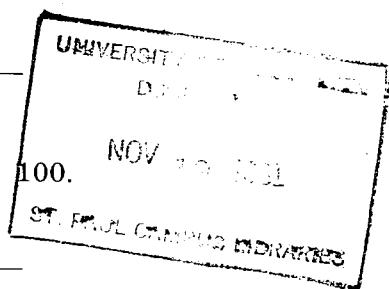


UNIVERSITY OF MINNESOTA.

Agricultural Experiment Station.

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ENTOMOLOGICAL DIVISION.

DECEMBER, 1906.

**THE CABBAGE MAGGOT AND OTHER INJURIOUS
INSECTS OF 1906.**

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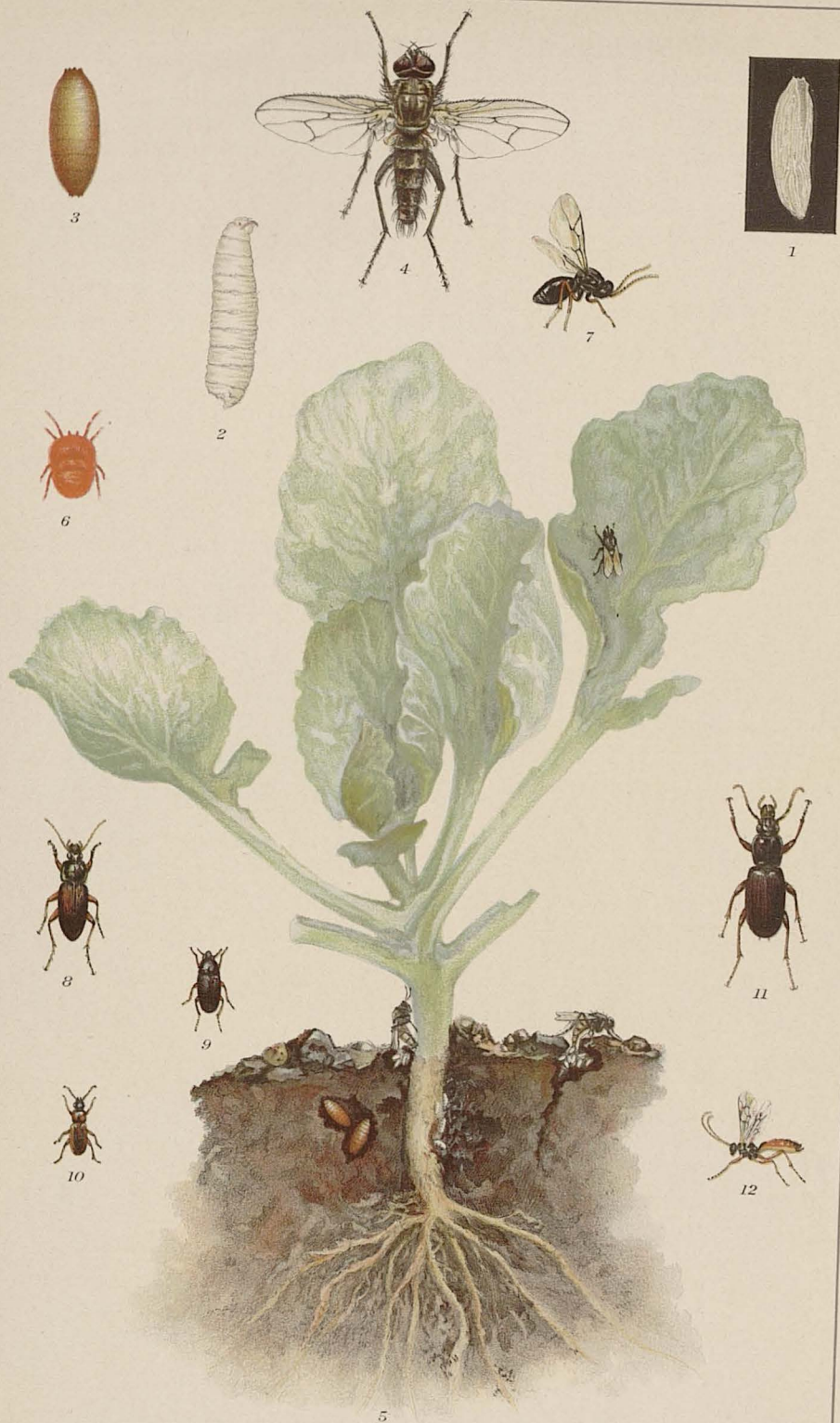
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EDITH REED, DEL. ET PINX.

THE CABBAGE MAGGOT AND SOME OF ITS ENEMIES

EXPLANATION OF COLORED PLATE.

Fig. 1, Egg enlarged about 25 times. Fig. 2, Maggot, much enlarged. Fig. 3, Puparium enlarged about 3 times. Fig. 4, Adult Fly, three times enlarged. Fig. 5, Young cabbage plant, showing maggots on stem below ground, two puparia in soil a short distance from plant, two flies egg-laying, one placing its eggs between the stem and the soil, the other in a crevice about an inch from plant; a fly natural size on leaf, and one egg in the axil of one of the leaves. Fig. 6, a Red Mite, *Trombidium scabrum*, Say, which feeds upon the eggs. Fig. 7, *Pseudeucoela gillettei*, Ashm., much enlarged, a parasite of the Cabbage Maggot. Fig. 8, *Pterostichus leucoblandus*, Say, natural size. Fig. 9, *Amara impuncticollis*, Say, natural size. Fig. 10, *Agonoderus pallipes*, Fab., natural size. Fig. 11, *Pterostichus coracinus*, Neum., natural size. These four beetles when brought in from the field, immediately devoured cabbage maggots given them, and are therefore placed by the writer among predaceous enemies of *Phorbia*. Fig. 12, a parasite, *Plectiscus*, sp., about twice enlarged, reared from puparium of Cabbage Maggot.

TABLE OF CONTENTS.

CABBAGE MAGGOT	1
CLUB ROOT OF CABBAGE.....	18
ONION MAGGOT	19
INSECT CONDITIONS AND IDENTIFICATIONS OF IN- SECTS	21
NURSERY INSPECTION	26
SPRAYING IN NURSERY AND ORCHARD.....	38
ENTOMOLOGICAL CALENDAR	41
COTTONY MAPLE SCALE.....	54
SOFT SCALE OF PLUM.....	57
ARMY WORM	59
STALK BORER	62
CUT WORMS IN GREENHOUSES.....	64
SOME RECENT OBSERVATIONS ON THE USE OF HY- DROCYANIC ACID GAS.....	64
SOME COMMON HOUSEHOLD INSECTS.....	67
AN EXPERIMENT WITH LANTERN TRAPS FOR WHITE GRUBS IN LAWN.....	74
THE NEW INSECTARY.....	76
ADDITIONAL MINNESOTA DIPTERA.....	79
PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT SINCE 1895	82
INDEX	85

THE CABBAGE MAGGOT AND OTHER INJURIOUS INSECTS OF 1906.

By F. L. WASHBURN, STATE ENTOMOLOGIST.

THE CABBAGE MAGGOT.



FIG. 1.—A cabbage plant "wilted down" as the result of the work of the maggot. (Author's illustration.)

The Cabbage Maggot, one of the most destructive pests connected with the raising of cabbage, cauliflower, turnips and radishes, has occupied much of our attention during the season just past, and enough has been accomplished this year to outline our experimental work for next season, narrowing it down to a few processes to be used, some on a small scale, others on a large acreage, which we are confident will give good results. In the mean while we have made some observations, a few of them new to science possibly, which we include below. Many of these have a more or less practical bearing on remedial treatment.

The pest is so wide-spread and of such economic importance that a colored plate precedes this article, illustrating the appearance of the fly, its life history, showing the method of egg-laying, and some of its enemies, for it must be known it does not lead an existence entirely free from dangers of this kind.

SUMMARY OF RESULTS OF SEASON'S WORK.

1. Fields exposed to breeze, and where all old stalks of preceding year in the neighborhood were plowed under last fall, have been much less affected than fields not so located, and not so fortunate as regards clean cultivation. Plants in sandy soil appear to suffer more, other things being equal, than those planted in heavy soil.
2. Measures tending to prevent the maggot attacking the stem would appear more practical than a "cure" (carbolic emulsion, etc.) after the pest is in or on the stem below the surface of the ground.
3. We need another year's experimentation, in order to use on the early crop of cauliflower methods which this year's work leads us to believe will be efficacious.
4. Cultural methods may possibly prove our best means to control the maggot.
5. Natural enemies help us in this fight. Several ground beetles, p. 8, a red mite which sucks the eggs, p. 8 and various parasitic insects, p. 8. See also colored plate.
6. Young maggots lived in the laboratory for two hours and twenty minutes immersed in carbolic emulsion (1 part to 30 of water), and adult maggots required three hours and forty minutes of such immersion before dying, p. 6. Some eggs hatched after thirty seconds' treatment with carbolic emulsion of the same strength.
7. Good results were obtained by immersing the roots at time of setting with hellebore and water (p. 12), and also by the use of brän and glue and sawdust and glue (pp. 12 and 13).
8. Flies under observation laid fertilized eggs in captivity.
 - b. Length of life of egg, 3 to 5 days (p. 5).
 - c. Length of life of maggot, about 21 days (p. 6).
 - d. Duration of pupal stage, first brood, 13 to 15 days (p. 7).

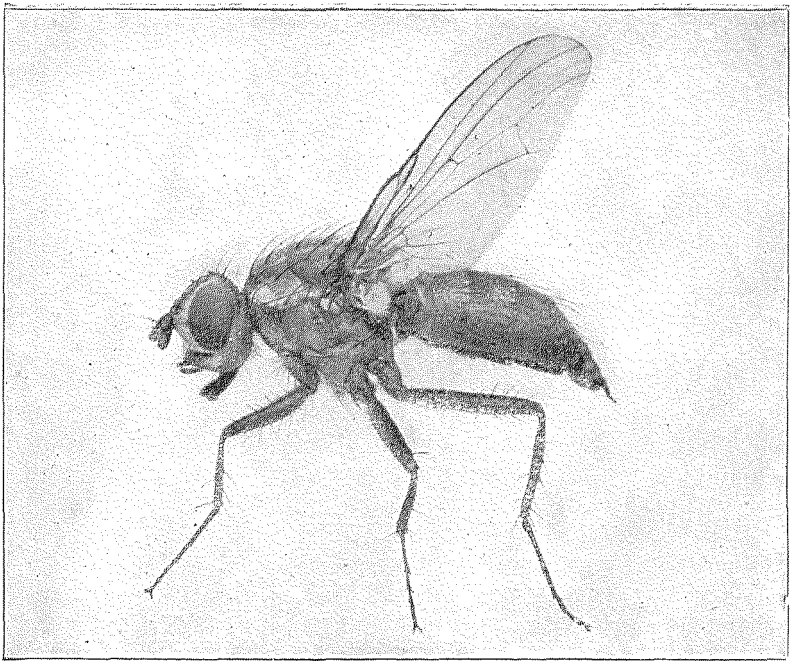


FIG. 2.—Female Fly, much enlarged. (After Slingerland.)

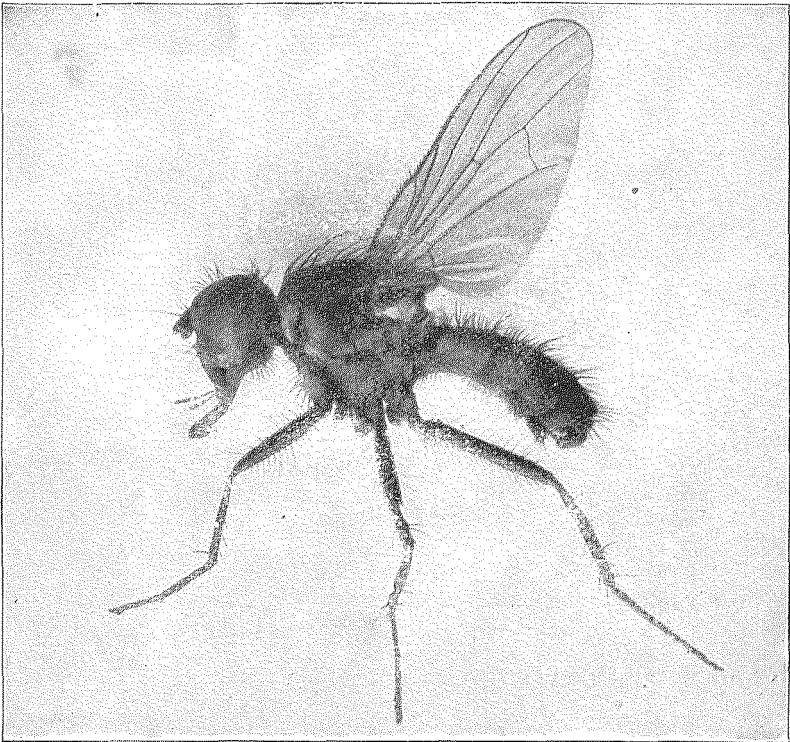


FIG. 3.—Male Fly, much enlarged. (After Slingerland.)

OBSERVATIONS ON ITS LIFE HISTORY.

Notes on the Occurrence of the Fly. First observed as early as May 9th, more numerous May 11th, but no egg observed on this date. Specimens emerged in breeding jars in laboratory as late as September 26th.

The Egg and Egg Laying. Eggs were found abundantly on May 16th, both on cabbage and cauliflower, 75 per cent of the cabbage examined being infested, some cabbages having as many as ten eggs to the plant. Of cauliflower plants examined on this date, over 90 per cent were infested; the largest number of eggs found on a single plant being twenty-two. This indicates emphatically their preference for cauliflower.

The action of the fly in ovipositing was repeatedly observed by members of this department, and the observations coincide so closely that I give here almost verbatim the report of an assistant whom I had put to work on this problem. Naturally every fly will not act in exactly the same way, but his account will serve to show in general the actions of the female at that time.

"When a fly lights on a plant in search of a place to deposit her eggs she runs quickly down the stalk to the ground. Here she searches alternately with her forward and rear end or ovipositor for some crevice or crack through which she can obtain access to the stalk of the plant under ground. She acts rather nervously, occasionally running up on to the leaves. The ovipositor is, when extended, nearly as long as the abdomen, very flexible and pointed. With this she tries every place offering any chance of furnishing what she desires. When she has finally found a crevice she forces the ovipositor in to the limit and stands still for several seconds, meanwhile usually polishing her head with her fore pair of legs. Then she withdraws her ovipositor, and after climbing on to the plant again, flies with a slow flight near the ground to a point of vantage or to another plant. I watched five flies at work, and they all laid eggs while I was watching them.

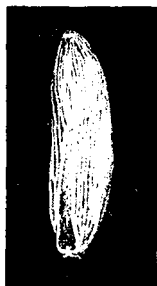


FIG. 3½.—Egg of cabbage maggot fly, much enlarged. (Author's illustration.)

Only one of them laid more than one egg in a place, and she laid two. The eggs were carefully concealed, and were not visible from the outside without disturbing the soil."

In this connection it may be said that several eggs were often found in the soil near a plant in one bunch, indicating that sometimes a single fly may lay a number in one place.

The egg, see enlarged figure on colored plate; is white, just visible to the naked eye; under the microscope showing fine reticulations, and on one side an incomplete groove.

On May 18th in the same field above referred to there was hardly a plant free from eggs, showing pronounced activity on the part of the fly at this time. Between this date and the 23rd much rain fell, and many of the eggs previously observed had been washed away. At this date too, many eggs were found on young plants not yet taken from the hot beds.

Will Disturbing the Egg Prevent Hatching? Evidently not, for two eggs laid Friday the 18th at 3 P. M., placed in



FIG. 4.—Larva emerging from egg. Observed under microscope. (Author's illustration.)

a vial, and considerably shaken in transportation, hatched on Wednesday the 23rd, *five days later*. Other eggs collected in the field and shaken, also hatched.

Duration of Egg Stage. The two eggs above referred to hatched in five days from time of laying. Of two eggs laid on the 23rd, one hatched on the 26th, three days and about five hours. It may be said then that the egg stage is from three to five days' duration.

On May 31st the first brood of flies appeared to be practically through with egg laying on cabbage and cauliflower, for although they were observed in the field, a week's examination failed to disclose any laying eggs. On June 1st eggs were observed on young radishes, and market gardeners began to report maggots in radishes.

Laboratory Observations on Egg. On July 2nd several cabbage maggot flies which had been confined under a bell jar with a potted cauliflower plant, *laid eggs on the ground near the plant. In other words, the flies bred in captivity.*

We do not understand why other workers failed to obtain this. The same observation was repeated with other specimens, the flies laying within four hours of the time they were confined, and placing their eggs in the axils of the leaves. The egg under both of these jars hatched on July 6th, a few hours over three days.

The Hatching of the Egg. The hatching of one egg was observed under the microscope. The active larva in this instance tried unsuccessfully for several hours to free itself of the empty shell, and finally died. The smooth surface of the glass slide may have been and probably was the cause of this failure. Later we figured one in the act of hatching, and it would appear that the larva emerges from the egg through the groove above referred to.

Laboratory Experiments with Eggs. May 27th 200 eggs collected and divided into two equal parts, one part treated with carbolic emulsion, 1 part to 30 parts water, for 30 seconds. Later three of the untreated eggs hatched, and five of those immersed in the emulsion.

Observations on Maggot. May 31st a few maggots observed. On June 5th many more were found, varying from those just hatched to those nearly and quite full grown. On June 12th many had changed to pupae. At this date too, practically all cauliflower with many market gardeners, was found to be ruined by the maggot. The very earliest set cauliflower, of which there was not a large amount, made a better showing than plants set out later. Many of the maggots observed early in June (June 5 to 7) were full grown, and by July 7th the majority of the maggots of first brood appeared to have transformed to pupae.

We cannot speak definitely to a day as to the length of life of the maggot. Some, which were believed to be but a day old when found, required twenty days to reach maturity, and transform to pupae, indicating that the larval life may last three weeks.

Laboratory Experiments on Maggots. Young maggots allowed to remain in carbolic emulsion (1 part emulsion and 30 of water) were killed in two hours and twenty minutes, full grown specimens required three hours and forty minutes before succumbing. Maggots immersed in lime water (2 lbs. slaked in 1 gal. water) for twenty minutes were killed.

Three out of four maggots were killed by immersion for one hour in solution of hellebore (1 oz. in 1 gal. water).

Observations on Puparia. The puparia of the last brood, brown cases containing the pupae, remain in the ground from a half inch to two inches from old stalks, or in the old stalks themselves, or in other debris left in the cabbage field over winter, flies emerging in the spring.

On May 7th they were found inside the stalk, and among decayed and dried leaves of last year's crop. They were more numerous, however, in the soil near the base of old plants. Near one plant examined on May 11th fifteen puparia were found. On June 17th a bunch of twenty puparia were taken from the soil near one cabbage plant. Eight maggots under observation transformed to pupae June 7th. Three of these emerged as flies June 20th, three on June 21st, and two on June 22nd, thirteen, fourteen and fifteen days respectively, after pupation. Another lot of maggots which changed to pupae June 6th, emerged as flies June 19th and 20th (13 and 14 days). It may be said then, with reservations, that ordinarily in Minnesota, the pupal stage of the first brood may be from thirteen to fifteen days' duration.,

Length of Life of Fly. Manifestly observations on this point cannot be made under rational conditions. Flies in captivity have lived in our laboratory three days without food.

CHRONOLOGICAL ARRANGEMENT OF THE APPEARANCE OF THE
DIFFERENT STAGES OF THE CABBAGE MAGGOT FLY
IN MINNESOTA IN 1906.

May 9	Flies first observed.
16	Egg laying well started.
31	First Maggots observed.
June 5	Maggots abundant.
12	Puparia found in large numbers, and all the cauliflower of many market gardeners reported destroyed.
July 7	Nearly all maggots transformed to pupae.
Sept. 26	Latest date at which flies emerged from puparia in laboratory.

Naturally these dates will vary from year to year, depending upon weather conditions.

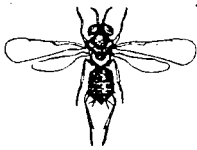


FIG. 5.—A parasite of the cabbage maggot. (Author's illustration.)

Predaceous and Parasitic Enemies of the Cabbage Maggot. Reference to the colored plate will demonstrate the fact that the life of the cabbage maggot is beset with dangers from this source. We know of at least one other Coleopterous enemy, a Staphylinid, not observed here, and hence not figured. There are many other predaceous and parasite forms preying upon this larva. The Cynipid parasite, *Pseudeucoela gillettei*, Ashm., shown enlarged as Fig. 7, col. plate, was collected in a maggot's burrow. It has long been known as a parasite of this species. Fig. 12 *Plectiscus* sp., (identified by Dr. Skinner) also enlarged was bred from a puparium of a cabbage maggot. The Carabid beetles, *Pterostichus coracinus*, Neum., Fig. 12 col. plate; *P. leucoblandus*, Say, Fig. 8, col. plate; *Agomoderus pallipes*, Fab., Fig. 10, col. plate, as well as *Amara impuncticollis*, Say, Fig. 9, col. plate, were continually observed in large numbers in all cabbage fields where the fly occurred. These were collected, brought into the laboratory, and immediately fed with maggots. The fact that they at once pounced upon and consumed the maggots given them would seem to warrant us in placing them among the enemies of the maggot, though not, as far as I am aware, referred to as such in previous writings. The following beetles were also observed in such numbers in cabbage fields as to lead me to suppose that they may also prey upon the cabbage maggot, though not observed to do so, *Heterothops fumigatus*, Lec., *Lathrobicum anali*, Lec., belonging to the *Staphylinidae*, and the Carabid, *Bembidium 4-maculatus*, Linn.

Perhaps its most persistent predaceous enemy is the red mite, *Trombidium scabrum*, Say, Fig. 6 col. plate, which we have observed sucking incredible numbers of eggs of *Phorbia*. On May 15th an assistant in the field reported this mite as very active, averaging about two to a plant, and occasionally four or five were observed about one plant. The activity of this mite at this date was evidenced by the fact that a large per cent of the eggs examined had been sucked. "Some times there would not be a single good egg around a plant out of

a dozen or more that had originally been laid there." This is most significant. This little agent calls for our respect in this particular. Through its agency evidently the cabbage maggot's numbers are materially reduced. Unfortunately we have not this season found it abundant in all localities where cabbages and cauliflower are found.

A little rove beetle, *Alcochara nitida*, LeConte, is known to devour large numbers of the maggot in various states and in Canada, as well as occurring in Europe, but while it may be present in Minnesota, we have not observed it. Another Staphylinid larva, *Maseochara valida* is possibly predaceous upon the cabbage maggot. It is probable that in our contest against the cabbage maggot we are aided by many predaceous and parasitic forms not yet known to us.

FIELD EXPERIMENTS, 1906.



FIG. 6.—At work in a badly infested field.

A large amount of work was accomplished in the field during the spring and summer. It is evident, however, that all experimental work on the part of the Entomologist, and

all practical work on the part of the market gardeners is most advantageously applied to the early crop of cauliflower and cabbage, which suffers most from the attacks of the Fly. This year almost all of the early crop of cauliflower in Minnesota was destroyed by this pest. A few fields within our knowledge were spared, generally, be it said, where plants were located in a field subject to some breeze, and where all stalks of the preceding year's crop had been destroyed by plowing the previous fall.

The field work has been classified under two heads. Series I representing work done between May 15th and June 7th, that is, on the early crop; and Series II, the work on late cauliflower, which, for the reasons given above, is not as productive of results as work earlier in the season.

We have abandoned entirely any attempt to use the tarred paper disk method for reasons given in the last Annual Report. We have also, in some instances, tried methods which have been experimented with and reported upon in other places in previous years, to note what results could be obtained here. Other remedies or methods of prevention are original.

We briefly tabulate experiments and results under Series I.

Carbolic Emulsion: The stock solution is made by dissolving 1 lb. of hard soap in 1 gal. boiling water, adding 1 pint crude carbolic acid, and churning immediately with a force pump or syringe until thoroughly emulsified.

On Radish: 1 part emulsion to 35 parts water applied on radishes (sown May 14, up May 19) on May 22nd, and a second application given May 28th. This crop was not troubled by the maggot, both check rows and treated rows making good showing.

