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## The Hessian Fly.

OBSERVATIONS COMMUNICATED BY

E. G. HERRICK, LIBRARIAN OF YALE COLLEGE.

The insect commonly called the *Hessian fly*, which has for so many years ravaged the wheat-fields of our country, appears to have been wholly unknown here before the American revolution. It is usually stated that the insect was first noticed in the year 1776 or 1779, on Staten Island and the westerly end of Long Island, and was generally supposed to have been introduced among straw brought hither by the Hessian troops in the service of Great Britain. The ravages of the insect soon attracted general attention; and as early as the year 1788, serious apprehensions were excited in England that the destroyer might be conveyed thither in some cargo of wheat. The alarm there was so great, that the government took up the matter; the privy council sat day after day, anxiously debating what measures should be adopted to ward off the danger of a calamity more to be dreaded, as they well knew, than the plague or pestilence; expresses were sent off in all directions to the officers of the customs at the outports, respecting the examination of cargoes; despatches written to the ambassadors in France, Austria, Prussia and America, to gain that information, of the want of which they were now so sensible; and so important was the business deemed, that the minutes of the council, and the documents collated, filled upwards of 200 octavo pages." (Kirby and Spence, p. 50.) On the 25th of June of that year, an order in council was issued, prohibiting the entrance into Great Britain of wheat raised in any of the territories of the United States; intending, by this measure, to keep out the much-dreaded enemy. Soon after the arrival of the news of this order, the supreme executive council of Pennsylvania addressed a letter of inquiry to the "Philadelphia Society for promoting Agriculture," who promptly replied that the plant of the wheat alone was injured, and that the insect was not propagated by sowing the grain which grew on fields infected with it.—The prohibition was doubtless based on the erroneous representation of Sir Joseph Banks and Dr. Blagden, which they continued to enforce even after they were better instructed by Dr. Currie. It is sufficiently remarkable, that, although the wheat was prohibited an "entry," it was allowed to be stored; so that the Hessian fly, if concealed among the grain, would, after all, have had a good opportunity to escape into the country. In eight or ten months, the government bought the imprisoned wheat at prime cost, kiln-dried it, and resold it at great loss, and almost immediately took off the prohibition. (Memoir of Currie, ii, 65.)

In the course of a few years after this, the Hessian fly was found in every part of our country where wheat was cultivated. From the period of the revolution down to the present time, no insect in the land has received so much public attention, or has called out so many volumes of pages of observation and speculation. These are to be found scattered through magazines, agricultural journals, and common newspapers. But, in defiance of them all, the Hessian fly continues its destructive work, and is probably as little under the actual control of man as it was half a century ago.

Whether this insect was an original inhabi-

tant of the country, or was imported by the Hessian soldiers, is a question not yet settled. At the time of the discussion which led to the prohibitory order, an extensive inquiry in Europe resulted in the conclusion that the insect was wholly unknown there. Yet, in the year 1834, it was found existing in several places in southern Europe, and injuring the wheat in the same manner as in this country. This important discovery was made by my friend, Mr. James D. Dana, who had previously been engaged with me in the examination of the Hessian fly, and was well qualified to decide upon the case.—(American Journal of Sciences, xli, 153.) Moreover, we have an account from the vicinity of Geneva, in Switzerland, reported by Duhamel, of an insect destroying the wheat there as long since as 1732, in the manner of the Hessian fly; and an account, in 1723, by Raddi, of what is probably the same insect, in various places in Italy. No traces have been detected of any insect of the habits of the Hessian fly, in our country, earlier than the year 1776; and if this insect is a native of North America, what plant sustained it before wheat, rye and barley, were imported? On the other hand we have no proof that the Hessian fly was ever found in Germany; and it is certain that if the wheat were reaped in the ordinary manner, nearly all the available insects would be left in the stubble; and further, the straw alleged to have been brought by the Hessians must have been that which ripened in the summer of 1775, and from which most of the insects which it contained would have escaped before August, 1776. On a question of such uncertainty, no one need quarrel with another's opinion.

