NOTES ON THE RECENT INVASION OF THE
ARMY WORM.

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INTRODUCTION.

The recent outbreak of the army worm has caused much alarm among farmers throughout the state and also much apprehension as to the probability of another serious invasion this season. Judging from our correspondence there is a general desire among farmers, especially among those who have suffered from the depredations of the caterpillars, to know something of the life-history and habits of the insect. Many are also inquiring if it is advisable to make further effort to prevent the increase of the worms during the remainder of the summer.

With this in mind the following brief bulletin has been written in which the life-history of the insect is given, together with a statement of such facts relating to the invasion as are judged to be of especial interest at this time. The short time necessarily allowed in the preparation of this bulletin precludes anything more than a brief review of the subject.

THE EXPERIENCE OF THIS SEASON.

Extent of the invasion in the state.—During the past three weeks, letters and telegrams have been received at the Station from various sections of the state giving accounts of the ravages of the army worm and asking advice as to the best known methods of checking the onward march of this destructive pest. Circular letters and telegrams were sent in reply giving instructions and suggestions. Up to date letters have been received from twenty-eight counties representing the more important agricultural sections of the state.

Although the attack has been widespread, the damage done seems to have been most keenly felt in those sections of the state which are devoted largely to dairying and stock raising. In these sections oats, corn, rye, wheat, and timothy are extensively grown while thousands of acres are reserved for pasture. Unfortunately the army worm feeds chiefly upon the crops above mentioned and has been especially destructive this year to both corn and oats. Add to this the fact that, owing to the comparatively dry weather during the past two years, the hay crop this season
is unusually light, and it will be readily understood that this invasion of caterpillars has been an especially serious matter to many farmers.

The invasion an unusual one.—This invasion of the army worm is one of the worst in the history of the state. Old residents say they have never before experienced such destruction to their crops by caterpillars of this kind. The amount of damage done would be difficult to estimate. Farmers in various sections of the state report that the oat and corn crops were practically ruined. In many cases the oats were cut and hauled to the barn with the worms still clinging to them. This soon produced such an unhealthy condition in the stacks that removal of the grain to open air was made necessary. Where the caterpillars attacked corn, the crop was usually ruined very quickly unless vigorous efforts were at once made to check the advancing insects.

In other states including Pennsylvania, Massachusetts, New Hampshire, and Michigan a similar invasion is reported. We have sent letters to the Entomologists of the various stations to ascertain the extent of the outbreak.

ACTION THAT IS ADVISED NOW.

Treatment of previously infested fields.—As we shall see later on, the caterpillars are now passing through the pupa stage. They have previously sought shelter under stones, bunches of dried grass, under pieces of board, bits of wood, along the fences under various kinds of rubbish, or have burrowed into the ground to a depth of an inch or two. In each case they have made for themselves snug cells of earth, or bits of rubbish and earth combined, as the case may be. In these retreats the wonderful transformation from an active caterpillar to an apparently lifeless creature takes place.

It is evident that, by destroying these pupæ, the moths will not be allowed to develop. This also means the destruction of many eggs. When practicable, therefore, it is desirable to burn over grass land and stubble where the caterpillars have been. When it is not practical to burn the fields over, and where the surface of the ground is moderately even, a heavy roller may be used to advantage. In addition to this, it is well to clear up all rubbish in the infested fields; also along the fences and in the fence cor-
ners bordering such fields. From our observations in the field, it seems evident that, when about to pupate, the caterpillars not only retreat under stones and rubbish, but that many of them find refuge under the matted grass in the fence corners and around the borders of the fields. In districts where infested fields adjoined the roads and especially where the caterpillars were known to have crossed the road, a careful examination should be made along the fence and under stones, rubbish, etc., along the roadside. If any pupae are found, the infested section should be burned over if it is practicable to do so. Many of the pupae can be gathered by hand and killed by dipping in kerosene oil or by crushing. Where furrows were plowed to check the insects, and especially if the holes were omitted, the dead grass and rubbish along their borders should be carefully examined.

*Crops attacked.*—Although the army worm feeds on a variety of plants, the grasses and grains are its favorite diet. In most cases, corn and oats seem to have suffered most severely. We have observed the caterpillar this season feeding on timothy, corn, oats, rye, barley, wheat, and the report has come to us that in one section of the state, the bean crop was seriously attacked.