On Cauliflower: a. Planted May 9th. Carbolic emulsion 1 part, water 30 parts; applications May 23rd and May 28th. On May 30th these were found infested with worms, and carbolic emulsion double strength (1 to 15) was applied, this being repeated June 5th. These last applications saved the plants. This double strength solution did not prove successful in every case, as is shown later.

b. Six rows treated (1 to 30) May 19th, second application May 23rd and June 3rd. On July 6th no marked dif-

ference could be noted between treated and check (untreated) rows.

On Cabbage: a. Plants set May 6th. Applications (1 to 30) May 15th; second, May 19th; third, May 26th; fourth, June 4th. On July 7th the following results were noted; 1st row 107 heads out of 150 plants treated; 2nd row 105 heads out of 150 plants treated; 3rd row 111 heads out of 150 plants treated. But in the check rows we observed the following: 1st row, 130 heads out of 150 plants; 2nd row, 117 heads out of 150 plants; 3rd row, 130 heads out of 150 plants. In other words the check rows made a better showing than the treated plants. These observations were based entirely upon the heading and is not to be regarded as a good test, for the plants were located in a breezy field where the maggots were not at all bad, and almost all the plants made a favorable growth, but did not show up very well in heads. The comparatively poor showing of the treated plants may or may not have indicated that the solution used had an unfavorable effect on the plants.

b. First application on plants set May 9, May 23rd; second, May 28th; third, June 5th. Examined June 7th; 2 plants out of 11 wilting. Checks: 6 out of 23 wilting.

Carbolic Emulsion, double strength (1 part emulsion, 15 parts water).

On Cauliflower: a. Earth hollowed (2 inches) about base of plants to hold emulsion.

Plat No. 1: Applications May 30, June 15. Poor results.

Plat No. 2: Three applications; first May 19 and last June 15. Results: A somewhat better showing for treated plants.

b. Earth not hollowed:

Plat No. 1: Applications May 3rd and June 5th (but hollows made around plants at second application because it was found that maggots were present). Examined June 7. No maggots. Evidently either driven away or killed by the solution.

Plat No. 2: Three applications, the first May 19, third June 15. On July 6th no appreciable difference between treated and untreated plants.

Plat No. 3: Applications June 2nd and June 5th (earth close to plant hollowed at time of second treatment). On

July 6th treated and untreated plants made about the same showing. The location was breezy, and where cultivation the previous fall had destroyed the standing stalks of the year before. The maggot was not bad here and hence there was no chance for a comparison.

On Cabbage: a. Earth hollowed:

Plat No. 1: Applications May 30 and June 5. On June 7 examination of these plants disclosed the fact that although all the maggots were not killed by this solution, the plants were making a good showing.

b. Earth not hollowed.

Plat No. 1: First application May 30. Examination June 2 showed presence of maggots, and earth was hollowed and second application made. On June 22nd all these plants had perished, killed by the maggot. It is very evident that although this solution may kill or drive away the maggot, it works an injury if applied to very young plants.

White Hellebore, Dry. Early Radish: Application May 22nd, May 28th and June 5th. On June 22nd these were ready for market, and neither treated plants nor checks showed evidence of work of maggot. That this was in part due to location is indicated by the fact that radishes of the same date about a quarter of a mile away, in private gardens, were badly eaten.

Late Radishes: Dusted June 23rd. (Series II). July 16th we found no maggots either in the treated or untreated plants.

White Hellebore and Water. (Series II). Roots dipped in same. The roots of 44 plants dipped June 23rd in a mixture of hellebore 1 part and hot water 2 parts. This was allowed to cool before plants were treated, and they were immersed deep enough to also coat the lower part of the stems. They were immediately planted and made an excellent showing. On October 1st every plant was standing. White hellebore costs about 15c at wholesale.

Sawdust and Gluc. The literature upon this pest does not indicate that this has been tried before, and it was suggested to the writer from his conviction that we must look to preventive measures for best results, rather than attempt to destroy the maggots when in or close to the stalk. There is no question but that carbolic emulsion at the proper strength,

will kill the maggot, if the latter is in direct contact with it for a long enough period, but that is where the difficulty lies. When once within the stalk the pest probably is not always reached by the liquid, and the hardening of the ground about the plant causes much of the emulsion to flow away, and distribute itself where it does but little if any good, unless one goes to the expense of hollowing the earth about the plant's stem.

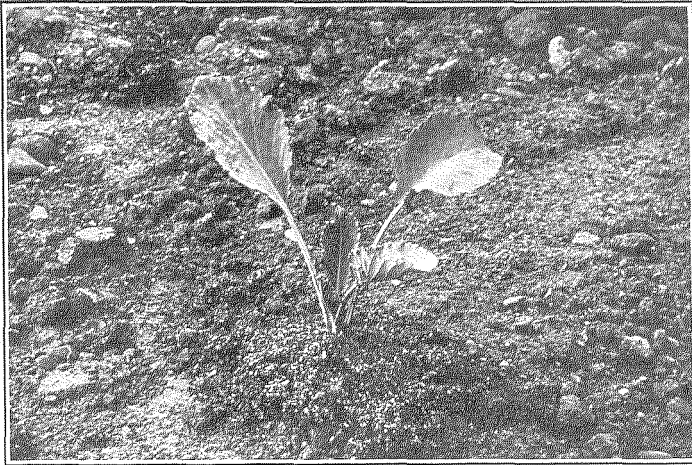


FIG. 7.—A cabbage plant with mixture of bran and glue about base. (Author's illustration.)

Sawdust was mixed with glue in the proportion of $\frac{1}{2}$ lb. of the former in 1 quart of the latter. The glue was not at all thick, but must represent at least 2 lbs. of hard glue in 1 gal. of water, and the mixture had about the consistency of chicken feed, though rather more "sloppy." It was applied warm with the hands, about the base of the plant, put well up on the stem, the diameter of the mass where it came in contact with the ground being about four inches, one quart was sufficient for fifteen plants. The stuff quickly hardened, and tho it softened somewhat during summer rains, it did not disintegrate after the rain. It was applied to twelve plants on June 5th, and was still in good condition on June 22nd. The plants so treated made an excellent showing. A man can treat six to eight plants per minute. This treatment would be hardly practicable on large acreage.

Bran and Glue: Prepared as above, using bran in place of sawdust. This makes a closer pack about the plant, but evidently does not go as far as the sawdust. I regard it as, on many accounts, better than sawdust.

Bran, Glue and Paris Green: Five ounces of Paris green were stirred into a peck of glue and bran. This is sufficient for about 30 plants. This was applied to 35 plants on June 23rd. It will be tried again next spring on the early crop to note its effect upon cut worms in their relation to the young plant. These late plants were free from maggot attack (which was not bad on any of the late cabbage and cauliflower) and altho four out of the twenty-five plants showed injury, possibly from the Paris green, the remainder made a good showing and formed good heads.

Bran, Glue and Hellebore: Hellebore substituted for the Paris green in the above, and five plants treated June 23rd with good results.

Air Slaked Lime: Radishes—Dry lime dusted on plants, and on ground close to plants. Applications May 22nd, May 28th, June 5th. On June 22nd, when these were ready for market, they were quite free from worms.

Milk of Lime: One half pound quick lime slaked in 1 gal. water.

On Cauliflower: Applications about base of plant May 23rd, May 28th, June 5th. Plants killed by maggots.

On Cabbage: Same applications and same results as above. Several killed by cut worms.

Dipping in Milk of Lime: Dipped the roots of 30 cabbage plants on May 18th before setting in solution 1 lb. lime to 1 gal. water, and planted. On the same date 30 plants were dipped in half that strength. In both cases the plants were injured. This injury was particularly noticeable when the solution was 1 lb. to 1 gal. About 60 per cent of these plants survived the treatment, and were not affected by the maggots.

Disturbing the Eggs by Stirring: On the supposition that possibly disturbed eggs would not hatch, we had the soil close to the stalks of 150 plants stirred with a pointed stick on May 15th, 17th, 23rd and June 4th. About five plants could be treated in a minute. Like other experiments tried in this field, where the fly was not abundant, there was no good opportunity to compare treated with untreated plants. References

have been made elsewhere to the fact that eggs which were shaken in a vial subsequently hatched.

Scraping Eggs away from Plant: The tiny white eggs just visible to the naked eye, are for the most part laid in the soil close to the stalk. It therefore, would seem that if these eggs could be scraped away from the plant six inches or more, that many maggots would perish before they could reach the stalk. Of course, every plant must be treated. Accordingly we had 280 early cabbage plants "scraped" on May 15th, again on May 23rd, again on May 28th, and for the last time on June 4th. The earth each time was scraped away with a putty knife to a depth of from $\frac{1}{4}$ to $\frac{1}{2}$ inch, about four plants being treated per minute. On July 7th we found that 127 treated plants out of 150 had headed. These plants were in the field above referred to as fairly exempt from attack, and no fair conclusions can be reached as to results. Some other tool might be more advantageously used than a putty knife. One would imagine that a sharp hoe in the hands of a careful workman would be a more advantageous and more easily handled instrument.

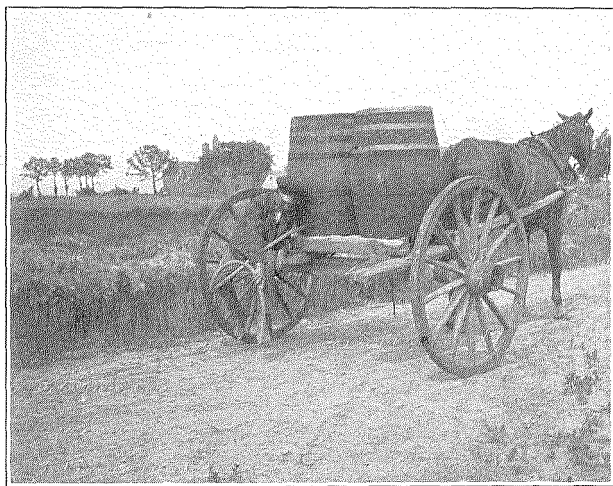


FIG. 8.—A rather crude apparatus for applying carbolic emulsion to cauliflower and cabbage plants.

Sand and Kerosene: 1 pint of kerosene mixed with 2 gals. of sand and placed about base of cauliflower plants as a

repellant after setting. This treatment was fatal to the plants. It also injured radishes, tho many survived and produced 70 per cent of marketable roots.

Acetate of Lead: 4 oz. in $\frac{1}{2}$ pint of water, and plants dipped. All killed by this treatment.

Napthaline (Moth Balls): Following a suggestion from New York (not made by an entomologist), two moth balls were planted close to each of several plants. The experiment was not extended enough to warrant conclusions, beyond the fact that such treatment does not appear practicable.

Field Experiments included under Series II began June 23rd, and the late set cauliflower plants, radishes and cabbages were made use of. As intimated above, the maggots were not bad late in the season and the cauliflower headed poorly; hence results obtained were not conclusive, and need not be reported here. A few of the later experiments have been listed above.

In addition to the above, additional field trials were made as follows: On May 28th sixteen cauliflower plants and sixteen cabbage plants were treated with 1-30 carbolic emulsion, about $\frac{1}{2}$ coffee cup full being poured around each plant. The ground was soaked about the base of each plant, and remained wet with the solution for at least fifteen minutes. Check rows were left for comparison. On June 5th the sixteen plants treated on May 28th were examined; results, fifty-eight maggots found in the plants, one plant containing thirteen. On June 7th sixteen untreated or check cauliflower plants were examined; results, eighty-two maggots, one plant having thirty worms in or on its stem. This showing favors somewhat the use of carbolic emulsion, 75 per cent of the treated plants being affected as against 88 per cent of the untreated. A 1-20 solution of carbolic emulsion, or even a 1-30 solution appears to affect very young plants unfavorably, and should be used with caution.

Effect of Location: On June 16th an assistant visited a market garden where some of the cabbages, as well as turnips and radishes had been planted in a sheltered position (near a wood), and others where they got the breeze. He reported as follows: "Conditions are such here as to show very plainly the effect of planting in exposed places. Mr. B.'s turnips and cabbages are pretty well protected from the south and west, the turnips very much so. As we get away from the shelter-

ing woods the affected plants are more and more scarce, till just over his line in a patch of cauliflower, which is pretty well upon the rise of ground, I was unable to find any sign of the pest. * * * There was not an egg, maggot or pupa to be seen. The number of maggots increased in direct proportion as the protecting woods were approached. The noticeable fact about the positions of the patches is that the flies took the *cabbages* which were the more sheltered in preference to going farther into the wind and getting the *cauliflower*."

Trap Crops: Mr. B. planted radishes and turnips amongst his cabbage as trap crops. At the time of the above visit, June 16th, the radishes (which were next the turnips) were practically ruined, hardly a sound root remaining, and the turnips nearly as bad, while the adjacent cabbages were fairly free.

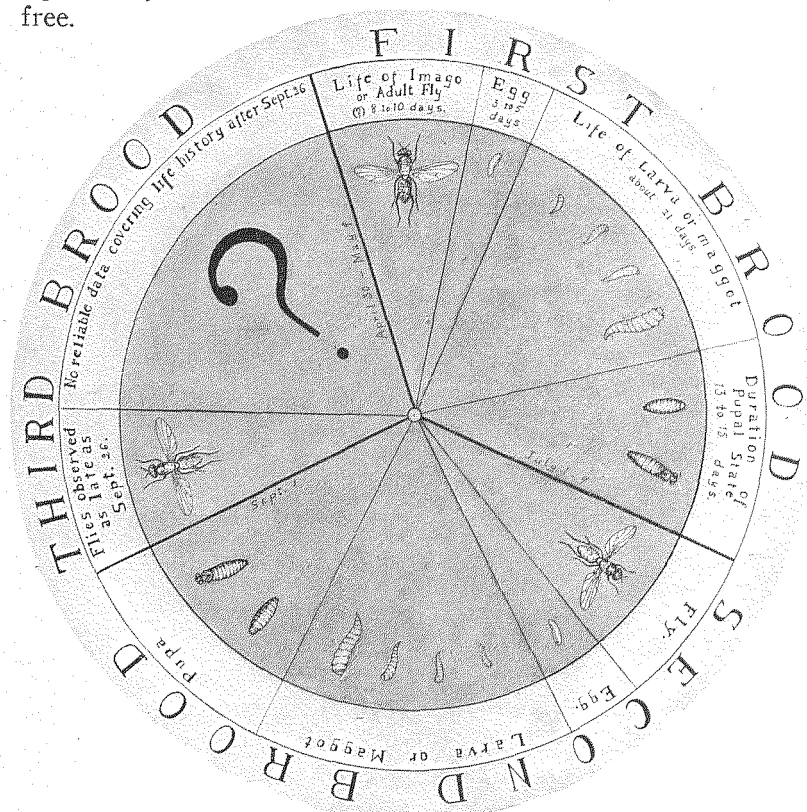


FIG. 9.—Diagram to illustrate the life cycle of the different broods of the cabbage maggot in Minnesota. (Author's illustration.)

CLUB ROOT OF CABBAGE.

Many market gardeners confound the work of the maggot with diseases which affect the root, and have no connection whatever with the maggot. This is noticeably true of a form of rot which sometimes affects the roots, causing wilting and death of plant. Club Root, also, which appears to be on the increase here, has been erroneously supposed by some to be connected with the work of the maggot. On June 23rd Club Root was found to be so bad on a certain field that the owner expected to lose his entire crop of cabbages. Over a large part of his place the plants were wilting, yellowing and dying. The first indication that he had, so he reported, of their being affected, was their wilting during warm days, and not recovering at night. He first observed this on his place four years ago, but did not recognize it, and took no measures against

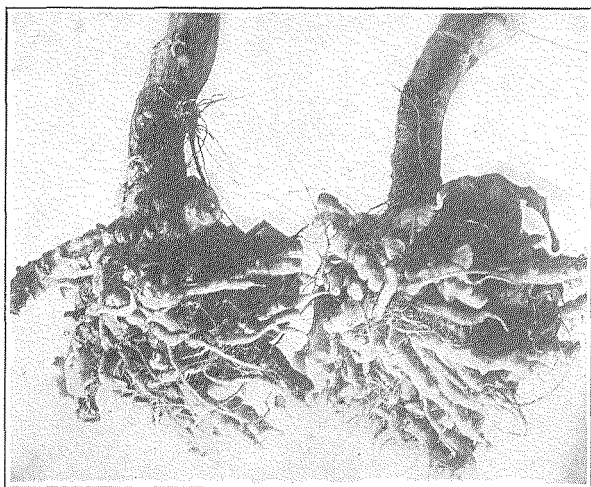


FIG. 10.—Club-root of cabbage. (Author's illustration.)

it. This disease of the cabbage, see photo, caused by a slime mould, known as *Plasmodiophora brassicae*, Wor., has nothing to do with insects whatever, and is becoming quite common in Minnesota. It also attacks radishes, turnips (particularly rutabagas), shepherd's purse, wild mustard, and probably a number of cruciferous plants. The vitality of the spores is such that manure from cows fed upon clubbed roots,

is said to affect crops grown on land where it is used. Such spores, it is claimed, will live for two or three years in the soil. Manure, then, is one of the means of infection. Soil, it is claimed, transferred from one infected field to another, will carry the spores, and thus infect the second field. Rotation of cabbage crops with some other not of the same family, care in choice of manure, the keeping down of all wild mustard and other weeds of the same family, and avoiding the infection of new fields by the transference of soil or refuse from infested fields, are all suggested as preventive or remedial measures. The broadcasting of air slaked lime, 75 bushels to the acre, has given satisfaction.

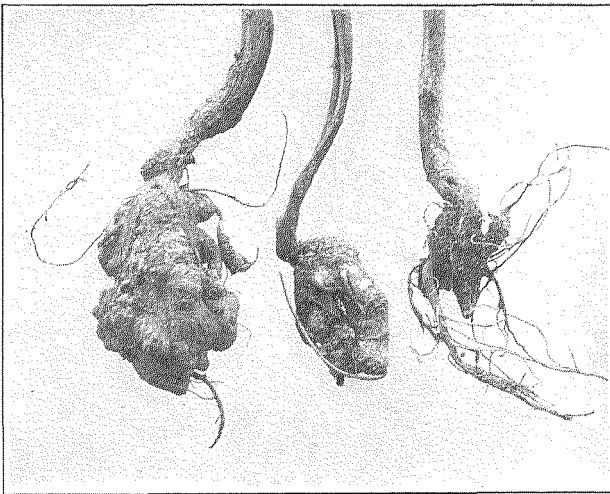


FIG. 11.—Club-root on mustard. (Author's illustration.)

TWO ONION MAGGOTS.

Previous to this year no maggots have been reported as injuring onions in Minnesota. We draw this conclusion from a study of Dr. Lugger's reports, wherein we find no mention of them, and the present Entomologist previous to this season has had no complaints regarding them, nor has he met them in the field.

This summer, however, on August 6th infested onions were received from Barnum, Carlton County, Minn., and on the

11th other infested plants were obtained from a field near the Experiment Station. These two sets were placed in the same

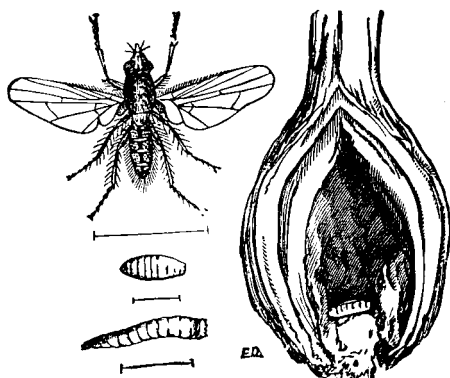


FIG. 12.—The common onion maggot. *Phorbia ceparum*.

breeding jar by an assistant, and in September two different species of flies, both enemies of onions, issued from the puparia. One, the common Onion Maggot, *Phorbia ceparum*, belonging to the family *Anthomyidae*, is shown in Fig. 12. The other, an entirely different fly, *Tritoxa flexa*, belonging to the *Ortalidae*, is shown in Fig. 13.

The common onion maggot fly lays its eggs early in the spring on the stems or leaves of the onion, close to the ground.

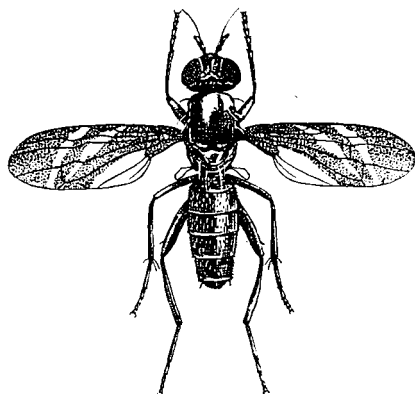


FIG. 13.—*Tritoxa flexa*, found in onions this season, much enlarged. (Author's illustration.)

The larvae hatching from the eggs work in the bulb, causing the plant to wilt and die, the bulb decaying. Young plants

are the sufferers. The flies are said to winter for the most part as pupae in the ground, tho some of the adults may hibernate.

Probably the most practicable remedy at our disposal is to pull up and destroy young plants as soon as the first appearance of the wilting is observed. This checks the increase of the maggot. Sand and kerosene (1 cupful of kerosene to 1 pailful of dry sand) placed about the bases of the plants, is said to be excellent where but a few plants are to be treated, but manifestly impracticable on a large acreage. Such treatment should be made early enough to prevent the egg laying of the fly. In some soils broadcasting a mixture of 600 lbs. kainit and 200 lbs. nitrate of soda per acre, first partially exposing a little of the root system with a hand plow, is successfully practiced. Evidently no such radical treatment has as yet been called for in Minnesota.

GENERAL INSECT CONDITIONS; IDENTIFICATION OF INSECTS, ETC.

A number of the leading inquiries received thru the mail, regarding injurious insects, are listed here. To the 1906 list we have prefixed the inquiries of 1905 omitted from last year's report which was almost entirely taken up with an account of the Diptera of this state. The list gives a good idea of what are our leading pests (barring the Chinch Bug whose name does not appear), and also shows that inquiries are received from practically all of our agricultural counties, as well as numerous others.

As evidenced by the species listed and by correspondence with field workers, the Chinch Bug has not been injurious during the last year, and the same may be said, with qualification, however, of the Hessian Fly. While there have been but very few complaints of this latter pest during the past two years, it is evidently present in localities and on the increase. A special field worker reported that on July 5th both larvae and "flax seeds" were found fairly abundant in Olmstead county. From "flax seeds" taken at that time flies issued in July. On July 12th he found this pest to be very abundant in both wheat and barley in fields near Rochester. By careful examination and subsequent figuring he estimated that in

this particular field there were 200 flies in some stage to every square yard. A week or so later stalks were falling down all over the field as a result of the work of the fly.

"Bald Heads" in the wheat in large numbers at this date indicated the work of a Joint Worm. This condition was noted in a large number of fields visited. The pest was found in barley and speltz as well as in wheat.

Meromyza americana: The wheat-stem maggot has been taken in quantities in wheat fields.

The Army Worm has been reported to the entomologist as quite abundant in various localities, and the chances are that it may be worse next year. Timothy was the crop most affected. This pest is discussed elsewhere. The Cottony Maple Scale, *Pulvinaria innumerabilis*, has been again abundant and destructive, and has been given a chapter by itself in this report. Not only in Minnesota has it made its presence felt, but also to our certain knowledge, in Wisconsin and Illinois, where many trees are claimed to have been killed by its ravages. Red Clover has suffered from the attacks of *Bruchophagus fuscus*, large numbers, with their parasites, having been reared from clover heads.

The Soft Scale of the plum, *Eulecanium cerasifex*, is becoming alarmingly abundant in Minnesota. It will be found illustrated and discussed on p. 57 of this report. In July willows were infested by one of the "willow worms" or "willow slugs," *Nematus* sp., black with yellow spots. It is easily combated with arsenical sprays. One of the most, if not *the* most annoying and destructive pests in the vegetable and flower garden is the Stalk Borer. It deserves, and has received in this report, a special discussion on p. 61.

The leaves of plum trees have, in localities, been destroyed by the work of the Plum Leaf Gall Mite, *Eriophyes padi*. Affected leaves appear like those shown in Fig. 14. The

NOTE: The attention of the writer has been called to the fact that in his report for 1905, at the beginning of the Letter of Transmittal he states that "The Hessian Fly has been present on grains and grasses," etc. A search thru his 1905 notes failed to disclose any authority for such a statement, and we are forced to the conclusion that it was a bit of carelessness which was overlooked in proof-reading. We have not found this pest breeding upon anything but wheat, rye, and barley, nor, according to recent letters from workers who are making a detailed study of this pest, has it as yet been reared from any but these last-named plants.

striped cucumber beetle, wrongly called by many "squash bug" has been, as usual, abundant and injurious.

