

Ohio Agricultural Experiment Station.

BULLETIN 96.

WOOSTER, OHIO, SEPTEMBER, 1898.

THE ARMY WORM AND OTHER INSECTS.

WHEAT AND GRASS SAW-FLIES.
THE CORN OR BOLL WORM.
THE PAINTED HICKORY BORER.
THE RASPBERRY CANE BORER.
THE PEACH SCALE.

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BULLETIN
OF THE
Ohio Agricultural Experiment Station.

NUMBER 96.

SEPTEMBER, 1898.

THE ARMY WORM
AND OTHER INSECTS.

BY F. M. WEBSTER AND C. W. MALLY.

INTRODUCTION.

In the ordinary work of the Entomological Department of the Experiment Station, there is continually accumulating a vast amount of information in the way of detached notes and observations, which are not of sufficient moment, in themselves, to warrant publication, at least outside of strictly scientific literature. If we are to await the time when these odds and ends would properly work into the ordinary Station bulletin, many of them would become ancient, or be lost sight of before they would get into print. For this reason, we have thought best to gather up these fragments and include with them a short treatise on the species of insects to which they relate, where such insects have not lately been discussed in the publications of this Station.

In some cases these insects are not especially destructive; in others, they are destructive only at long intervals and in isolated localities, while still others are more or less injurious every year; concerning all of them, however, we are continually called upon to furnish more or less information, as to their habits, etc. When observing any of these insects attacking any object having a commercial value, even though they may be present in most limited numbers, the first questions that arise in the mind of the ordinary husbandman are: Will these increase in numbers and work serious and widespread injury, or will they continue as they are without causing any material injury? These are questions that he will be unable to solve promptly, and upon which he will desire more

information. Even the most destructive insects usually appear, at first, in very limited numbers, and because of not knowing more of their habits, and being unable to separate them from those that are always common but seldom or never destructively abundant, the ordinary farmer or fruit grower allows them to go on increasing until they become quite unmanageable, when, sometimes, though not always, a little foresight might have prevented the outbreak, or at least enabled him to hold such insects in check. It frequently occurs that the further increase of certain injurious insects in fields may be stopped by a simple rotation of crops, by varying the time of plowing or planting of the fields, or by the use of other equally practical methods.

THE ARMY WORM.

Leucania unipuncta Haw.

Ord. LEPIDOPTERA.

Fam. NOCTUIDÆ.

PLATE I; PLATE II, FIG. 1.

This is one of the most common and among the most notorious of all our destructive insects. While it would seem that there is sufficient evidence going to show that it is a native of North America, yet its widespread distribution over the world would imply a possible foreign origin. Outside of North America, it is known to occur in South America, England, Madeira, Australia, New Zealand, Java and India. It is only in Australia, and in the United States and Canada east of the Rocky Mountains, that it has been known to be especially injurious. It is interesting to note that its ways in Australia, so far as known, do not differ materially from those in the United States and Canada.

From time to time in the past history of the country, there have been various accounts of the appearance of vast numbers of worms, and the references to these, though meager, would imply that such might have been army worms. The following references are taken from a report compiled for the Secretary of the State Board of Agriculture of Massachusetts, by Mr. Chas. L. Flint in 1854.

1632. "The worms made extensive ravages on corn."

1646 and 1649 "were caterpillar years."

1666. "The Indian corn eaten by the worms."

1743. "Millions of devouring worms in armies, threatening to cut off every green thing."

1762. "At last, when the corn was planted, millions of worms appeared to eat it up."

1770. "A very uncommon sort of a worm, called the Canker Worm, ate the corn and grass all as they went above the ground, which cut short the crops in many places."

Of these notices, that of 1743 seems to have been settled upon by scientific men as the most authentic, and this might have been the first

outbreak in this country, though it cannot be denied that the depredations of 1646, 1649 and 1762 might very likely be referred to this species.

As relating to the occurrence of 1743 the evidence is very nearly conclusive. John Bartram, in his account of his travels from Pennsylvania to Onondaga, Oswego and Lake Ontario, July 16, 1743, gives this account of his observations, while describing an Indian town, Tohican, on a branch of the Susquehanna River:

"Here I observed for the first time in this journey, that the worms which had done much mischief in several parts of our Province, by destroying the grass and even corn for two summers, had done the same thing here, and had eat off the blades of the maize and long white grass, so that the stems of both stood naked four foot high; I saw some of the naked, dark colored grubs, half an inch long, though most of them were gone, yet I could perceive they were the same that had visited us two months before. They clear all the grass in their way, in any meadow they get into, and seem to be periodical, as the locusts and caterpillar, the latter of which I am afraid will do us a great deal of mischief next summer."

And again later on under date of the 28th he records the information, received from Canada, to the effect that the worms had destroyed abundance of grass and corn in that country.¹

On the title page of Bulletin 133 of Cornell University Agricultural Experiment Station, Mr. M. V. Slingerland has given two extracts from the journal of Rev. Thos. Smith, Falmouth, Maine, which are even more conclusive and are as follows:

"June 27, 1743. There are millions of worms, in armies, appearing and threatening to cut off every green thing; people are exceedingly alarmed."

"July 1, 1743. Days of fasting are kept in one place and another, on account of the worms."

The discovery of the parent of the Army Worm is an honor that belongs to Ohio, as no one seems to have known just what they were like until they were reared by Mr. Kirkpatrick, in 1855, and it was not until 1861 that it came to be understood that this parent of the Army Worm had been described in England fifty years before.

As early as 1825, according to the Third Report of U. S. Entomological Commission, the Army Worm was known to be very destructive to the timothy crop in some parts of the state, and the same thing occurred again in 1835, while Mr. John Kirkpatrick describes their work in 1855 as follows:

"Last season (1855), in consequence of the heavy rains in the early part of June, the flats of the Cuyahoga (Northern Ohio) were flooded. After the subsidence of the water, and while the grass was yet coated with the muddy deposit, myriads of small blackish caterpillars appeared; almost every blade had its inhabitant; no animal could feed upon it without at every bite swallowing several; if a new blade sprung up it was immediately devoured; but, what was more

¹ Observations of John Bartram.

remarkable, the insects did not attempt to remove to land a foot or two higher, but that had not been covered with water."

The year 1861 was the most noted of all of the Army Worm years on account of their appearance in such destructive numbers over such an extent of country. Here, again, in many parts of Ohio the hay and grain crops were entirely destroyed. In 1875 the oats crop was very seriously injured in various parts of the state. Since this time the pest has made its appearance at irregular intervals, and sometimes works serious injury; never, however, appearing in destructive abundance two years in succession, in the same locality. In 1896 the pest occurred in destructive numbers in Ohio and in several other states to the eastward; complaints were received from Williston, Ottawa County; Ashtabula, Ashtabula Co.; Pemberville, Wood Co.; Paulding, Paulding Co. and Crestvue, Hamilton Co.

While this outbreak was distributed generally over the state, most of the occurrences were more or less local, so that the devastations were not wide-spread, though the injury was very severe in many localities.

Of course it is to be understood that the insect is with us in greater or less abundance every year, and in fact its occurrence in destructive numbers appears to be confined to the more northern portions of the United States; but definite estimates of the actual damage done in certain localities during particular years are few. The damage in Western Massachusetts in 1861 was placed at a half million of dollars, and based upon this estimate, Dr. C. V. Riley placed the total loss in twenty states for that year at not far from ten million dollars. The amount of damage done to the oats crop of Illinois and Indiana in 1881 was estimated by the same writer as not far from three-fourths of a million dollars. We know of no other attempts to estimate the financial loss caused by this insect.

DESCRIPTION OF WORM.

The Army Worm, when full grown, is nearly an inch and a half long, of a general greenish-black color, with very distinct stripes along its sides. "Along each side of the body extend three stripes of about the same width; the one just below the spiracles is of a light greenish-yellow with whitish edges; the one bordering on the dorsum is a little darker, with a mottled greenish-black center and narrow white lines along its edges; the central stripe, or the one with the spiracles on its lower edge, is black, sometimes lighter along its center. The dorsum is finely mottled with greenish-black and closely resembles the dark stig-matal stripe in color; along the middle line of the dorsum there extends a narrow white stripe, usually quite indistinct except on the thoracic and anal segments. The six true legs are light brown in color, and each pro-leg is marked with a large, shiny, blackish spot. The head is of a greenish-brown color, rather coarsely mottled with black which merges into distinct blackish stripes along the sutures." The matter in quotation is from Bulletin No. 133, Cornell University Experiment Station.

