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State of New York.

FROM
D. P. JOHNSON
SECRETARY
N. Y. STATE
AGRICULTURAL SOCIETY
ALBANY, N. Y.

REPORT OF DR. FITCH

ON THE

NOXIOUS AND OTHER INSECTS,

DETRIMENTAL TO AGRICULTURE,

ALSO

AN ADDRESS,

DELIVERED BEFORE THE

NEW YORK STATE AGRICULTURAL SOCIETY.

BRARY OF CONGRESS.

[SMITHSONIAN DEPOSIT.]

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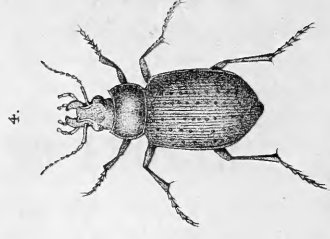
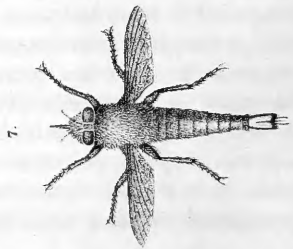
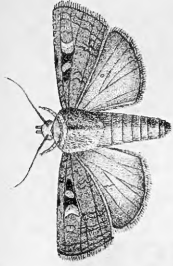
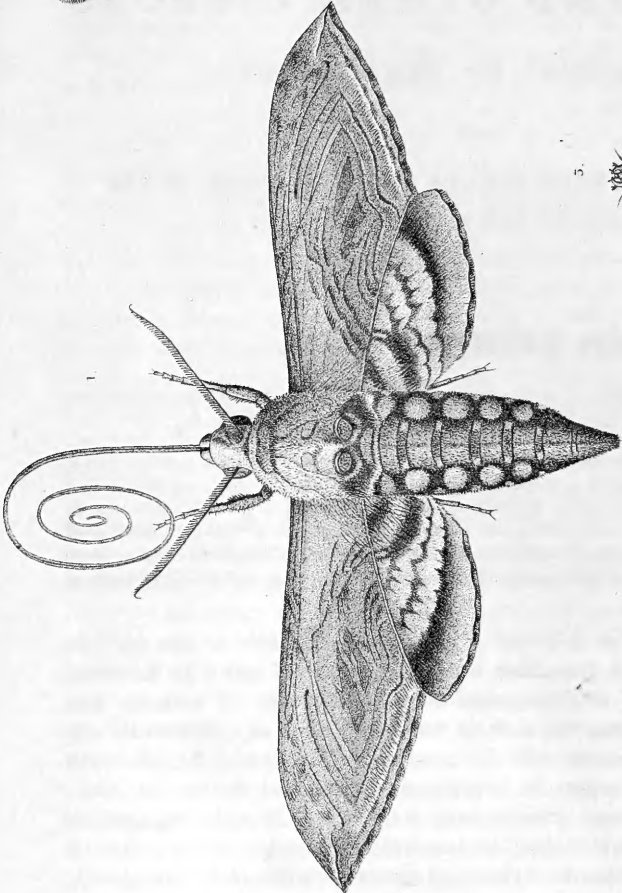
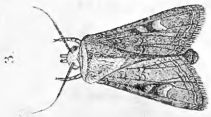
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INSECTS. PLATE 4.
(*Stoll of Cur-worms, &c.*)

Lith. of C. Van Berthouysen, Albany, N.Y.

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9th

REPORT OF DR. FITCH

ON THE

NOXIOUS AND OTHER INSECTS

Detrimental to Agriculture.

ALSO

AN ADDRESS DELIVERED BEFORE THE NEW YORK STATE
AGRICULTURAL SOCIETY.

INSECTS INFESTING GARDENS.

9. NORTHERN TOBACCO-WORM, POTATO-WORM, TOMATO-WORM, *Sphinx quinquemaculata*, Haworth. (Lepidoptera. Sphingidæ.) Plate 4, fig. 1.

Eating the leaves of potatoes, tomatoes, and tobacco, in July and August, a large green worm, the size of one's finger, with a black horn at the end of its back and along each side a row of seven white or pale yellow marks resembling the letter < with its pointed end forward; lying under ground in its pupa state during the winter and spring, and producing a large gray moth, four and a half inches wide across its extended wings, having a row of five yellow spots along each side of its body and two narrow black zigzag bands across the middle of its hind wings.

Hon. William Kelly, in a letter enclosing to me one of the millers which had been obtained from the tobacco-worm by Charles L. Roberts, Esq., of Tariffville, Ct., well remarks that the culture of tobacco has become so important an interest now at the North, that any information in regard to its insect enemies will be read with interest. Mr. Roberts alludes to this tobacco-worm as being quite prevalent in his vicinity. And the pains which some other correspondents and friends engaged in the culture of tobacco have taken to transmit specimens of the worm or the miller to me is an evidence of the importance they attach to this insect. And it may well be regarded as an important enemy; for this tobacco-worm makes the growing of tobacco twice as laborious a task as it would be if we had no such insect in our country.

This is currently supposed to be a new insect here at the North, unlike anything which we previously had, and that its presence here is due to the extensive growing of tobacco which has recently been commenced. It, however, is the same worm which, from time immemorial, we have been accustomed to meet with in midsummer upon our potato vines, and

TOBACCO-WORM. ITS HABITS. THE PUPA. DEPTH OF ITS INTERMENT.

the plants in the greatest numbers. They move about but little during the daytime, and being of the same green color as the stalks and leaves, they are difficult to discover. Usually, the presence of one of these worms upon our tomatoes is first indicated to us by the large black pellets of excrement which it drops, some of which frequently lodge in the forks of the stalks or adhere to the glutinous hairs of the plant. These pellets are of a short cylindrical form, and deeply grooved lengthwise; and the worm, as if to guard against its presence being betrayed hereby, when it is crawling along the stalks, if it chances to come to one of these pellets, it pauses and takes it up in its jaws and drops it to the ground.