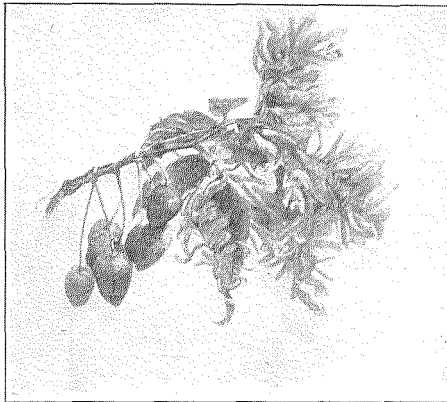


FIG. 14.—Plum leaves affected by Plum Leaf Gall Mite. (Author's illustration.)

Up to May 30th of the present year injurious insects were not unpleasantly numerous, the cold and rainy weather of that month appearing to hold them in check. Cut worms, however, were fairly numerous during May, as were also wire worms, and white grubs.

During the year, from November 1st, 1905, to November 22, 1906, the entomologist has written 1,739 letters, mostly regarding injurious insects; has mailed 442 postals, and issued 2,008 circulars containing information regarding certain especially destructive insects.

DATE.	COUNTY.	INSECTS IDENTIFIED.	HOST PLANTS, ETC.
1904.			
Dec. 15	Boston, Mass.....	Confused Flour Beetle, <i>Tri- bolium confusum</i>	Paper sacks of flour.
Dec. 15	Becker	<i>Lecanium</i>	Oleander.
1905.			
Jan. 14	McLeod	<i>Pieris rapae</i>.....	.....
Feb. 20	Morrison	<i>Ephestia kuehniella</i>	Flour moth in mill.
Mar. 3	Itasca	<i>Nematus ribesii</i>	Currants and gooseberries.
Mar. 4	Yellow Medicine...	Eggs of plant lice.....	Nursery stock.
Mar. 7	Kandiyohi	Eggs of plant lice.....	.....
Mar. 9	Ramsey	Eggs of Katydid.....	Supposed to be oyster shell scale.
Mar. 18	Brown	Striped Poplar Beetle, <i>M. scripta</i>	Norway poplar.
Mar. 20	Manila, Ia.....	<i>Mytilaspis pomorum</i>	Oyster shell Scale.

DATE.	COUNTY.	INSECTS IDENTIFIED.	HOST PLANTS, ETC.
Mar. 28	Rock	<i>Belostoma americana</i> .	
Mar. 29	Hennepin	Cabbage maggot pupae.	Stumps of cabbages.
Mar. 29	Bristol, S. D.	Eggs of <i>Hemileuca</i> .	
Mar. 29	Polk	Carabid beetles, <i>Amara</i> , sp.	
Apr. 4	Lac qui Parle.	<i>Chionaspis salicis</i> .	Scale on Russian poplar.
Apr. 6	Stearns	Cabbage maggot.	Cabbage and Cauliflower.
Apr. 13	Otter Tail.	Plant lice eggs.	Willow and cottonwood.
Apr. 21	Hennepin	<i>C. furfurus</i> .	Scale on elm.
Apr. 23	Rock	<i>Chionaspis furfurus</i> .	Scurfy scale on plum.
Apr. 28	Hennepin	Currant borer.	Currants. No specimen.
Apr. 30	Wright	<i>Samia cecropia</i> .	
Apr. 30	Scott	Currant borer.	No specimen.
May 4	Clay	Plant lice.	Apples and currants.
May 8	Rock	Aphis eggs.	Apple.
May 9	Nobles	Plant lice.	Minnesota crab. No specimen.
May 10	Hennepin	Cocoons <i>S. cecropia</i> .	Plum tree.
May 11	Lake	Orthopterous eggs.	Strawberry roots.
May 29	Polk	Wire worms.	Wheat.
May 30	Norman	Cut worms.	Flax. No specimen.
May 30	Norman	Cut worm.	Cabbage and tomato. No specimen.
June 1	Rice	Cabbage maggot.	Cabbage and cauliflower.
June 2	Marshall	<i>Eriophyes padi</i> .	Making galls on plum leaves.
June 7	Dakota	<i>Ithycerus noveboracensis</i> .	New York weevil injuring apple.
June 7	Dakota	<i>Basilarchia archippus</i> .	
June 7	Freeborn	<i>Ithycerus noveboracensis</i> .	
June		<i>Plusia (Autographa) brassicae</i>	
June 9	Hennepin	<i>Nematus ribesii</i> .	Lettuce.
June 10	Ramsey	Lice	Currants.
June 13	Hennepin	<i>Lachnosterna</i> , sp.	Asters. No specimen.
June 14	Ramsey	<i>Selandra ? barda</i> .	Saw fly on ash.
June 14	Big Stone.	<i>Selandra ? barda</i> .	Saw fly on ash.
June 14	Dodge	<i>Diabrotica vittata</i> .	Cucumbers.
June 15	Wright	<i>Eriophyes padi</i> .	Plum leaf gall mite.
June 15	Douglass	<i>Nematus ribesii</i> .	Currant worm.
June 15	Stearns	Cabbage maggot.	
June 15	Stearns	<i>Diabrotica vittata</i> .	Striped cucumber beetle.
June 16	Renville	<i>Diabrotica vittata</i> .	Striped cucumber beetle.
June 16	Renville	<i>Nematus ribesii</i> .	Currant worm on currant.
June 18	Hennepin	<i>Pulvinaria innumerabilis</i> .	Cottony Maple Scale.
June 19	Rock	<i>Pulvinaria innumerabilis</i> .	Maple.
June 19	Nobles	<i>P. innumerabilis</i> .	Box elder and soft maple.
June 19	Otter Tail.	<i>Eriophyes padi</i> .	Plum leaf gall mite.
June 19	Hennepin	Fleas	
June 20	Big Stone.	<i>Podosesia syringae</i> .	Ash (boring in ash and causing it to fall).
June 22	Ramsey	<i>Rynchites bicolor</i> .	<i>Rosa rugosa</i> .
June 23	Bristol, S. D.	Scarabeid	Supposed to be killing evergreens (too injured to admit of identification.)
June 24	Cottonwood	Cut worms.	No specimens.
June 25	Crow Wing	Cercopids	Jack pine.
June 25	Crow Wing	<i>Retinia ? comstockiana</i> .	
June 25	Hennepin	<i>Papaipema nitella</i> .	Stalk borer in peonies.
June 27	St. Louis.	Cut worms.	No specimens.
June 27	Hennepin	<i>Eriophyes padi</i> .	Plum leaves.
June 27	Hennepin	<i>Diabrotica vittata</i> .	Cucumbers.
June 27	Hennepin	<i>Diabrotica vittata</i> .	
June 29	Carlton	Cabbage maggot.	
June 30	Ramsey	Rose slug.	No specimen.
July	Wabasha	<i>Bruchus obtector</i> .	Beans.
July	Fillmore	<i>Constrachelus nenuphar</i> .	Plum Curculio.
July 6	Hennepin	<i>Pulvinaria innumerabilis</i> .	Maple scale.
July 9	Wabasha	<i>Bruchus obtector</i> .	Bean weevil.
July 10	Olmstead	Hessian fly.	

DATE.	COUNTY.	INSECTS IDENTIFIED.	HOST PLANTS, ETC.
July 12	Freeborn	Lice	Plum. No specimen.
July 12	Freeborn	<i>Papaipema nitella</i>	Young corn.
July 12	Hennepin	<i>Papaipema nitella</i>	Grain.
July 12	Blue Earth	<i>Papaipema nitella</i>	Young corn.
July 18	Traverse	<i>Papaipema nitella</i>	Golden Glow.
July 19	Hennepin	<i>Lachnosterna</i> (?) sp.	Lawn.
July 20	Hennepin	Lice	Peas. No specimens.
July 25	Dakota	Fleas	In cellar.
July 25	Lyon	<i>Papaipema nitella</i>	Young corn.
July 26	Freeborn	<i>Coelodasys unicornis</i>	Unicorn Prominent.
July		<i>Plusia (Autographa) brassicae</i>	
July 27	Ramsey	Cabbage worm, cabbage <i>Plusia</i>	Lettuce.
July 27	Hennepin	Lice	Sweet peas. No specimen.
July 28	Lyon	Curran borer.	No specimen.
Aug. 1	Mower	<i>Chrysomela, sp.</i>	Wheat.
Aug. 4	Stearns	<i>Vanessa cardui</i>	Thistle.
Aug. 4	Kandiyohi	<i>Aphis mali</i>	Apple.
Aug. 4	Kandiyohi	Cecropia larva.	
Aug. 4	Waseca	<i>Diacresia virginica</i>	Supposed by correspondence to be Flour Moth.
Aug. 5	Wabasha	<i>Bruchus obtector</i>	B an weevil.
Aug. 9	Todd	Plant lice.	Turnips. No specimens.
Aug. 9	Hennepin	<i>Diaspis rosae</i>	Rose.
Aug. 9	Hennepin	Fleas	
Aug. 17	Isanti	<i>Colopha ulmicola</i>	Cockscumb gail on elm.
Aug. 19	Norman	<i>E. padi</i>	Galls on plum leaves.
Aug. 24	Wright	<i>Hemerocampa leucostigma</i>	
Sept. 1	Hennepin	Book lice.	
Sept. 1	Ramsey	Book lice.	
Sept. 5	Wright	Plant lice.	Celery. No specimen.
Sept. 6	West Superior Wis.	<i>Ptinus fur.</i>	Flour.
Sept. 23	Ramsey	Cabbage maggot.	
Sept. 27	Big Stone	<i>H. armiger</i>	Corn.
Sept. 27	Grand Forks, N. D.	Oestrid larva (<i>Gastrophilus</i> ?)	Thigh of man. Dead when received.
Sept. 29	Otter Tail	Dragon fly (<i>Aeschna</i>)	Supposed to be killing hens which fed upon them.
Oct.	Wisconsin	<i>Tribolium confusum</i>	Flour in sacks.
Oct.	Rice	<i>Necrophorus tomentosus</i>	
Oct. 9	Nobles	<i>H. armiger</i>	No specimen.
Oct. 21	Watsonwan	<i>Tenebroides mauritanicus</i>	Larva in flour.
Oct. 28	Cass	<i>Celerio lineata</i> , Fab.	"Hawk Moth."
Oct.	Wabasha	<i>Heliothis armiger</i>	Corn worm.
Nov. 4	Nicollet	<i>Heliothis armiger</i>	Corn worm.
Nov. 15	Ramsey	<i>Lepisma, sp.</i>	"Fish Moth," silk lining in dresses. No specimen.
1906			
Apr. 28	Polk	Red ant.	Lawn.
Apr. 30	Ramsey	Cut worms, <i>Peridromia saucia</i>	Smilax, cannas, etc., in greenhouse.
May	Hennepin	<i>Coccus pini-corticis</i> , Fitch.	Pine.
May 2	Chippewa	Tree hopper	No specimens.
May 11	Pine	Wood tick.	
May 12	Redwood	Cut worms.	Corn. No specimens.
May 14	Pope	Cut worms.	No specimens.
May 16	Hennepin	<i>Monomorium pharaonis</i>	Ants in house.
May 16	Hennepin	Lice	Snowball. No specimens.
May 16	Ramsey	Ants	Lawn. No specimens.
May 22	Martin	<i>Nematus ribesii</i>	Currants and gooseberries.
May 22	Yellow Medicine	Buffalo tree hopper	Apple trees. No specimen.
May 28	Roseau	Cut worms.	No specimens.
May 29	Cass	Cut worms.	No specimens.
May 29	Ramsey	<i>Eulecanium cerasifex</i>	Plum.
May 31	Hennepin	<i>Eulecanium cerasifex</i>	Elm.
May 31	Hennepin	<i>Trombidium scabrum</i> , Say.	Feeding on cabbage maggot eggs.

DATE. 1904	COUNTY.	INSECTS IDENTIFIED.	HOST PLANTS, ETC.
June	Hennepin	<i>Trapezonotus nebulosus</i>	Timothy.
June 5	Ramsey	<i>Nematus ribesii</i>.....	.....
June 7	Douglass	<i>Samia cecropia</i> , pupa.....	.....
June 7	Ramsey	Silver fish.....	No specimens.
June 11	Fertile, Ia.	<i>Ithycerus noveboracensis</i>	Apple.
June 13	Ramsey	Currant worms.....	No specimens.
June 14	Sioux City, Ia.	Lice.....	Cherry. No specimens.
June 14		Wire worms.....	Barley. No specimen.
June 16	Todd	Lice.....	Box elder. No specimen.
June 16	Ramsey	Ants.....	Lawn. No specimens.
June 16	Rice	<i>Papaipema nitella</i>	Plum.
June 19	Renville	Cecropia moth.....	.....
June 20	Wright	Cecropia moth.....	.....
June 21	Stearns	Currant worms.....	.....
June 24	Redwood	<i>P. nitella</i>	Currants and corn.
June 28	Kandiyohi	<i>Pulvinaria innumerabilis</i>	Box elder.
July 2	Dodge	<i>Cotophya ulmicola</i>	Elm.
July 2	Douglas	Cottony Maple scale.....	Basswood and other forest trees.
July 2	Ramsey	<i>Papaipema nitella</i>	Hollyhocks, rose, canna, peony, corn, dahlia, wheat.
July 2	Ramsey	<i>Mamestra picta</i>	Hollyhocks.
July 9	Douglas	Cottony Maple scale.....	Basswood and elms. (Some trees will die.)
July 20	Douglas	Cut worms.....	In gardens. No specimens.
July 20	Douglas	Potato beetle.....	.....
July 20	Douglas	Hessian fly.....	On rye.
July 23	Kandiyohi	Plant lice.....	Wheat. No specimens.
July 23	Blue Earth	<i>Aphis cucumeris</i>	Melons.
July 25	Becker	Grain plant lice.....	No specimens.
July 28	Rice	Grain plant lice.....	No specimens.
July 29	Stearns	White grub.....	Grass land.
July 29	Todd	<i>Hemerocampa leucostigma</i>.....	.....
July 29	Denver, Col.	Locust borer.....	No specimens.
Sept. 6	Douglas	<i>Ptinus fur</i>	Cereal food.
Sept.	Hicks Wharf, Va.	<i>Conocephalus robustus</i>	Supposed by correspondence to girdle pecan and persimmon trees.
Sept. 19	Wabasha	<i>Plodia interpunctella</i>	Seed corn.
Sept. 22	Dakota	Silver fish, <i>Lepisma saccharina</i>	Silk dresses and books.
Oct. 2	Blue Earth	<i>Tenebroides mauritanicus</i>	Mill products.
Oct. 17	Lawrenceburg, Ind.	<i>C. oryza</i> , <i>Tribolium confusum</i> , <i>Silvanus surinamensis</i> , <i>C. granaria</i>	Wheat in elevator.
Oct. 23	Milwaukee, Wis.	Cottony Maple scale.....	.....
Oct. 30	Hennepin	Clothes moth.....	Furs. No specimens.
Nov. 2	Lac qui Parle	<i>Samia cecropia</i> , cocoons.....	Very abundant.
Nov. 23	New York State	<i>Tenebroides mauritanicus</i>	Wheat in storage.
Nov. 26	Wabasha	<i>Diastrammena marmorata</i>.....	.....
Nov. 30	Hennepin	Cigarette beetle, <i>Lasioderma serricorne</i>).....	In "Lucky Strike smoking tobacco, from Richmond, Va.

NURSERY INSPECTION.

The Minnesota nurseries which ship out of the state, and others desiring it have been inspected according to law. The names of these nurseries, with the number of the certificate of each, and the expenses of inspection are here given:

NURSERY INSPECTION.

1906.	Name and Town.	No. of Cert.	Cash.
June 25.	Twin City Nursery, Hopkins.....	111	\$2.60
June 27.	Clinton Falls Nursery, Owatonna.....	112	
June 27.	Mitchell Nursery, Owatonna.....	113	
June 28.	Wedge Nursery, Albert Lea.....	114	
June 28.	Albert Lea Nursery Co., Albert Lea.....	115	
June 28.	Minnesota State Nursery, Albert Lea.....	116	
			43.31
June 28.	Gopher State Nursery, Albert Lea.....	117	
June 29.	Winnebago Nursery Co., Winnebago City..	118	
June 29.	St. John Nursery Co., Fairmont.....	119	
June 29.	Amber Lake Nursery, Fairmont.....	120	
June 30.	McKisson's Fairmont Nursery, Fairmont..	121	
June 30.	Kanaranzi Nursery, Adrian.....	122	
July 1.	Luverne Nursery, Luverne.....	123	
July 5.	Hutchinson Nursery, Hutchinson.....	124	6.00
July 7.	Deephaven Nursery, Excelsior.....	125	1.50
July 7.	Chas. Hawkinson Nursery, Excelsior.....	126	1.50
July 9.	Jewell Nursery, Lake City.....	127	5.48
July 10.	County Line Fruit Farm, Lake City.....	128	5.48
July 10.	Pleasant Valley Nursery, Winona.....	129	5.48
July 11.	Vinegar Hill Nursery, R. No. 4 Rushford..	130	5.48
July 11.	Preston Nursery, Preston.....	131	5.48
July 12.	Spring Valley Nursery, Spring Valley....	132	5.48
July 12.	Turtle Creek Nursery, Austin.....	133	6.00
July 16.	Hoyt Plant & Seed Co., St. Paul.....	134	1.25
July 16.	Rose Hill Nursery, Minneapolis.....	135	1.25
July 16.	Vine Grove Nursery, Minneapolis.....	136	2.60
July 17.	L. L. May & Co. St. Paul.....	137	
July 17.	Mayfield Nursery, St. Paul.....	138	
			5.70
July 17.	Old Fashioned Flower Garden, Excelsior..	139	1.50
July 17.	Excelsior Nursery, Excelsior.....	140	1.50
July 12.	Wright County Nursery, Cokato.....	141	3.00
July 12.	Howard Lake & Victor Nurseries, H. Lake.	142	3.00
July 12.	North Star Fruit Farms, Cokato.....	143	3.00
July 13.	Lyon County Evergreen Nursery, Cotton- wood	144	6.00
July 19.	West Concord Nursery, West Concord....	145	2.00
July 20.	Byron Nursery, Byron.....	146	2.00
July 20.	Dodge County Nursery, Mantorville.....	147	2.00
July 18.	Hennepin Co. Nursery, Eden Prairie.....	148	3.00
July 19.	Andrews Nursery, Faribault.....	149	2.50
July 19.	Campion Nursery Co., Faribault.....	150	2.50
July 19.	Farmers' Seed Co., Faribault.....	151	2.50
July 19.	Brand Nursery, Faribault.....	152	2.50
July 20.	Cannon Falls Nursery, Cannon Falls.....	153	6.17
July 21.	Strand Nursery, Taylors Falls.....	154	5.00
Aug. 13.	F. A. Ward, Pipestone.....	155	7.00
Sept. 15.	Jackson Nursery & Fruit Farm, Jackson..	156	9.00
Sept. 15.	Sherburne Nursery, Sherburne.....	157	8.00
Total	.....		\$176.75

We also add a brief synopsis of the latest inspection laws of the various states, there having been some changes since we last published them. The attention of our nurserymen is called to the fact that any shipment of nursery stock into South Dakota now requires a certificate. This synopsis is compiled largely from the latest circular on the subject.

ALABAMA: Persons outside the state wishing to do business in Alabama must file a signed copy of their inspection certificate with the Secretary of the Board. Accompanying the certificate must be sufficient money to pay for the necessary Alabama tags. A tag must be attached to every package delivered in the state. Tags are furnished at cost as follows: First one hundred, 65c; 200, \$1.00; 500, \$1.60; in lots of 1000, \$2.20, sent by express collect. (Acts of 1903.) R. S. Mackintosh, Secretary and State Horticulturist, Auburn, Ala.

ARIZONA: No law.

ARKANSAS: Shipments of nursery stock into the state must be accompanied by a certificate of inspection and bear the name and address of consignee and consignor, otherwise the transportation company must notify the consignor and not deliver the shipments until a certificate is furnished. (Laws of 1903.) Mr. C. F. Adams, Entomologist and State Inspector, Fayetteville, Ark.

CALIFORNIA: Shipments into the state are subject to inspection on arrival and must be marked with the name and address of the shipper, name of consignee and name of place where grown. All nursery stock infested with pests not existing in the orchards, vineyards and farms of California will be immediately sent out of the state or destroyed, at the option of the owner or agent at his expense. All nursery stock coming from districts where the disease known as Peach Yellows and Rosette are known to exist shall be refused entry and shall be destroyed or returned at the option of the owner. Notice of shipment should be given to Mr. Edw. M. Ehrhorn, Ferry Bldg., San Francisco, Cal.

COLORADO: Shipments into any county of the state having a horticultural inspector shall have attached to each box, package or parcel a label, showing the name of the owner, agent and shipper, the name of the grower, and any further evidence necessary to determine the locality where grown. Nursery stock arriving in the state is subject to inspection

under the direction of the State Board of Horticulture. (Laws 1899.) Martha A. Shute, Secretary, Denver, Colo.

CONNECTICUT: Certification and treatment of nursery stock is discretionary with the State Entomologist. Shipments of nursery stock into the state shall bear a statement that it has been thoroughly fumigated in addition to the certificate of inspection issued by a State or Government officer. (Laws of 1903.) Dr. W. E. Britton, State Entomologist, New Haven, Conn.

DELAWARE: Shipments into the state must bear a certificate of inspection from a duly qualified state officer of the state in which the shipment originated, given not earlier than September 1st. Fumigation may be required by State Board of Agriculture. Prof. Wesley Webb, Inspector, Dover, Del.

FLORIDA: No law. Certificates to nurserymen are issued by Dr. E. H. Sollards, Entomologist, Agricultural Experiment Station, Lake City, Fla.

GEORGIA: Nurseries are inspected annually. A signed duplicate of inspection certificate, together with a signed statement by the nurserymen that all stock intended for Georgia will be fumigated in accordance with directions furnished them, must be filed in the office of the State Entomologist. Official tags of the Georgia State Board of Entomology will be furnished by the State Entomologist at the following price: One hundred tags, 60c postpaid; 200 tags, 85c postpaid; 300 tags, \$1.10 postpaid; 500 tags, \$1.35, sent by express collect; 1,000 tags, \$2.00, sent by express collect. Each shipment of nursery stock into the state of Georgia must bear the official tag of the Georgia State Board of Entomology, and also a duplicate certificate of inspection of the state from which the shipment is made. (Regulations adopted January 26, 1906.) Mr. R. I. Smith, State Entomologist, Atlanta, Ga.

IDAHO: No person can engage in the business of selling or importing nursery stock without filing a bond and acquiring authority from the State Board of Horticulture. Shipments into the state must bear an authorized certificate of fumigation, together with labels on each package showing names of consignee, consignor and name of place where stock was grown. (Horticultural Law, Seventh Session.) Mr. A. F. Hitt, State Horticultural Inspector, Boise, Idaho.

ILLINOIS: Nurseries are subject to inspection by the State

Entomologist. Shipments into the state must be accompanied by certificates of inspection, the original of which was signed by a state or government inspector. Prof. S. A. Forbes, State Entomologist, Urbana, Ill.

INDIANA: State nurseries shall be inspected at least once each year. Every package shipped into the state must be labeled with the name of consignor and consignee, and a certificate of a State or Government inspector of current year's date. (Chapter 138, Laws of 1899.) Prof. J. Troop, State Entomologist, Lafayette, Ind.

IOWA: State nurseries are inspected as owners request, or if supposed to be infested with dangerous injurious insects or plant disease, and nurserymen are prohibited from selling or shipping without the inspection. Shipments into the state must be accompanied by a certificate of apparent freedom from dangerous injurious insects or plant diseases, signed by an inspector duly approved by the State Entomologist of Iowa. H. E. Summers, State Entomologist, Ames, Iowa.

KANSAS: No law.

KENTUCKY: Nurseries are inspected annually. Every package of nursery stock shipped into the state must have a copy of a certificate of inspection attached and bear on the label a list of the contents. Duplicate certificates of inspection may be filed with the State Entomologist. Prof. H. Garman, State Entomologist, Lexington, Ky.