The first scientific description of the Hessian fly was published in the Journal of the Academy of Natural Sciences of Philadelphia, for July, 1817, (No. 3, i, 45,) by the late distinguished entomologist, Thomas Say. He there gives it the systematic name of the *cecidomyia destructor*; and to this description adds a few remarks relative to its habits, and furnishes, also an account of another insect, by which the fly is often destroyed. Without going into a minute and tedious technical description, the following account is offered, as probably sufficient to enable an observer to identify the insect in its various transformations: The Hessian fly is a two-winged insect, with head, eyes, and thorax, black; the head is small and depressed; the palpi (or mouth feeders) are three or four jointed—the basal one being the smallest; antennæ are about half as long as the body, and consist each of from 14 to 17 oval joints, besides the basal joint which appears double; the wings are large, hairy, rounded at the tip, and have each two or three longitudinal nerves; the abdomen is of a tawny red, and furnished, irregularly, with many black hairs; consists of seven rings and segments, besides the ovipositor, which is of two sides, and of a rose-red color; the ovipositor, when extended to the utmost is about one-third as long as the abdomen; the length of body, from the front of the head to the end of the abdomen, about one-eighth of an inch; the legs are long and slender, pale red and covered sparsely with dark hair. The male is equal in size to the female, but generally less black, with antennæ somewhat longer, and about three-fourths the length of the body. The joints of the antennæ are globular, and slightly separated from each other. Several other species of the genus *cecidomyia*, or one closely allied to it, are common in this region. But the Hessian fly is the largest and darkest of our species, with which I am acquainted.

The eggs are laid in the long creases or furrows of the upper surface of the leaves (i. e. the blade or strap-shaped part) of the young wheat plant. While depositing her eggs, the insect stands with her head towards the point or extremity of the leaf, and at various distances between the point and where the leaf joins and surrounds the stalk. The number found on a single leaf varies from a single egg up to thirty, or even more. The egg is about a fifth of an inch long, cylindrical, rounded at the ends, glossy and translucent, of a pale red color, becoming, in a few hours, irregularly spotted with deeper red. Between its exclusion and its hatching, these red spots are continually changing in number, size, and position; and sometimes nearly disappear.

A little while before hatching two lateral rows of opaque white spots, about ten in number, can be seen in each egg. In four days, more or less, according to the weather, the egg is hatched; the little wrinkled maggot, or larva, creeps out of the delicate membranous egg-skin, crawls down the leaf, enters the sheath, and proceeds along the stalk, usually as far as the next joint below. Here it fastens, lengthwise and head downwards, to the tender stalk, and lives upon the sap. It does not gnaw the stalk, nor does it enter the central cavity thereof; but, as the larva increases in size, it gradually becomes imbedded in the substance of the stalk. After taking its station, the larva moves no more, gradually loses its reddish color and wrinkled appearance, becomes plump and torpid, is at first semi-transparent, and then more and more clouded with internal white spots; and, when near maturity, the middle of the intestinal parts is of a greenish color. In five or six weeks (varying with the season) the larva begins to turn brown, and soon becomes of a bright chestnut color. In this state, the insect bears some resemblance to a flax-seed; and many observers speak of this as the *flax-seed* state. The larva has now become a chrysalis, or pupa, and takes no more food. The pupa within gradually cleaves off from the outer skin, and, in the course of two or three weeks, is entirely detached from it, so that the skin of the larva (now brown and hardened, and of a sort of leather texture,) has become a case or shell for the pupa inside. The pupa shell is, of course, in size and form, like the larva: it is oval, bulging out beneath, and of the same curve above as the outside of the stalk; divided by cross lines into twelve segments, and is about an eighth of an inch long. Within this shell the pupa gradually advances towards the winged state; it contracts in length, but not in breadth; and its skin appears covered with minute elevations. Just before evolution, we find the pupa invested in a delicate membrane, or scarf, (which, not long previous, was its outer skin,) through which many parts of the future fly may be distinctly seen. Finally, this scarf splits along the thorax, or back, and the insect comes forth, both from this and the pupa shell, a perfect two-winged fly.

This is, in brief, the history of an individual which has been so fortunate as to escape all the numerous enemies with which its race is surrounded from the moment the egg is deposited; but of these, more hereafter.