When the worm is grown to its full size it leaves the plant on which it has hitherto been living, sometimes wandering away to a distance from it, and roots down into the ground to the depth of some inches below the surface. It here becomes quiescent, and casting off its larva skin it appears in its pupa or chrysalis form. By this change it is diminished a third in its size and is now of an oval form, four times as long as thick, and covered with a hard crustaceous shell of a glossy bright chestnut color. This pupa of the tobacco-worm is particularly curious from having its forward end prolonged on one side into a long slender limb which is bent backwards, reaching the middle of the body, where its end touches and is firmly soldered to the surface, thus forming a kind of loop resembling the handle to a pitcher—this being the sheath in which the tongue is enclosed, which in the perfect insect becomes developed to such a remarkable length. In this state the insect remains through the winter and spring. It is currently stated that it lies so deep in the ground as to be beyond the reach of the winter's frost, but this point requires further investigation, for frequently in harvesting potatoes this chrysalis is disinterred, lying only a few inches below the surface. Every laborer who has been much employed in digging potatoes, and every boy who has been assigned the task of picking them up, will recollect having noticed it, the curious loop or pitcher-like handle on one side having particularly drawn his attention to it. In the garden, also, where tomatoes have been grown, I have met with it only slightly underground. The subsoil, moreover, beneath where it is loosened by the plow, is in most situations so compact and hard that it would be a very arduous labor for the worm to penetrate downward in it twelve inches or more; and for the moth, after it comes out from the pupa shell, to force itself up such a distance through this compact subsoil, would seem to be quite impossible. We know, furthermore, that the pupæ of the other lepidoptera, several of them equalling this in size, pass the winter, some in cocoons elevated above the ground, others upon the surface, others slightly under the surface, where they one and all become congealed by the winter's cold without impairing their vitality. I am therefore led to conclude that the repeated instances in which I have met with this pupa lying but a few inches within the loose surface soil were not abnormal, but that this is the depth to which it is commonly buried; and that previous accounts, which represent it as lying deep in the ground, beyond the reach of the frost, are erroneous. When the

warmth of spring has penetrated the earth sufficiently to quicken it again into life, its internal parts continue their growth and development, until the perfect insect becomes formed within the pupa shell. This shell then cracks open and the moth withdraws itself from it, crowds its way upward through the ground, and comes forth in its perfect form.

We next proceed to describe this insect in its different states.

The **MOTH** or perfect insect (Plate 4, fig. 1, is densely coated over with hairs and scales, wholly hiding the surface of the body from view. Its dimensions vary in the two sexes—the body of the female being somewhat shorter and more thick than that of the male. The former usually measures two inches in length, the latter a quarter of an inch more. Its width from tip to tip of the extended wings is much the same in both sexes—seldom varying but a trifle from four inches and a half.

The **HEAD** is pale gray with a brown spot upon each side forward of the eye. The eyes are large and protuberant. The palpi are large and appressed to the under side of the head, with their ends projecting forward and forming a bluntly-rounded apex to the head. The long spiral tongue is glossy, yellowish brown, with its basal portion black on each side. The antennæ are almost half the length of the body, and somewhat shorter in the female than in the male. They are brown, and on the exterior side hoary gray. They are nearly straight, and of a thick clumsy appearance, increasing in thickness very slightly and gradually from the base almost to the tip, and then rapidly taper into a sharp point, which is curved backward. In the males they have along the two flattened faces of their inner side a fine fringe of short hairs placed at the end of each joint.

The **THORAX** is gray, and in front is crossed by two curved black lines meeting at their ends, forming the outline of a crescent having its convex side forward. And on each side of the middle are two black lines parallel with each other through most of their length, extending backward and outward along the edges of the shoulder cover. The hind part of the thorax is brown, with a large black spot upon each side—each of these black spots having on its fore side a roundish blue gray spot, which is edged anteriorly with a transverse line of white or sky-blue hairs. The sides are pale gray, with a brown streak extending from the eye backward to the under side of the wing socket.

The **ABDOMEN** has the form of a cone nearly three times as long as thick. In the males it is composed of seven rings—the last ones becoming gradually shorter, and ending in two compressed tufts of hair, which are of a broad elliptical form, and tapering to a point at their ends. In the females the abdomen is plainly shorter and thicker, composed of but six rings—the last one larger than that which precedes it, and ending in a crown of hairs forming a short cylindrical brush. On the back it is of a gray color, with a slender black stripe along the middle, a white band at the base, and a row of white spots along each side placed in the sutures—the opposite spots being in some instances prolonged into each other, and thus forming a white band upon each suture. Upon the sides the ground color is coal black—this color being notched into at the sutures by the above mentioned row of

TOBACCO-WORM. THE MOTH. ITS LEGS. PRELIMINARY REMARKS ON THE WINGS.

white spots along its upper side, and more deeply along its lower side by a similar row of larger white spots; and on the middle of each of the five first rings is a large round spot of a bright ochre yellow color—the hind ones smaller. The under side is pale gray, with a row of round black spots along the middle, from three to five in number—the second one being the largest.

The **Legs** are gray, paler on their undersides, the feet becoming brown towards their tips, with white rings on the joints. The middle and hind shanks have a pair of spurs at their tips on the underside, and the hind ones have a second pair placed a short distance above the first. These spurs are gray, with naked brown shining thorn-like tips, one spur of each pair being longer than its mate. The feet are five-jointed, the first joint being much the longest, and the following ones successively shorter, with a pair of sharp hooks at the end. On their undersides are rows of small black or brown prickles, with a crown of larger ones at the apex of each joint, and along the hindside of the forward feet and shanks is a series of much larger ones.