LOUISIANA: Nursery stock delivered within the state must be labeled with an official certificate of inspection. Shipments not so labeled shall be liable to confiscation. The entomologist has power to require any one in the state to fumigate trees and plants if deemed necessary. (Laws of 1904 and Circ. No. 1.) Mr. Wilmon Newell, Entomologist of the Crop Pest Commission, Baton Rouge, La.

MAINE: Nurseries are inspected at least once a year by an entomologist employed by the Commissioner of Agriculture. All nursery stock shipped into the state shall bear on each box or package a certificate of inspection, otherwise stock will be returned at the expense of the consignor; provided, however, that any shipment bearing a certificate of fumigation in the form of an affidavit made before a Justice of the Peace that all stock sold by the consignor has been fumigated in a manner approved by the inspector of the state from which

said stock is shipped, may be accepted as those bearing the proper certificate of inspection. (Laws 1905.) Hon. A. W. Gillman, Commissioner of Agriculture, Augusta, Maine.

MARYLAND: Nurseries inspected at least once in six months. All nursery stock subject to attack of insect pests must be fumigated under the direction of state officials. Shipments into the state must be labeled with the name of consignor and consignee and each package bear a certificate of inspection. Duplicate certificates should be filed with the State Entomologist. (Chap. 289, Laws of 1898.) Prof. T. B. Symons, State Entomologist; Prof. J. B. S. Norton, State Pathologist, College Park, Md.

MASSACHUSETTS: Nurseries are inspected at least once each year, and if clean, receive a certificate; instead thereof, a nurseryman may fumigate his stock under the direction of the State Inspector, using 2-10 of a gram of potassium cyanide to each cubic foot of space, under forty minutes exposure, and attach an affidavit of such fumigation to each package shipped. Certificates do not cover the Brown-tail Moth, tho all reasonable care is used to have stock free from it. Shipments into the state must bear on each package a certificate of inspection by an authorized officer or an affidavit relative to fumigation as above required. (Chap. 495, Laws of 1902.) Dr. H. T. Fernald, State Nursery Inspector, Amherst, Mass.

MICHIGAN: Nurseries are subject to inspection; infested trees must be destroyed, and the remainder of the stock within a half mile must be fumigated. Shipments into the state must bear on every package, plainly labeled, the name of consignor and consignee, statement of contents, and a certificate showing that the contents have been inspected by a Government or State officer, and that the stock has been properly fumigated. All nurserymen, whether residents of Michigan or other states, who wish to grow or sell stock within the state must apply to the State Inspector of Nurseries on or before August 1st of each year for a license, for which the fee is \$5, and a bond for \$1,000 must be filed. A license will not be granted until a State or Government inspection certificate has been filed. (Laws of 1903.) Prof. L. R. Taft, State Inspector of Nurseries and Orchards, Agricultural College, Mich.

MINNESOTA: There is an annual inspection of all nurseries from which stock is shipped out of the state. Ship-

ments into the state must be accompanied by a certificate of inspection. Carrying companies accepting packages of nursery stock without a certificate of inspection are liable. (Laws 1903.) Prof. F. L. Washburn, State Entomologist, St. Anthony Park, Minn.

MISSISSIPPI: No law. Nursery stock for export is inspected by Prof. Glenn W. Herrick, Agricultural College, Miss.

MISSOURI: Shipments into the state must be accompanied by certificate of inspection. (Laws of 1901.) Prof. J. M. Stedman, Entomologist, Agricultural Experiment Station, Columbia, Mo.

MONTANA: All stock brought into the state must be unpacked, inspected and fumigated at one of the designated quarantine stations, viz.: Miles City, Billings, Missoula, Kalispell, Great Falls, or Glasgow. Nursery stock may be inspected and fumigated at other points of delivery on payment of all cost. To sell or deliver nursery stock it is necessary to first obtain a license by paying a fee of \$25 and by filing with the Secretary of the State Board of Horticulture a bond in the sum of \$1,000 annually. Notice of shipment, including an invoice of stock, should be sent to the Secretary of the Board. Mr. Fred Whiteside, Secretary and Inspector at Large, Butte, Mont.

NEBRASKA: No law. State nurseries are inspected by Prof. Lawrence Brunner, Acting State Entomologist, Lincoln, Neb.

NEVADA: Nurseries and shipments of nursery stock are subject to the inspection of a county horticultural commissioner. (Chap. 66, Laws of 1903.)

NEW HAMPSHIRE: Nurseries are inspected at least once each year. Shipments into the state must be accompanied by a certificate of inspection, or, in lieu thereof, a certificate of fumigation, with an affidavit that all stock has been fumigated in manner prescribed. Each car, box and package shall be properly labeled. (Law March 4, 1903.) Prof. E. D. Sanderson, State Nursery Inspector, Durham, N. H.

NEW JERSEY: The law requires the inspection of all nurseries at least once in each year. Shipments into the state must be accompanied by a certificate of inspection, or copy thereof, attached to each car or parcel, together with a state-

ment from the shipper that the stock therein is a part of the stock inspected and whether such stock has been fumigated with hydrocyanic acid gas or not. If stock comes into the state without a certificate it may be detained for examination, wherever found, by the State Entomologist, and if found to be infested with any insects injurious or liable to become so, will be destroyed. (Chap. 249, Laws of 1903.) Dr. John B. Smith, Entomologist, New Brunswick, N. J.

NEW MEXICO: No law.

NORTH CAROLINA: The regulations in this state have been revised and the tag system abolished. Nurseries are inspected annually. Shipments must have duplicate certificates of inspection attached, and must be fumigated shortly before made. Shipments into the state must have a copy of a certificate of inspection; it is desired that the stock shall have been first fumigated, and a certificate of the consignor to that effect attached. Duplicate certificates must be filed with Mr. Franklin Sherman, Jr., State Entomologist, Raleigh, N. C.

NORTH DAKOTA: No law.

OHIO: Nurseries are inspected each year or oftener if necessary. Every package of nursery stock shipped into the state must be labeled with the name of the consignor and consignee, and a certificate showing that the contents have been inspected or fumigated by a State or Government officer. Agents must file a sworn statement with the Chief Inspector that the stock sold by them is covered by an official certificate before delivering the same. Blanks for statement will be furnished. Provision is made for issuing official certificates of fumigation to the nurserymen of the state. (Laws of 1904.) Mr. A. F. Burgess, Chief Inspector, Ohio Dept. of Agriculture, Columbus, Ohio.

OKLAHOMA: Foreign nurseries must request their state inspector to make report of inspection of their stock to the Secretary, on blanks with which they have been provided, and obtain a permit before doing business in the Territory. Agents are required to carry a duplicate of permit of their principals and a letter of agency from said principals, stating that they are duly authorized to act as such. Shipments must be accompanied with an official certificate of inspection (tag) certified to over fac-simile signature of the Secretary of the Oklahoma Board of Agriculture, Guthrie, Okla.

OREGON: Stock on arrival is subject to inspection at specified quarantine stations. Mr. Geo. H. Lamberson, Secretary State Board of Horticulture, Portland, Oregon.

PENNSYLVANIA: Nurseries are inspected twice each year. Transportation companies are required to reject all nursery stock not accompanied by a certificate of inspection, and also to reject all such stock entering the state without a certificate of fumigation. Nursery stock shipped into the state from another state, shall be plainly labeled on every package with the name of the consignor, the name of the consignee, and the certificate showing that the contents have been inspected by a State or Government officer and that the nursery stock, excepting conifers and herbaceous plants, are properly fumigated and free from dangerously destructive insects and diseases. (Chapter 60, Laws of 1905.) Prof. H. A. Surface, Economic Zoologist, Harrisburg, Pa.; Mr. Enos B. Engle, Inspector, Harrisburg, Pa.

RHODE ISLAND: The State Board of Agriculture appoints a State Nursery Inspector, whose duties shall be to inspect nurseries and grant an annual certificate. Owners of nurseries who shall fumigate all stock sold by them may make affidavit of the fact and attach a copy to each package shipped in lieu of a certificate of inspection. All nursery stock shipped into the state shall bear on each package a certificate that the contents have been inspected by an authorized inspecting officer. In case nursery stock is brought within the state without such a certificate, the consignee shall return it to the consignor, provided, however, that any package or box bearing a certificate of fumigation, which meets the requirements, may be accepted as tho bearing a certificate of inspection. (Chap. 1159, Laws of 1904.) Mr. A. E. Stene, State Nursery Inspector, Kingston, R. I.

SOUTH CAROLINA: Nurseries must be inspected annually and it is unlawful to sell or ship without a certificate. All persons outside the state must register a copy of their certificate of inspection, furnished by the authorized official of the state in which he resides, with the chairman of the Board of Entomology, which copy shall state that in addition to inspection the nursery stock has been fumigated under the direction of the official issuing the certificate. Upon the filing of the proper certificate as prescribed any person outside the state

dealing in nursery stock will receive official tags, one of which must be placed, together with a copy of his certificate of inspection, on each consignment of stock entering the state. (Circular 1, August, 1903.) Mr. Chas. E. Chambliss, State Entomologist, Clemson College, S. C.

SOUTH DAKOTA: Nurseries in this state are inspected between the 1st of June and the 15th of September each year. It shall be unlawful for any person to ship nursery stock into this state, unless such stock is accompanied by a certificate of inspection. (Laws of 1905.) Prof. W. A. Wheeler, State Entomologist, Brookings, S. D.

TENNESSEE: Nurseries are inspected annually or oftener, if necessary, and all shipments must be accompanied by a copy of a certificate of inspection. Any person outside the state, before shipping into the state shall register his name, or the firm or corporation name, and file a copy of an official certificate of inspection with the Secretary of the State Board of Entomology, and all packages must be marked with the name of the consignor and consignee and a certificate that the contents have been inspected. All stock sold in the state shall be fumigated immediately before shipment or delivery. Every individual sale or bill of trees must bear a copy of inspection certificate. Prof. H. A. Morgan, Secretary and State Entomologist, Knoxville, Tenn.

TEXAS: All nursery stock brought into the state must be accompanied by a certificate from the consignor, that it has been fumigated. Every package shall be labeled with the name of the consignor, the name of the consignee, the contents, and in addition to the certificate of fumigation, by a certificate that the contents have been inspected by a State or Government officer, and that the nursery stock therein contained appears to be free from all injurious insects and diseases. Hon. W. J. Clay, Commissioner of Agriculture, Austin, Tex.

UTAH: The State Board of Horticulture control inspection in Utah. "It shall not be lawful for any nurseryman, corporation or private individual to import into this state or to ship in the state any trees, shrubs or vines, unless the same are properly certified * * * as having been fumigated or disinfected by hydrocyanic acid gas before shipment. Importation of trees or shrubs unaccompanied by such certificate of

fumigation shall be held in quarantine at owner's risk until so fumigated at the cost of the importer. * * *” (Laws 1905.) Mr. J. Edward Taylor, Secretary State Board of Horticulture, Salt Lake City, Utah.

VERMONT: No law.

VIRGINIA: Nurseries are inspected at least once each year. It is unlawful for any person to sell or deliver any nursery stock, unless he shall first procure from the Auditor of Public Accounts, Richmond, Va., a certificate of registration, which certificate shall contain such rules and regulations concerning the sale of nursery stock as the Board of Crop Pest Commissioners may prescribe. Registration fee is \$20 for principals, with duplicates for agents free. Duplicate certificates of nursery inspection must be filed with the State Entomologist, and stock entering the state must be accompanied by an official tag, which may be obtained of the State Entomologist at the cost of printing, after the duplicate has been filed. (Laws of 1903.) Mr. J. L. Phillips, State Entomologist, Blacksburg, Va.

WASHINGTON: Persons to engage in the business of selling nursery stock as an agent, or importing nursery stock, must first obtain a license to do business in the state, and file a bond in the sum of \$1,000. The license fee for nurserymen and dealers is \$5, and for their agents or salesmen, who shall be furnished a copy, \$2.50. Notice of shipments into the state must be sent and shall contain the address of both consignor and consignee, with a copy of invoice of goods shipped. (Laws of 1905.) Commissioner of Horticulture, Tacoma, Wash.

WEST VIRGINIA: Nursery stock must be fumigated before delivery. Each package of stock shipped into the state shall be labeled with the names of consignor and consignee, and a certificate that the contents have been inspected and fumigated. Every dealer or grower of nursery stock who employs agents for the sale of the same shall take out a license in some county of the state, said license to be issued by the assessor, and he shall pay to the sheriff of the county wherein said license is issued the fee, which is fixed at ten dollars per annum. Every such dealer or grower shall file with the clerk of the county court in each county where such individual has traveling salesmen or agents, a list of all agents in said county.

(Laws of 1893 and Chap. 61 of Laws of 1905.) Mr. J. B. Garvin, Secretary Board of Agriculture, Charleston, W. Va.; Mr. J. H. Stewart, Director of Agricultural Experiment Station, Morgantown, W. Va.

WISCONSIN: Nurseries are inspected each year. Shipments into the state must have attached the certificate of inspection of a duly appointed State or Government officer. (Chap. 180, Laws of 1899.) Prof. E. P. Sandsten, Inspector, Agricultural Experiment Station, Madison, Wis.

WYOMING: Any person or firm wishing to do business in this state must first obtain a license. Licenses are issued on application, for a period terminating on July 1 of the next succeeding inspection year (approximately two years). All applications must be accompanied by the license fee (\$25.00), a bond in the sum of \$500 conditioned that the principal will faithfully obey the law of the state of Wyoming, and by a certified certificate of inspection from an authorized inspector in the state from which shipments are to be made. On receipt of these, the Secretary of the State Board issues authorized shipping tags (at cost). Nursery stock may not enter the state and transportation companies may not deliver unless such tag be attached to each and every box, bundle or bale. The presence of the shipping tag shall be taken as *prima facie* evidence of inspection and no further inspection is required, tho the Board reserves the right to re-inspect if for any cause it may deem it wise to do so. For circular of detailed information address the Secretary State Board of Horticulture, Laramie, Wyo.

CANADA: Within the Province of Ontario all nursery stock, except greenhouse plants, herbaceous perennials, herbaceous plants, conifers, bulbs and tubers, must be fumigated before shipment.

Shipments into Canada must be addressed so as to enter Canada at one of the named ports of entry, where the stock will be unpacked and fumigated by the authorities.

The fumigation seasons for the various stations are as follows: Vancouver, B. C., October 15th to May 1st; Winnipeg, Man., March 15th to May 15th, and October 7th to December 7th; Windsor, Ont., March 15th to May 15th, and September 26th to December 7th; Niagara Falls, Ont., March 15th to May 15th, and September 26th to December 7th; St.

Johns, Que., March 15th to May 15th, and September 26th to December 7th; St. John, N. B., March 15th to May 15th, and October 7th to December 7th. (Regulations 1905.) Dr. James Fletcher, Dominion Entomologist, Ottawa, Canada.

SPRAYING IN NURSERY AND ORCHARD.

It is a pleasure to note a very general awakening amongst orchardists and nurserymen along this line, as evidenced by numerous letters and inquiries.

We have initiated a series of experiments in different parts of the state with both liquid and dust sprays, but prefer to do more work before reporting. Briefly, we may say, that in one nursery where liquid Bordeaux was used, and where 200 rows of nursery stock were sprayed, each row 80 rods long, the season's work called for $38\frac{1}{2}$ barrels of the solution, and three men and one team were employed for what was equivalent to five days' time. The season's spraying, labor and material cost about \$38.00. The field workers in charge reported in November generally good results; that the stock made excellent growth during the latter part of the season, etc., but in this case it would have been impossible to personally superintend the experiment, and the work was not done as systematically as might be desired. More detailed results are expected next year.

Another orchardist in Norman County sprayed his Plums and Apples thoroly in April with liquid Bordeaux (4-4-50), and in October reports trees and fruit free from fungus, a result which he attributes to the spraying.

On our experimental garden at the Station we sprayed our nursery trees with weak Bordeaux (3-6-50) on May 28th, June 2nd and June 25th. The trees were kept generally free from fungus, but the spraying appeared to have but little effect upon the disease known as Shot-hole Fungus.

Mr. Fred Mohl, a progressive orchardist and nurseryman and a prominent citizen of Adrian, Minnesota, is an enthusiastic supporter of the dust spray, and certainly an examination of his well kept nursery, showing a marked absence of insects and fungus diseases, goes far to substantiate his claims for this method. He declares that the cost of applying dust will not exceed one half the cost of liquid spraying, and that

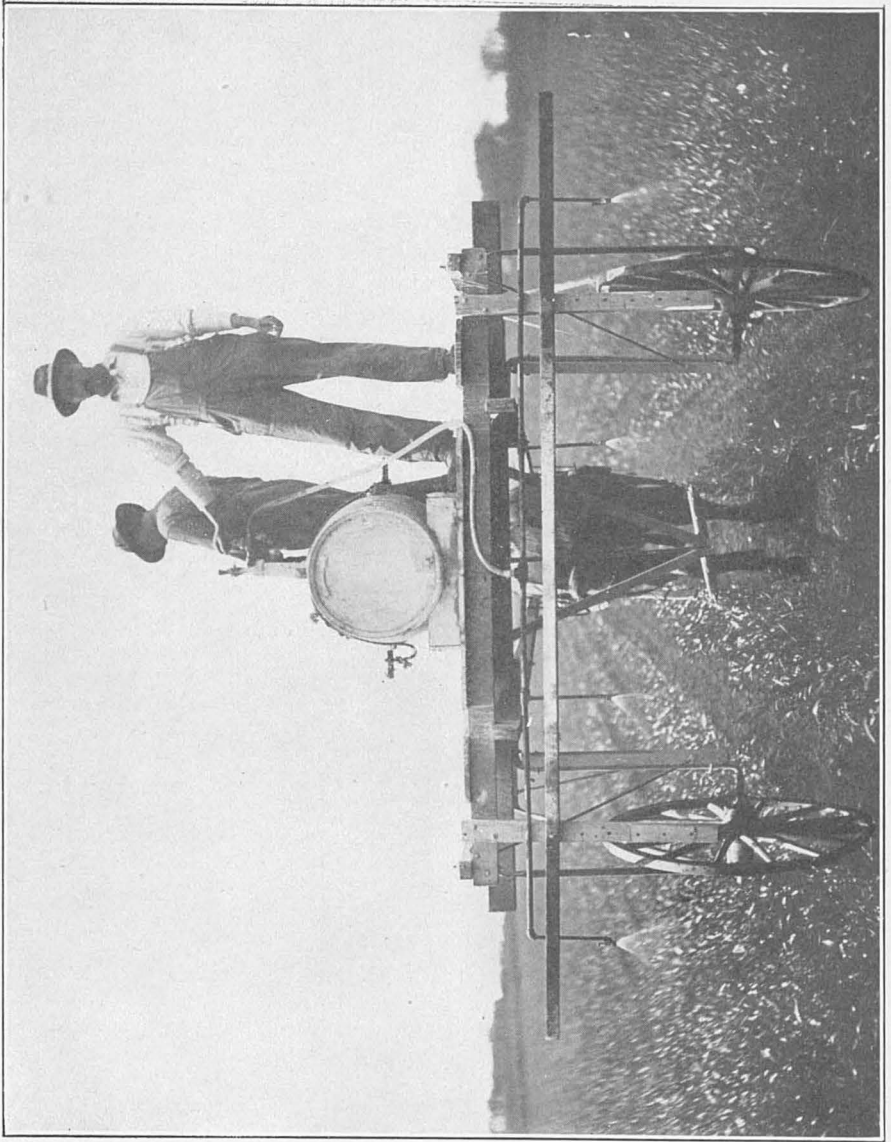


FIG. 15.—Spray cart in use in a Southern Minnesota Nursery.

one gallon of dust spray will go as far and effectively as one barrel of liquid Bordeaux.

On July 6th, at my request, he kindly submitted a report of the work done with dry Bordeaux in both his nursery and orchard. He sprayed a ten acre orchard of ten year old trees on May 5th, May 19th and June 1st, and averaged 65 lbs. of dust each time. The time required for the first spraying was four hours, and two men and one team were required. His dust, consisting of a mixture of ground lime, Sal Bordeaux, Sulphur and Paris Green, compounded and prepared by the dealer, cost him 4c per lb. Basing my computations upon the usual wages of men thus employed, and cost of team, the labor and material for the three sprayings, amounted to about \$22.50. From the fact that this was done on an orchard, whereas the spraying with liquid Bordeaux, cost of which is given above, was done in a nursery, and for other evident reasons, the two can hardly be compared as to cost. I give Mr. Mohl's own words in reply to certain questions sent him from this office on July 14th.

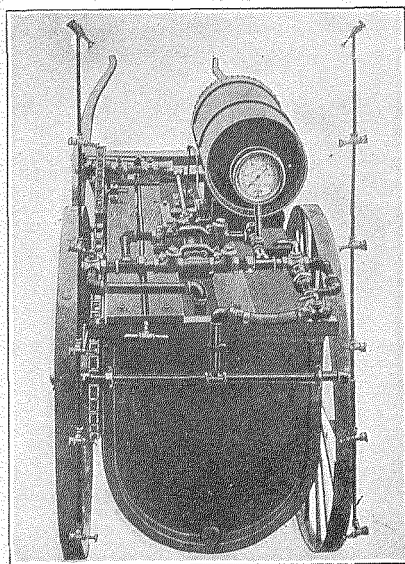


FIG. 16.—A machine which bids fair to be useful in spraying nursery rows.

“In regard to the questions regarding dust spraying will say that best results I think can be obtained on a still morning

when there is some dew on the foliage, but good results can be obtained most any time on a still day, or even when there is a gentle breeze.

“On a perfectly still day it will not inconvenience the workmen or horses for the reason that the machine blows the dust away from the operator, that is to say, they are behind the gun, and it is not one-fourth as disagreeable as handling liquid Bordeaux. If a little dust should settle on them, it can easily be brushed off. If it falls on the horses, it does them no harm. As a rule there is always a perceptible breeze and of course we spray to the windward. As for thoroughness of the work and the results obtained, the easy method of applying the dust and for time occupied, the liquid Bordeaux is not in it with double strength dust formula and in my opinion the dust formula can be purchased as cheaply as one can properly make it and thus avoid the disagreeable feature of mixing it up.”

The above two experiments were planned for a comparison between dust and liquid spraying. Unfortunately there is no good basis for comparison, and, as intimated at the beginning of this article, we need more time and more careful detailed work before giving conclusive report. From personal observation we are of the opinion that both methods, if intelligently and faithfully followed, give good results.

Fig. 15 illustrates a high cart used for spraying nursery trees in a large nursery in Southern Minnesota. It is modeled somewhat on the lines of the nursery sprayer constructed by this department some years ago and figured in an Annual Report. In this cart, however, as can be seen from the photograph, the axle is so constructed that the wheels can be shifted to accommodate different widths between rows. One defect, which can be easily remedied, is the small size of the receptacle, which obliges the outfit to return to the base of supplies too frequently, thereby losing time. The owner of this cart writes that while no detailed account was made of the effect of the season's spraying, he did not hesitate to say that the results were good and that no nurseryman could afford to raise trees without spraying.

Fig. 17 shows a hand apparatus, which we find very useful, and which can be advantageously employed in any small gar-

den, orchard or even nursery; its cost, complete, is about \$15.00.

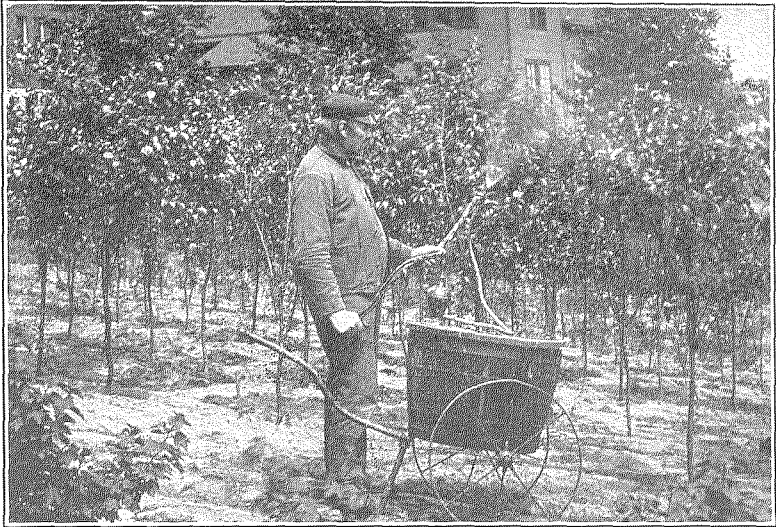


FIG. 17.—A practical apparatus in use in our experimental garden. (Author's illustration.)