*Crops to take the place of corn and oats destroyed by the army worm.*—With many farmers the ravages of the army worm have doubtless caused a serious shortage of fodder crops for fall and winter feeding. There appears to be no way of entirely making good this deficiency from crops which may be produced this season.

In those cases where corn was intended to be used as a fall soil-ing crop, barley and peas may be grown as a partial substitute. This mixture may be sown as late as August 10th at the rate of two bushels each of barley and peas. The crop is not injured by frost and will furnish green fodder during October.

If more is grown than what can be fed green, the excess may be preserved in the silo with fair success, although the silage will be inferior in quality to corn silage.

Where crops are destroyed by the army worm as early as the first week in July, Hungarian, if sown at once, will produce an abundant crop which may either be fed green or cured for hay.
LIFE-HISTORY.

Name and classification.—The popular name "army worm" comes from the abnormal habit of the caterpillars, or "worms," as they are incorrectly called, of moving in great armies in search of food. The scientific name of this species is probably Leucania unipuncta, although it has been suggested that this may be the species known as Leucania albilinea or, popularly, the wheat-head army worm as, when attacking wheat, barley, or rye, many of the heads are found cut off by the caterpillars. These army worms belong to a large family of insects known as the Noctuidae, which includes the night flying moths. It is also interesting to note that this insect is closely related to some of our most destructive cutworms.

Some habits of the army worm, Leucania unipuncta.—Although unsuspected by most of us, the army worm is present in some of our fields every year. The grass land is its natural home. The caterpillars are usually found in those places where the grass grows most luxuriantly. Here they may remain season after season, one brood following another, feeding unnoticed almost before our eyes. It is not until meteorological conditions are favorable for them, however, that the abnormal increase occurs. It is only at such times that the unusual habit of moving in vast armies is developed. As a rule also, it is said, the caterpillars are usually nearly half grown before the march in search of food begins. They seem to be especially ravenous at this time and the rapidity with which a field of grain may be ruined is truly surprising. An acre or more of corn may be destroyed in a single night. The caterpillars usually feed more rapidly at night than during the day, although they are very active on cloudy days or during the cool of a bright day.

Life-history and descriptions.—The life-history of the army worm, Leucania unipuncta, together with descriptions of the different changes which take place during the life cycle, may be briefly stated as follows: The mature insects are dull brown moths having a white spot in the center of each anterior wing. When the wings are spread a single female moth will measure over an inch and a half from tip to tip. The body is about three-fourths of an inch long.
The eggs are very small, globular in form and nearly white in color. They are usually laid in the leaf sheaths of grasses and grains, the terminal sheath being most frequently selected. According to Dr. Riley* the early brood of moths oviposit freely "in the cut straw of old stacks, in hay ricks and even in old fodder stocks of corn stalks." He also adds that "old bits of corn stalk upon the surface of the ground in pastures have been repeatedly found . . . with hundreds of eggs thrust under the outer sheaths or epidermis, while the last year's stalks of grass in the fields around Washington have been found to contain these eggs in similar position." Dr. Riley also states that, lacking both stubble and fodder stalks, the moths will deposit their eggs in fields of winter grain. In this connection it may be stated that, in several cases with which we are familiar, the caterpillars evidently came from fields of winter rye to attack other crops, leaving the fields very soon after the rye was cut. Dr. Riley found that a single female moth is capable of depositing from five hundred to over seven hundred eggs. This wonderful prolificacy explains in part at least why, under certain meteorological conditions which favor the development of the eggs, the caterpillars appear in such vast numbers. In seasons when the army worms are not unusually abundant it is probable that only a small percentage of the eggs hatch.

The young caterpillars come forth in about ten days from the time the eggs are laid. In case the eggs were placed on fresh grass or grain, the young larvae feed for a time in the sheath where the eggs were placed but finally include the whole blade in the bill of fare. They are full grown in about four weeks. At this time a single larva measures about an inch and a half in length and a quarter of an inch in diameter. They may be briefly described as being smooth, naked caterpillars moderately dark in color with longitudinal stripes running the full length of the body. A broad, dark stripe is especially prominent along each side. Fig. 1 is from a photograph of some of these caterpillars. They are represented as somewhat reduced in size.

