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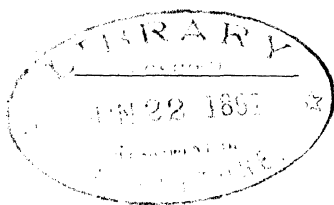
Commonwealth of Massachusetts.

STATE BOARD OF AGRICULTURE.

GYPSY MOTH DEPARTMENT.

BULLETIN OF INFORMATION.

JUNE, 1891.



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A DANGEROUS INSECT PEST IN MEDFORD.

FROM SPECIAL BULLETIN HATCH EXPERIMENT STATION, NOVEMBER,
1889, C. H. FERNALD.

THE GYPSY MOTH (*Ocneria dispar* L.).

“ On the 27th of last June, during my absence in Europe, several caterpillars were received at the Station, from Hon. William R. Sessions, secretary of the Board of Agriculture, with the request for information as to what they were and the best methods of destroying them. These caterpillars were brought into the secretary's office by Mr. John Stetson of Medford, Mass., who stated that they were very destructive in that town, eating the leaves of fruit and shade trees. Mrs. Fernald, who had charge of the entomological work during my absence, determined the insect to be the gypsy moth (*Ocneria dispar* Linn.) of Europe, but as the moths were emerging and laying their eggs for next year's brood, there was nothing to recommend at that time except to destroy the moths and their eggs as far as possible, and prepare for the destruction of the caterpillars when they first appear next spring.

First Importation into America.

“ There is a statement in the second volume of the American Entomologist, page 111, published in 1870, and also in Riley's Second Missouri Report on Insects, page 10, that ‘ only a year ago the larva of a certain owlet moth (*Hypogymina dispar*), which is a great pest in Europe both to fruit trees and forest trees, was accidentally introduced by a Massachusetts entomologist into New England.’

“These are the only notices I have thus far been able to find of the introduction of this insect into America. Mr. Samuel Henshaw and Dr. Hagen of Cambridge have both informed me that the entomologist who introduced this insect was Mr. L. Trouvelot, now living in Paris, but at that time living near Glenwood, Medford, where he attempted some experiments in raising silk from our native silk worms, and also introduced European species for the same purpose. Dr. Hagen told me that he distinctly remembered hearing Mr. Trouvelot tell how they escaped from him after he had imported them.

“It seems, then, that this was an accidental introduction, but that they have now become acclimated, and are spreading and doing so much damage as to cause very great alarm.

Distribution.

“The gypsy moth is abundant in nearly all parts of Europe, northern and western Asia, and it even extends as far as Japan. . . . (In this country it has been found only in nineteen cities and towns of Massachusetts. The whole of Medford, Malden and Everett and sections of Arlington, Melrose, Somerville, Cambridge and Chelsea are thoroughly infested, while in Stoneham, Winchester, Belmont, Saugus, Revere, Lynn, Lexington, Swampscott, Wakefield, Burlington and Charlestown they have been found more or less prevalent.)

Food Plants.

“The food plants of this insect given in Europe are apple, pear, plum, cherry, quince, apricot, lime, pomegranate, linden, elm, birch, beech, oak, poplar, willow, hornbeam, ash, hazel-nut, larch, fir, azalea, myrtle, rose, cabbage and many others. Curtis, in his *British Entomology*, states that they are sometimes very destructive in gardens. Prof. W. P. Brooks reported this insect as very abundant in Sapporo, Japan, in 1883, and gave strawberry as a food plant in addition to those mentioned above.¹¹

“(It has been ascertained by experiment at the office of the Gypsy Moth Department in Malden, Mass., that they will feed on the following-named trees and plants: maple, elm,

willow, horse chestnut, balm of gilead, birch, ash, sycamore, walnut, oak, basswood, witch hazel, pine, spruce, cedar, hemlock, apple, peach, cherry, pear, quince, blackberry, currant, barberry, grape, whortleberry, blueberry, strawberry, hop, cabbage, beet, lettuce, radish, corn, dandelion, woodbine, tulip, hawthorn, azalea, rhododendron, wistaria, hollyhock, wygelia, syringa, rose and Japan quince.)