In the northern and middle States, at least, winter wheat is sown in September or October. Soon after the plants have appeared above ground, the Hessian fly begins to lay her eggs upon them; and this operation is continued during several weeks, according to the season.—The eggs laid on the green leaves are in a few days hatched, and the young larvæ crawl down the stalk, and take their stations; generally clustering around the stalk at the nearest joint below. Here, by sucking of the plant, they increase in size, become full and hard, and, pressing deeply into the stalk, they impair its growth; and if their number about one joint is large, the stalk is killed. Frequently the plant, although impoverished, advances far enough to head out; but when the grain begins to fill, its own weight, or perhaps the wind, causes the stalk to break down. The injury done to the wheat is occasioned by the exhaustion of the sap, and by the pressure on the yielding-stalk.

In five or six weeks the larvæ stop feeding, the outer skin turns brown, and within this brown and leathern case the pupæ pass the winter—generally a little below the surface of the earth. In April and May the fly is again found depositing her eggs on the same wheat, (viz: that from grain sown the preceding autumn,) and also on the spring wheat which has just come up. These eggs hatch, and the larvæ therefrom operate in the same manner as those of the autumn previous. These larvæ become pupæ about the middle of June. The flies which lay their eggs in the spring are probably in part from the pupæ which became such late in the preceding autumn, and partly from pupæ contained in stubble left the preceding summer. The period of the existence of the Hessian fly in the pupæ or flax-seed state is exceedingly variable. After much observation, my own opinion is, that, in general, pupæ which become such late in the autumn evolve

the winged insect partly during the next spring, and partly in the summer and autumn following. Those pupæ which become such about June, evolve the winged insect partly during the next autumn and partly during the year succeeding.

The Hessian fly is attacked by numerous foes, which, in various stages of its existence, destroy a large part of every generation.—Whether it has, in its winged state, any enemies, except the ordinary destroyers of flies, I know not. The eggs, while lying on the leaves of the young plant, are visited by a very minute four-winged insect, (a species of *platygaster*), which lays in them its own eggs. From later observation, it appears that, occasionally, as many as five or six eggs of this parasite are laid in a single egg of the Hessian fly. The latter egg hatches and becomes a pupæ, as usual; but from the pupæ case, instead of the Hessian fly, issues one or more of these minute parasites.

The pupæ, while imbedded in the stalk, are attacked by at least three different minute parasites, (four winged hymenoptera,) which, boring through the sheath of the stalk, deposit their eggs in the body within; and the latter is finally devoured by the parasite larvæ. These are the principal means by which the multiplication of the Hessian fly is restrained within tolerable limits.

Although the loss annually sustained by the wheat growers of this country, in consequence of the ravages of the Hessian fly, is severe, yet it is well nigh impossible to ascertain even its probable amount. As long since as 1800, Dr. S. L. Mitchell, of New York, affirmed that the "insect is more formidable to us than would be an army of 20,000 Hessians." In 1804, President Dwight, of Yale College, remarked that "this insect is feeble and helpless in the extreme, defenceless against the least enemy, and crushed by the most delicate touch; yet, for many years it has taxed this country, annually, more, perhaps, than a million of dollars." At the present day, the amount of the injury inflicted, probably exceeds what it was forty years since; and to discover some feasible mode of exterminating the insect, or at least of arresting its ravages, is an object of great importance to this country.

Various remedial measures have, from time to time, been proposed; most of which I will here state.

1st. Steeping the seed-wheat in elder juice, solution of nitre, boiling water, or other liquids; or rolling in lime, ashes, or some other substance, in order to kill the eggs. But as the eggs of the Hessian fly are not on the seed, they will never be hurt by such processes. So far as these means give vigor to the plant, they may be of some little service.

2d. Sowing seed obtained from places in which the insect has not made its appearance, (American Museum, iv, 57.) This recommendation also assumes the error, that the eggs are laid on the grain, and will be found, as it has often proved, useless as respects this insect.

3d. Abstaining rigidly throughout the whole grain-growing region of North America from planting wheat, rye, barley, or oats, for one, two, or three years, and thus starve out the insect! This plan might be effectual, but would obviously involve some inconveniences.

4th. Manuring the land very highly, so that the plants will grow vigorously, and the sooner out of the way of the insect, and also better able to resist it. This proposal has some merit, but does nothing towards destroying the insect.