Preliminary to our description of the wings of this moth the reader should be apprised of some generalities respecting the markings of the wings in the insects of this order. In the immensely numerous group which in common language we designate as millers or moths, and which are scientifically termed the Crepuscular and Nocturnal Lepidoptera, an almost endless diversity in the spots and marks upon the fore wings is met with. Upon looking them over, one after another, no one will suspect there is any system, any uniformity, to these spots and marks, except it may be here and there among the individuals of a particular genus or tribe. And yet, when we come to inspect them more particularly, we shall discover that the same general designs are repeated, the same pattern is copied, more or less completely and distinctly, all through this vast series of objects, it being variations only in the minor details of the figures, as to their particular form, size, colors and distinctness, that make up the wonderful diversity which exists. These markings, which are common to the wings of such numbers of these moths, are situated and designated as follows: First, between the centre of the wings and its outer margin we observe sometimes one but more commonly two small spots of a peculiar aspect. These are called the stigmas or stigmata, this name stigma having been anciently given to a mark burned with a hot iron upon the foreheads of slaves who had been convicted of theft or other crime. Second, extending across the middle of the wing and between the two stigmas is frequently a darker cloudiness, which has been termed the median shade. Finally, the wing is also crossed by three bands, bars or strigæ, as they are differently termed by different writers; first, the anterior, extra-basal or sub-basal, which is placed immediately forward of the anterior stigma; second, the post-medial or elbowed band, immediately back of the posterior stigma; and third, the sub-terminal, sub-apical or penultimate, which is usually more slender and distinct than either of the others and is parallel with and a short space forward of the hind margin. In the moth which is now before us the spots and marks upon the

fore wings appear to have been regarded by previous writers as being so confused and obscure that they have attempted to give no full description of them. Yet we here find the same series of bands extending across the wings as are mentioned above, though portions of some of them are so modified, so faint and irregular, that they can be satisfactorily made out only in specimens which are most perfect, and by an eye that is well exercised in tracing the very obscure marks which so frequently occur upon the wings of this order of insects.

The WINGS are long and narrow, the hind ones twice and the forward ones nearly thrice as long as broad. They are traversed by strong longitudinal veins, of which there are eight in number ending in the hind margin of each wing and running nearly parallel and equidistant from each other. The upper wings are gray with a large faint brown cloud occupying the disk and apex. Two bands, each formed of three parallel brown or blackish lines extend across these wings, very irregularly, the one before, the other behind the middle. The anterior band we describe as follows. On the inner margin towards the base are three parallel lines, usually very distinct, running obliquely backward and outward half way across the wing to the anterior end of the brown cloud, each line being turned abruptly forward and forming an acute angular point upon the seventh one of the eight longitudinal veins. Beyond this, these lines become very obscurely traced, only one or two of them being dimly perceptible, extending along the outer side of the anterior end of the brown cloud, till they nearly reach the small stigma spot, where they again turn obliquely forward and outward, here becoming more distinct for a short distance on the inner side of the first vein, across which they are continued in three very oblique streaks to the outer margin, the anterior one ending about opposite to its commencement on the inner margin. The stigma is a very small egg-shaped spot, placed obliquely, with its smaller end towards the inner base of the wing, its centre gray and no paler than the ground color around it, it being in most instances marked only by the dusky ring around its margin. The three lines forming the post-medial band commence near the middle of the inner margin, the two anterior lines running backwards parallel with the inner margin, till they reach the inner vein of the wing, between which and the next vein they each form a mark shaped like an arrow-head, at a considerable distance apart. They then pass upon the brown cloud which occupies the central portion of the wing, where they are widened into two broad, dusky streaks, which are cloud-like and obscure, running obliquely and nearly parallel with the hind margin until they reach the fourth vein, where they abruptly turn to a transverse direction and extend onward to the margin at right angles therewith, these lines being formed of confluent arrow-headed spots, which are more distinct in the anterior line, particularly at its outer end. The third line of this band extends across the wing parallel with the second one, the space between them being grayish, this color forming three or four pale cloud-like spots on the inner side of the middle of the wing occupying the angles formed by the arrow-heads composing this portion of the second line. Where this third line crosses the

inner vein it juts backward, forming a very acute angle, as it does also in a less degree in crossing most of the other veins. Extending across the three lines of the post-medial band, in the space between the third and fourth veins, are two very slender black lines, which are united at their ends, forming a very narrow, elongated ellipsis, its anterior end very acute and reaching almost to the stigma. And parallel with this on its inner side, in the space between the fourth and fifth veins is a similar ellipsis, which is less than half the size of the outer one. These ellipses sometimes appear merely as gray streaks, the black lines along their edges being obsolete, that along the outer edge of the outer one being most prominent and near its forward end widened into a small oval spot. Forward of the hind margin is a coal black line, the sub-terminal, the most distinct and conspicuous of all the marks upon the wings. It is waved towards its inner end, conforming to corresponding but more slight curvatures of the third line of the post-medial band, with which line it is parallel through its whole length, a narrow brown space intervening between them. It is frequently deflected forward as it crosses the fourth vein, and it here terminates in the hind end of the elongated ellipsis. Behind this line, extending along the border of the wing near its extreme edge, is a white line, the space between it and the black line being clouded with bluish gray. Finally, upon the brown ground at the apex of the wing is an oblique coal black line, extending from tip forward and inward to the post-medial band, where it ends between the second and third veins. Its hinder portion is margined on the outer side by a pale streak, and where it crosses the second vein it curves forward and forms an acute angle. The fringe is short and brown, alternated with small gray spots placed half way between the ends of the veins.