DESCRIPTION OF THE MOTH.

The parent insect is a moth, Plate II, Fig. 1, the general color of which is clay or fawn, very thickly speckled with black; the veins crossing the forward wings are clearly seen and there is a very distinct white spot near the center; the hind wings are of a dusky brownish color, darker towards the outer margin, and the veins more blackish; the size and form of the adult is shown in Plate II, Fig. 1, *a, b*.

LIFE HISTORY.

It has come to be generally understood that the insect may pass the winter either as an adult moth or in the pupa stage, and Mr. Slingerland suggests that in the state of New York the young worms may also winter over. The moth probably hibernates in old stumps, under loose bark of trees, or about buildings or rubbish wherever it can secrete itself, and while the pupæ would, of course, remain in the ground, the young caterpillars would necessarily pass the winter under matted grass and rubbish unless they should work their way down under the surface of the ground after the manner of young cut worms, which they are not known to do.

Among our notes made here at the Station, we have the following: Nov. 6, 1896, adult moth was captured, the weather being very warm for this season of the year; another adult was observed flitting about the light in the insectary on Dec. 8, 1896. The only way that this last adult could be accounted for, was in the fact that some blue grass sod had been brought in from the field, in early autumn, and that among this was either a pupa or larva which had continued to develop. This shows pretty conclusively that, in the latitude of Wooster, Ohio, 40°.48', the insect may pass the winter either as an adult or in the pupa stage, and if the young worms can withstand the winter of New York there seems no reason why they should not be able to survive the winter of Ohio, although we have no proof that they actually do so.

Dr. C. V. Riley states in his Eighth Annual Report as State Entomologist of Missouri, pages 46-47, that in ordinary seasons the Army Worm is reported along the thirty-second parallel in Texas early in March, and about a week later with each degree of latitude as we advance northward. If this statement is correct, as it certainly appears to be, the Army Worm would be observed in extreme southern Ohio about the first of June and in the northern part of the state about three weeks later. In 1896, however, we have a statement under date of July 13, that they were to be found by the million in the oats fields of the northern central part of Hamilton County, which is in extreme southern Ohio. On the same date, however, we have a statement from Pemberville, in northern Ohio, that these worms were destroying whole fields of oats and corn at that time; they were reported from Paulding, Paulding Co., Ohio, July 9, as attacking oats, and corn-fields adjacent thereto. July 14 a report was received from Williston, Ottawa Co., to the effect that the worms had completely ruined some fields

of oats and had commenced on the corn. These worms at this date were from three-fourths to one and one-half inches in length.

From the foregoing it would appear that the first brood of Army Worms were not observed to be destructively abundant in Ohio, in 1896, so far as we have learned. The young worms were observed by Mr. Mally, at Ames, Iowa, early in May, while the first brood, to which these seem to have belonged, worked some injury, both in Illinois and New Jersey. Furthermore, our correspondence would indicate that the second brood was engaged in its work of destruction over the entire state at about the same period, viz:—during July. That the first brood does, sometimes, work serious injury, was clearly shown in the season of 1890 in extreme southern Indiana, where a careful study of an outbreak was made and the results published in *Insect Life*, Vol. III, page 112, as follows: "The season of 1890 was not noted in Indiana for any considerable appearance of this pest, except in the extreme southern portion of the State. In Point Township, Posey County, a very serious invasion occurred on the farm of Mr. F. W. Nolte, whereby 150 acres of promising meadow was totally destroyed, not a pound of hay being obtained from the entire area. This meadow and adjacent cultivated lands were situated on second bottom of the Ohio River, and all were overflowed during March, the overflow remaining long enough to destroy the young wheat.

Very small, young worms were noticed in great numbers in the meadow on May 2, but the magnitude of the outbreak did not become apparent until some days after. By June 7 the worms had done their work and generally disappeared, leaving what was a few weeks before a fine field of thrifty, growing timothy, just coming into head, as bare as a stubble-field, except an occasional clump of red clover. While the young worms were observed, generally, throughout this meadow, the appearance of the place on June 14 indicated that their course had invariably been from the Ohio River, in precisely the same direction that a similar invasion is said to have taken place in 1881.

On June 14, both pupæ and adults were found in considerable numbers, while parasites were literally swarming. These were chiefly *Winthemia quadripustulata*, and in several instances they were in turn being destroyed by a spider, *Oxyopes scalaris*. The ravaged meadow was of two years' standing. Other fields of one years' standing, situated near by were injured, but the destruction was not so complete; though a field of young corn, situated in the path of the advancing hosts, was eaten to the ground."

The only indications we have of the occurrence of a third brood in Ohio are (first) the appearance of adults on August 4, 1896 and August 28, 1897, the latter from larva found August 8, 1897, and (second) the occurrence of adults Nov. 6 and Dec. 8, 1896, as previously stated. The moth taken Nov. 6, 1896, was clearly from the third brood of larvæ, as also that of Dec. 8; the former escaping from the pupa in the fall and

the latter, under artificial conditions, appeared in winter; whereas, ordinarily, it would not have emerged until spring.

It will be seen, then, that the history of the Army Worm in Ohio, during the entire year, would be approximately as follows: The eggs are deposited during late April or early May, by female moths, which either passed the winter as such, or emerged in spring having wintered as pupæ. It is of course possible that larvæ might, in exceptional cases, winter over also. The worms from these eggs would develop and give rise to a second brood of moths, which, ovipositing, would produce a second brood of worms during July, this being the destructive brood of 1896. The moths developing from this second brood of larvæ, and ovipositing in August or September would produce a third brood of larvæ, and the moths from these would constitute the first brood of moths of the following spring.

The Army Worm is essentially a grass insect, though often forced to feed upon other plants. The eggs are, as a rule, laid in the sheath of grass blades, but Mr. Webster has found good evidence that the adult moths may oviposit in fields of small grain in spring, and the fact of their ovipositing in fields of young corn seems not to have been recorded prior to 1890. See *Insect Life*, Vol. III, page 112. From the 4th to 28th of June, 1888, about Lafayette, Ind., he frequently observed the larvæ, varying in length from one-half to three-fourths of an inch, depredating on the plants, in the midst of quite extensive corn-fields, from 50 to 100 yards from the margins. With a single exception, the fields in which these worms were found had been cultivated for a number of years, and in all, the present crop was being continually worked with plows, thereby precluding the possibility of the larvæ having originated outside of these fields, and, except corn, there was nothing else to tempt the parent moth to deposit her eggs. The smaller larvæ were frequently attacked by a species of *Microplitis*, which Dr. Riley found to be similar to, but specifically different from that mentioned in the third report of United States Entomological Commission, p. 127. A peculiarity of this parasite was that after leaving its host, it usually constructed its cocoon under the body of the latter, after the manner of *Perilitus Americanus*, which similarly attacks *Megilla maculata*. In this case, however, the body of the host was not so fastened as to form a protection, as in the case of *Megilla*. This attack on young corn is all the more interesting as the worms certainly prefer growing oats to corn. In 1881, in DeKalb County, Illinois, Mr. Webster had an opportunity of observing this preference as shown by the larvæ. A horde of worms had originated in an orchard and were pushing their way across a country road, on the opposite side of which was a field of corn, and by the side of this a field of oats. The dividing line between the fields, if extended far enough, would have divided the body of moving worms into two nearly equal sections, and had they held strictly to their course, after crossing the road, about half

would have gone into the corn-field and the other half into the oats field. As a matter of fact, however, they all went into the oats field, leaving the corn uninjured.

Mr. Slingerland states, in his Bulletin 133, page 244, that observations indicate that most of the eggs are laid during the earlier part of the night, the moths remaining hidden during the day. We have before noticed that the moths are more abundant during the earlier part of the night than they were later on. It has also been stated that early in the season the moths prefer to oviposit about old hay, straw and stacks of corn fodder, and even in bits of old corn stalks, scattered about in pastures. The eggs have also been found about very young plants of small grains.