Danger of Spreading.

“The fact that this insect has now been in this country for the last twenty years, and has not only held its own but has multiplied to such an extent as to cause the entire destruction of the fruit crop and also to defoliate the shade trees in the infested region, is sufficient cause for alarm. The citizens of Medford are immediately interested, but the entire Commonwealth and country are threatened with one of the worst insect pests of all Europe. In 1817 the cork-oaks of southern France suffered severely from the attacks of this insect. One of the papers of that time stated that the beautiful cork-oaks which extended from Barbaste to the city of Podenas were nearly destroyed by the caterpillars of the gypsy moth. After having devoured the leaves and young acorns they attacked the fields of corn and millet, and also the grass lands and fruit trees.

“In 1878 the plane trees of the public promenades of Lyons were nearly ruined by this same insect. Only last summer (1889) I saw the moths in immense numbers on the trees in the zoölogical gardens of Berlin, where the caterpillars had done great injury; and the European works on entomology abound with instances of the destructiveness of this insect. When we consider its long list of food plants, we can see how injurious this insect may become if allowed to spread over the country and become established.

“The opinion was expressed to me by prominent entomologists in Europe, that if the gypsy moth should get a foothold in this country it would become a far greater pest than the Colorado potato beetle, because it is so prolific, and feeds on so many different plants, while the potato beetle confines itself to a small number.”

How to Destroy Them.

“All the masses of eggs should be scraped from the trees and other places where the females have deposited them and *burned*. Crushing is not sufficient, as possibly some might escape uninjured. This should be done in the fall, winter or early spring, before the eggs hatch. It is not at all probable that one will find all the egg-masses, even with the most careful searching on the trees in a small orchard; but when one remembers that this insect deposits its eggs on all kinds of shade and forest trees also, it appears a hopeless task to exterminate this pest by an attempt to destroy the eggs. It is a habit of these caterpillars, after they have emerged, to cluster together on the trunks or branches of the trees between the times of feeding, and this affords an opportunity of destroying vast numbers by crushing them; and after they have changed to pupæ they may be destroyed wherever they can be found. The female moths are so sluggish in their flight, and so conspicuous, that they may be easily captured and destroyed as soon as they emerge; yet any one or all of these methods, which have been employed in Europe, are not sufficient for their extermination. At best they will only reduce the numbers more or less according to the thoroughness with which the work has been done. I could not learn that any attempts have ever been made in Europe to destroy this insect by means of poisonous insecticides, and it is to this method that we may look for positive results in this country.

“If all the trees in the infested region be thoroughly showered with Paris green in water, one pound to one hundred and fifty gallons, soon after the hatching of the eggs in the spring, the young caterpillars will surely be destroyed, and if any escape it will be because of some neglect or ignorance in the use of the insecticide. *It will be absolutely necessary to shower every tree and shrub in that region*, for if a single tree be neglected, it may yield a crop sufficiently large to eventually restock the region.

“I can hardly feel confident that all these insects can be exterminated in one year, but if this work of showering the trees be continued during the months of April and May for

two or three years, under competent direction, I have no doubt but that they may be entirely destroyed.

“ This is, in my opinion, the cheapest and surest method of exterminating this pest, but its effectiveness depends entirely upon the thoroughness and carefulness with which it is done, and those who do the work must have authority to shower the trees not only on public but on private grounds. ”

Description of the Insect.

“ The males (Fig. 1) are of a yellowish brown color, with two dark brown lines crossing the forewings, one at the basal third, the other on the outer third, somewhat curved, and with teeth pointing outwards on the veins. The outer end of all the wings is dark brown. A curved dark brown spot (*reniform*) rests a little above the middle of the wing, and a

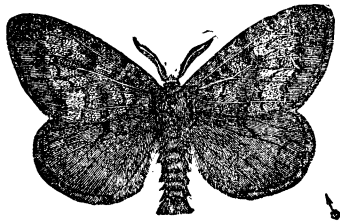


FIG. 1.

small round spot of the same color (*orbicular*) is situated between this and the base of the wing, just outside of the inner cross-line. A similar spot rests near the middle of the base of the wing. The fringes on the forewings are dull yellowish, and broken by eight brown spots. The antennæ are strongly bipectinated, or feather-like. The forewings expand about an inch and a half.