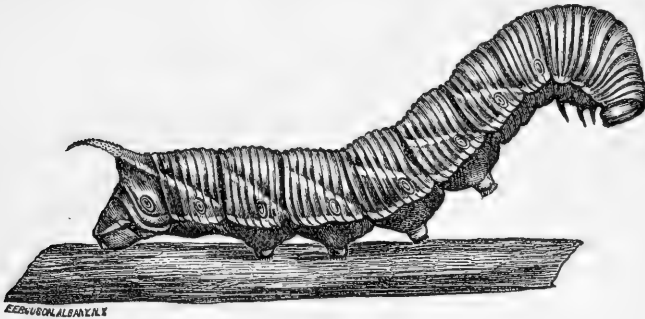
The under wings are blackish at their base, and have a broad, gray hind border, all their middle portion being dull white, and crossed by four black bands. The anterior band is curved, and is commonly united with the second band inside of the middle, and again at its inner end. The second and third bands are parallel or slightly recede from each other towards their outer ends, their inner ends being usually curved almost to a half circle, with the concave side facing forward, the second band being widened and often becoming double in the middle of its curvature. Through the remainder of their length these bands are zig-zag or composed of arrow heads united at their ends, which form acute points projecting backward upon each of the veins. The fourth band is broader than the others, but towards its inner end it tapers and gradually becomes slender, its outer end being curved forward. It is parallel with the hind margin, and forms a border to the gray color of the hind part of the wing. The fringe is short, and of a brown color alternated with white, and becoming wholly white at the inner angle.

On their undersides their upper wings are dull brownish gray, more clear gray along the outer border, and are crossed in their middle by two obscure dusky bands, sometimes with a third band very dimly perceptible between them. These bands, as is particularly obvious in the hind one, are

TOBACCO-WORM. THE WORM DESCRIBED.

formed of a series of curves on the spaces between the veins, with their ends turned backward and forming angles upon the veins; and at the tips of these wings is a black oblique line, corresponding with that upon the upper side, but much more slender and simple. The hind wings are gray, with their hind border down, and are crossed by two blackish bands, which are repetitions of the two middle bands of the upper surface, but more dim, more slender, and running back upon the veins in longer and sharper points.

The LARVA grows to the thickness of one's little finger, and is somewhat over three inches in length or three and a half inches when it is crawling, it being then more elongated than when at rest. Its surface is destitute of hairs or bristles. It is divided into thirteen segments, those at each end



Tobacco Worm.

being shorter and less distinct. The surface of each segment of the body is crossed transversely by impressed lines and roundly elevated intervening spaces, giving them a ribbed appearance, there being eight of these elevated ribs to each segment. In viewing this larva the eye first of all notices a formidable looking, stout, thorn-like horn, placed at the hind end of the back, and projecting obliquely upward and backward, about as long as the segment which is next forward of it, slightly curved, and its surface rough from little projecting points. Low down upon each side is a row of large oval dots, which are the spiracles or breathing pores. The head is small, horny and shining, of a flattened spherical form, and the mouth furnished with a pair of stout jaws. It has three pairs of small tapering feet placed anteriorly upon the breast, each having a sharp hook at its end, and four pairs of short, thick, fleshy pro-legs along the underside of the body, with two similar ones at the tip.

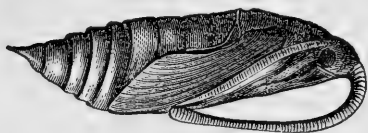
The color of this worm is commonly bright green marked with white. Numerous faint whitish dots are usually perceptible, at least on the fore-part and underside of its body, and along each side are seven straight oblique stripes, the last one of which is prolonged more or less distinctly to the base of the curved horn. These stripes are usually margined along their upper sides by a faint dusky cloudiness; and meeting their lower ends is a longitudinal stripe, placed low down upon each segment, and forming with the oblique stripe, a V-shaped mark, having its point directed forward, with the breathing pore placed in the angle which is thus formed. The hind-most breathing pore also has a much shorter and more faint white stripe

TOBACCO-WORM. VARIES GREATLY IN COLOR. THE PUPA DESCRIBED.

on its upper and another on its lower side, the two stripes uniting together forward of it; and at the anterior end a faint white streak is commonly visible for a short distance forward of the lower end of the first oblique stripe. At the hind end of the body is a flattened triangular space which is margined with white upon each side. The head is green, sometimes with a vertical black streak upon each side. The anterior legs are dusky towards their tips, and on their inner sides are a few small black bristles. The soles of the pro-legs are black, as is also the curved horn at the end of the back.

This larva is liable to vary in its colors to a surprising extent. Many persons from noticing in their gardens worms which are so totally dissimilar in their colors confidently suppose there are two or three different species of them infesting their tomatoes. And the same varieties occur upon the potato, and probably also upon tobacco. Its most common color is leek green. From this it varies to lighter yellowish green, and on the other hand to various shades of darker brownish and blackish green. In other instances the green color wholly vanishes, and the worm is pale or deep amber brown, blackish brown, purplish black or pure black. In these brown and black varieties the head sometimes retains its normal green color, but is usually the same color with the body. The dots upon the skin and the oblique stripes along the sides are very often light yellow instead of white; and where the ground color of the worm is dark brown or black, these markings are always yellow, or sometimes pale pink red. The breathing pores are black, but sometimes dark red or dull yellow, and are surrounded by a ring of white or pale blue, which is usually inclosed in a second ring which is sometimes brown, sometimes black. The curved tail-like horn, so far as my observation goes, is the only part which is constant in its color, this being always black.