It will probably be safe to say that the eggs which produce the larger portion of the destructive brood are placed in the sheaths of grass where there is a heavy growth, or where it is matted together in such a way as to constitute a cool, damp retreat, wherein the very young can feed undisturbed, and it is only when the food supply becomes insufficient, on account of excessive numbers, that the worms seek new pastures. Although each female is capable of producing several hundred eggs, it is doubtful if the worms would work such serious destruction as they do, were it not for the fact that the females seem to flock to desirable localities to oviposit, and the young, when partly grown, and food becomes scarce, instead of distributing themselves over a large area, still follow the gregarious habits of the moths and move forward in compact bodies, frequently devouring all of the leaves of grasses and grains in their path; and thus it comes about that the worms appear suddenly and so unexpectedly to the farmer that he is at a loss to understand from whence they came, and, as they nearly all reach their maximum size and descend into the ground to transform to moths within the space of a few hours, he is equally perplexed to account for their as sudden disappearance.

When the female moth finds a stalk of grain or grass suited for her purpose, she clasps it with her legs and thrusts her ovipositor into the unfolded base of the leaf or down into the sheath where it surrounds the stalk. Here, within the space of a few minutes, she will lay a large number of eggs, sometimes 50 or more. These eggs have been described as smooth and white; but Mr. Slingerland states that they have a distinct yellowish tinge, and that the shell is marked with a network of very fine ridges, but that the sculpture and color are both obscured by a whitish substance with which the moth covers them. The eggs are about .025 of an inch in diameter, and in from 8 to 10 days the young Army Worms are hatched.

When newly hatched, the worms are about .078 of an inch in length, of a translucent, whitish color, with dark brown heads. It is not until later that the stripes begin to show upon their bodies. They have the looping gait of the measuring worms, and when disturbed drop themselves down at the ends of silken threads, after the manner of young canker

worms. During the first day or two of their lives they feed upon the shells of the eggs from which they have hatched; then they begin feeding upon grass, which food, showing through the skin of their bodies, gives them a greenish tinge. When full grown they descend into the ground to the depth of an inch or so, and by working themselves about construct an earthen cell, become shorter, more robust, and of a lighter color. The old skin now bursts and is pushed off, posteriorly, and the insect now becomes a brown pupa. Sometimes, however, pupation takes place under boards and rubbish and even on top of the ground, but these are exceptions to the general rule. The pupal period is not always the same, varying from 10 days to 3 or 4 weeks during the warmer months, while, as has already been stated, the insect may pass the entire winter months in this stage.

METEOROLOGICAL INFLUENCES.

While climatic conditions may not precipitate an outbreak of the Army Worm, it is nevertheless true that such conditions are known to exert a considerable influence. It has generally been conceded that outbreaks of the Army Worm are usually preceded by dry seasons and we believe that, in the east, outbreaks may occur during what are commonly termed dry seasons; but here in the west, outbreaks are more likely to occur when the spring is cold and wet, than where the conditions are the reverse. In 1896, in southern Ohio, there was but little rainfall during the spring prior to the 15th of May, but after that date rains came in considerable abundance, and we had in Ohio a phenomenon that rarely occurs; that is, both Chinch Bugs and Army Worms occurring in destructive abundance and over the same areas. It is quite probable that the amount of precipitation, as with the Chinch-bug, has very little influence except so far as it comes at certain critical periods, between the vernal equinox and the first of July. Although we may not yet be able to say just what the relations are between the weather conditions during spring and outbreaks of the Army Worm, the association of the latter with much rainfall and a low temperature occurs too frequently to be looked upon as a mere coincidence.

NATURAL ENEMIES.

One of the most interesting facts connected with the history of the Army Worm in America, is in that the insect is not known to have occurred in destructive abundance over the same area two years in succession. If we cannot attribute this phenomenon to meteorological influences, we must look elsewhere for the cause of what seems to be a fully established law. It would be too much to say that this was due to the influence of natural enemies, but yet one who has studied this matter, carefully, during a serious outbreak, and noted the vast number of natural enemies

which are to be observed on going over the fields that were ravaged, just after the worms have disappeared, would find it difficult to disabuse his mind of the impression that these enemies had made enormous inroads upon the Army Worms, and thus greatly reduced the number of progenitors for the coming generation.

Of these enemies, those belonging to the Diptera are probably the most abundant and efficacious, though this may be to some extent an illusion due to the fact that the Hymenopterous, or four-winged parasites, are much smaller and make no noise in flying about. While, on the other hand, the parasitic flies are sometimes so abundant that in flying about among the short grass, weeds and stubble, the hum of their wings resembles the buzzing noise made by the honey bees. There are four species of these flies that are known to destroy the Army Worm, namely: *Belvosia unifasciata* Desv.; *Phorocera leucaniæ* Coq.; *Senotania trilineata* W. (?); *Winthemia q-pustulata* Fabr.

These parasitic flies place their elongated, somewhat flattened, ivory white eggs on the body of the larva, preferably near the head, though they may be scattered elsewhere over the body, and especially is this true where great numbers are placed upon the same worm. When the eggs hatch, the young maggots make their way directly downward into the body of the Army Worm and develop there, sometimes as many as four or five in a single individual. The Army Worm may make its full growth, and even pass into the pupa stage before the maggot will cause its death. The latter then emerges and forms its own brown pupa.

Besides these flies, which are usually larger than the common house-fly, there are quite a number of small, active, wasp-like insects which place their eggs under the skin of their victims. The young, hatching and subsisting upon the fleshy portions of their prey, finally emerge, leaving nothing but the shrunken skin. The following of these are known to destroy the Army Worm in this way: *Rhogas terminalis* Cr.; *Stib-eules pettitii* Cr.; *Mesochorus scitulus* Cr.; *Limneria oxylus* Cr.; *Bassus scutellatus* Cr.; *Microgaster militaris* Walsh; *Apanteles congregatus* Say; *Apanteles limenitibis* Riley; *Pezomachus mininus* Walsh; *Haltichella perpulchra* Walsh; *Ophion purgatus* Say; *Amblyteles suturalis* Say; *Ichneumon jucundus* Brulle. Besides these there are a considerable number of beetles that attack and destroy these worms. Insectivorous birds, as well as toads and frogs, all combine to destroy the worms; so that, taken all together, it is hardly to be wondered that the pest should not become excessively abundant in the same locality two years in succession.

REMEDIES.

By whatever method we may attempt to destroy the Army Worm or prevent its devastating marches, the measure must be applied promptly and vigorously. In fact, it is usually due to a lack of promptness that

the worms are allowed to run their full course and get possession of a field before anything is done. As a farmer once expressed it: "We waited to see what they were going to do and by the time we found out, it was too late for *us* to do anything." If they can be found in the act of entering the field, and deep furrows are plowed in front of them, running the land-side of the plow along the part to be protected, the worms, on reaching this furrow, will fall into it, and, being unable to extricate themselves promptly, can be killed in the bottom of the furrow, either by sprinkling them with undiluted kerosene or by dragging a log backward and forward in the furrow. In case kerosene is used it will be found advisable to dig holes along the bottom of the furrow every eight or ten feet. The worms will fall into these and thus a large number can be killed with less expense of time and kerosene. Where it is practical, if the grass or grain directly in front of the advancing hosts can be sprayed or sprinkled with Paris green and water they can be poisoned. The trouble with this is, that in showery weather the poison is readily washed away and the measure thus becomes ineffective. The trenching and kerosene treatment, if applied promptly at the start and faithfully carried out, will invariably prove comparatively inexpensive and effectual.

WHEAT AND GRASS SAW-FLIES.

Ord. HYMENOPTERA.

Fam. TENTHRIDINIDÆ.

PLATE II, FIG. 2.

Nearly every year there appear upon the nearly full-grown wheat, and also upon various grasses, the larvæ or young of several species of saw-flies. Though these are of small consequence, so far as their effect upon the crops are concerned, yet they may and do become sufficiently abundant to cause serious apprehension. As far back as 1883 attention was called to attacks of some of these saw-flies in the wheat fields of Ohio, by Mr. J. C. Hostetter of Minerva, and Dr. W. I. Chamberlain, at that time Secretary of the State Board of Agriculture. As the following note appears to have been the first published report on this subject, it has been reprinted from Bulletin 4, United States Department of Agriculture, Division of Entomology, published in 1884:

"I have as fine a field of wheat as I have seen this season. This morning, in looking over it, I find upon the heads quite a number of such worms as are here inclosed. They take a portion of the grains out of the heads they attack. They are not very numerous, perhaps three or four in a rod square. I am at a loss to know what they are, or whether they will materially injure our wheat. My neighbors also have them. Will you please inspect them?" (J. C. Hostetter, Minerva, Ohio, June 16, 1883.)