AN ENTOMOLOGICAL CALENDAR.

The following suggestions for practical work during the various months of the year may be useful to many of our farmers and orchardists:

JANUARY.

Prune off and destroy eggs of tent caterpillars and canker worms on apple and other trees.



FIG. 18.—Eggs of Tent Caterpillar.



FIG. 19.—Eggs of Tentless Caterpillar.

If Oyster-shell Scale or scurfy scale is on your trees, spray with lime-sulphur wash, clean out pump and nozzles thoroughly after using this wash.

Pick off and destroy the cocoons of the Cecropia Moth, and all other cocoons, on plum and other fruit trees.

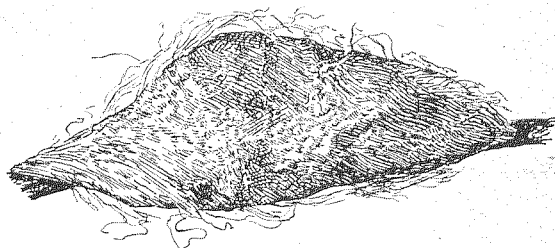


FIG. 20.—Cocoon of Cecropia moth.

Collect and destroy all "plum pockets" still clinging to trees or lying on ground. Litter under plum trees should be burned.

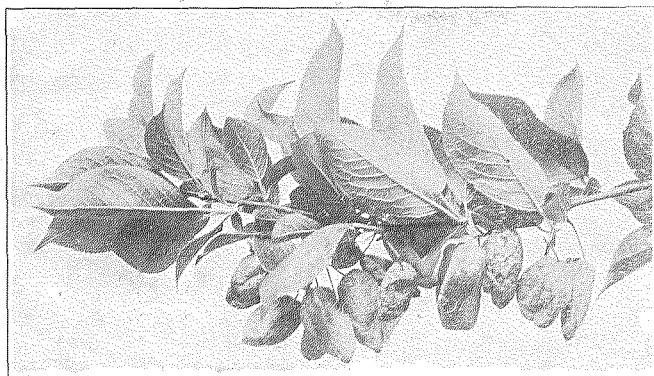


FIG. 21.—Plum Pockets. Summer condition. Photograph by H. Cuzner, Horticultural Department, Minnesota Experiment Station.

Hang suet or meat of some kind in your orchard to encour-



FIG. 22.

age the presence of birds. The chickadees and downy woodpeckers will find codling moth larvae in their cocoons and eat them. The former bird also eats the eggs of plant lice.

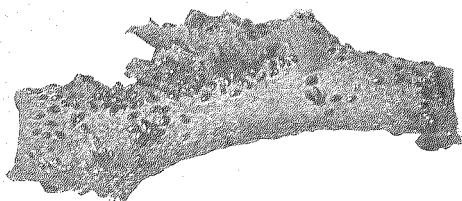


FIG. 23.—Eggs of Plant lice.

Look at your seed beans and peas to see that the bean weevil or pea weevil is not working therein. If they are present, place seed in an air-tight receptacle and fumigate with bisulphide of carbon. Avoid bringing a light of any kind near this liquid.

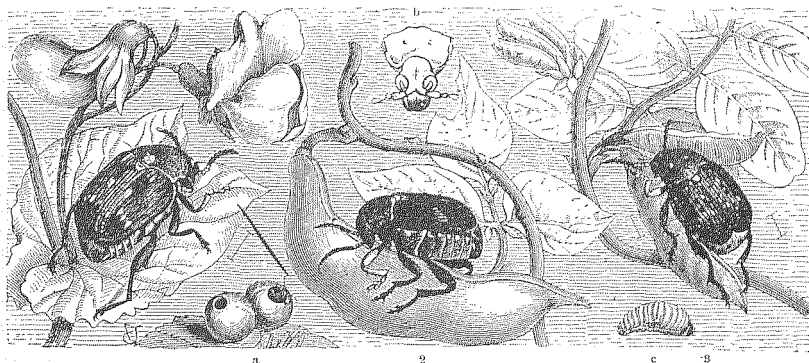


FIG. 24.—Bean weevil and Pea weevil. Summer condition. After Brehm.

FEBRUARY AND MARCH.

Finish any uncompleted work of January.

Scrape off loose bark from trunks and large branches of old fruit trees with a sharp hoe or scraper made for the purpose. This single scraping should precede any winter spraying.



FIG. 25.

If Lecanium scales (soft scales) are on the plums, spray during a warm day with kerosene emulsion (1 part emulsion to 4 parts water.) A spraying with lime-sulphur wash will kill *all* scales. A coat of whitewash on trunk and larger branches is excellent, though not fatal to all scale insects.

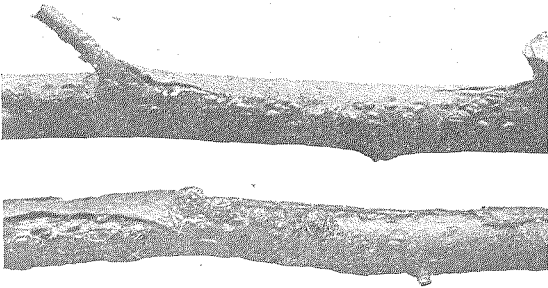


FIG. 26.—Lecanium scales.

Brittle currant canes are probably hollowed by the currant borer. Infested canes should be burned.

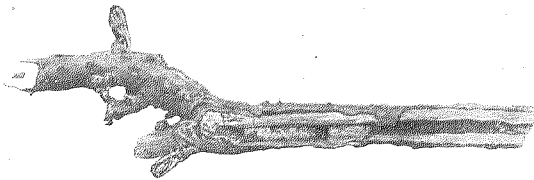


FIG. 27.—Work of the Currant borer.

Burn leaves and rubbish under gooseberry bushes to destroy gooseberry-fruit worm and other injurious hibernating insects. Do the same with leaves and trash in your plum and apple orchards.

If the Scurfy Scale or Oyster-shell Scale are on your apple trees, and you did not spray in January, do not fail to do so **now**.

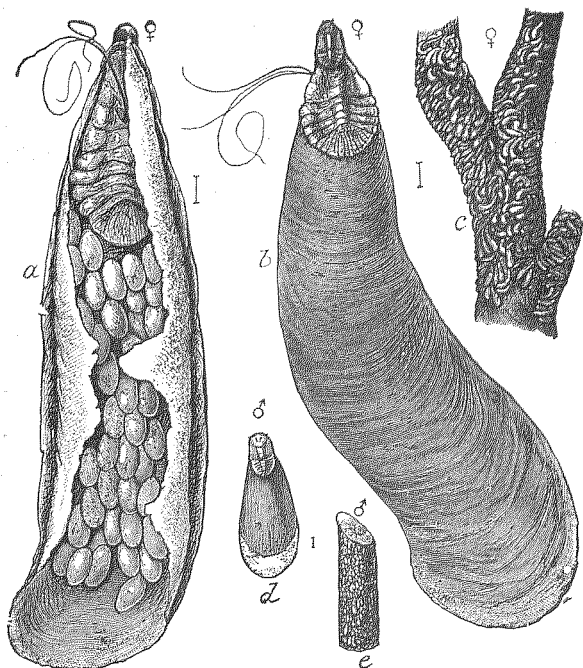


FIG. 28.—Oyster shell scale. After Bureau of Entomology, U. S. Dep. of Agriculture.

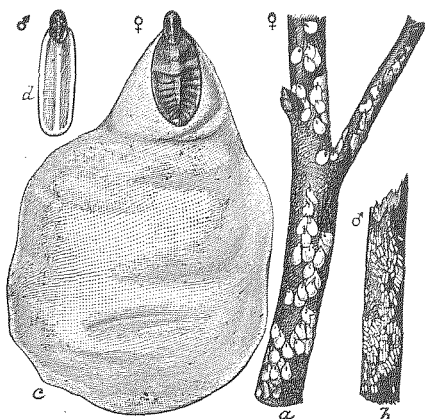


FIG. 29.—Scurfy scale. After Bureau of Entomology, U. S. Dep. of Agriculture.

See that your spray pump, hose, nozzles and the remainder of your outfit is in good condition for spring work. Order any apparatus and all insecticides (Paris green, etc.) you may need for spring and summer spraying.

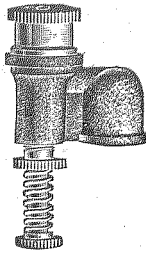


FIG. 30.

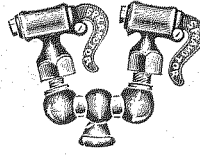


FIG. 31.

Put bird houses in your orchard in order to invite the presence of these helpful friends later.

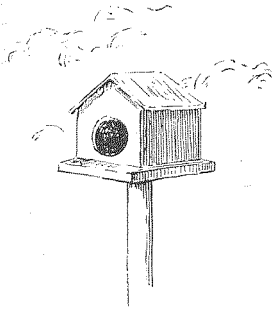


FIG. 32.—NOTE: If the round hole is made the size of a silver quarter, it will admit wrens and keep out English sparrows.

APRIL.

Use strong Bordeaux, (4-6-50) on your orchard and

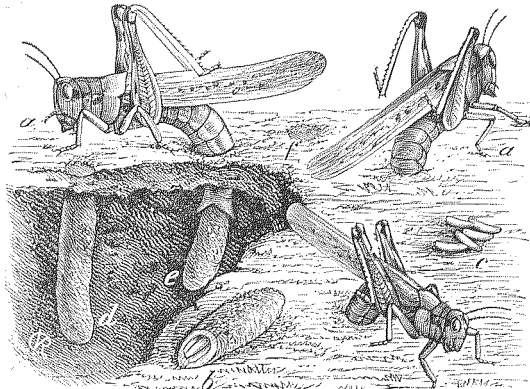


FIG. 33.—Grasshoppers egg laying.

nursery trees, giving them two thoro sprayings with an interval of ten days or two weeks betewen sprayings.

Land infested with grasshopper eggs, and not plowed last fall, should receive attention this month as early as possible.

Look over your bushes and berries again and cut out all infested canes. Raspberry and blackberry vines may show slits of the snowy tree cricket. Such affected canes should be destroyed.

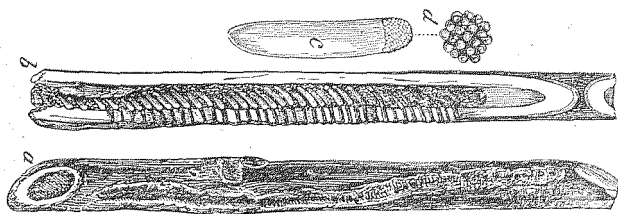


FIG. 34.—Egg laying of Snowy Tree Cricket.

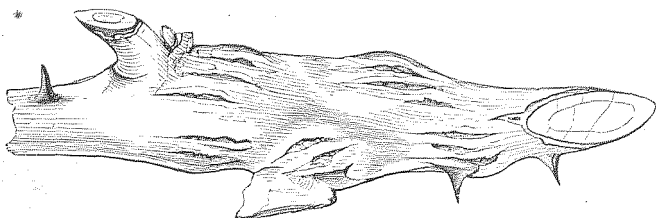
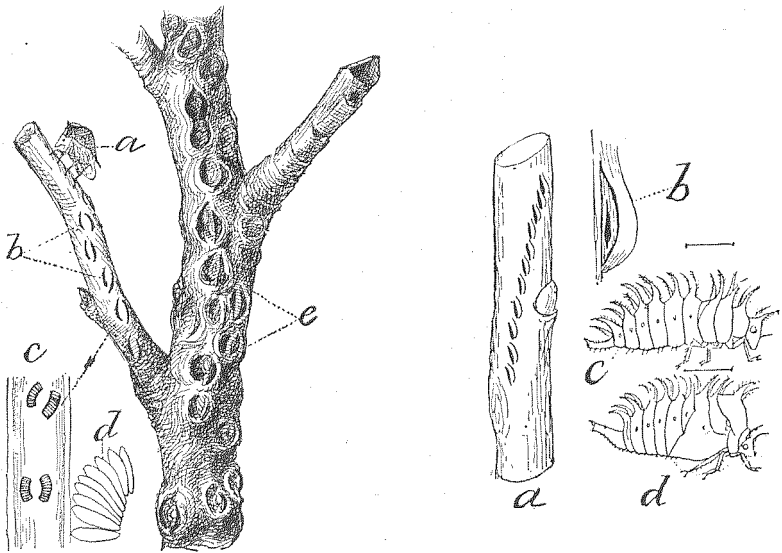


FIG. 35.—Work of Red-necked cane borer. After Riley.



FIG. 36.—Burrow of Raspberry cane borer.

If not done before, prune out and burn the twigs showing fresh wounds made by the Buffalo tree hopper the previous year.



FIGS. 37 and 38.—Two Buffalo tree hoppers occurring in Minnesota. FIG 37 after Bureau of Entomology, U. S. Dep. of Agriculture. FIG. 38.—After Riley.

Burn all trash not destroyed in the fall.

Plowing this month will turn up the pupae of army worms and other cut worms, and is still advisable as treatment for the Hessian fly and wire worms.

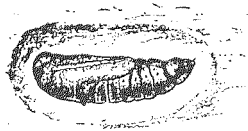


FIG. 39.—Pupa of Army worm.

MAY AND JUNE.

Early in May complete any April work prevented by unfavorable weather. Between May 1st and 10th, and later look out for cut worms.

Spray nursery and orchard trees with Bordeaux just before the blossoms open in the orchard (and the same date in the nursery), using it at the strength of 4-6-50. Repeat immediately after all bloom has fallen, adding Paris green to the Bordeaux for leaf-eating caterpillars, Codling Moth, Plum

Curculio, etc. Bordeaux itself will kill the spores of fungous diseases. Repeat ten days later, and give a fourth spraying with poisoned Bordeaux (8 oz. of Paris green or 3 lbs. of Arsenate of lead in every 50 gals. of Bordeaux) twelve days after the last. Do this work thoroly. On plums and other tender foliage, 4-6-50 is the best strength of Bordeaux.

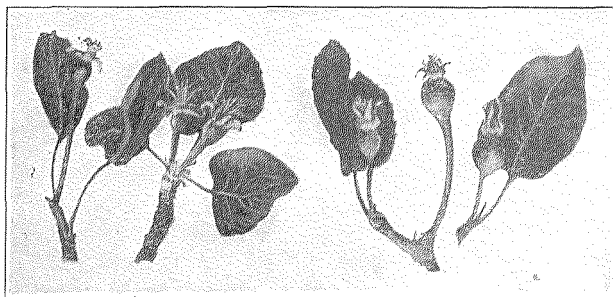


FIG. 40.—Proper time to spray.

Turn a strong stream from the hose upon the Cottony Maple Scale wherever you see it, or brush it off from all vines, etc.

Plant lice get busy during these two months, and can be killed in nursery rows by bending over young growth affected with lice and "swashing" it back and forth in a soap solution (5c cake of Ivory Soap dissolved in 10 to 12 gals. of water and applied when warm), or soap and tobacco solution. Or 1 lb. whale oil soap in 8 gals. water. The same solutions can be used as a spray.

The currant worm may be working on the currants and gooseberries. Hellebore will kill it.

The latter part of June the young of Lecanium scales are hatching and can be killed by Ivory Soap sprays (5c cake in 7 gals. water.)

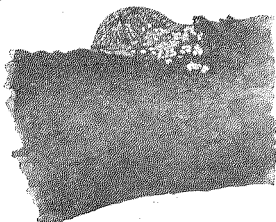


FIG. 41.—Female lecanium scale with eggs.

Look out for stalk borer in vegetable and flower garden.

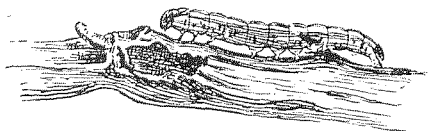


FIG. 42.

During June and July take active measures against the Green Cabbage Worm. Pay the children a little something to catch and kill all the white cabbage butterflies they see hovering about the cabbages.

JULY AND AUGUST.

Spray fruit trees about the middle of July and again toward the last of the month with Paris green and Bordeaux (4-6-50 for apple; 3-6-50 for plum), for Codling Moth, Plum Curculio, caterpillars and fungous diseases.

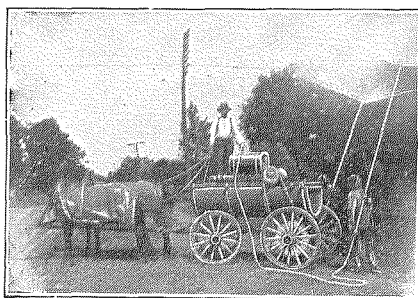


FIG. 43.

The yellowish eggs of the squash bug can readily be found on the under side of the leaves of squashes, etc. Destroy them.

Should numerous destructive leaf-eating caterpillars appear in force, spray foliage at once with Paris green solutions (1 lb. in 150 gals. and kept stirred while using), or arsenate of lead—3 lbs. to every 150 gals. of water. The latter can be used safely on evergreens, upon which one should *never* use Paris green.

Pigs, if allowed to run in the orchard, will eat fallen fruits which contain Codling Moth or Plum Curculio larvae.

In July your lawn may be dying in spots on account of the work of the White Grub. Plenty of water will sometimes cause the grass to out-grow their ravages. The robins will help you by eating them.

Note whether your wheat, barley or rye is "crinkling down" owing to the presence of Hessian Fly or Chinch Bugs. If the "flax seed" of Hessian Fly is present in abundance, make a mental note to turn under the stubble without fail in the fall.

Do not let plant lice get the better of you, as they will in roses, golden glow, buckthorn and plum and apple trees, if not vigorously treated.

SEPTEMBER AND OCTOBER.

Wormy apples should not be stored for any length of time in fruit cellar, barn or shed, for the Codling Moth larvae ("apple worms") will find secure retreats in such places, and emerge as moths in the spring.

If you have reason to suspect the presence of grasshopper eggs in large numbers in any of your fields, plow as late as possible in the fall. This prevents the young hopper from emerging in the spring.

NOVEMBER AND DECEMBER.

Clean up fallen limbs, rubbish and everything which offers secure retreats for injurious insects during the winter season.

Pruning limbs of fruit trees in winter will remove with the cuttings many lice eggs, and frequently hibernating insects as well.



FIG. 44.

Burn all limbs pruned during fall and winter.

Old melon, cucumber and squash vines should be burned, and all rubbish near ground which has been in such crop should be destroyed. By such treatment, hibernating squash bugs, cucumber beetles, and the eggs of the melon louse will be destroyed.

Burn old straw stacks where straw is not needed. Such places offer winter resting places for several varieties of injurious insects.

All fallen leaves under fruit trees, berry bushes, currants and grape vines should be destroyed in the late fall. These afford hibernating places for insects.

* * * * *

DON'T spray with arsenic. One Minnesota man did because the stuff was cheap. Result, some dead turkeys, and dead lambs which fed on the alfalfa under the sprayed trees.

Paris Green and water at the rate of one pound of the former to 150 gallons of the latter will not injure stock which might graze in an orchard immediately after it had been sprayed. Of course, if a large amount of the solution should be dumped on the grass in one place, and stock should crop that particular spot damage might result.

Quick lime added to Paris Green solution at the rate of one pound of lime for every pound of Paris Green will prevent burning by neutralizing the acid in the Paris Green. More lime might be added with perfect safety. Clear lime water added to the Paris Green solution would naturally produce the same result.

RECEIPT FOR BORDEAUX MIXTURE.

For use as a liquid spray there are several formulae for this very important fungicide, but the principle of making is the same in each.

Have a stock solution of copper sulphate made by suspending copper sulphate (blue vitrol) in a bag just below the surface of a tub of water, at the rate of one pound to a gallon of water. Make also a stock solution of lime; use a known quantity of good lime, slake slowly and add water to make a thick milk of lime; allow to cool before using, and always keep the lime covered with water. When ready to spray dilute the

required amount of each of the stock solutions to 25 gallons, and then pour the two diluted solutions together.

For dormant trees use:

Cu So₄, 6 pounds;

Lime, 6 pounds;

Water, 50 gallons.

For plants in foliage use:

Cu So₄, 4 pounds;

Lime, 6 pounds;

Water, 50 gallons.

For tender foliage, such as plum, etc., use:

Cu So₄, 3 pounds;

Lime, 6 pounds;

Water, 50 gallons.

TESTS FOR BORDEAUX.

One must be sure that the solution is alkaline.

There are three simple tests which may be used to determine this. "First, hold a clean, bright knife blade in the Bordeaux Mixture for at least one minute. If it becomes copper-plated more lime should be used. Second, pour some of the Bordeaux Mixture into a shallow dish, and, holding it up to the light, blow gently across its surface. If properly made a thin pellicle will form on the surface of the liquid. If this does not form more lime should be added. Third, dissolve one ounce of ferro-cyanide of potassium in five or six ounces of water. Pour some of the Bordeaux Mixture into a white dish and add to it a few drops of the ferro-cyanide solution. If sufficient lime has been used no change will be noticed. If a brownish-red discoloration takes place more lime should be added."

RECIPE FOR LIME-SULPHUR WASH.

To 2 gallons boiling water add 2 lbs. quick lime. After lime has slaked add 1½ pounds of powdered sulphur (first stirring it up with a little water to form a paste). Boil one half hour or more and strain thru a netting or sieve, and add enough water to make 5 gallons. Or, the following proportions may be used.—20 lbs. lime, 15 lbs. sulphur, 50 gals. of water.

Another excellent lime-sulphur wash is made without external heat as follows:

"Add 30 lbs. of lime to 6 gals. of warm water. While it is slaking add 15 lbs. of powdered sulphur, which has previously been made into a thin paste. Mix it thoroly with the slaking lime. Then add four to six pounds of caustic soda to prolong the boiling, adding water to the hot mass from time to time as needed. Keep thoroly stirred, and when all chemical action has ceased add 44 gallons of water (making 50 in all)." Eight to ten pounds of sal soda can be used in place of the caustic soda if desired.

This wash has given excellent satisfaction, in some cases.

MINNESOTA NEEDS LAWS TO PREVENT THE SALE HERE OF ADULTERATED AND INFERIOR PARIS GREEN.

THE COTTONY MAPLE SCALE,

Pulvinaria innumerabilis.

The accompanying photograph is a good illustration of the injury caused by this very common pest. Not only has it continued to afflict our shade trees in Minnesota, but it has been destructive in many other localities of the middle West, as well as in some states nearer the Rocky Mountains. Milwaukee reports great damage to shade trees in its streets and parks, and correspondence with Chicago parties indicates a similar condition there. In fact many trees have been killed by this scale in both of these places. As evidence of its wide distribution in the United States, we might say that it occurs in all but about eighteen of the states, ranging from Washington and southern California on the west to New York and Florida on the east, and from Wisconsin and Minnesota to Texas. In a recent excellent bulletin from Colorado, which contains a map showing its distribution, we note that Mr. Johnson has failed to indicate that it occurs in Minnesota. As a matter of fact, it is one of the worst pests we have on soft maple, and has been injurious here for several years. The Box Elder Maple is also a sufferer, and the Elm, beside a large number of other trees, and many vines and shrubs. The Hard Maple does not appear to be affected.