“ The females (Fig. 2) are pale yellowish white, with dark brown cross-lines and spots similar to those of the males. The cross-lines in both sexes are much darker and more prominent on the forward edge of the wings (*costa*) than elsewhere. In some specimens there is a faint stripe of brown across the middle of the wing (*median shade*), and a toothed line across the wing near the outer edge (*subterminal line*). The fringes of the forewings have eight dark spots between the ends of the veins, as in the males, and similar but fainter spots often occur in the fringes of the hind wings.

The body is much stouter than in the males, and the antennæ are not so heavily feathered. The expanse of wings is from one and three-fourths to two and three-fourths inches.

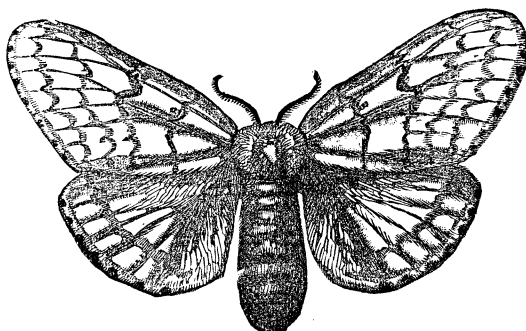


FIG. 2.

“ The eggs are globular, about one-eighteenth of an inch in diameter, nearly salmon colored and with a smooth surface. They are laid on the under side of the branches, on the trunks of the trees, often below the surface of the ground, where the latter has shrunk away from the tree, and not infrequently on the fences or on the sides of buildings. They are laid in oval or rounded masses, often to the number of four hundred or five hundred, and covered with ochre yellow hairs from the abdomen of the female. The eggs are laid in the early part of July, but do not hatch till the following spring. The caterpillars remain together, feeding upon the leaves, and when not feeding they habitually rest side by side on the branches and trunks of the trees.

“ The full-grown caterpillar (Fig. 3) is about an inch and three-fourths in length, very dark brown or black, finely

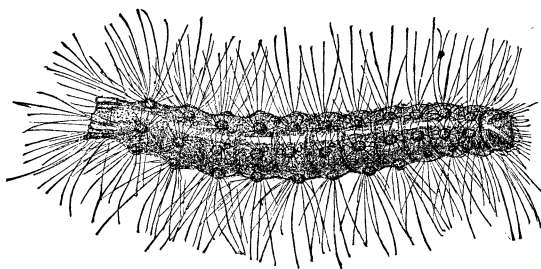


FIG. 3.

reticulated with pale yellow. There is a pale yellow line along the middle of the back and a similar one along each

side. On the first six segments following the head there is a bluish tubercle armed with several black spines on each side of the dorsal line, and on the remaining segments these tubercles are dark crimson red. In the middle of the tenth and eleventh segments there is a smaller red tubercle notched at the top. The whole surface of the body is somewhat hairy, but along each side the hairs are long and form quite dense clusters.

“The pupa (Fig. 4) is from three-fourths of an inch to an inch in length, and varies in color from chocolate to reddish brown. On each side, at the base of the wing-covers, is a dark reddish brown, oval, velvety spot. The wing-cases are quite broad and reach to the posterior third of the fifth segment. The antennæ cases are strongly curved, and are quite wide in the middle. There are a few yellowish brown hairs

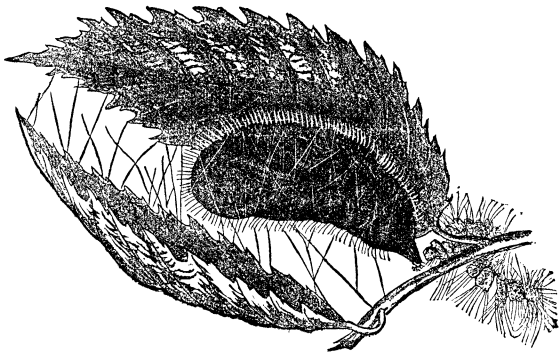


FIG. 4.

on the face and head, also on the first five segments, arranged in broken circles or clusters, which are in longitudinal and transverse rows. The *cremaster* or spine at the posterior end is flattened, rounded at the outer end, grooved longitudinally, and has twelve or more minute hooks at the end. The moths emerge from the pupæ from the first to the middle of July.”