"Your favor of 21st instant is at hand; also mailing box and stamps. I have just returned from a walk around a twenty-acre field of wheat. My object

was to pick off a dozen or more of those worms to send you. To my utter surprise (though making diligent search) I found but three, one of which I lost on my way to the house. Only a week ago I could have found any number of them in the same field. They are now gone, having either dropped off, or been taken by the birds, or both. Please pardon me, therefore, for sending only those two discoveries for inspection. If I find more I will send again. I think these are full size, or nearly. I found them on small heads of wheat, the same inclosed. You are evidently clearly right in saying we need not apprehend much damage from them. Their time is of short duration and seems to be confined to the period soon after the wheat is in head. I don't think they affect the kernels when fully formed." (J. C. Hostetter, Minerva, Ohio, June 25, 1883.)

The larva above mentioned was that of a species of saw-fly (family Tenthredinidæ). We sent for a number of additional specimens in order to endeavor to obtain the mature insect, for we did not recall any record of injury to wheat by a Tenthredinid in this country. Curtis gives an account of one in Europe, the description of which agrees very closely with this larva, but from his account it would seem to have come from some neighboring woods and not to have been naturally feeding on wheat. As many of the saw-fly larvæ, when abundant, have a habit of wandering from their original food-plants, such may have been the case in this instance. We endeavored to get positive evidence of its wheat-feeding habits, but failed, and the larvæ received from Mr. Hostetter died before transforming, so that the species was not even ascertained. The same larva was reported by W. I. Chamberlain, Secretary of the State Board of Agriculture, as occurring on wheat at Columbus, Ohio.

Later, the senior author reared several species of saw-flies from young, either found in the act of feeding upon the leaves of wheat or grass, or reared from eggs that were deposited in the leaves of wheat. These were afterwards studied by C. L. Marlatt, of the United States Department of Agriculture, and the results of such studies were published in "Insect Life," Volume IV, pp. 168-179.

One of these species of grain and grass saw-flies, also perhaps the most common, may be known as the Maryland Saw-fly, *Pachynematus extensicornis* Norton, as illustrated in Plate II, Fig. 2 from material furnished by the same author.

The female saw-fly, Plate II, Fig. 2, *f*, is about five-sixteenths of an inch in length, of a resinous or sulphur-yellow color with black markings, while the male, though about the same length, is more slender and almost entirely black in color. The eggs are deposited during the latter part of April and first of May, the female cutting a small slit in the edge of the leaf and placing an egg in each slit, as shown at *a, a*, in Plate II, Fig. 2. These eggs hatch in about sixteen days and within this time they enlarge to such an extent that the slits are pushed open so that the eggs may be easily seen within the pocket, and just prior to hatching the black eyes of the young can be seen through the thin shell of the egg. The young develop in about five weeks and at first feed together, as shown in Plate II, Fig. 2, *b*, but later they separate and are practically solitary. They feed upon the blades of wheat, but so far as observed they have not the habit of cutting them off.

When the larvæ are full fed, Plate II, Fig. 2, *c*, they enter the ground and construct long cocoons of brownish silk intermixed with particles of earth, Plate II, Fig. 2, *d*. There appears to be but one generation each year.

Mr. Marlatt records the rearing of a single hymenopterous parasite *Lampronota frigida* Cr., from a cocoon of this saw-fly, and also an undetermined species. The larvæ are also known to be attacked by a species of *Ophion*, in Illinois, and larvæ with the eggs of some species of *Tachina* attached to the upper surface of the thoratic segments were observed in Indiana.

Although these worms sometimes appear in Ohio, in considerable numbers, and have been mistaken for the Army Wörm, they have not been known to work any serious injury.

There are at least two other species of saw-flies, and perhaps more, whose larvæ or young attack the Graminæ in this country. Two species *Dolerus arvensis* and *D. collaris* have both been reared, and the adults of these may be observed in the spring, hovering about the opening pear buds. Larvæ of the latter species, taken near Wooster, Ohio, June 15, 1897, on wheat, and also two individuals on blue grass, and placed in a breeding cage, entered the ground in about ten days. The first adult from these larvæ appeared, in the Insectary, January 11, 1898. The cast skin of the larva and pupa were found about one and one-half inches below the surface of the ground in the breeding cage. In this case there was no evidence of any cocoon having been constructed, though this was perhaps due to its unnatural surroundings. Some of the larvæ are easily separated from others by the presence of a lateral white stripe, on which is a row of black spots, one on each segment, just above the stigmata; a similar spot occurs at the base of each of the thoracic and abdominal legs, these last probably being the young of *Dolerus arvensis*.

THE CORN OR BOLL WORM.

Heliothis armigera Hubner.

Ord. LEPIDOPTERA.

Fam. NOCTUIDÆ.

PLATE III, FIG. 1; PLATE IV, FIG. 1.

This is another one of our cosmopolitan insects, having been found in almost every quarter of the globe. It probably occurs throughout the whole United States, except, possibly, along some portions of the extreme northern border, and extends southward through Mexico. In South America it occurs in Venezuela, Brazil and doubtless elsewhere. In the Eastern Hemisphere it seems to extend from about latitude 55° north to 45° south.

Although known in the northern United States as the corn worm, and in the southern states as the cotton boll worm, the insect is, nevertheless, a very general feeder. It works on both the tomato plant and fruit, and tobacco, red pepper, jimson, ground cherry, garden pea, string beans, cow pea, and a leguminous plant, *Erythrina herbacia*, which grows wild in the south, more especially along the coast. It also attacks asparagus, lucerne, chick-pea, pumpkin, squash, okra or gumbo and other food plants belonging to the families Iridaceæ, Convolvulaceæ, Urticaceæ, Resedaceæ and Geraniaceæ. In New South Wales, Australia, it is a serious enemy to tobacco.

The larvæ have been reported as boring into the stems of geraniums and eating the leaves of this plant in flower gardens in Colorado, and we as also others have found it attacking the same plant in the greenhouse; while it has been sent to us by Mr. Nelson Cox, of Bradrick, Lawrence Co., O., with the complaint that it was quite destructive to ripening peaches. In this case it seemed to attack the ripening peaches upon the tree much in the same manner as it does tomatoes on the vines. We have observed it attacking asparagus in Ohio and also, to a limited extent, tobacco. Though it is not known as a tobacco pest in this country, in New South Wales, Australia, it is a serious enemy, sometimes completely "topping" the plant, thus preventing the main stem from further growth.¹ Mr. Coquillett observed it attacking the blossoms of the wild sunflower, while Mr. E. C. Coates, of Calcutta, British India, reported it as feeding upon the poppy, and, lastly, they have been known, on some occasions, to feed upon each other, the larger individuals attacking the smaller. They are also known to attack the pupa of the cotton worm, and the larvæ of the native cabbage worm.

The following descriptions are taken from Fourth Report of United States Entomological Commission:

"The Egg." (Plate IV, Fig. 1, *a, b*.) "The egg of *Heliothis* is 7mm. in diameter, its axis being about equal to its greatest diameter, which is near the base. In color it is nearly white, rather inclined to yellowish, and is easily detected against the green background of leaf, stem or involucre. Upon certain of the eggs shortly after being laid there appears a reddish brown band near the summit, which disappears with the growth of the embryo. The worm itself can be seen through the semitransparent shell as it approaches the hatching point."

"The Larvæ." (Plate III, Fig. 1; Plate IV, Fig. 1, *c*.) "In markings the worms vary from almost perfectly immaculate, unstriped individuals, to those furnished with many spots and regular stripes. The commonest (we can hardly say the normal) arrangement of the markings is as follows: On each side of the body, extending from the head to the anal joint and including the spiracles, is a broad, whitish, lateral or stigmatal stripe. Just above this is a less broad, subdorsal dusky stripe. Down the middle of the back is a narrower, dusky, medio-dorsal stripe, including a fine white line, and between this and the subdorsal dusky stripe, in what may be called the dorsal space, are four or five very delicate

¹Agricultural Gazette of New South Wales, Vol. IX, part 8, p. 870, 1898.

whitish lines, so delicate in fact as not to interfere with the general color of the body. Of spots there are usually eight dorsally to each abdominal joint, normally black in color, the four dorsal spots arranged trapezoidally, the anterior part closest together. These spots are simply piliferous tubercles and are very constant, a close examination of even the immaculate individuals showing them still to be present, though colorless. Upon the meso- and meta-thoracic joints these tubercles are arranged across the dorsum in a single transverse row. Of the stripes the most constant appears to be the whitish lateral, all the others being more often wanting."