The PUPA or chrysalis is of an oval form, its opposite sides nearly parallel through most of its length, and tapering at each end. It is four times as long as thick, its length being two to two and a half inches. It is of a chestnut-brown color, paler in some places and blackish in others. The anterior end is irregularly narrowed and at its apex is prolonged into a remarkable



Tobacco-worm Pupa.

ably long cylindrical tongue-case the thickness of a coarse knitting-needle, which projects downward and is curved backward at a distance of nearly a fourth of an inch from the surface of the breast, becoming straight through the last half of its length and reaching half the length of the body. It is thickened and bluntly rounded at its end, which slightly touches the surface of the body and is firmly soldered thereto. It is evenly ribbed transversely, appearing as though the enclosed tongue were divided into a number of short joints like the antennæ, and along its outer and its inner sides are two elevated lines extending its whole length. The wing-sheaths are smooth and glossy, with faint elevated lines marking the veins of the inclosed wings. They are firmly soldered

to the body, and reach two-thirds of its length, and interposed between them at their ends is a single pair of the leg-sheaths, which exactly equal them in length. Along their lower edges are the antennæ-sheaths, regularly marked with transverse impressed lines, and tapering to a very acute point on each side of the end of the tongue-case. The rings of the body are closely and confluent punctured on their anterior sides and show numerous transverse irregular scratches and fine wrinkles towards their posterior edges. The breathing pores form a row of oval impressions along each side, each having two acutely elevated lines and between them a narrow elliptic cleft. On the back at the base of the abdomen is a smooth black transverse ridge interrupted in its middle. The three short rings at the hind end are rapidly narrowed, forming a conical point having at its tip two small thorn-like points, one larger than the other.

We come in the next place to consider the natural enemies and destroyers which restrain this insect from becoming excessively multiplied and numerous. Large and vigorous as this tobacco-worm is, enveloped in such a tough, leathery skin, and jerking its body about with the force and spitefulness it does when anything molests it, we should scarcely suppose any other creature would care to encounter it. And yet it finds its mortal foe in a little four-winged fly, scarcely a thousandth part of its size. It is truly wonderful that such a pigmy as is this fly is able to attack and destroy such an elephant as is this worm. The fly alights upon the worm, and with the short sting or ovipositor with which it is furnished pierces its skin and inserts a minute egg in the puncture. It continues to repeat this operation at one point and another upon the back and sides of the worm, until its whole stock of eggs, amounting to a hundred or more, is exhausted. These eggs hatch minute maggots, which distribute themselves all through the body of the worm, feeding upon its fatty substance, but without attacking any of its vital parts. And thus the worm continues industriously to feed and elaborate nourishment for feasting and pampering these greedy parasites which are luxuriously rioting within it. If a worm which is thus infested be cut into, it appears to be everywhere filled with these little fat maggots. When they have got their growth they gnaw out through the skin, but instead of dropping to the ground and there secreting themselves as they would be expected to do, they still cling to the unfortunate worm, each maggot spinning for itself a little oval white cocoon, one end of which it fastens to the skin of the worm at the orifice where it has issued from it. Thus the worm comes to present the remarkable spectacle of being clothed, as it were, with a hundred or more of these cocoons, resembling little white seeds like kernels of rice adhering to and in places wholly covering its back and sides. I have counted one hundred and twenty-four of these cocoons upon a single worm, and a still larger number will probably be found in some instances.

These parasitic cocoons are milk white and of a regular oval form, 0.15 long and 0.06 broad. Their walls are no thicker than thin writing paper but are very dense and firm. Their surface is minutely uneven, with a few loose, wrinkled threads at one end, whereby they are held to the skin of

the worm, yet so slightly that they are liable to be detached by the slightest force, some of them falling off, sometimes, merely from the motions of the worm.

When these parasites issue from it the worm has become so weakened and exhausted that it ceases feeding and moving about, and in about three days afterwards all traces of its vitality have vanished. The multitude of minute hooks with which the soles of its pro-legs are furnished, however, continue to hold the dead worm to the stalk of the plant, with its head hanging downwards and its body shrunken and flaccid from the evaporation of its fluids, until some agitation of the plant by the winds or other violence detaches it and it falls to the ground.

In the meantime the parasites change to pupæ, and after remaining in the cocoons seven days they come out from them in their perfect form. The flies are black, with clear transparent wings, and legs of a bright tawny yellow color, the hue of bees-wax, with the hind feet and the tips of the hind shanks dusky. They belong to the order HYMENOPTERA, and to that group of the Ichneumon-flies, which in works of science have been termed *Ichneumonides adsciti* or the family BRACONIDÆ. Several of the species of this family present the singular character of having the eyes pubescent, numerous fine short erect hairs arising from their surface. These pertain to a particular genus which has received the name *Microgaster*, from two Greek words, equivalent to our English term "small-bellied." It is to this genus that these parasites of the Tobacco-worm belong. And they were described by Mr. Say, in a posthumous paper which was published in the year 1835, in the Boston Journal of Natural History, vol. i, p. 262, under the name *Microgaster congregata* or the Congregated Microgaster, in allusion to their young being found together in such numbers upon a single worm.

The TOBACCO-WORM PARASITE, *Microgaster congregata*, is of a coal black color and 0.14 long when living. After death it contracts in drying and is then scarcely 0.12 in length, and the male is a size smaller, not exceeding 0.10. Its head is spheroidal, or of a flattened globular form, with the antennæ inserted in the middle of the front side. The antennæ are coarse, thread-like, and longer than the body in the male, shorter in the female. They are composed of about seventeen joints so closely connected that their articulations are difficult to perceive. The joints gradually become slightly shorter and less thick as they approach the tips. The palpi and jaws are white. The eyes are distant from each other on the sides of the head, and in a strong light their surface is seen to be closely bearded over with minute short hairs. Between them on the crown the eyelets or ocelli appear as three small glassy dots placed at the corners of a triangle. The thorax is the broadest part of the body. It is egg-shaped, its surface minutely and closely punctured, and back of the middle it is crossed by a deep groove. The abdomen is oblong oval, and about the same length as the thorax. It is smooth and shining, except the two first segments which are rough from obscure shallow punctures, with an elevated longitudinal line in the middle. On its underside the three first segments are pale yellow, with a dusky