Fortunately this scale, a native of this country, has many

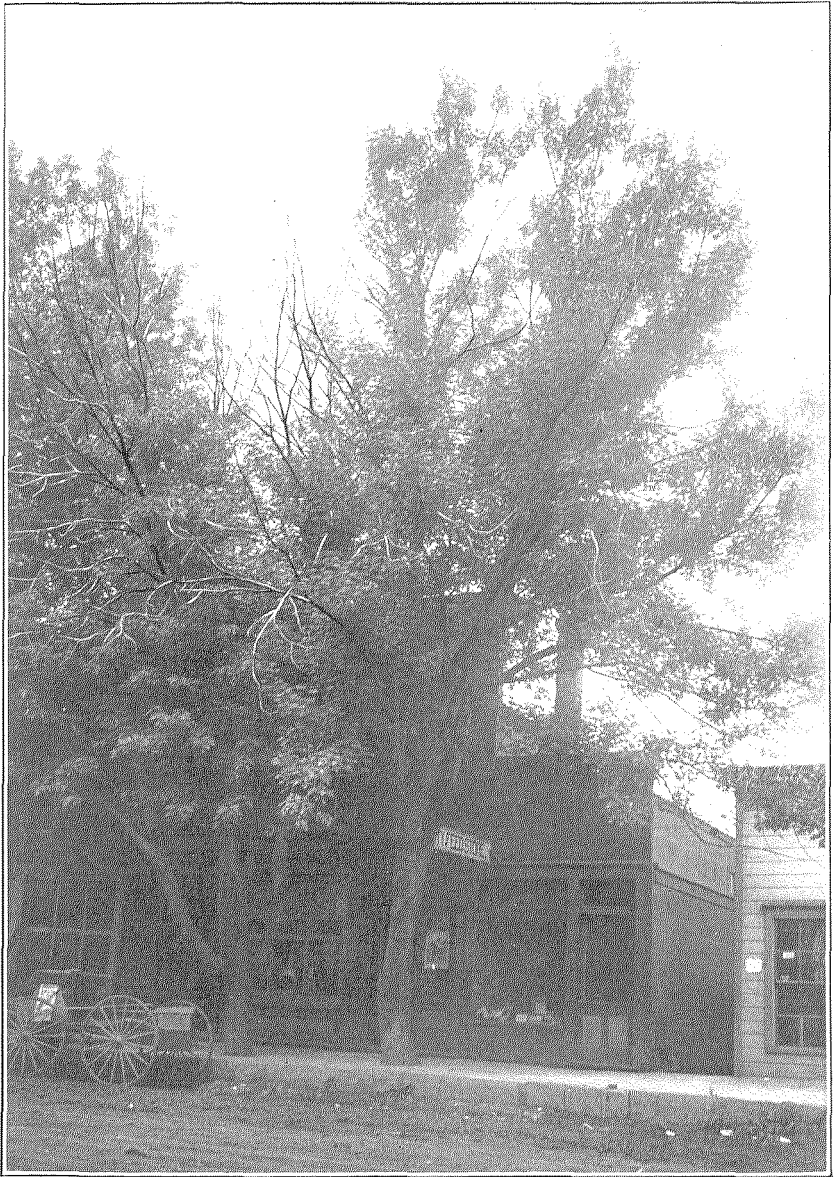


FIG. 45.—Work of the Cottony Maple scale on Maple trees at Luyverne, Minn.
Note the dead branches.

enemies, both parasitic and predaceous. It is preyed upon by several of the so-called "Lady-birds," beetles belonging to the *Coccinellidae*, which, both in the young and adult condition, consume large numbers of the pest. Fig. 47 is a photograph of a number of larval skins containing pupae of one of these beneficial beetles, found by a correspondent upon a tree which has been affected with Cottony Maple Scale, and supposed by him to be some other form of injurious insect.



FIG. 46.—The Cottony Maple scale. (Author's illustration.)

Treatment: We cannot rely entirely upon the natural enemies of the Maple Scale, but should resort to some of the following expedients to free our trees of this destructive insect.

Summer treatment, as a rule, is not practicable, for inasmuch as the young are hatching during a long period, four, five or six sprayings are called for, yet relief can be obtained if one has city water, by spraying the scales with a strong stream. They congregate chiefly on the under side of the branches, and a small jet from the hose, if it strikes them with sufficient force, will dislodge them. The larvae hatching from the eggs under the scales, as the latter lie on the ground, will hardly be able to reach the trees. When the young scales are hatching, a

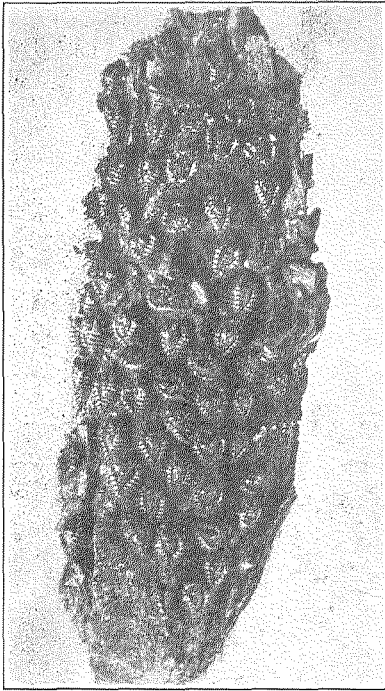


FIG. 47.—“Lady Bird” larval skins (containing pupae) on bark of tree infested with Maple scale. (Author’s illustration.)

spray consisting of one pound of whale-oil soap dissolved in four gallons of water, applied several times, will be beneficial. When trees are dormant, or any time after the leaves have fallen, use 20 per cent kerosene emulsion (one part stock solution to four of water). This strength must not be used when the trees are in foliage. A 5 per cent solution, however, can be used with safety, when trees are in leaf and if applied when the scales are first hatched, is fatal to them. One pound of whale oil soap in one gallon of water is also good when the trees are dormant.

Directions for making kerosene emulsion:

Hubbard Formula—

Hard soap, or soft soap, one pound,
Kerosene, 2 gals.,
Water, 1 gal.,

Dissolve the soap in boiling water; remove from the stove and add the kerosene while the water is still boiling hot; churn with a spray pump until it gets to be a soft butter-like mass.

Judicious pruning in fall, winter or early spring, before the eggs hatch, or at the time when the cottony secretion first becomes conspicuous is helpful.

THE SOFT SCALE OF THE PLUM.

Eulecanium cerasifex, Fitch.

This scale, which seems to be rapidly increasing in Minnesota, we found in large numbers in June on the Plum, Elm, Mountain Ash, different Spireas, and a species, which appears identical, also occurs on the Hard and Soft Maple. An owner of a plum orchard in Ramsey county reports it as very abundant this year on his trees and those of his neighbors, and in July a number of specimens were received from Aitkin county.

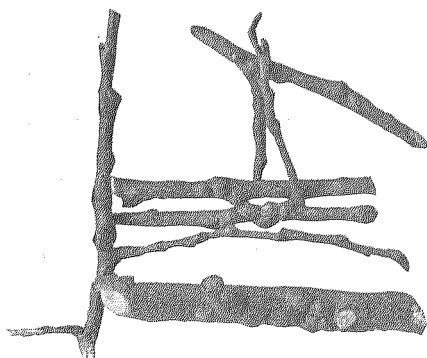


FIG. 48.—*Eulecanium* on Elm. (Author's illustration.)

Its Life History: The large brown scales noticed on the twigs and branches during the year are females. The young of the preceding year, flat, spindle-shaped, much smaller than their parents, having hibernated on the stems and branches amongst the larger scales, begin to move about early in the spring, and attach themselves finally, for the most part, to the undersides of the small branches. These little animals grow rapidly, and before the summer is through are as large as their parents. The winged males issue from delicate scales, known by their smaller size, and whitish color. The males may issue in May, possibly, and they perish after mating with the females. The fertilized females soon begin to lay eggs, and finally the hemispherical scale is nothing but a covering over thousands of tiny eggs, the body of the female shriveling up as egg laying proceeds. Although this dead scale is in itself no menace to the fruit grower, its presence is proof positive that there are also on the tree hundreds of young scales which will work destruction if not killed.

Owing to the enormous number of eggs laid by this species, the rapidity of its growth, and the avidity with which it feeds upon a large variety of trees and shrubs, it is to be regarded as a dangerous pest.

We kept careful watch during spring to determine the date of the first hatching of the young scale, in order to know when best to apply sprays fatal to it at this tender, unprotected stage. The hatching proved to be late, June 12th still finding no change, and it was not until late in June and early in July that the young emerging from the eggs, were observed crawling over the branches. They were found then to be arranging themselves along the veins on the under side of the leaves. By July 9th, practically all the eggs had hatched. During this month (July), two tiny parasites were reared from these scales, one *Coccophagus lecanii*, Fitch (identified by Howard), a well known hymenopterous enemy of this scale; another hymenopter, *Blastothrix longipennis*, Howard, both belonging to the family *Chalcididae*. We have also found a Coccinellid, *Hyperaspis*, sp., feeding voraciously upon what appears to be this scale on the Jack Pine. In fact a few years ago we found this Coccinellid so abundant amongst the Lecanium scales on Jack Pine on the station grounds that we stopped spraying and left the beetle and the scale to fight it out by themselves. The former, either entirely by its own efforts, or aided possibly by the presence of parasites, came out victorious, and at the present time there is little, if any, of this scale upon our evergreens.

Treatment: Pruning in the winter and early spring while the scales are dormant, and destroying the infested cuttings would seem to be practicable and desirable. They can also be easily brushed off the limbs. Accessory to this, two or three sprayings about July 1st (or as soon as the young scales are observed to be hatching), with a solution made by dissolving a 5-cent cake of Ivory soap in five gallons of water, is recommended. We suggest this as the result of experiments made by this division of the Experiment Station, in which the above solution gave good results. A kerosene emulsion (1 part stock to 15 of water), carefully made and applied as a spray in the early summer, while the young are still active, is also recommended. To secure good results kerosene emulsion must be made exactly

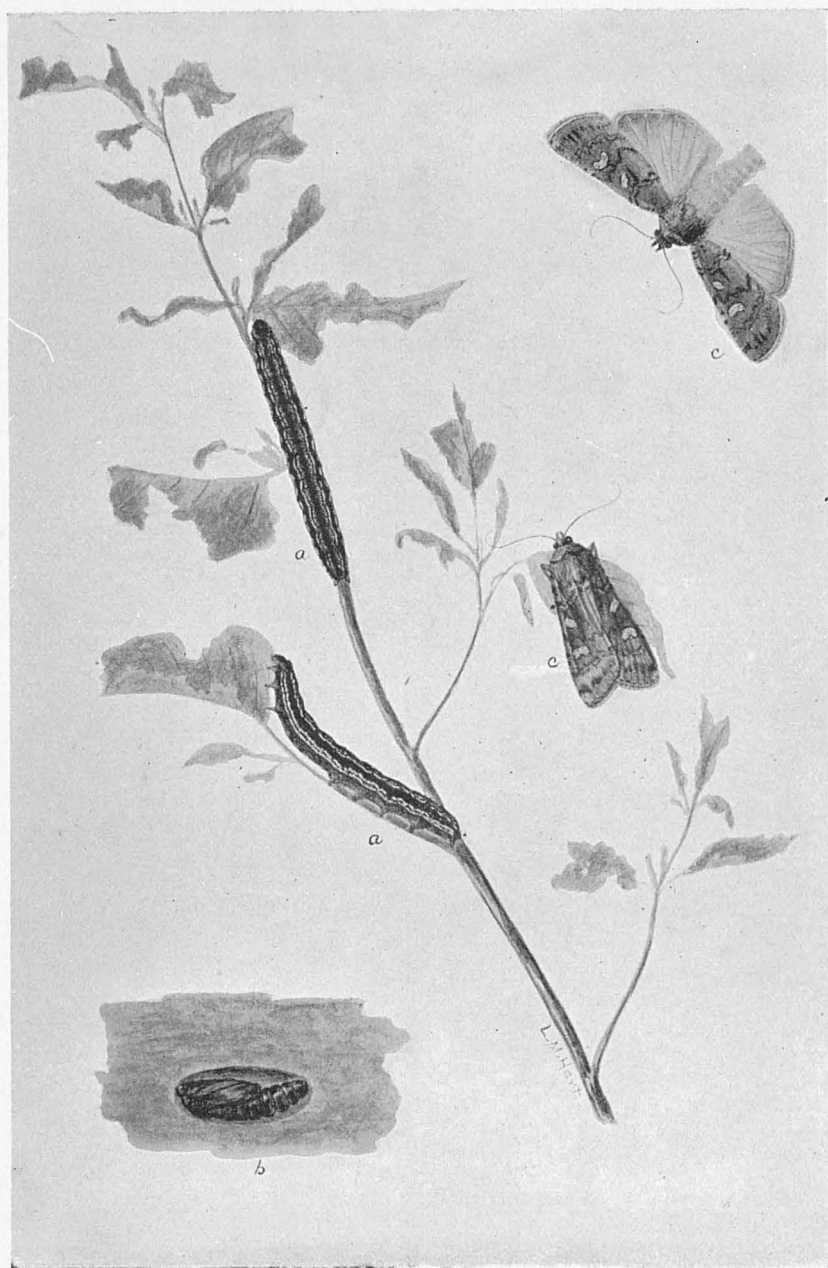


FIG. 49.—Erratic Army worm. Luger.

according to directions (see p. 56), and diluted with care. Since a little oil will rise to the surface during its use in the field, it is advisable to pour away the last of the pailful or canful, and not let it touch the foliage. The Ivory soap solution is safer. It is to be noted that after the young scales have become attached to the under side of the leaves it is almost impossible to reach them all with a spray, hence, it is desirable to attack them *as soon as they have hatched*. In winter this emulsion may be applied to the adult scales as strong as 1 to 4. Spraying to be effectual must be thoro.

THE ARMY WORM.

Leucania unipunctata.

The season just passed has been characterized by a large number of complaints of the ravages of the Army Worm, which, upon examination, proves to be the above species. Timothy appeared to be the crop which suffered most, and from reports, we judge this pest may be heard from in still more harmful numbers next season.

It is probably known to our readers that this is really one of the cut worms, but that it is found some seasons in such numbers, attacking our crops in vast armies, that it well deserves the name given to it.

Its life history is in general that of any cut worm: One female lays about 500 or more eggs, placing fifteen or twenty, or more, together on a blade of grass. In from six to ten days these hatch, and at once begin to attack the vegetation upon which they occur. Frequently a farmer will see the effect of their work without being aware of their presence. Most of our grasses, as well as the cereals, corn included, are subject to their appetite. It also has been known to feed upon apple foliage, and its eggs have been found on this tree. They reach their full size in from one to two months, and at that time are about $1\frac{1}{2}$ inch long. They are generally characterized by four broad stripes on either side, the upper two stripes lighter than those below. When full grown the caterpillar works its way an inch or more into the ground, and within a smooth, oval cell in the soil, transforms into a brown pupa not quite an inch long. With us, it is claimed the insect passes the winter as a partially grown caterpillar and finishes its trans-

formations the following year. From about the middle of June (sometimes earlier), the brownish moths begin to emerge from the pupae, and are found flying way into September.

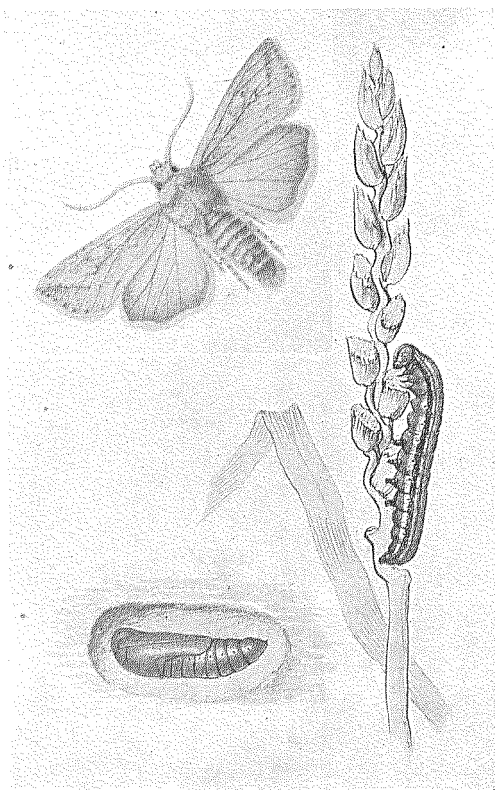


FIG. 50.—Army worm, *L. unipunctata*.

In their marches, it is asserted, the caterpillars will sometimes destroy young fields of flax, by biting off portions of the plants without utilizing them for food, and when feeding on oats, too, they work the greatest injury by causing kernels which are not eaten to fall to the ground.

Treatment: The most effective method of combating the army worm is ditching; if two or more furrows be turned up with a plow between the advancing army and the crop which it threatens, the steep side of the furrow being toward

the latter, the worms tend to congregate therein, brought to a stop by the wall of dirt. These furrows should be about two feet, or more, apart. Better yet, if time and labor are available, is to dig a ditch next the crop which is in danger, since it is harder for them to extricate themselves from a ditch, than from a furrow. Several furrows, however, will check them until they can be killed. Killing can be accomplished by putting dry straw on the worms in the furrow and hurriedly firing it, after wetting it slightly with kerosene. Or, kerosene may be poured directly on the worms. This in itself is fatal, but rather expensive. Crushing the worms when in the ditch or furrow by dragging a small log or piece of timber through it is practiced by some. Fall plowing (as late as possible), as in the case of many other of our insect pests, is excellent, as it either exposes many of the pupae where birds can find them, and variations in the weather can affect them, or buries them so deeply that the moths cannot emerge from the soil.

Some spread dry straw over them when on their food plants and fire it, thus burning them and saving their attacking a nearby crop which would otherwise have suffered. Inasmuch as the vicinity of old straw stacks offers an ideal place for hibernation, such rubbish, which is also a haven of refuge for other pests as well, should not be allowed to stand undisturbed for any length of time.

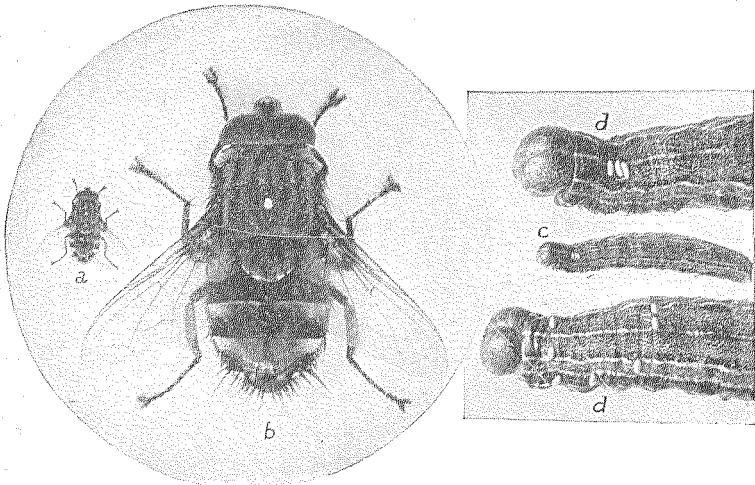


FIG. 51.—Parasitized Army worms and the fly which attacks them. Slingerland.

Like caterpillars and other pests which congregate in large numbers, the army worm is subject to disease and the attacks of parasites, which thus indirectly aid the farmer.

THE STALK BORER,

Papaipema (Gortyna) nitella.

Among the minor pests in this state, the Stalk Borer continues to be very near the head of the list, increasing in numbers and enlarging its range of food plants yearly. While its presence is felt more keenly in the flower garden, tomato and potato plants, young corn, raspberries and blackberries suffer, and even cereals are not exempt, the pest having been found in wheat and oat stalks. Shrubs and even trees which have a soft, pithy center are occasionally attacked. In the flower garden, as previously mentioned, we have found it in dahlia, hollyhock, golden glow, aster, gallardias, phlox, and various other much prized plants.



FIG. 53.—Weapons to be used against the Stalk Borer. (Author's illustration.)

This year in addition to the above it has occurred in peonies and lilies, ragweed and pigweed, and in the laboratory it has fed eagerly upon a variety of plants.

This pest is particularly insidious, from the fact that one does not realize its presence until the drooping of some choice

lily, dahlia or other plant causes an examination of the stalk, in which the borer's hole may then be found below the wilted portion, and nine times out of ten the borer itself lies within the stalk, either above or below the opening. Occasionally the affected stalk can be saved if treated at the very first appearance of the drooping. We have rescued a number of dahlias by dropping with a medicine dropper about a quarter to one-half teaspoonful of bisulphide of carbon into the hole, and then stopping it with cotton. Occasionally the worm can be reached, in stems which are straight, without seriously injuring the plant, by pushing a flexible wire into the burrow through the opening. In extreme cases we have slit the stem with a pen-knife from the opening up (if the worm is not above, it must be sought for below the opening), removed and killed the worm, and bound up the stem with raffia. The radical treatment is to cut off the stem considerably below the opening, and destroy the borer, thus preventing its subsequent increase.

A significant fact was the finding the pest this year working in burdock in a vacant lot adjoining the writer's flower garden, indicating a handy source of supply constantly threatening the plants, in spite of faithful work within the garden's confines. Evidently, one who would raise plants free from injury should see to it that all burdock (and, evidently, many other weeds), in neglected spots should be eliminated from the neighborhood.

We believe this worm leaves one stalk in which it has fed, for another which offers a fresh food supply; in other words, it probably does not necessarily complete its larval life in one plant or one stem of the plant. Normally, it pupates in the ground just below the surface, the pupa giving rise to a brownish moth, with a narrow white line in each fore wing. It is a member of the *Noctuidae*, the family which contains the cut-worms. From pupae obtained from hollyhocks in August, we have had the moth emerge in September. The caterpillar described in a previous report, varies considerably in color; it has eight stripes running along the body, and may, when young, have more or less of a purplish tinge. As it gets older it becomes duller colored, and about midway of its length the color is such as to make that part appear diseased. Many points in connection with the life history of this insect, points which will have a bearing on remedial treatment, remain to be

learned, and we look forward to next season's work with the insect to throw light upon these points. Our newly made insectary will be of service in this direction.

Bisulphide of carbon must not be brought near a light, match, cigar, pipe or lamp. It should be bought in one-half pint cans if possible, as being cheaper than when a smaller quantity is purchased.

CUT WORMS IN GREEN HOUSES.

In April we received complaints from two different greenhouses in Ramsey county, that young plants were being eaten by cut worms. These turned out to be *Peridroma saucia*, and the superintendent of one greenhouse recalled, when he had been told that the egg from which the caterpillar came was laid by a moth, that such moths were very abundant in the greenhouse early in the season, but he, of course, was unaware of the danger which its presence involved. Pupae of these moths must be brought inside with the soil, particularly with sod, and in this case the trouble, assuming that there were no egg-laying inside, would only occur after new soil had been brought in.

We advised trapping the moths, should they appear again, by placing lighted lamps at night over pans of kerosene and water, and later, if there were many worms, to use sweetened bran mash poisoned with Paris green, exercising care in placing it on the soil amongst the plants, lest in watering the Paris green be washed around the roots of tender plants. We also counselled the burying of small 3-inch flower pots in the soil at intervals, close to edges of the benches, letting the rim of the pots be even with or slightly below the surface. Worms crawling along at night will tumble into these traps and can be collected and destroyed in the morning.

SOME RECENT OBSERVATIONS ON THE USE OF HYDROCYANIC ACID GAS.

This gas, fatal to all insect life, and, it must be said, to human life also, if carelessly used, and made by the union of cyanide of potash, in itself a poison, with sulphuric acid, is employed very successfully against various pests in household,

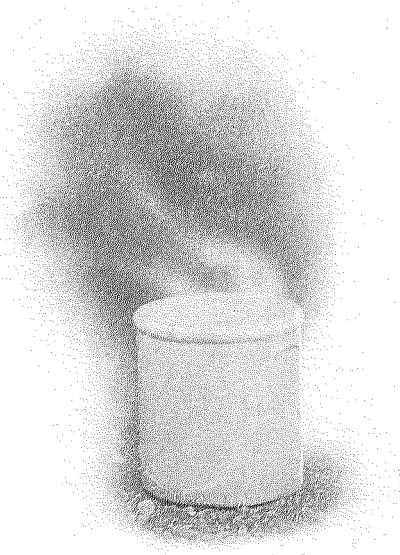


FIG. 54.—Fumes of Hydrocyanic acid gas, arising from jar. (Author's illustration.)

mills, warehouses, etc., and when handled with proper precautions by one conversant with its deadly nature, is not only highly effective, but perfectly safe. We have used it repeatedly with success, and so far, with absolutely no accident, but we are free to admit, that, realizing the inherent danger, we take each step in the process with the utmost care. These precautions have now, through repeated use, become automatic, as it were, and we do not hesitate to handle this gas as freely as we would the less dangerous and correspondingly less effective bi-sulphide of carbon, and this department has published from time to time circulars giving careful directions for its use to millers who would fumigate their mills, and to others. We will gladly mail these directions to any citizen of Minnesota who desires them.

As commonly employed .25 of a grain of cyanide is used for every cubic foot of space to be fumigated, the amount being reduced to ounces, and the charges tied up in three-pound packages in *double* manila paper sacks. Each charge calls for a four-gallon crock, similar to the one shown in photo-

graph, in which we place 5 lbs. of commercial sulphuric acid with a specific gravity of 1.83 or over, and $7\frac{1}{2}$ lbs. of water. When everything is ready, provision made for outside ventilation, etc., the package of cyanide is dropped into the jar, and the operator leaves the room. As the gas formed is lighter than air, and ascends, the one dropping the charge must go down to the story below, *not to the one above*.