"The Pupa." (Plate III, Fig. 1; Plate IV, Fig. 1, *d*.) "Length, 20mm. (0.8 inch); color, light mahogany brown, darker toward head. Head covered with small, faint granulations and with a few shallow transverse impressed lines anteriorly; also a few irregular impressions behind the eye; about midway from the posterior angle of the eye and the posterior border of the head is an impressed puncture, from which a short stiff hair arises; there is also another shallow triangular impression on the medio-dorsal line near the posterior border of the head. The whole dorsal surface of the thoracic joints is finely punctate, and is covered with irregular, shallow, impressed, transverse lines; the methathoracic joint is much wrinkled dorsally. The surface of the abdominal joints is similarly sculptured; the anterior margins of joints 4 to 7 are coarsely punctured; joint 4 has but few punctures, but on 5, 6 and 7 they are numerous; the more anterior of these punctures are deep, and they extend posteriorly into long, shallow longitudinal impressions; the posterior dorsal margins of each of these joints are covered with dark brown granulations of differing forms. The other joints, except the last, have nothing peculiar in their structure; the last joint is rounded and furnished at the tip with two long, slender black spines. Ventrally the last and the penultimate joints have each a deep longitudinal medial impressed line. Wing, leg and antennal cases covered with shallow punctures."

"The Imago." (Plate III, Fig. 1; Plate IV, Fig. 1, *e, f*.) "In general color the moths vary from a dull ocher-yellow to a dull olive green. In these figures the normal type of markings is also shown, but in this respect, also, there is a great variation. Many individuals exhibit almost immaculate front wings, while in others the typical markings are deepened far more than in the figures. In a general experience, covering some twenty years, with this moth, as found in corn-fields in the West, and covering some half-dozen years in the cotton fields of the South, we believe that the former are on an average brighter colored and darker than the latter. The markings of the hind wings, although much more constant than those of the fore wings, vary principally in the breadth and depth of color of the dusky band on the hinder margin, and in the size of the light spots within this band."

NUMBER OF BROODS.

While there may be three broods in Southern Ohio, in the northern part of the State there are probably but two. These broods appear to be interminably mixed before fall, and so late as November partly grown larvæ may be found in the ears of corn, Plate III, Fig. 1. These young undoubtedly perish, as in no instance are the larvæ known to make their way into the ground to hibernate and emerge therefrom in spring to continue their development. There can be but little doubt that all larvæ that are sufficiently developed to do so enter the ground in the fall, and

after constructing a vertical channel, station themselves at the bottom and pass into the pupa stage, and continue in this condition until the following spring.

PREVENTION AND REMEDIES.

The insect has been known in Ohio since 1845, and it is not likely to become much more destructive than it is at the present time. It is much more abundant some years than others.

Serious trouble has been reported among those who grow tomatoes in considerable areas, because of the larvæ eating into and destroying the green and ripening fruit. In such cases it is always best not to plant tomatoes in close proximity to corn, but when possible, on ground that has been fall or winter plowed.

That fall plowing is the best and most practical measure as against this pest, here in Ohio, is shown by the experiments made by Prof. G. H. French and given in the "Prairie Farmer" of October 26, 1878, as follows:

"When the larva attains its growth it descends to the ground, into which it goes to pupate. In doing this it usually selects some place where the earth is rather firm, seeming to prefer the security a compact soil can give, to ease in digging.

It digs a hole into this several inches in depth apparently cementing the dirt as it goes down, so that when it reaches the desired depth there is a smooth channel from the bottom to near the surface, there being a thin film of dirt over the entrance.

This hole, as I found in digging about corn-hills, is about a third of an inch in diameter, larger at the bottom than at the top, apparently so as to give free motion to the chrysalis, and is usually bent in its course so that the lower part would have an inclination of often as much as forty-five degrees. I found the chrysalis at the bottom of this, the small end downward. In one instance I found a hole so bent that the chrysalis occupied a horizontal position. I began digging for the chrysalids in November, in a field where the worms had been abundant in the corn, using at first a spade and digging at random. I had expected to find them in oval 'cocoon,' as they were supposed to make, but cutting across channels in which I afterwards found chrysalids led me to dig a little more carefully. I soon found that by running the spade along the row and taking off half an inch or less of the surface I could tell where every chrysalis was to be found."

NATURAL ENEMIES.

The secluded habits of the larvæ, and the nocturnal habits of the adults render attacks from natural enemies less efficient than would otherwise probably be the case.

Insectivorous birds probably destroy more or less of them while two species of flies, *Frontina armigera* Coq., and *F. frenchii* Will., lay their eggs on the larvæ and their maggots destroy them.

THE PAINTED HICKORY BORER.

Cyllene pictus Drury.

Ord. COLEOPTERA.

Fam. CERAMBYCIDÆ.

PLATE III, FIG. 2.

This insect belongs to a very large group of wood-boring beetles, some of which so closely resemble each other that it is difficult to distinguish them. Plate III, Fig. 2, represents *Cyllene pictus* which measures about three-fourths inch in length and is of a dark olive brown or black color and banded with bright golden yellow, there being a distinct W of the latter color on the base of the wing covers. Plate III, Fig. 3, represents a very closely related species, *Cyllene robinia*, which is very destructive to locust trees. The former species appears as adult in May and June, while the latter does not appear until September. Both species deposit their eggs in the rough bark and as soon as hatched the young larvæ bore directly into the trunk. During the first part of their development they work in the sap-wood, but during the latter part they bore into the solid wood, which, if the larvæ are very abundant, will be completely honeycombed. They pass the pupa stage in these burrows and the adults work their way out at the proper time.

While the species under consideration seems to prefer the hickory we have reared it very abundantly from Osage orange. On September 19, 1896, we received from southwestern Ohio a section of Osage orange post, one and one-half feet in length and four inches in diameter, with the complaint that a worm was eating up a lot of fence posts of this kind of timber, some of these posts having been set in the ground, the others merely piled together. In the case of the latter the dust was stated to be two inches thick underneath the pile. In the specimen section received the sapwood was badly eaten and tunneled by the larvæ, some of these larval chambers extending directly into the heartwood. The section was placed in a breeding cage, but nothing appeared therein until the following February 4, when a single example of *Cyllene pictus* Drury emerged. We were well aware that the borer was a cerambycid, but did not expect this species. From this small section there emerged in all 27 individuals, the greatest number appearing during any one day being 4. The record of appearance of adults is as follows: February 4, 1; 10, 1; 13, 2; 15, 1; 17, 1; 19, 1; 23, 3; 24, 4; 26, 1; March 4, 4; 6, 3; 8, 1; 10, 1; 23, 1; April 12, 1; 14, 1; the period of issuance thus covering two months and ten days. Nothing else appeared with these adults except a small mite, thus showing the absence of natural enemies. The section of wood was kept continually in the insectary and, hence, under greenhouse conditions. Under natural conditions the beetles would have

emerged during May and June. During the present year, 1898, the beetles have been reported as continuing and extending their depredations, doing special damage to fence posts of this kind in actual use. There is no very practical way of preventing the injury and it cannot be stopped after the larvæ once enter the bark. There is some indication that removing the bark from the posts, as soon as cut, may be an advantage in that the surface would be less attractive and would offer less inducement for the female to deposit eggs. Much may be accomplished by burning all useless hickory and Osage orange wood and brush which, if left from year to year, furnishes a splendid breeding place for it. Choice timber, such as is desirable to keep for some special purpose, may be kept safely by placing it in a compartment sufficiently tight to exclude the beetles; but care must be exercised to see that the wood is not already infested.

The fact that this insect attacks fence posts in use would seem to indicate that there is nothing to be gained by trying to avoid its injury by cutting the trees at any particular time.

In the case of valuable shade trees it is a good plan to watch them closely during May, and as soon as any of the beetles are seen crawling about on the bark the trunk and larger limbs of the trees should be coated with soft soap, or else scrubbed thoroughly with strong soapsuds every ten days. The soap will destroy any eggs that may have been deposited previously and tend to prevent any further deposition. By the second method the great majority of the eggs will be destroyed before the young larvæ enter the bark. A bar of ordinary hard soap, placed in the forks of the trees, would render good service, because every rain would dissolve some of the soap and so tend to destroy the eggs and render the surface more or less repulsive to the female.

THE RASPBERRY CANE BORER.

Oberea bimaculata Oliv.

Ord. COLEOPTERA.

Fam. CERAMBYCIDÆ.

PLATE III, FIG. 4; PLATE IV, FIG. 2.