TOBACCO-WORM. PARASITE DESCRIBED. ITS WINGS.

spot on the middle of each, that on the third segment being large, and as the sutures contract in drying these spots become united. At its tip the abdomen in the female is compressed and vertically truncated, with the sting forming a conspicuous projecting point at the lower end of the truncation. In the male the tip is rounded and without any projecting point, though when living it may sometimes be seen to protrude two styles or slender cylindrical processes pointed at their tips, and between these a thicker process from the apex of which a fine bristle is occasionally thrust out. The *legs* are bright tawny yellow, becoming more dull and pale in the dried specimen. The hind feet and tips of the hind shanks are smoky or blackish. The hind thighs are also blackish at their tips, and frequently show a dusky line along their upper sides, extending nearly to the base. The *wings* are hyaline, glassy and iridescent. The forward pair have the stigma appearing as a large, opaque, triangular, brownish black spot on their outer side slightly beyond the middle. The rib or marginal vein is thick and brownish black, becoming paler brown towards its base. The basal portion of the wing is traversed by two pale longitudinal veins, which are parallel, the outer one straight, the inner one curved towards its base. The outer vein sends off a long and nearly straight branch obliquely outward and backward to the anterior end of the stigma, this branch bounding the discoidal and the first cubital cells on their fore sides. The discoidal cell is triangular, with the vein on its inner side brown and angularly bent at one-third and again at two-thirds of its length, giving off at each of these angles a short oblique veinlet, the first one of which is brown and the other colorless. The first cubital cell is of the same size with the discoidal, and is irregularly six-sided, the anterior and the inner sides being quite short; and the veinlet bounding this cell posteriorly is thick and brownish black, the inner half of its length being oblique and the outer half transverse, ending in the inner angle of the stigma. Beyond this, traversing the apical third of the wing are three longitudinal veins, which are very slender and colorless. The middle one of these veins is abruptly thickened and blackish brown for a very short distance at its base, this thickened portion forming, with the oblique inner end of the veinlet last described, two of the sides of the small triangular cellule which is common in the wings of the insects of this genus and family, but the short veinlet which should complete the enclosure of this cellule on its hind side, is wholly wanting.

Mr. Say is wholly silent respecting the interesting habits of this insect, merely remarking that he obtained eighty-four of the flies from the larva of a Sphinx in the month of June. As I have had the flies come from the cocoons in July and also in September, it is probable that they are abroad upon the wing during the whole summer season, actively searching for suitable worms to inoculate with their eggs. As will be seen from a statement in one of the following pages, this parasite does not appear to be limited to the tobacco-worm, but preys upon the larvæ of other species of Sphinx also. And some of our other species of *Microgaster* have the same habit of fastening their cocoons to the larvæ from which they respectively

TOBACCO-WORM. PARASITE'S COCOONS MISTAKEN FOR EGGS. ITS RAPID INCREASE.

issue. It is not rare, therefore, to meet with a worm which is thus burthened and shackled; and they are justly regarded as great curiosities. Correspondents have frequently sent me examples of this kind; some of them supposing in the fullest confidence that the little cocoons adhering to the back of the worm were eggs which the worm had laid, thus demonstrating, as it was thought, that the statements made in these Reports were erroneous, that it is only in their perfect and never in their larva state that insects produce eggs. This is an error into which every one who is not acquainted with insects and their wonderful habits and transformations will be very apt to fall, the shape, color and size of these cocoons being so much like eggs which a large worm like this might be expected to generate. And it shows in a strong light how important it is that our population should be correctly informed and measurably intelligent in this science. For a person destroying one of these worms will be particularly careful to also destroy all these supposed eggs; deeming that in each one of them he in effect destroys another worm; instead of which he hereby protects and insures the upgrowth of another worm—thus doing the very thing which he is aiming to prevent.

Of the hundred flies which are bred from one of these Ichneumonized tobacco-worms, we may assume that fifty at least will on an average be females, to destroy fifty more worms. We thus see what efficient agents these insects are in checking the increase of this moth, and what an important service they hereby render us. Indeed, when we recur to the fact that these parasites attain their growth in a space of time so very much shorter than does the tobacco-worm, whereby there is probably two generations of them to one of the latter, it will appear that the parasites issuing from a single Ichneumonized worm will suffice to destroy two thousand and five hundred other worms within the time that one brood of these worms is growing up to maturity. They would therefore speedily exterminate these worms from existence, were they permitted to go on multiplying themselves without any check. And they are so well secreted and protected that there would seem to be little risk of their being discovered and destroyed by any enemy. For during their larva state, when they are soft and tender and without feet or any other means of defence or escape, they are lodged within the body of the tobacco-worm where they are secure from harm; and when they issue therefrom they immediately enclose themselves in tough paper-like cocoons, in which they lie hid until they have acquired wings wherewith to fly away from any danger which menaces them. Thus they would seem to be protected and safe from injury. Yet the artifice of enclosing themselves in cocoons fails to procure them immunity. Another minute insect has been created and endowed with the sagacity to discover them in the little pods in which they hide themselves, and there this creature metes out to them the same treatment which the tobacco-worm receives from them. Thus the tobacco-worm does not die unavenged. The lingering, miserable death which it has suffered, its enemies, as if by an act of retributive justice, are doomed to undergo in their turn.

TOBACCO-WORM. A DESTROYER OF THE PARASITE DISCOVERED.