The foregoing was prepared by Professor Fernald from knowledge acquired largely from European sources. Observation in this country shows some slight variation in dates of transformation, size of insect in the various stages, etc.

The eggs hatch here later, and consequently spraying cannot commence until May and must be continued through June.

AN ACT TO PROVIDE AGAINST DEPREDACTIONS BY THE INSECT KNOWN AS THE *OCNERIA DISPAR* OR GYPSY MOTH.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. The State Board of Agriculture is hereby authorized, empowered and directed to provide and carry into execution all possible and reasonable measures to prevent the spreading and to secure the extermination of the *Ocneria dispar* or gypsy moth in this Commonwealth; and to this end said State Board of Agriculture shall have full authority to provide itself with all necessary material and appliances and to employ such competent persons, servants and agents as it, said State Board of Agriculture, shall from time to time deem needful in the execution of the purposes of this act; and said State Board of Agriculture shall also have the right itself or by any persons, servants or agents employed by it, said Board, under this act to enter upon the lands of any person.

SECT. 2. The owner of any land so entered upon, who shall suffer damage by such entry and acts done thereon by said State Board of Agriculture, or under its direction, may recover the same of the city or town in which the lands so claimed to have been damaged are situate by action of contract; but any benefits received by such entry and the acts done on such lands, in the execution of the purposes of this act, shall be determined by the court or jury before whom such action is heard, and the amount thereof shall be applied to the reduction of said damages, and the Commonwealth shall refund to said city or town one-half of the amount of the damages recovered.

SECT. 3. Said State Board of Agriculture shall have full authority to make from time to time such rules and regulations in furtherance of the purposes of this act as it shall deem needful; which rules and regulations shall be published in one or more newspapers published in the county of Suffolk; and copies of such rules and regulations shall be posted in at least three public places in each city or town in which said *Ocneria dispar* or gypsy moth shall be found by said State Board of Agriculture to exist, and a copy thereof shall be filed with the city clerk of each such city, and with the town clerk of each such town; and any person

who shall knowingly violate any of the provisions thereof shall be punished for each violation by a fine not exceeding twenty-five dollars.

SECT. 6. Any person who shall purposely resist or obstruct said State Board of Agriculture or any persons, servants or agents employed by it under this act, while engaged in the execution of the purposes of this act, shall be punished by a fine not exceeding twenty-five dollars for each offence.

SECT. 7. It shall be unlawful for any person knowingly to bring the insect known as the *Ocneria dispar* or gypsy moth, or its nests or eggs, within this Commonwealth; or for any person knowingly to transport said insect, or its nests or eggs, from any town or city to another town or city within this Commonwealth. Any person who shall offend against the provisions of this section of this act shall be punished by a fine not exceeding two hundred dollars or by imprisonment in the house of correction not exceeding sixty days, or by both said fine and imprisonment.

SECT. 8. The said State Board of Agriculture may exercise all the duties and powers herein conferred upon said Board by and through its secretary and such members of said Board as said Board may designate and appoint to have in charge, in conjunction with its secretary, the execution of the purposes of this act.

At a special meeting of the State Board of Agriculture held April 28, 1891, to consider an act of the Massachusetts Legislature, entitled "An Act to provide against depredations by the insect known as the *Ocneria dispar* or gypsy moth," and to provide for carrying out the provisions of said act, it was

Voted, That Wm R. Sessions, N. S. Shaler and Francis H. Appleton be a committee of the Board to exercise all the duties and powers conferred by the above-mentioned act upon the State Board of Agriculture.

WM. R. SESSIONS,
Secretary.