This pest also belongs to the group of wood-boring beetles. The adult, Plate IV, Fig. 2, is about one-half inch long, slender and of a dark color, except the thorax, which is yellowish and usually marked with three black dots, two near the center and one near the posterior margin, the two former sometimes being obscure.

The larva, Plate IV, Fig. 2, is footless, and when full grown is about one inch long, quite slender, segments distinct and rounded at the sides, head small and dark brown in color; general color light yellow.

Complaints of injury to raspberries and blackberries are received occasionally, but on June 8, 1896, it was reported to us for the first time

as injuring young twigs of apple and pear, Mr. Jacob Wertenberger, Arlington, Ohio, sending a section of an apple twig containing a larva boring longitudinally therein. This twig was spliced upon a similar one on a small tree in the insectary. The larva continued its course downward in the living wood, eating out the heart and leaving only a thin cylinder of wood and bark, Plate III, Fig. 4. Round holes were eaten through the walls of this cylinder, at intervals, through which the excreta were ejected in filiform masses made up of oblong sections, usually of about one-sixteenth of an inch in length, Plate IV, Fig. 2. Sometimes these would fall to the ground detached from each other and at other times they might be observed in sections of several, amounting in length to about one-fourth of an inch. Mr. Slingerland had previously observed the same habit while studying this species in blackberry canes in 1888.¹ On July 24 a similar larva was found in a twig of witch-hazel, *Hamamelis virginiana*, in the woods at Wooster, and brought into the Insectary. The voidings of the two larvæ were collected between the hours of 11 a. m. July 27, and the same time on the following day. In the case of one the aggregate length of the voidings was $24\frac{3}{8}$ inches and the weight 0.05 gram; in the other the excreta were not in shape to be measured, but the weight was exactly the same.

The apple tree on which the infested twig was spliced was very small and the connection was made about 18 inches from the ground. In order that the progress of the larva might be observed, with the least disturbance, as it made its way downward, the part of the twig through which it had passed was removed occasionally until only about 6 inches of the base of the tree remained, when the larva ceased feeding, plugged up the cavity with chips, both above and below itself, and to all appearances was preparing to transform. For fear of injuring it no subsequent examinations were made. The adult issued in the Insectary March 17, 1897, but under natural conditions this would probably have taken place during June. The larva in the witch-hazel twig bored through into the soil similar to the way Mr. Slingerland described in the case of the larvæ working in blackberry canes. When found it was scarcely alive and, although placed on a fresh twig, did not recover.

The females are said to deposit their eggs near the tips of the canes. The cane is first girdled at two places about one-half inch apart and then a puncture is made midway between them in which the egg is deposited. The tips of the girdled canes soon wither and hence can be seen readily.

This species is not very abundant and can be kept under control very easily by simply removing and burning the infested parts. This should be done as soon as the young, tender growth is noticed to wither, so as to prevent the more extensive injury to the canes.

All writers heretofore have represented this species as requiring only one year to complete its development, but several points have come

¹ Bul. 23, Agr. Exp. Station, Cornell University, pp. 122-4.

to light which seem to indicate that it requires two years. In 1888 Mr. Slingerland found larvæ boring only in the bearing canes of black-berry, having made burrows 2 inches long by the latter part of July, then working much more rapidly during August and September, reaching the roots by early autumn. They have been recorded as wintering in the roots, transforming to adults and emerging the following June. The eggs are said to be deposited in the tips of the young canes. That being true, how can they be only in the bearing canes in July since the fruit is always on second year canes? The fact that we received two larvæ, one-half to two-thirds grown, early in June, before the eggs are really supposed to be deposited, would indicate quite definitely that the species requires two years to complete its transformations. This will explain the apparent discrepancy in the reported development. No doubt the eggs are deposited, as indicated, during June, but the larvæ, in place of boring down to the roots the same season, must winter in the upper part of the canes and then during the second season continue their work, thus causing the injury to the bearing canes. This also corresponds with other observations of our own on this point.

The fact that it is not more abundant and destructive is undoubtedly due to general cultural methods, for it is the general practice to top back the young canes during July, thus removing many of the eggs or very young larvæ. Then, during the latter part of July and during August, when the fruit has been gathered, all the old canes are cut out close to the ground, so as to turn the full strength of the plant into the young canes which will bear fruit the next year. In this way there is a constant destruction of the larvæ, the grower unconsciously doing exactly the right thing. But too much weight must not be placed on the above system of summer pruning, because injury is seldom reported even in neglected raspberry patches where little or no pruning is done at the proper time. The facts in hand indicate that it is somewhat of a general feeder, thus distributing its injury.

THE PEACH SCALE.¹

Diaspis amygdali Tryon,

Ord. HEMIPTERA.

Fam. COCCIDÆ.

PLATE IV, FIG. 3.

In the year 1889, Mr. Henry Tryon, Assistant Curator of the Queensland, Australia, Museum, in a report on the insect and fungus pests, published as report No. 1, by the Department of Agriculture of Queensland, pp. 89-91, describes a species of scale insect found on the peach, as the White Scale, *Diaspis amygdali*, and reported its occurrence both at Bris-

¹First published in "Canadian Entomologist," April, 1898.

bane, Queensland, and Sydney, New South Wales. Although described as the White Scale, the author continually refers to it as the peach scale, in his paper, and the latter name has been adopted in America for the species. Of its habits Mr. Tyron states that:

"At first its presence is betrayed by small white spots or patches on the bark of the smaller branches; but as the insect increases these soon become in many places confluent, and the individual scales overlap one another, or are contorted by being squeezed together closely, or even appear to lie one over the other, and where the male scale insects crowd together these spots present a more finely chaffy appearance. As it will occur quite up to the tips of the branches, the complete destruction of any tree subjected to the attack of the peach scale, and owing to it, is only a matter of time. When already in patches on the branchlets prior to the formation of the leaves and fruit, in early spring, it does not hinder their formation; the leaves are green as usual, the fruit sets, but is soon retarded in its growth and shrivels up."

Writing me under date of November 7, 1897, however, Mr. Tryon has this to say of its present condition in Queensland:

"This Coccid is far from being generally distributed in Queensland, and nowhere have I observed it to act very prejudicially to the trees that it attacks."

In March, 1897, a consignment of Japan Flowering Cherry, both the single and double varieties, was received direct from Japan by the importers in Ohio. A few months later, it was discovered that some of the double flowering variety were infested by a species of scale insect, which proved to belong to this species, and which had not before been known in Ohio. A thorough spraying with kerosene emulsion did nothing more than to check its increase, and did not exterminate it. (It has since been found on *Prunus pandula* and *P. pseudo-ceraceus*, also recently from Japan.)

The distribution of the Peach Scale, *Diaspis amygdali*, and its food plants are also of interest. Mr. T. D. A. Cockerell has given an extended list of the food plants of the species,¹ and others have since been reported. It is now known to attack *Hibiscus (Abelmoschus) esculentus* L., and *Gossypium barbadense*, or Jamaica cotton, about Kingston, Jamaica. Cultivated Pelargoniums; the grapevine², dwarf peach and cherry³ (cited as *Diaspis amygdali*, Putnam, in Proc., but correctly in CAN. ENT.), on *Bryophyllum calycinum*; *Carica papaya*; Persimmon; *Jassium*, in Jamaica; Oleander; *Calotropis procera*, *Capsicum*, *Argyria speciosa* when under cultivation in Jamaica, also *Acanthus*, and *Cyus media*. Mr. E. E. Green found it on *Callicarpa lanata* and *Tylophora asthmatica*, at Punduloya, India⁴, and Mr. W. M. Maskell received it on Geranium from Hong

¹ Food Plants of Scale Insects (Coccidæ), by T. D. A. Cockerell, Proc. U. S. Nat. Mus., Vol. XIX., pp. 725-785, No. 1122.

² Townsend, Jour. Inst. Jamaica, 1893, pp. 283, 378.

³ Cockerell, CAN. ENT., 1895, p. 260.

⁴ Indian Museum Notes, Vol. IV., p. 4, 1895.