The question, as to how much time elapses between the dropping of the charge and the first giving off of the fatal gas is a vital one, in view of the deadly nature of the gas and one we have endeavored to settle by various experiments. In doing the work personally, I have allowed fifteen seconds as a conservative estimate in this direction, and acted accordingly. To place this matter beyond any doubt, however, we have, this fall, made several trials, timing the interval between the dropping of the double bag of cyanide into the jar, and the first appearance of the fumes (see figure), with surprising results. A double manilla sack was used in each case, that is, one sack inside another, and various makes of sacks. One yellow, marked "Pacific;" another, H. P. B. sugar sack; another, "Mayflower" No. 17, etc. In each case the liquid was quite warm (the heat being caused by adding water to the acid), but no observation was made on its exact temperature. We found in a series of trials that this interval varies from 29 seconds, the lowest, to four minutes, the latter being the highest, the variation, evidently, being largely due to variations in the thickness and character of the paper of which the sacks are made. Of course, a variation in the warmth of the liquid would cause a difference.

In connection with these experiments, the question arose, "Is it not possible that fumes which would be fatal if breathed, rise from the jar before they are visible?" This was answered in the negative, by placing a live guinea pig in a wire cage about six inches above the top of the jar, immediately after the charge of cyanide had been lowered into the acid. Visible fumes began to rise two minutes after placing the charge, and a few seconds later the guinea pig succumbed, showing that *the dangerous gas was not given off in a fatal amount until fumes were observed*. It would seem, then, from these results, that on a very conservative estimate *one can depend upon, at*

least, twenty seconds when double sacks are used, and much can be done in that time.

Another important question connected with the use of hydrocyanic acid gas is the distance it will penetrate into a semi-solid mass, a sack of bran, for instance, or masses of cereals held together by the webbing made by the flour moth larva.

An apparatus used by this department to ascertain this was found to be faulty, too late in the year to remedy the defect, and the results of that particular experiment, therefore, cannot be relied on. However, the matter was given a practical test by exposing a mass of webbing, over two inches thick, containing live worms, pupae (and probably eggs), of the flour moth to the fumes of the gas, as commonly used at the above strength, and for over ten hours, the time usually occupied in a fumigation. As far as could be observed at the time everything in this mass was killed, and after three months' observation of the same in our laboratory, no sign of the flour moth in any stage was apparent, indicating, possibly, that this gas has a greater penetration than we had supposed. At the same time this isolated experiment should not be relied upon as certifying absolutely upon this point.

While this gas in no way affects dry flour, meal, or any cereals; in fact, any food product which contains no moisture, milk, butter, drinking water, or any moist food intended for use should not be exposed to the fumes. Neither is it desirable that silverware, nickle or brass should come in contact with it at this strength, unless coated with vaseline. Further, in its use, one should always bear in mind that one good whiff of the fumes might prove fatal.

SOME COMMON HOUSEHOLD INSECTS.

There are certain very common pests of the household, regarding which, the entomologist has ever recurring inquiries, and at the risk of appearing to repeat information previously printed by this department, we give here detailed remedies of these injurious forms, without, however, describing the insects, which have already been so thoroughly discussed that they are generally familiar objects to every housekeeper.

CLOTHES MOTH.

It is well to remember that camphor, naphthaline, moth balls, etc., kill neither this insect nor its eggs, but act merely as repellants, nor will storing furs and woolens in a cedar chest, the odor of which may be repulsive to the insect, be of avail if there are already eggs or larvae of the moth in the same when so stored.

As a rule, clothes which are used occasionally, or brushed or shaken, in order to dislodge any eggs thereon are not appreciably injured. These eggs hatch in about six or seven days. If their presence is suspected in any furs or other material, a mild beating and brushing of such articles will remove most, or all. When one is absolutely sure that no eggs or larvae (worms) are present, a very good practice is to store articles in pasteboard boxes which are afterwards thoroly sealed by pasting paper over the cracks. It is usually not safe to let woolens, furs or feathers remain undisturbed a long time in an ordinary trunk, since, as a rule, such trunks are not moth proof.

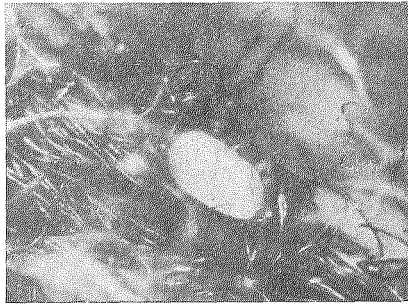


FIG. 55.—Egg of clothes moth, much enlarged. (Author's illustration.)

Cold storage is much resorted to for the preservation of furs during the summer, and this is quite a feature in the business of many of the cold storage plants in cities. The pest cannot work in a temperature below 40 degrees Fahr. Frequent beating of furs, furniture, curtains, woolens, etc., during the spring and summer, say, in May, June, July and August, is helpful.

The writer, in his own house, has practiced the following method for several years with marked success. A galvanized

iron chest was constructed, about two feet square at the ends, and three and a half feet long. The cover fits in with a flange, and a strip of felting is glued on the cover, round the edge which rests on the edge of the chest when the cover is in place; six hooks on the cover fasten into eyes soldered on chest, and serve to keep the former in tight. Into this receptacle in the spring goes all of our clothing, not to be used during the summer, and which is attractive to moths. At the same time into a saucer-like dish placed on top of the clothing is poured four tablespoonfuls of bisulphide of carbon, and the chest closed. It should not be opened for any purpose for three or four days. We repeat this performance about ten days later, since the vapor fatal to the larva does not kill the egg, and perhaps once or twice more at intervals during the summer. These latter fumigations are probably not necessary, but would kill any insect life should a moth have, by chance, crawled in. This vapor, heavier than air, sinks through the clothes stored in the chest. It is explosive when mixed with the atmosphere, and no light of any kind should be brought near it. Bisulphide of Carbon should be purchased in pint or half-pint cans. It in no way injures the clothes.

CARPET BEETLE, "BUFFALO BUG," "BUFFALO MOTH."

A beetle, not a bug, and not a moth.

Midsummer house-cleaning of infested houses, or two house-cleanings each year is desirable, and should be most thoroly attended to. If carpets are used they should be thoroly beaten, and, if possible, sprayed out of doors with some such liquid as benzine or gasoline, and well aired afterwards. Rooms should have their bare floors thoroly swept, washed with hot soap-suds, and all cracks drenched with kerosene or benzine. If possible, it is desirable in bad cases to lay tarred paper on the floor before laying down the carpet. Should the carpet show any spots at any time during the year after such a treatment, affording evidence of the pest, we are advised by the United States Department of Agriculture to lay a damp cloth smoothly over the places affected, and iron with a hot iron, thus creating steam which will pass through the carpet and kill all insects below. This calls for much "elbow grease." The use of rugs on bare floors, or

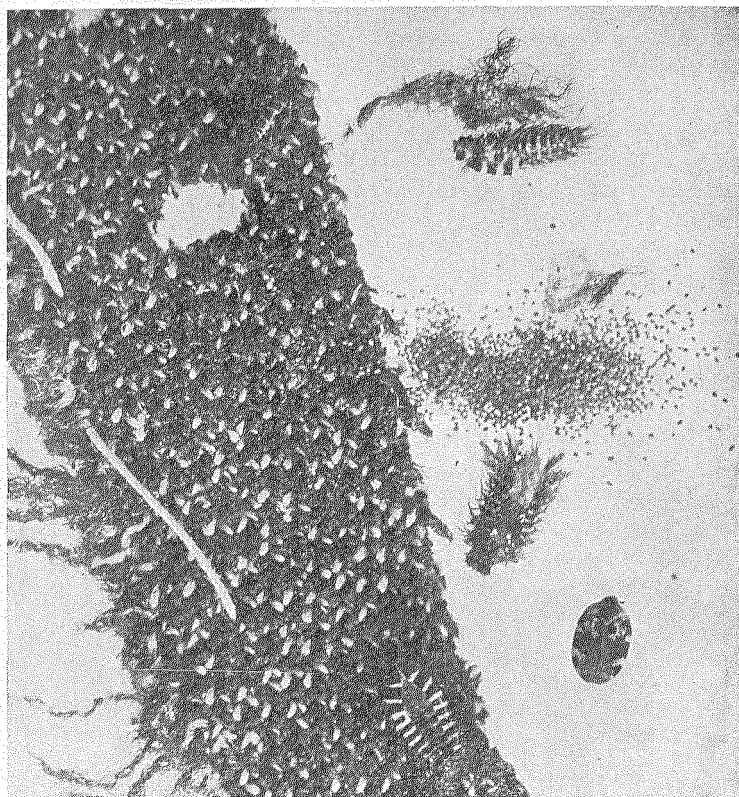


FIG. 56.—Carpet Beetle in various stages and its work. (Author's illustration.)

even rugs upon matting, is preferable to the use of carpets, for obvious reasons. In protecting furs and feathered goods and woolens from the ravages of these pests one should proceed in the same way as in the case of protection from moths, viz.: storing in tight chests or closets, with a supply of camphor or naphthaline balls, and frequent examination during the summer months. Chests lined with tarred paper, which paper is to be replenished each season, are useful.

Houses where doors and windows are screened in spring and summer have an advantage. One party claims to have killed this pest effectively with sulphur fumes. Three or four pounds of sulphur were burned in tightly closed rooms for four or five hours, at the time when the insects were first

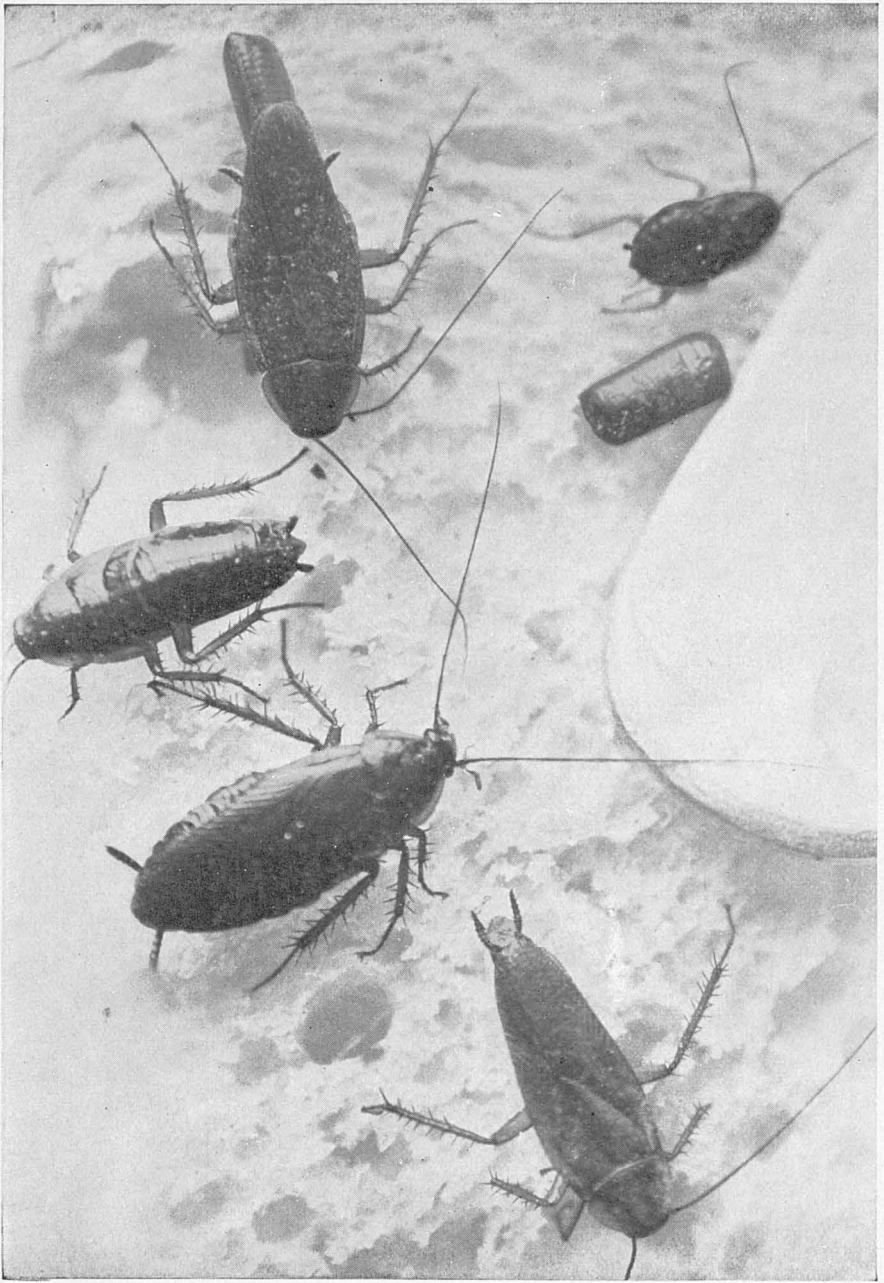


FIG. 58.—Roaches, young and adult and egg case, all much enlarged. (Author's illustration.)

observed. A common frying pan made a good dish to burn the sulphur in, and this was placed in a pan of earth, which in turn rested upon two bricks on the floor. It must be remembered that these fumes tarnish silver, gilt picture frames, and all bright metals.

“SILVER FISH,” “FISH MOTH.”

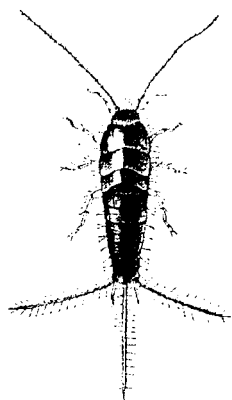


FIG. 57. "Silver Fish."

This is the small, silvery insect which slips around so rapidly on book shelves amongst old books, and in bureau drawers, where clothes are kept, and elsewhere. It is not a moth, and certainly not a fish, but belongs to the lowest and simplest order of insects. It is nearly half an inch long, and is shown in Fig. 57.

It is somewhat of a disputed point as to whether this insect's principal food is of a vegetable nature, starch, for instance, or whether, when it annoys us in the household, it is really after the glue on backs of books, in sizing, under the wall paper, etc. We have known of its ruining several silk dresses, and of its attacking rugs made of silk scraps.

Fresh pyrethrum powder dusted freely on book shelves amongst the books is of some help. In houses badly infested silk dresses and starched clothing should be frequently handled, and not left untouched for long periods in bureau drawers.

Starch paste poisoned with arsenic, and white glue melted and similarly poisoned, both being spread upon pieces of cardboard and placed in drawers and elsewhere, wherever this pest occurs, is being at present tried by this department, starch thus used having been previously recommended; the white glue idea being suggested by the claim above referred to, that this insect seeks glue rather than starch. As we go to press the results of this comparative test are not available for publication, the experiment having been tried in a distant town.

ROACHES, COCK ROACHES, CROTON BUGS.

A hard pest to control if it once obtains a foothold. Particularly, is this so, where a family lives in a flat, since infestation from one flat to another is comparatively easy. Under favorable conditions, that is, in a house standing by itself they can be combated, though it requires perseverance, with some degree of success. A family known to the entomologist has conquered roaches by the persistent use of powdered borax in the kitchen where they occurred. This was dusted in all cracks and crevices about the room daily (particularly, in the evening), for two weeks, care being taken to use it liberally along the entire length of mop board wherever there was a crack large enough to hide a roach, and its use was persisted in for some time after all insects had apparently disappeared. Firms which sell bakers' supplies generally carry in stock a patent powder, said to be extremely effective.

Hydrocyanic acid gas used in a house standing apart from others would kill all such pests, but as the fumes are fatal to human beings as well, its use calls for extreme care.

FLEAS.

Housekeepers who have been away during the summer, leaving their houses closed, are frequently surprised, upon their return in the fall, if the proper conditions as to moisture have prevailed during their absence, to find the house overrun with fleas. They ascribe this condition to all sorts of causes, but rarely hit upon the right explanation.

The writer has yet to see a dog or cat which, at some time, is not troubled with these pests, and, if proper precautions are not taken, rugs or carpets or matting are quite sure to be overrun with the pests, as well as the animals themselves.

The eggs of this species are laid among the hairs of the dog or cat (according to some authorities in the bedding of the animals and not on the hairs) and readily drop off. Hence they may be distributed in any room to which these animals have access, and will be found particularly numerous in places which they especially frequent, such as rugs before the fire and the like. The maggots, which hatch from the eggs in about two weeks, are white, footless, with a pale yellow head. They live in the dirt of undisturbed carpets or rugs, or beneath the same in cracks and crevices of the floor.

feeding upon minute particles of decaying vegetable or animal matter found therein. They become full grown in about twelve days, turn into pupae, and in from ten to sixteen days (Osborn) come forth as full grown fleas. Thus the time elapsing from the laying of the egg to the perfection of the flea is, in round numbers, about forty days.

Houses where rugs are used in place of carpets, or straw matting, allowing of a frequent, thoro shaking and cleaning of the rugs, and a frequent and thoro sweeping of the bare floors, coupled with a scrubbing or other special treatment of the latter, are naturally less troubled than houses where the floor coverings are fastened down, thus allowing the insects to develop without disturbance. When serious infestation of a house occurs, carpets in infested rooms should be generously dusted with Persian insect powder. If this treatment is not successful, carpets and floors as far as possible should be sprayed with benzine, or gasoline, proper precaution being taken to prevent the fumes coming in contact with lights and fires during the operation and for some hours afterward. If necessary, and in addition to the above, carpets or matting should be taken up, thoroly beaten out of doors, and the floors thoroughly washed with hot soapsuds, taking care to reach every crevice. One writer claims that spraying a badly infested house, inside, with pennyroyal, a somewhat expensive process, will quickly drive them from the building.

The cat or dog can be made to sleep on a rug provided for the purpose, and this rug shaken into some receptacle, and the dust containing the eggs and maggots burned. This of itself would be a decided help.

For ridding a cat or dog of fleas, Creolin, for sale at many drug stores, is the best agent known to us. For dogs' use four teaspoonfuls of this liquid in a quart of water; for cats, two teaspoonfuls in a quart of water. Shake well and apply with the hands or a brush, or make enough to submerge the animal. The latter is the best method, holding the animal in the liquid until the fur is completely saturated. The animal requires no further washing. The fleas upon the fur will all be killed and the fur benefited. Floors may also well be treated with this same preparation, using it twice as strong as for dogs, and the animal's bedding or matting upon which it sleeps can be fre-

quently submerged with good results. Of course, fleas will return to a cat or dog when sufficient time has elapsed after treatment as above. We must remember that neglected bedding is the chief source of trouble.

Other species of fleas are found on human beings, on rabbits, moles, pocket gophers, squirrels, rats, mice, fowls, etc.

AN EXPERIMENT WITH LANTERN TRAPS FOR WHITE GRUBS IN LAWN.

Although lantern traps, as a rule, are not regarded as practical, and certainly are of not the slightest advantage in the orchard, we suggested its use, among other things, last spring to the superintendent of a large cemetery near Minneapolis, where the white grub (larva of *L. rugosa*, in part), had been destroying the lawn over a large area. He was at the same time advised of the regard, or lack of regard, in which the lantern trap was held, and warned of possible failure. As a matter of fact, in the case of the May beetle, for parties who can go to the expense of a large number of such traps, and where the injury caused by the grubs is sufficiently great to induce one to leave no stone unturned in an effort to lessen their havoc, the lantern trap may be of some benefit, and it was upon this basis that the traps were used in this instance. The entomologist hardly cares to report on the results of the work until the experiment has been given another season's trial. We might say, however, briefly, that the traps (three doz. in number), were set out in different parts of the cemetery on May 8th, and were in use every night for about six weeks. The superintendent writes me under date of December 4th, that they caught in round numbers about 3,000 beetles, not all *L. fusca*, or *L. rugosa*, however. He states that the injury to the grass this season was not as great as the previous year, which condition may have been due in part to the presence of the traps. It is to be noted, however, that since these larvae live for two years before turning into beetles, marked injury to the grass, due to the ravages of large numbers of nearly and quite full grown grubs one season, would naturally be followed by a period of exemption from injury the following season, at which time there might be a comparatively small number of the *full grown* larvae, while the *new*

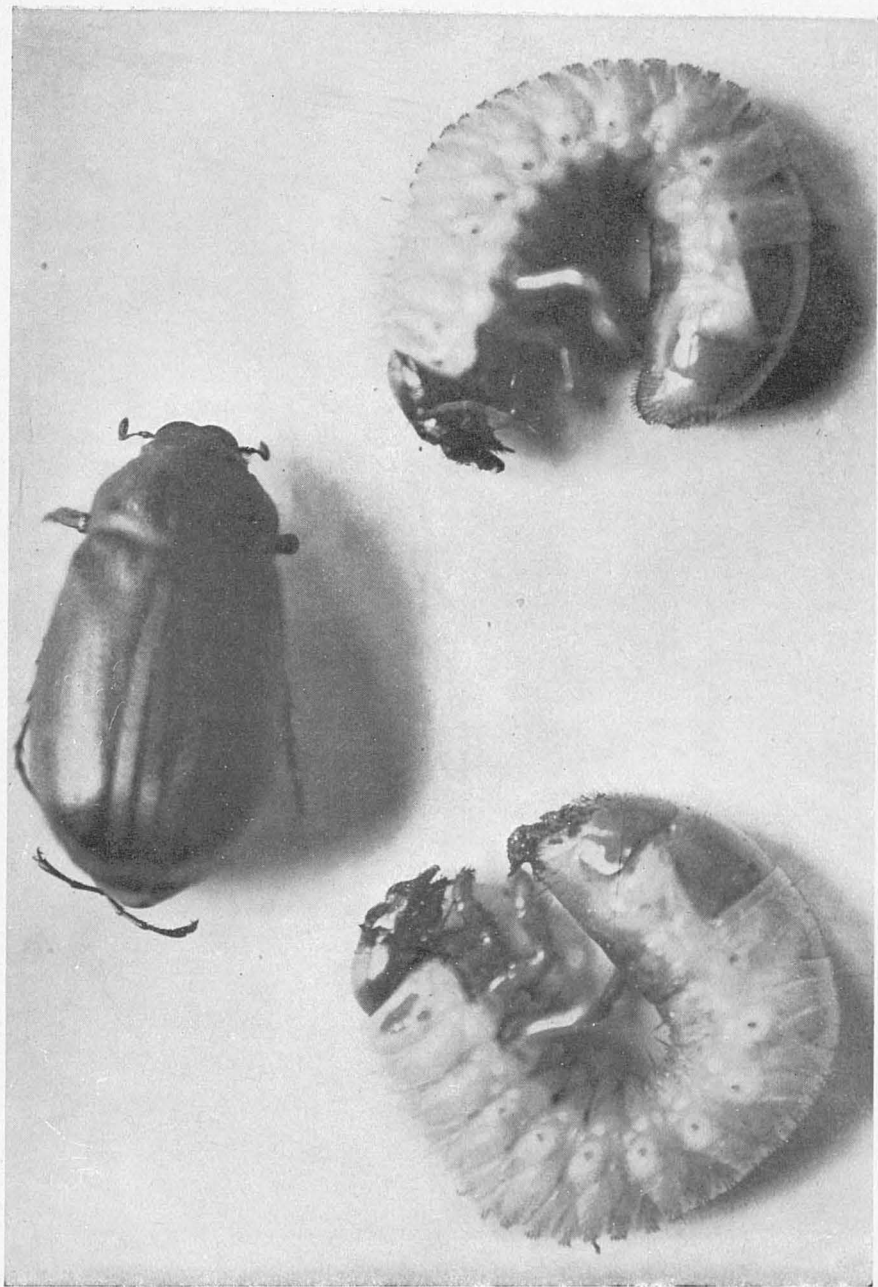


FIG. 59.—The White Grub, *L. rugosa*, which kills the grass in lawns and the beetle which produces it. All much enlarged. (Author's illustration.)

crop of larvae, quite small the first season, would not make their presence seriously felt until the following year. Of course, if the beetles were extremely numerous every year, their egg-laying each season would insure a succession of full grown injurious grubs every summer.

The chief objection to lantern traps lies in the fact that they apparently attract very many more males than females, and that many of the females which are captured appear to have laid their eggs. The results, therefore, of this experiment, another season will be awaited with interest.

The entomologist was privileged to examine one catch of beetles made at the cemetery with the following results as to species: *Bolbocerus parctus*, 1; *B. lazarus*, 81; *Serica sericea*, 4; *Copris* sp. (mutilated) 1; *Lachnosterna tristis*, 1; *L. fusca* and *L. rugosa*, 75; total, 163.