In view of the prejudice of many people against the use of Paris green in spraying their trees and shrubs, the following extracts from Bulletin No. 13, April, 1891, of the Hatch Experiment Station, Amherst, Mass., and Bulletin No. 53, August, 1889, of the Agricultural College Experiment Station of Michigan, and the fourth report of the United

States Entomological Commission, together with a statement of Prof. C. V. Riley, entomologist of the United States Department of Agriculture, are appended as samples of the opinions and experience of the most reputable scientists and experiment station directors of this country.

* “The destruction of our fruits to so large an extent for the past few years by fungous pests and insects shows us the *necessity* of using every remedy that we know of for the destruction of the causes of this loss.

“The many letters received at this Station asking for specific instructions relating to the use of the best known fungicides and insecticides have led to the issue of this bulletin.

“Our information is based upon the experiments made at this Station, those of the Department of Agriculture at Washington, the work of many other stations of the country, and the practice of the large orchardists and vineyardists of the country, who have made successful use of the remedies.

“The time which experiments have been carried on in this line has not been sufficient to decide *in every case* and under *all conditions*, what may be the most economical and the safest remedy or mode of application, but enough has been learned to warrant the recommendation of the use of a few of the best known remedies, and we feel confident that if the directions are carefully followed and no unusual conditions present themselves, great benefit may be derived from their use.

Treatment for the Apple.

1. As soon as the petals have fallen, spray with the Bordeaux † mixture and *Paris green*, one pound to two hundred gallons of the mixture, for the insects and apple scab.
2. Apply the same mixture again in eight or ten days. Should it have *rained hard* within a few days of either spraying, another application must be made at once.
3. In about two weeks spray again with the same mixture.

* Prof. S. T. Maynard, in Bulletin No. 13, April, 1891, of the Hatch Experiment Station of the Massachusetts Agricultural College.

† BORDEAUX MIXTURE (*Formula*).—Dissolve six pounds copper sulphate in two or three gallons of hot water. (If in a powdered form it will dissolve readily in cold water.) Slake four pounds of fresh caustic lime in water enough to make a thin whitewash. When both are cool, pour the two mixtures together, stirring thoroughly, then add water enough to make twenty-five gallons of the mixture. Strain through a fine wire or cloth strainer before using.

Treatment for the Pear.

1. When the fruit has set, *i. e.*, the petals have fallen, spray with the Bordeaux mixture and Paris green.
2. Repeat the spraying in eight or ten days.
3. Spray again with same mixture in two weeks.

Treatment for the Plum.

1. As soon as the petals have fallen, use the Bordeaux mixture and Paris green.
2. Spray again in eight or ten days.
3. Spray again in two weeks.

Treatment for the Grape.

1. Just before the blossoms open, use the Bordeaux mixture and Paris green for the 'rose beetle.'
2. Use the same mixture eight or ten days later, or as soon as the fruit has set.

Treatment for the Strawberry.

1. Apply the Bordeaux mixture and Paris green as soon as the leaves begin to grow vigorously.
2. Use the Bordeaux mixture and Paris green just before the first blossoms open.
3. After the fruit has been gathered, if the bed is to be continued, make one application of the above mixture. The Paris green is included to destroy the '*crown borer*,' which is injurious in some sections."

Injury to the Foliage.

* "Another practical question of no small moment in this use of the arsenites refers to injury to the foliage of the trees treated. In an elaborate series of experiments the past season we desired to learn the effect on different trees of the different arsenites, and whether the date of treatment and atmospheric condition had any influence. . . . I think we are warranted in the following conclusions: *First*, London purple is more injurious to the foliage than is Paris

* Prof. A. J. Cook, in Bulletin No. 53, August, 1889, of the Agricultural College of Michigan Experiment Station.

green; and white arsenic — arsenious acid — is more harmful than is either London purple or Paris green. . . . It would seem that spraying soon after the foliage puts out is less harmful than when it is delayed a few days. For ten years I have sprayed both apple and plum trees in May, and for several years with London purple, and often used a mixture as strong as one pound to one hundred or even fifty gallons of water; yet in most cases no damage was done.

Poisoning the Pasture under the Trees.