Kong.¹ Mr. D. W. Coquillett found it at Los Angeles, California, on dwarf flowering almond, recently imported from Japan,² and the case on dwarf peach and cherry, previously noted, also occurred on trees from Japan. Dr. L. O. Howard reported it some years ago as occurring in an orchard at Molino, Florida, and in another orchard at Bainbridge, Georgia. It was first discovered in this country on some seedling peach trees on the grounds of the Department of Agriculture, at Washington, in 1892. Besides inhabiting Jamaica, it is also found in Trinidad, Martinique, Grand Cayman, Barbadoes and San Domingo.³

Under the caption of "The White Peach Scale," Mr. Charles P. Lounsbury, Government Entomologist for Cape Colony, South Africa, includes the species as one of the insect pests of that Colony. He gives the Fiji Islands as an additional habitat, and states that there is no doubt but that it has been in South Africa for at least fifteen years, and good reasons for believing it to have been there double that length of time. Mr. Lounsbury characterizes the insect as a highly injurious one, the favorite food plants of which are the peach and mulberry, the apricot and plum being severely attacked and sometimes killed, the cherry being liable to be severely attacked, while the pear has been slightly infested. *Myoporum insulare*, Yellow Jessamine, *Jasminum* sp. ? Granadilla, *Passiflora edulis*, *Polygala myrtifolia*, Morning Glory, *Ipomœa* sp. ? Fuchsias and Geraniums all may become very badly infested, while the Cape Goosberry and other Solanaceous plants suffer to a less degree.⁴

Four species of Lady beetles and a Chalcid fly, the latter apparently identical with *Aspidiotophagus citrinus* Craw, attack the species in Africa. None of these parasites, however, seem powerful enough to hold the scale insect in check.

In October two of the most seriously infested of the trees imported from Japan into Ohio were dug and transplanted to the Insectary of the Experiment Station at Wooster, and one of them enclosed in a breeding cage. Early in December a very minute parasite was reared, and the females were observed in the act of ovipositing in the bodies of the scales on the tree. On these parasites being referred to Dr. L. O. Howard of the United States Department of Agriculture, he at once pronounced the species as belonging to both a new genus and species, he having previously drawn up a manuscript description from specimens reared in Paris, France, by Dr. Paul Marchal, who had reared it from *Diaspis ostræformis*. It has since been discovered that the same insect was reared in Ceylon by E. E. Green, from *Chionaspis vitis*, and it has also been reared from a species of *Aspidiotus* on sweet gum from Savannah,

¹ Trans. New Zealand Inst., 1896, p. 299.

² Insect Life, VI., p. 290.

³ Year Book of the U. S. Dept. Agr., 1894, pp. 265-267.

⁴ Report of the Government Entomologist for the year 1896, Cape of Good Hope, pp. 76-83.

Georgia. The species will now be known as *Archenomus bicolor* Howard, the description having appeared in Proc. Ent. Soc., Washington, Vol. IV., No. 2, page 136. There can hardly be a doubt but that this parasite was imported with its host from Japan, and well illustrates the wide distribution of insects, both injurious and beneficial, in articles of commerce. Both the scale insect and its parasite are new to Ohio. While it is almost impossible to determine the native home of the Peach Scale, *Diaspis amygdali*, at the present time, it is likely that this honor will fall either upon Japan or the West Indies, though it might have been first diffused from the East Indies. That the little parasite, *Archenomus bicolor* Howard, should be reared at such widely separated points as Paris, France; Ceylon; Savannah, Georgia; and Wooster, Ohio, with the probability of the species having been imported into Ohio from Japan, is somewhat surprising, and well illustrates the almost universal diffusion of some of our parasitic insects.

EXPLANATION OF PLATES.

PLATE I.

Army worm, *Leucania unipuncta* Haw.: Worms at work on corn plant. Nearly natural size. (After Slingerland.) Bul. 133, Cornell Univ. Agr'l. Exp. Sta.

PLATE II.

Fig. 1: *a*, Army worm moth at rest; *b*, Army worm moth with wings spread — natural size; *c*, Army worm moth much enlarged. (After Slingerland.)

Fig. 2: *Pachynematus extensicornis* Norton: *a, a*, eggs in wheat blades; *b*, young larvæ; *c*, full grown larva; *d*, cocoon from which an adult has emerged; *e* and *f*, adult insects — *e*, male, *f*, female; *a* and *b*, natural size; *c* to *f*, enlarged. (After Riley and Marlatt.) Ins. Life, Vol. IV, p. 175.

PLATE III.

Fig. 1: Corn or Boll Worm, *Heliothis armigera* Hbn.: Larvæ working on ear of corn, at the right of which are shown the adult moth at rest, the pupa, and the earthen cell in which the pupa is found. (After Riley).

Fig. 2: Adult of *Cyllene pictus* Drury. (Original.)

Fig. 3: Adult of *Cyllene robinia* Oliv. (Original.)

Fig. 4: Section of twig showing work of larva of *Oberea bimaculata*. (Original.)

PLATE IV.

Fig. 1: Corn or Boll Worm, *Heliothis armigera* Hbn.: *a*, egg, from side; *b*, same, from top — enlarged; *c*, full grown larva; *d*, pupa in earthen cell; *e*, moth with wings spread; *f*, same, at rest — natural size. (After Riley.)

Fig. 2: Adult of *Oberea bimaculata* Oliv., at the left of which is shown the larva, and at the right a portion of the larval excrement.

Fig. 3: Peach Scale, *Diaspis amygdali* Tryon: *a*, branch covered with malé and female scales, natural size; *b*, female scale; *c*, male scale; *d*, group of male scales enlarged. (After Howard.)

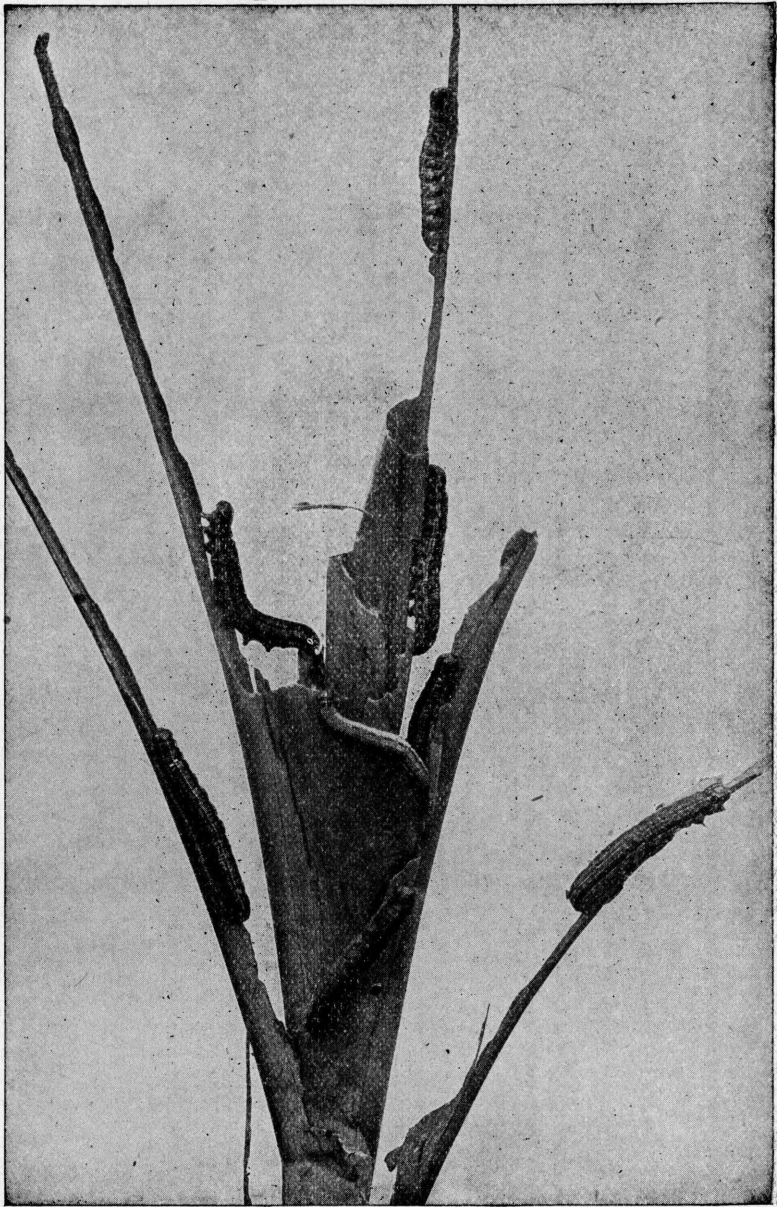
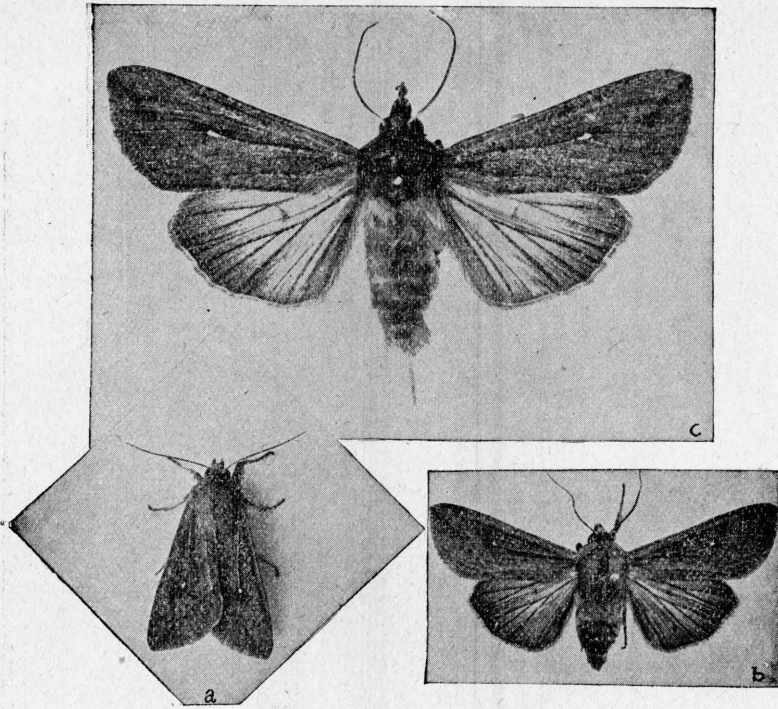
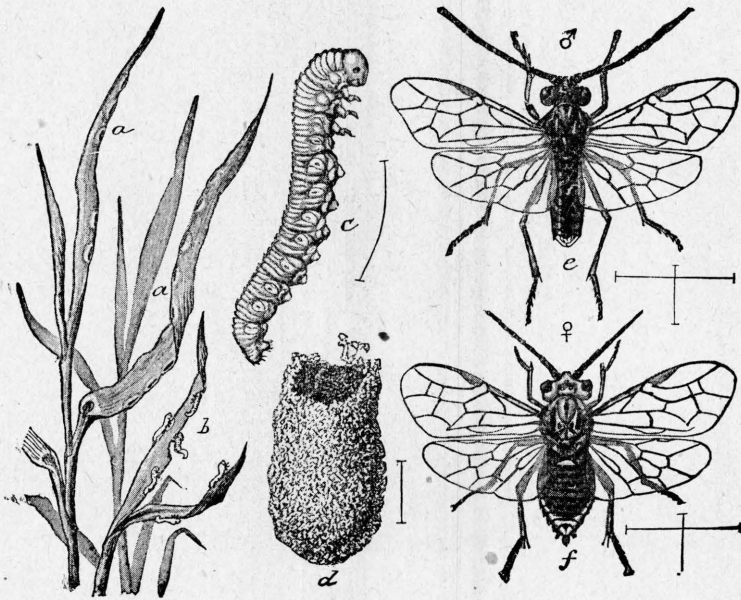