On one occasion, when I was contemplating one of the tobacco-worms which I met with covered over with parasitic cocoons, I noticed a very small fly wandering about among the cocoons. My first thought was that this fly was probably one of the *Microgaster* parasites which had just then come from some one of these cocoons ; but the query soon arose in my mind, whether it might not be an enemy, stinging the cocoons to destroy their inmates in the same manner they had destroyed the tobacco-worm. Its very small size did not enable the eye to discover whether it really was one of the *Microgaster* flies. I was so fortunate as to succeed in enclosing it in a small vial, and then upon examining it with a magnifier, I became assured it had not come from the cocoons, for I perceived it pertained to a different group of parasites from that to which the *Microgaster* genus belongs. But how could the highly interesting and important point be ascertained, whether it actually was a destroyer of the inmates of these cocoons? With the hope of obtaining further light upon this subject a portion of the stalk of the plant with the tobacco-worm adhering to it was cut off and enclosed in a glass jar. On the fifth day thereafter, two *Microgaster* flies made their appearance in the jar, and the worm now being dead and beginning to become putrid, the cocoons were all removed from its surface and enclosed in a vial. It was feared that this slight violence to them had destroyed their inmates, as day after day now elapsed and no more flies came from them. But, three months later, in December, they being kept in a warm room, a dozen flies were discovered, wandering around in this vial ; and for some weeks after, others continued to come forth from the cocoons. And these proved to be identical with the single fly which had been captured among these cocoons so long a time before. It was therefore evident that that fly was the parent of these which were now issuing from the cocoons ; and so industrious had that little creature been, that it had punctured and dropped one of its eggs into all save two of the cocoons, which were more than a hundred in number ; and these two, it is probable, would not have escaped, if the fly had not been interrupted and taken away from its work.

These destroyers of the insect which destroys the tobacco-worm are very small four-winged flies of a shining dark green color, with pale yellowish legs and white feet. They belong to the order HYMENOPTERA and the family CHALCIDIDÆ, and are closely related to the Hessian fly parasite, *Semiotellus destructor*, figured in my Seventh Report, plate 3, fig. 1, which figure will also serve to represent this insect in almost every particular. It pertains to the genus *Pteromalus*, a name derived from two Greek words, meaning bad wings, the wings in these insects being nearly destitute of ribs or veins. As they, by destroying the parasite of the tobacco-worm, cause that worm to be more numerous and hereby more injurious to the tobacco, and as they will often occur lurking about this plant in search of the cocoons upon which to bestow their eggs, they may not inappropriately be named the Tobacco *Pteromalus*. All the flies which came from the cocoons were females, from which the following description is drawn.

The TOBACCO PTEROMALUS (*Pteromalus Tabacum*), is one-tenth of an inch

long to the end of its body, and is of a dark or bottle green color with a brassy reflection, and finely shagreened upon the head and thorax. The *head* is large and placed transversely, about three times as broad as it is long, convex in front and concave at its base. Viewed in front it is nearly circular, with a large oval eye slightly protruding upon each side, of a dull red color fading to brown after death. On the crown three ocelli or eyelets appear as glassy dots placed at the corners of a triangle. The jaws are yellow, their ends brown, with four minute teeth. The palpi or feelers are dull white. The antennæ are inserted in the middle of the face and when turned backward reach about half the length of the thorax. They become a little thicker towards their tips, and are of a brown color with the long basal joint dull pale yellow, and are clothed with a short incumbent beard. They are composed apparently of nine joints, the first joint being long and smooth, and forming an angle with the remaining joints. The second joint is the smallest of the series, being but little longer than thick and obconic in its form. The third joint is thrice as long and nearly thrice as thick as the preceding, and has the shape of a pear, the contracted portion of its base being formed of two rings or small joints which are rarely perceptible even in the live specimen when highly magnified, except these organs be put upon the stretch. The fourth and following joints are a third shorter than the foregoing, and are nearly equal and square in their outline, each successive joint very slightly increasing in thickness and diminishing in length. The last joint is about thrice as long as the one preceding it, of an oval or sub-ovate form, rounded at its base and bluntly pointed at its apex, and is probably composed as in the other species of this genus of three joints compactly united together. The *thorax* scarcely equals the head in width and is egg-shaped and thrice as long as wide. On each shoulder is a slightly impressed line extending obliquely backward and inward. The *abdomen* is a third shorter than the thorax, and in the live insect surpasses it in thickness, is egg-shaped and convex with its tip acute pointed. When dried it scarcely equals the thorax in thickness, and becomes strongly concave on the back and triangular when viewed from one side. It is smooth, polished and sparkling, of a green black color, the middle segments each with a broad purple black band visible in particular reflections of the light. Beneath it is black and at the tip shows some fine impressed longitudinal lines forming the edges of the groove in which the sting is inclosed. The *legs* are slender, pale wax yellow, with the feet and ends of the shanks dull white, the hips of the hind legs being stout and black, with their outer faces green blue and their tips pale yellow. The feet are five-jointed and dusky at their tips. The *wings* are transparent and reach slightly beyond the tip of the abdomen when at rest. The anterior ones are broad and evenly rounded at their ends, and have, near the outer margin, a thick brown rib or subcostal vein extending more than a third of their length and then uniting with the margin and terminating some distance forward of the tip, after sending off a short straight stigmal branch which is thickened at its end, with its apex notched. Towards the inner margin an exceedingly fine longitu-

dinal vein is perceptible, which, near its middle, gives off a branch running almost to the inner hind end of the wing. The hind wings are much smaller and without veins, except a brown subcostal one, which extends into the outer margin and abruptly ends a little beyond the middle.