“ Another important practical question which I have tried to settle this season, 1889, concerns the danger of pasturing under trees which have been sprayed with the arsenites. A gentleman wishing to spray his orchard, in which he was pasturing seventy-five hogs, consulted me as to the wisdom of doing so without first removing the swine. I told him I believed there was no danger. I said use a mixture, one pound of London purple to two hundred gallons of water, watch your hogs closely and if any seem affected remove all at once, and I will be responsible for damages to the amount of twenty-five dollars. The gentleman did so and reports no damage.

“ In the following experiments I used the mixture twice the strength which should be used, that the experiment might be the more convincing. I used one pound to one hundred gallons of water. In every case the spraying was very thoroughly done. Care was taken that every twig and leaf should be drenched.

“ In tree number one a thick paper was placed under one-half of a rather small apple tree. The space covered was six by twelve feet, or seventy-two square feet. The paper was left till all dripping ceased. As the day was quite windy the dripping was rather excessive. In this case every particle of the poison that fell from the tree was caught on the paper. Dr. R. C. Kedzie analyzed the poison and found four-tenths (.4) of a grain. Tree number two was a large tree with very thick foliage. Underneath this tree was a thick carpet of clover, blue grass and timothy just in bloom. The space covered by the tree was fully sixteen feet square, or equal to two hundred and fifty-six

square feet. As soon as all dripping had ceased the grass under the tree was all cut, very gently and very close to the ground. This was taken to the chemical laboratory and analyzed by Dr. R. C. Kedzie. There was found two and two-tenths grains of arsenic. Now as our authorities say that one grain is a poisonous dose for a dog, two for a man, ten for a cow and twenty for a horse, there would seem to be small danger from pasturing our orchards during and immediately after spraying, especially as no animal would eat the sprayed grass exclusively. To test this fully, I sprayed a large tree over some bright tender grass and clover. I then cut the clover carefully, close to the ground, and fed it all to my horse. It was all eaten up in an hour or two, and the horse showed no signs of any injury. This mixture, remember, was of double the proper strength, was applied very thoroughly, and all the grass fed to and eaten by the horse. This experiment was repeated with the same result. I next secured three sheep. These were kept till hungry, then put in a pen about a tree under which was rich, juicy June grass and clover. The sheep soon ate the grass, yet showed no signs of any injury. This experiment was repeated twice with the same result. It seems to me that these experiments are crucial and settle the matter fully. The analyses show that there is no danger; the experiments confirm the conclusion.

“Thus we have it demonstrated that the arsenites are effective against the codling moth, that in their use there is no danger of poisoning the fruit, and when used properly no danger to the foliage, nor to stock that may be pastured in the orchard.”

* “Not only hundreds of tons, but thousands of tons of these mineral poisons have been employed during the past decade by farmers throughout the country, whether to protect the potato crop, or the cotton crop, or other products of the soil from the ruinous attacks of insects. The general experience during this long period and over the whole country is so emphatically in favor of their use, and their perfect safety and harmlessness, with ordinary precautions, as to render

* Fourth Report United States Entomological Commission.

almost laughable the objections of the few persons referred to. No advancement, no improvement, no general benefit to the human race is ever accomplished without some attendant danger, and those who inveigh against such improvements as increasing the risks to life stand on the same footing as the opponents to arsenical poisons as insecticides."

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY, WASHINGTON, D. C., May 26, 1891.

Mr. WM. R. SESSIONS, *Secretary Massachusetts State Board of Agriculture, Boston, Mass.*

DEAR SIR:— Your favor of the 21st instant duly received. In reply I may state that . . . I consider that the prejudice you refer to (against the use of Paris green in spraying), on the part of Massachusetts fruit growers, is totally unjustified, from a long experience covering some fifteen years; and while I do not advise recklessness in its use, I feel no hesitation in saying that its use in the manner and for the purpose which you have in mind (spraying with Paris green to destroy the gypsy moth) involves no danger to man or beast if proper care be taken in the mixing and spraying.

Yours very truly,

(Signed)

C. V. RILEY,
Entomologist.