PLATE I.

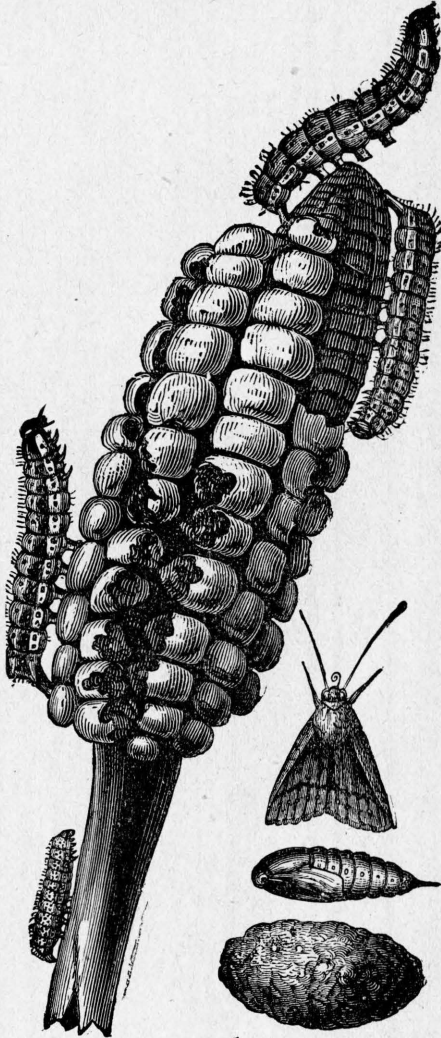


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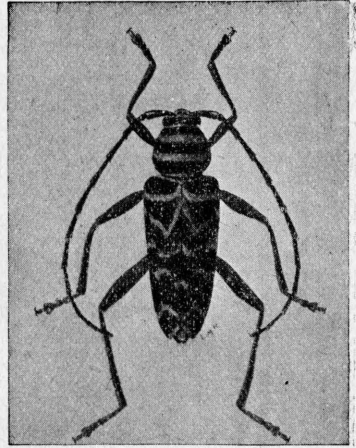


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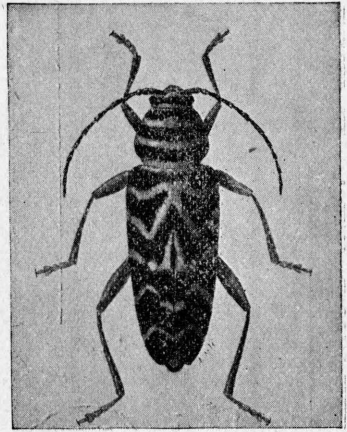
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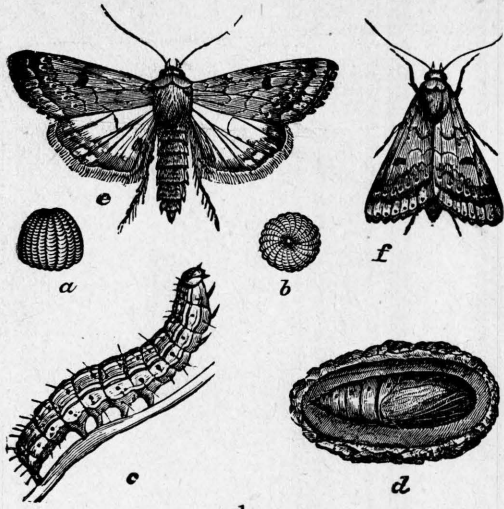
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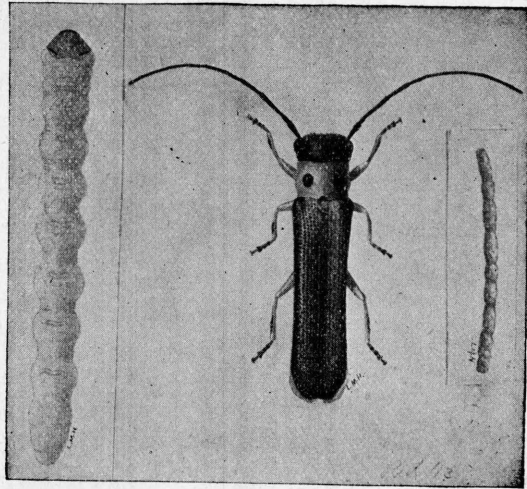
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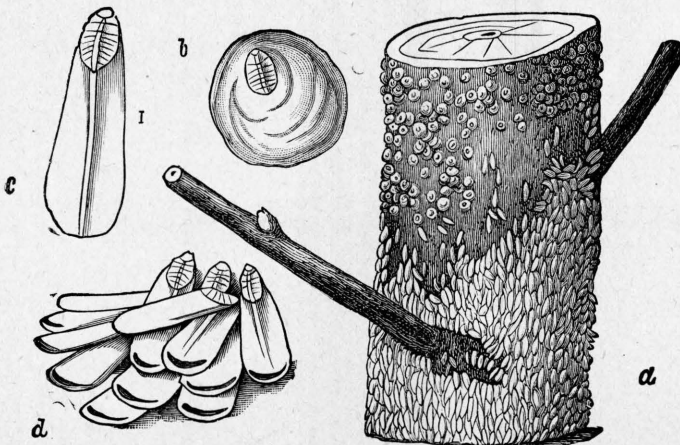
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PLATE IV.

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