5th. Sowing some variety of bearded wheat, &c., supposed to have a harder and more solid stalk than common wheat, and better able to withstand the impression of the larvæ. A suggestion of some value, but, equally with the 4th, leaves the insect unharmed.

6th. Fumigating the wheat field, and sprinkling the young wheat with infusion of elder and with other steeps. If successful, which is quite uncertain, it is plain that these measures are impracticable on a large scale.

7th. Sowing winter wheat very late in the autumn, so that the fly shall have mostly disappeared before the plants are large enough to be attacked. No doubt this plan is to some extent useful, but the wheat sown late is in great danger of perishing during the winter. The fly will of course attack it in the spring, yet one attack will do less damage than two.

8th. Sowing oats early in the autumn on the intended wheat field, it is supposed the fly will lay its eggs on the plant: then let them be ploughed in, and the wheat sown. The fly having nearly exhausted itself on the oats, the wheat will suffer less. This plan may possibly be of some partial utility.

9th. Drawing a heavy roller over the young wheat both in autumn and spring. This process may be useful in crushing many eggs and larvæ.

10th. Permitting sheep and other animals to graze the wheat-fields while the insects are laying their eggs. By these means, large numbers of the eggs will be devoured with the leaves.

11th. Burning the stubble immediately after harvest, and ploughing in the remains. This is by far the most practicable and effectual mode of exterminating the insect, or, at least of checking its increase. In the stubble are many pupæ of the fly, at this time completely in our power; if, in reaping, the stubble is left high, the fire would sweep rapidly over a field, and destroy nearly all these pupæ; the few which escaped the fire, would, by the plough, be buried so deep as to perish in the earth; mere ploughing in of the stubble must be highly useful. If the two recommendations last named were thoroughly put in practice over the whole country—not only upon wheat, but also on rye and barley, and any other plants attacked by the Hessian fly—the ravages of this insect would, in all probability, ere long, become scarcely worthy of notice.

It may not be improper, in this place, to state that the foregoing account of the habits of the Hessian fly is derived from my own long-continued observations, and that I have moreover endeavored to consult all the papers of any importance which have been published on the subject.

There are in the United States, besides the Hessian fly, several other insects which attack the wheat while in the field. Those persons who assert that the former lays its eggs on the grain in the spike or head have undoubtedly mistaken for the Hessian fly some one of these other insects. The following brief notices of the more important of these enemies, I have abridged from the accounts comprised in Dr. T. W. Harris' "Treatise on some of the insects of New England, which are injurious to vegetation;" (Camb. 1842: 459 pages, 8vo.) a work of great interest and value.

In the inquirer will find a faithful digest of all the reliable information we have on the numerous insects which injure our plants, fruits, and trees; and, in addition, he will learn the means of defence, so far as any have been discovered. The book ought to be in the hands of every intelligent farmer and orchardist.

1. A grain moth, (Angoumois moth—*alucita cerealella*, Oliv.) probably the same as described by Colonel Carter, in the *Transactions of the American Philosophical Society*, volume i, 1771, and by J. Lorain, in Mease's *Archives of Useful Knowledge*, volume ii, 1812. It is about three-eighths of an inch long when its wings are shut. The upper wings are of a light brown satin color and lustre, covering the body horizontally above, but drooping a little at the sides. The lower wings and the rest of the body are ash-colored. The moth lays her eggs usually on the young and tender grain in the field; each caterpillar from these eggs selects a single grain, burrows into it, and remains concealed, devouring the meal within. Subjecting the grain to a heat of 167 degrees Fahr., for twelve hours, in an oven, will kill the insect.

2. The English wheat fly (*tipula tritici*, Kirby,) is a small orange-colored two-winged gnat, which lays its eggs in the head of wheat while blossoming. The maggots from these eggs are without feet, tapering towards the head, at first perfectly transparent and colorless, but soon becoming orange-yellow; and when mature, are each about an eighth of an inch long. It is supposed they devour the pollen, and prevent the setting of the grain; the maggots fall from the spike to the earth, within which they undergo their final transformations. This insect (or one very similar to it) has done much damage in the Northern States and Canada, for several years past; but no effectual mode of preventing the mischief, or of destroying the insect, appears to have been devised.