Robins aid in the extermination of this pest and are frequently seen in numbers pulling the grubs from under the dead patches of grass. It has been found, too, that where a copious supply of water is obtainable, by keeping the dying patches thoroly wet all the time, the grass can "keep ahead" of the grub and be made to appear green in spite of them. Dr. Smith of New Jersey, advises the use of a liberal amount of ground tobacco broad-casted over the entire lawn, followed

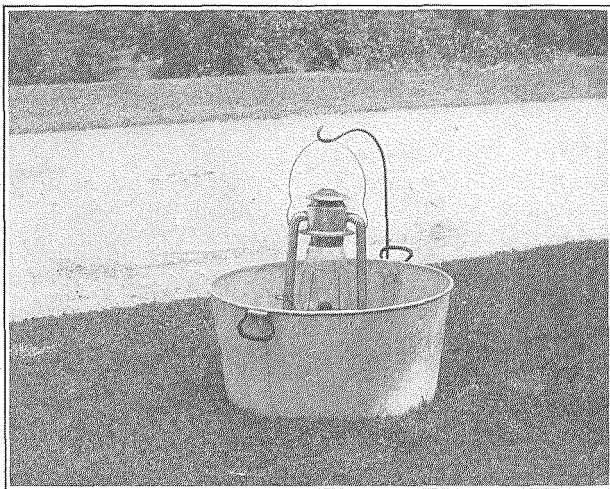


FIG. 60.—A lantern trap.

by copious watering. He claims that the grubs disappear. Application should be made immediately upon the appearance of the pest.

Some experiments tried by the entomologist in 1902, show interesting results.

Grass drenched with kerosene emulsion (1 part emulsion to 6 parts water); grass injured and grubs not killed; one part emulsion to ten of water, same results; tobacco water ($\frac{1}{2}$ lb. stems steeped in 1 gal. water), no effect whatever; bisulphide of carbon, 1 oz. in shallow pan placed under tight box inverted over dead patch of grass (capacity of box 3,458 cubic inches), killed all grubs in three hours without in the slightest way injuring the green grass with which it came in contact. This is in round numbers, 1 part of liquid to 1,900 parts of atmosphere. Bring no light of any kind near bisulphide of carbon. We illustrate one of the lantern traps referred to above in Fig. 60. The tub contains a few inches of water covered with kerosene.

THE NEW INSECTARY.

The accompanying photograph illustrates the exterior of our new insectary, just completed, at a cost of \$2,500.00, that sum being appropriated for the purpose by the last legislature. The plans were made, following suggestions of the entomologist, and the construction superintended by Messrs, Boss & Bull of the Mechanical Division of the institution, to whom the writer's thanks are due for many courtesies, and much painstaking effort.

Here, we can study the life history of any insect, under the most favorable conditions, and at almost any time of the year, anticipating the summer season, and profiting by being thus enabled to work before the arrival of the busy season, when more demands are made upon the time of an entomologist for outside work. Further, by having any special groups of insects thus under control, and in a condition where very close and accurate observations may be made, one has a great advantage, for it is very difficult and some times impossible to make these observations in detail in the field. The need of such a building has long been felt here, and we are to be congratulated upon finally realizing our ambitions in this direc-

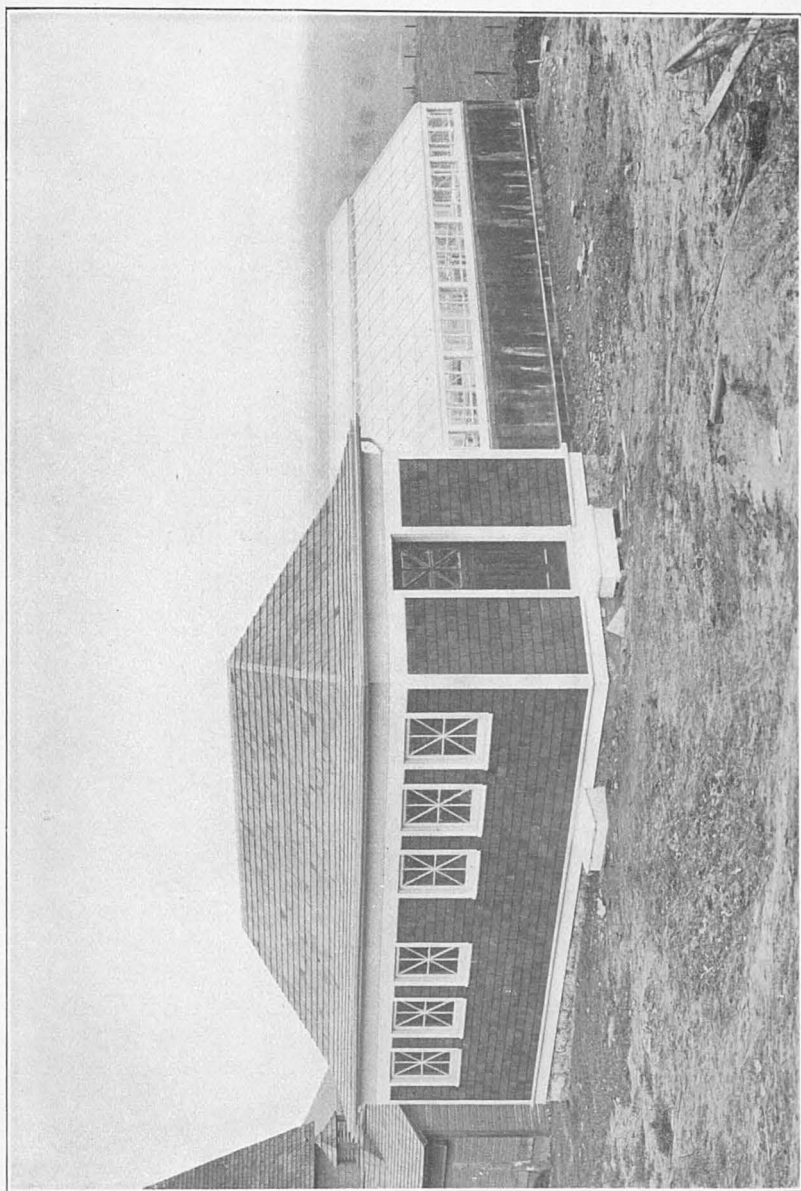


FIG. 61.—Our new Insectary.

tion, and thus being placed upon an equal footing with other leading experiment stations, most of which are provided with similar accommodations. The insectary stands upon about a quarter of an acre of good ground granted the entomologist by the Director and Board of Regents, for an experimental garden. This will be used in the future in the place of the old garden previously allowed, but undesirable for many reasons.

The building, located to the south and east of the new main building, consists of two parts, a glass portion or greenhouse portion 35 feet by 18 feet, and a wooden part 32 feet

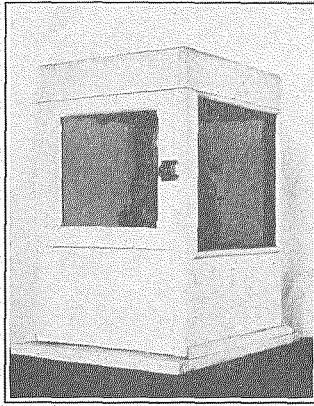


FIG. 62.—A breeding cage.

by 12 feet, which is divided into a work-room and store-room, the latter for our spraying apparatus, insecticides, etc. Beneath the work-room, and reached by a flight of stairs from the greenhouse, is a cellar 12 by 16, and about $6\frac{1}{2}$ feet high, originally intended as a place for wintering our bees, but inasmuch as we have been obliged to instal therein an automatic pump to effect the return of water from our heating plant, its pressure may make it too warm. In this case, we shall endeavor to construct another cellar under our store-room, which will be free from this objection. Between the store-room and work-room a small dark room is located, for an insectary offers ideal conditions for photography, and in future all of our indoor pictures of insects and insect life will be taken under the best of auspices. The work-room is supplied with bench, drawers, cupboards, cases for instruments and books, and well lighted.

The greenhouse portion is provided with benches for our breeding cases and breeding jars, tables for photographic outfit, earth beds for growing food plants of insects, places to plant trees and shrubs, an aquarium, cement walks, curtains for shading plants from too much sunshine, and is heated and gets its water supply from the main heating and water plants of the institution. The glass part of the insectary, further, is divided into a "warm room" and "cold room," the former 20 by 18, the latter 15 by 18 feet, a glass partition dividing

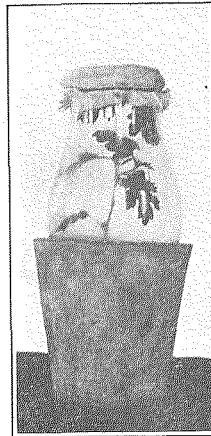


FIG. 63.—A breeding jar.

the two. In the warm room a summer temperature, or even tropical conditions may be obtained during the winter, if desired, while the cold room, although it can be warmed if needed, is intended for the small trees, shrubs or breeding cages which we wish to keep at the outside temperature. The sash is made of the very best of seasoned Gulf Coast cypress, and modern ventilating and lifting machinery (top and sides) has been installed.

The walls designed to keep out the cold, and to help maintain an equable temperature inside deserve special mention. They are laid on an eight-inch concrete footing. Above this is 12 inches of concrete foundation to the floor line, the walls proper, $3\frac{1}{2}$ feet high from floor line to sash, being composed

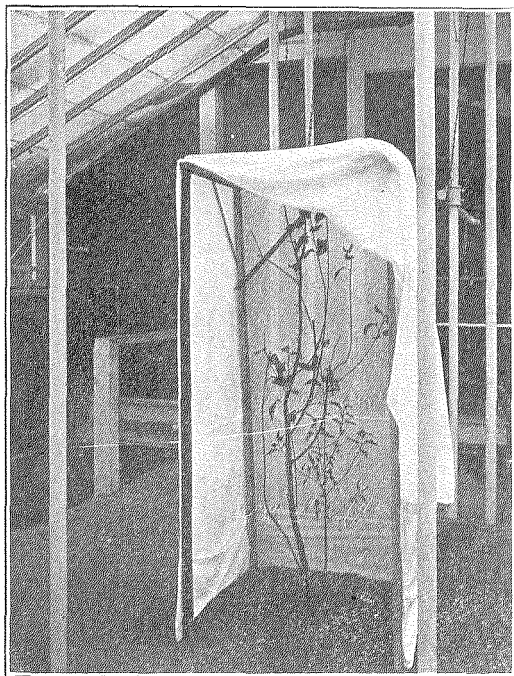


FIG. 64.—Apple tree in breeding cage in Insectary.

of two layers of hollow tile with a 1-inch space between, and 7-8 inch of cement plaster over tile on outside and inside of wall.

The building taken as a whole is well worth the amount appropriated, and bids fair to be of much usefulness.

ADDITIONAL MINNESOTA DIPTERA.

The following new species of Minnesota flies have been secured since the report for 1905 (*Diptera of Minnesota*) was issued. The identification has been made in part by Mr. Coquillet. The different families are arranged alphabetically for convenience of reference.

AGROMYZIDAE.

Desmometopa m-nigrum, Zett.; *D. latipes*, Meig.;
Agromyza aeneoventris, Fall.; *Ceratomyza dorsalis*, Loew;
Olfersia americana, Leach.

ANTHOMYIDAE.

Pegomyia bicolor, Wied.; *Hylemya alcathoe*, Walk.;
Schoenomyza dorsalis, Loew; *Coenosia*, sp.; *C. lata*, Walk.;
C. flavifrons, Stein; *Mydaea*, sp. *Hylephila*, sp.

ASILIDAE.

Holopogon, sp.; *Asilus notatus*, Wied.; *A. novaescotiae*,
 Macq.

BIBIONIDAE.

Scatopse atrata, Say.

CECIDOMYIDAE.

Diplosis, sp.

CHIRONOMIDAE.

Ceratopogon sanguisuga, Coq.; *C. cilipes*, Coq.

CONOPIDAE.

Sphiximorpha (Ceria) signifera, Loew.

CULICIDAE.

Culex frickii, Ludlow, n. sp., (?) Fort Snelling, Minn.,
 October 1, 1905.

DOLICHOPODIDAE.

Argyra albicans, Loew.; *Chrysotus*, sp.; *C. obliquus*,
 Loew.; *Diaphorus*, sp.; *Dolichopus acuminatus*, Loew.; *D.*
angustatus, Ald.; *D. batillifer*, Loew.; *D. longipennis*, Loew.;
D. luteipennis, Loew.; *D. pachycnemus*, Loew.; *D. reflectus*,
 Ald.?: *Gymnopternus* sp.: *Neurigona lateralis*, say Ald.
 =N.

superbiens, Loew.; *N. Nothosympycnus nodatus*, Loew.;
Pelastoneurus vagans, Loew.; *Sympycnus lineatus*, Loew.;
Synarthus palmaris, Loew.

DROSOPHILIDAE.

Drosophila amoena, Loew.; *D. punctulata*, Loew.; *D.*
(Scaptomyza) graminum, Fallen.

EMPIDAE.

Hilara femorata, Loew.; *Platypalpus trivialis*, Loew.;
Rhamphomyia fumosa, Loew.; *R. vittata*, Loew.

EPHYDRIDAE.

Hydrellia hypoleuca, Loew.; *Paralimna appendiculata*,
 Loew.; *Psilopa atrimanus*, Loew.; *P. sompta*, Meig.; *Scatella*
stagnalis, Fall.

GEOMYZIDAE.

Anthomyza tenuis, Loew.; *Diastata vagans*, Loew.

HELOMYZIDAE.

Helomyza plumata, Loew. — *H. quinquipunctata*, Say.

LEPTIDAE.

Arthropeas, sp.; *Leptis scapularis*, Loew.; *Xylomya palipes*, Loew.

LONCHOPTERIDAE.

Lonchoptera lacustris, Meig.; *L. lutea*, Panz.

MUSCIDAE.

Calliphora erythrocephala, Meig.; *Muscina assimilis*, Fallen; *Muscina dissimilis*, Fallen; *Myiospila meditabunda*, Fab.

MYCETOPHILIDAE.

Platyura, sp.; *Zygoneura*, sp.

ORTALIDAE.

Meliera ochricornis, Loew.; *M. similis*, Loew.; *Rivellia basilaris*, Coq.; *Tritoxa flexa*, Wied.

OSCINIDAE.

Chlorops proxima, Say; *Elachiptera costata*, Loew.; *E. longula*, Loew.; *Hippelates flavipes*, Loew.; *H. plebeius*, Loew.; *H. pusio*, Loew.

PHORIDAE.

Aphiochaeta rufipes, Meig.

PIPUNCULIDAE.

Pipunculus houghii, Kert.; *P. nigripes*, Loew.; *P. subvirescens*, Loew.

PSILIDAE.

Loxocera cylindrica, Say.

SAPROMYZIDAE.

Lonchea polita, Say; *Sapromyza longipennis*, Fab.; *S. lupulina*, Fab.; *S. philadelphia*, Macq.

SCATOPHAGIDAE.

Cordylura adusta, Loew.; *Parallelomma varipes*, Walk.

SCIOMYZIDAE.

Tetanocera canadensis, Macq.; *T. saratogensis*, Fitch.

SEPSIDAE.

Nemopoda minuta, Wied.; *Prochyliza xanthostoma*, Walk.; *Sepsis cynipsea*, Linn.

SIMULIIDAE.

Simulium meridionale, Riley.

STRATIMOYIDAE.

Euparyphus atriventris, Coq.; *Odontomyia plebeja*, Loew.; *Stratiomyia apicula*, Loew.

SYRPHIDAE.

Baccha fascipennis, Wied.; *Mesogramma boscii*, Macq., *Myiolepta nigra*, Loew.

TACHINIDAE.

Blepharipeza leucophrys, Wied.; *Cistogaster immaculata*, Macq.; *Exorista nigripalpis*, Town; *Hemysda aurata*, Desv.; *Macromaignia chrysoprocta*, Wied.; *Polidea areos*, Walk.; *Sturmia bakeri*, Coq.; *Tachina rustica*, Fallen.

THEREVIDAE.

Thereva candidata, Loew.

TRYPETIDAE.

Eutreta sparsa, Wied.; (*Tephritis puciola*, Bigot, = *Ensina humilis*, Loew., Ald) *Oedaspis setigera*, Coq.; *Rhagoletis suavis*, Loew.

PUBLICATIONS OF THE ENTOMOLOGICAL DEPARTMENT SINCE 1895.

The following list shows what publications from this division of the Experiment Station are available at the present time (December 1906). Parties sending for any of these must bear in mind that while the bulletins are franked and require no postage, we have to stamp the reports. Requests for reports, therefore, should be accompanied by stamps.

The Fourth Annual Report requires for unbound copies 11 cents; the Fifth Report takes 9 cents for unbound copies; the Sixth Report takes 10 cents for unbound copies; the Eighth Report, 9 cents for bound and 7 cents for unbound copies; the Ninth Report, 7 cents for unbound copies; the Tenth Report, 8 cents for bound copies and 6 cents for unbound copies; the Eleventh Report 8 cents for bound copies, and 6 cents for unbound copies. Special Reports require as a rule, 2 cents each, and circulars, 1 cent.

DATE	REPORT	EQUIVALENT BULLETIN	SUBJECT	CONDITION OF OUR FILES
1895	1st Report.	Bulletin 43.	General insect conditions, Chinch Bug, Locusts, etc.	Exhausted.
		Press Bulletin No. 5.	Hog Cholera, Swine Plague.	Exhausted.
1896	2nd Report.	Bulletin 48.	Chinch Bug, Animal parasites, Mosquitoes, Flies, etc.	Exhausted.
1897	3rd Report.	Bulletin 55.	Grasshoppers and Locusts.	A few Bulletins still for distribution.
1898	4th Report.	Bulletin 61.	Butterflies and Moths.	About 12 Reports for distribution.
1899	5th Report.	Bulletin 66.	Beetles.	About 125 Reports and 12 Bulletins for distribution.
		Bulletin 64.	Black Rust, Hessian Fly, Grasshoppers.	Exhausted.
	Special Report.		Black Rust, or Summer Rust (There is more recent information available.)	About 200 for distribution Postage 3c.
1900	6th Report.	Bulletin 69.	Bugs.	About 75 Reports for distribution.
1901		Press Bulletin No. 13.	Hessian Fly.	Exhausted.
1902	7th Report.	Bulletin 77.	General insect conditions, Hessian Fly, Grasshoppers, Chinch Bug, etc.	Exhausted.
1903	8th Report.	Bulletin 84.	Spraying Methods and Compounds, Nursery Laws, Insects affecting Fruit Trees, etc.	About 75 Reports still for distribution.

DATE	REPORT	EQUIVEMENT BULLETIN	SUBJECT	CONDITION OF OUR FILES
1904	9th Report. Special Report.	Press Bulletin No. 16. Bulletin 88.	Criddle Mixture for Grass-hoppers. Insects affecting Raspberries, Blackberries, Gooseberries, Strawberries, Grapes, Melons, Squashes and Cucumbers; Mediterranean Flour Moth.	About 100 for distribution. About 45 Reports for distribution.
1905	10th Report.	Press Bulletin No. 19. Bulletin 93.	Mediterranean Flour Moth. A Plea for some of our Common Birds.	About 100 for distribution. Postage 2c. 200 for distribution.
1906	11th Report.	Flies of Minnesota. Press Bulletin 22. Press Bulletin No. 25 Circular. Circular. Press Bulletin No. 26. Bulletin 100.	Insects and Insect like Animals attacking Live Stock. Results of work in 1905 with the Cabbage Maggot. Hydrocyanic Acid Gas Method of Fumigating Flour Mills. Some Recent Observations on the use of Hydrocyanic Acid Gas. An Entomological Calendar. The Cabbage Maggot and other Injurious Insects of 1906.	About 75 Reports for distribution. 50 for distribution. 100 for distribution. 200 for distribution. Postage 1c. 200 for distribution. Postage 1c. 500 for distribution. 16,000 copies just printed.

INDEX.

A

	Page.
Apples, When to Spray.....	49
April, Work for.....	46
Army Worm.....	59
August, Work for.....	50

B

Birds in Orchards.....	42
Bordeaux Mixture, Receipt for.....	52
Borer, Currant.....	44
Breeding Cage.....	77
Breeding Jar.....	78
"Buffalo Bug".....	69
"Buffalo Moth".....	69
Buffalo Tree-hoper.....	48

C

Cabbage, Club Root of.....	18
Cabbage Maggot.....	1
Cabbage Maggot, Effect of Location of Plants.....	16
Cabbage Maggot, Enemies of.....	8
Cabbage Maggot, Field Notes.....	9
Cabbage Maggot, Laboratory Experiments.....	6
Cabbage Maggot, Life History.....	4
Cabbage Maggot, Remedies.....	2
Cabbage Maggot, Season's Work.....	2
Carpet Beetles.....	69

	Page.
Cart, Useful Spraying.....	41
Circulars Mailed by Entomologist.....	23
Clothes Moth.....	68
Club Root on Mustard.....	19
Club Root on Shepherd's Purse.....	18
Coccinellids and Maple Scale.....	56
<i>Coccophagus lecanii</i>	58
Cockroaches	71
Cocoon of Cecropia Moth.....	42
Cottony Maple Scale.....	54
Croton Bugs.....	71
Currant Borer.....	44
Cut Worms in Greenhouses.....	64
D	
December, Precautions to be Taken Against Insects.....	51
Diptera, Additional Minnesota.....	79
E	
Entomological Calendar.....	41
Entomological Publications since 1895.....	82
<i>Eulecanium cerasifex</i>	57
F	
February, Work for.....	43
"Fish Moth".....	71
Fleas	72
G	
Greenhouse, Cut Worms in.....	64
H	
Household Insects, Some Common.....	67
Hydrocyanic Acid Gas, Some Recent Observations on the Use of.....	64
I	
Insectary, The New.....	76
Insect Conditions, General.....	21
Insects, Identification of.....	23
J	
January, Work for.....	41
July, Work for.....	50
June, Work for.....	48
K	
Kerosene Emulsion, Recipe for.....	56

L

	Page.
<i>Lachnosterna fusca</i>	74
<i>Lachnosterna rugosa</i>	74
<i>Lachnosterna tristis</i>	74
Lantern Traps, Experiments with.....	74
Lawn, White Grubs in.....	74
Letters Written by Entomologist.....	23
<i>Leucania unipunctata</i>	59
Lime-Sulphur Wash, Recipe for.....	53

M

Maple Scale.....	54
March, Work in.....	43
Minnesota Diptera, Additional.....	79

N

November, Precautions to be Taken Against Insects.....	51
Nursery Inspection.....	26
Nursery Laws.....	28
Nursery, Spraying of.....	38

O

October, Work Against Insects for.....	51
Onion Maggots, Two.....	19
Orchard, Spraying of.....	38

P

<i>Papaipema nitela</i>	61
Paris Green Solution, Recipe for.....	52
<i>Peridroma saucia</i>	64
Plum, Soft Scale of.....	57
Publications since 1895.....	82
<i>Pulvinaria innumerabilis</i>	54

S

September, Work Against Insects for.....	51
"Silver Fish".....	70
Soft Scale of Plum.....	57
Soft Scale of Plum, Parasites of.....	58
Soft Scale of Plum, Remedies for.....	58
Spraying in Nursery and Orchard.....	38
Stalk Borer.....	61

T

Tent Caterpillars.....	41
------------------------	----

W

White Grub in Lawn.....	74
-------------------------	----

The Entomologist of the Experiment Station is always glad to answer inquiries relative to insect pests. Samples of injury and insects themselves should always be sent with the inquiry, and a statement of the nature and extent of the depredation. Postage on such matter is 1c. for each ounce. Insects should be inclosed in tight tin or wooden boxes, sealed. It is not necessary to leave any openings in the package. Write your name and address plainly on the package, so that it may be referred to the proper correspondence. It is against the law to enclose a letter in such a package. Do not send insects in glass bottles or vials, and do not send them loose in letters, or in pasteboard boxes.

Telephone, Twin City, Park 6158.

Telegraph address, Minneapolis, and request them to 'phone the message to Experiment Station.

Express address, St. Anthony Park, via St. Paul.

Specimens and inquiries regarding insects should be addressed to

THE ENTOMOLOGIST,

Experiment Station,

St. Anthony Park, Minn.