it in Ontario, Wayne and Monroe counties.

V. INJURY TO PEACHES BY THE TARNISHED PLANT BUG.

On June 15, Mr. W. T. Rudman, of Rochester, N. Y., brought in a number of Elberta peaches having much the appearance of those shown at Plate VIII, Fig. 6. Some of them showed more injury than those shown in the picture, being nearly covered with sap and much withered. On June 17 the orchard from which these peaches were taken was visited. The cause of the injury was easily ascertained as there were many tarnished plant bugs on the peaches. A number of them were watched through a lens and could be plainly seen forcing their beaks into the fruit. In several cases a single insect made from four to eight thrusts before leaving the fruit. Mr. Rudman stated that he had noticed the bugs on the fruit for the first time about six days previous to this date. They began to leave the fruit late in June and did not return again during the season.

Nature of the injury.—The bugs usually confined their attacks principally to the under side of the fruit making large numbers of punctures with their sharp beaks. Within a short time after the punctures were made drops of sap would flow and finally the skin begin to wither. The injured peaches when mature were deformed to a greater or less degree depending upon the extent of the injury to the young fruits.

Location of infested trees.—All of the trees in which the injury was done were close to the west side of a rather dense woods consisting principally of chestnut and white oak with an undergrowth of sassafras. The trees in the first three rows nearest the woods were most seriously attacked. On the fourth and fifth rows very little injury was done and only an occasional injured fruit could be found in the remainder of the orchard.

DESCRIPTION OF PLATES.

Plate I.—Forest tent-caterpillar on apple twig: 1, Dorsal; and 2, lateral view of same caterpillar. From life; natural size. (Original.)

Plate II.—Forest tent-caterpillar: 1, A later photograph of the same twig as in Plate I. The caterpillar has drawn the leaves together and is forming the cocoon within; 1¹ and 1² show the male and the female moths, natural size; and 2, some of the caterpillars on a young plum tree. Their recently cast skins are seen on the right. From life. (Original.)

Plate III.—Cocoon of forest tent-caterpillar: At 1 the leaves have been partially cut away exposing the cocoon, the caterpillar being still at work within the cocoon when this picture was taken; 2 is from a photograph taken three days later, the cocoon being cut open to expose the chrysalis. From life, enlarged. (Original.)

Plate IV.—Fruit bark-beetle: 1, Branch from cherry tree showing leaves killed by beetles; 2, one of the buds enlarged showing hole made by a beetle; 3, exudation of sap from wounds made by the beetles; 4, row of eggs in twig, enlarged; 5, single egg, enlarged. (Original.)

Plate V.—Exudation of sap from bark of peach tree caused by fruit bark beetle.

Plate VI.—1, Quince mealy-bugs enlarged; 2, egg cocoon, natural size and enlarged; 3, single mealy bug greatly enlarged, with group natural size. 4, Apple leaves distorted by *Ornix prunivorella*; 5, one of the mines greatly enlarged showing the interior. From life. (Original.)

Plate VII.—1, Edge of apple leaf being drawn over by larva of *Ornix prunivorella*; 2, from a later photograph; 3, the edge of the leaf is drawn completely over and encloses the larva; 4, cocoon within folded leaf; 5, larva. From life, enlarged. (Original.)

Plate VIII.—1, Mine of *Tischeria malifoliella*; 2, larva; 3, larva in mine; 4, larva about to pupate; greatly enlarged; 3 and 4 from life. 5, Peaches injured by tarnished plant-bug.