The third stage in the insects' life begins when the caterpillars go into the ground or under stones or rubbish to make the wonderful change from an active caterpillar to an apparently lifeless creature. This stage is called the pupa stage or, in the case of butterflies and moths, is more familiarly known as the chrysalis stage. A single chrysalis measures about three-fourths of an inch in length. They are at first light brown in color but soon change to a deep chestnut brown. Fig. 2 is from a photograph of several of these chrysalides. The moths come forth in about two weeks. There are probably two or three broods every year in the more northern states. It is usually only the first brood of the season, however, which occurs in such unusual numbers.
**Hibernation.**—The caterpillars of the last brood of the season are but half grown when winter overtakes them. For protection they hide away under any convenient shelter where they become very sluggish, in which condition they remain until spring. The moths from this brood of caterpillars come forth quite early in the season. As above noted, it is this generation of moths which, under favorable circumstances, produce the vast armies of caterpillars such as we have witnessed this summer.

**NATURAL ENEMIES.**

Fortunately nature takes a hand in checking the onward march of such armies as these. Judging from our observations in the field and from specimens sent us, the present generation of army worms is being seriously crippled by several species of parasites and predaceous insects. We have also found many of the caterpillars attacked by a fatal bacterial disease which seems to resemble the bacterial disease of cabbage worms. In one or two instances it was estimated that twenty-five per cent. were attacked by this disease. Of the parasites referred to, one of the most prominent is a species of Tachina fly. This active little insect resembles a house fly in general appearance. The Tachina fly lays its eggs on the backs of the ill-fated caterpillars just back of the head. Many caterpillars were found with three or four of these small, white eggs attached. Few, if any, such caterpillars reach maturity as the eggs soon hatch into minute white maggots which burrow through the skin to feed on the fleshy tissues beneath. The maggots grow rapidly and soon the unfortunate caterpillars succumb although not until the maggots have had sufficient food to meet their wants. Among the most prominent predaceous insects which were found attacking the army worms, were the fierce larvae of some of our common ground beetles. Some of these larvae grow to nearly the size of the cutworms themselves. They are very active and fight fiercely for the mastery over their prey, which they grasp in their strong jaws and endeavor to hold firmly while sucking the victim's juices. Several species of birds also feed upon the army worm.
Plan E. - View of a cornfield where the army worms were successfully checked by surrows between the rows of corn.
Plate II.—View in a cornfield where a strip about a rod wide was being sprayed with poison to check the army worms. See p. 129. (From a photograph).
METHODS RECOMMENDED FOR CHECKING THE ARMY WORM.

The methods which are usually recommended for checking the army worm are mainly these: Plowing deep furrows around infested fields or around an infested section of a field; also where possible in front of the army of advancing insects. It is better to make the sides of the furrows as near perpendicular as possible and, where the soil will permit, to slant them back, especially the side opposite the infested section. Holes should be dug in the furrows at intervals of from ten to fifteen feet. The caterpillars which fall into the furrows, not being able to get out, will crawl along the sides, finally falling into the holes where they may be easily killed by crushing or by the application of kerosene oil. The caterpillars in the furrows may also be killed by scattering straw over them and burning it, or they may be crushed by a log drawn back and forth through the furrow. Plate I is from a photograph of a field of corn in which the advancing army of caterpillars was successfully checked by furrows plowed between the rows of corn. In this case the soil was light and stony and it would have been a difficult matter to make the sides remain perpendicular. The soil being very loose, however, gave way with the weight of the caterpillars as they attempted to climb up the sides and hence prevented their reaching the top. In this case the furrows were made promptly and hence nearly the entire crop was saved. The caterpillars were first seen in the field of rye shown on the left.

In pasture fields where the surface of the ground is comparatively even and the soil is firm, the caterpillars can be crushed by a heavy roller. Spraying of crops with a strong mixture of Paris green and water may also be resorted to. It is usually unnecessary to spray more than a strip about a rod wide in advance of the caterpillars. Where possible the poisoned portion of the crop should be burned to prevent possible danger of injury to stock. Plate II is from a photograph taken in an infested field of corn showing the work of the poison in protecting the crop. A heavy roller was also used in this field but the soil was too light for the best results by this method.