All the examples of this species, which I have obtained from cocoons upon the Tobacco-worm, have been females. The last of August, 1862, I received from Dr. Allen of Saratoga Springs, a larva of the *Sphinx Kalmiae* to which thirty-six cocoons were adhering. And the middle of July, the following year, H. Markham, Esq., of Stony Brook, Long Island, sent me the same larva, similarly infested. It may here be incidentally observed that both these gentlemen met with these larvæ upon the leaves of the grape-vine. As I have repeatedly observed it, in different years, upon the lilac, the leaves of which are certainly its usual food, the interesting query arises, whether, when it is infested internally with parasites, they do not cause a morbid appetite in the worm, whereby it ceases to relish its natural food and comes to crave the leaves of the grape in place of those of the lilac? Flies were obtained from more than half the cocoons upon the first mentioned worm, and these being all of one species, I supposed they were probably the true parasites of the Lilac-worm. But I now find on comparing them, that they are identical with this species which is now under consideration. It thus appears that the cocoons adhering to the Lilac-worm had been formed by a species of *Microgaster*, probably this same species which infests the Tobacco-worm, and that the flies I obtained were its parasites and consequently were protectors instead of destroyers of the Lilac-worm. The cocoons from Mr. Markham, might perhaps have given more light upon this subject, and I now regret that, when they came to hand, supposing they would only produce the same flies which I had examined the preceding summer, I felt that it would be a waste of time to attend to the rearing of their inmates.

Of the flies obtained from the Lilac-worm, four were males, whereby it appears that this sex differs from the females above described, in the following particulars: 1st, their color is lighter and more bright, being brilliant metallic green, when dried becoming blue green; 2d, their antennæ are tarnished yellow, longer, and not at all thickened toward the tips, their joints being cylindric and a third longer than thick, with the last joint egg-shaped and but little longer than its predecessor; 3d, the abdomen is flattened oval and rounding at its tip, with a large translucent pale yellow spot near the base; 4th, the legs are paler and pure yellow without any mixture of orange or tawny.

One who is acquainted with this insect and the *Microgaster* fly, will readily distinguish them by their motions, notwithstanding their smallness and similarity in size. The *Microgaster* is very brisk and active in its movements, running about with agility and flying away if any danger menaces it. This insect on the other hand, appears tame and sedate, walking around slowly, and as if with deliberation as to what it is doing; and if any annoyance approaches it, to escape therefrom it gives a slight skip, throwing itself about an inch, and repeating this leap again and again if pursued, it being not at all inclined to take wing.

TOBACCO-WORM. HAS A SECOND PARASITE. REMEDIES.

And after these flies have left their cocoons, it is readily told by the appearance of each cocoon, whether it is a *Microgaster* or a *Pteromalus* fly which has come out from it. The *Microgaster*, by which all the cocoons are constructed, makes an opening for its escape in a more neat and artistic manner than does its destroyer. When it passes from its pupa state and awakens to life in its perfect form, it finds itself closely pent up within its narrow cell — so closely that about the only motion it is able to make is to turn its head from side to side. And it discovers that by grasping with its jaws the wall of its cell, it is hereby able to gradually roll itself over in its bed. And now, with the minute sharp teeth at the ends of its jaws, it cuts a slit transversely through the wall of its cell, lengthening this slit more and more as it gradually turns itself around. Thus it cuts the end of its cocoon smoothly off in the form of a little lid, a few unsevered fibres being left on one side, which serve as a hinge to hold this lid in its place. The inclosed fly then pressing its head against this lid raises it up and crawls forth from its prison. Thus the evacuated cocoon has its end smoothly cut off, with the severed portion usually adhering to it. The *Pteromalus* fly, on the other hand, being a size smaller, is able to move about and can probably turn itself around inside of the cocoon. And to make its escape it gnaws a hole through the side near one end, of sufficient size for its body to pass through; this hole in different instances being round, oval, or irregular, and its edges ragged and uneven.

In addition to the eggs of the *Microgaster*, which are inserted under the skin of the Tobacco-worm and thus are not visible externally, I have occasionally met with a worm having one or more eggs glued upon its surface, usually placed in a crease of the skin to render the attachment to it more secure. These eggs are about three-hundredths of an inch long and a third as thick, oval, white, smooth and glossy like enamel. Within them a minute soft white worm or maggot becomes formed, which is hatched by gnawing through the shell of the egg at one end, and as it is coming out, it sinks itself downward through the skin of the worm and into its body, a blackish dot upon the skin near the end of the empty egg marking the point where it has entered. Its history I have not been able to trace further than this. The facts show it to be another parasite destroying the Tobacco worm, and that it is probably a two-winged fly belonging to the order DIPTERA.

The remedies for this insect are remaining to be spoken of. But as we have had no personal experience in combatting it, it will not be expected that we dwell upon this branch of the subject at any length.

The leaves of the potato and tomato being of no value, the presence of this worm upon them is wholly disregarded, as its limited numbers never consume the foliage to such an extent as to perceptibly diminish the growth of the tubers in the one or of the fruit in the other of the plants. But with the tobacco it is very different. The whole value of this plant depends upon its leaves; consequently every morsel which this worm consumes from them is a loss, and if the leaves are much eaten the loss is great. The utmost vigilance is therefore required to save the tobacco from injury from

this enemy. At the South, where they have had long and sore experience with the twin sister of our insect, the only remedy found to be effectual is searching out and destroying the worms. This "worming" of the tobacco fields, as it is termed, is an indispensable measure, forming a regular part of the tobacco culture. After the leaves are grown to a sufficient size for the worm to begin to feed upon them, not a day is suffered to pass without examining them. The leaves are so large and so very tender and brittle, except for a short period at mid-day, when they become pliant from being somewhat wilted by the heat of the sun, that the utmost care is requisite in passing among them to avoid breaking and tearing them. Notwithstanding the closest scrutiny some of the worms will be overlooked, at each search which is made. Moreover, new moths are coming out and depositing their eggs day after day, whereby a succession of worms are appearing. Thus it becomes necessary to repeat this examination daily, searching out and destroying every worm while it is yet young and small.

When these ugly looking worms first began to be noticed upon the tomatoes in our gardens, some sensitive persons were much alarmed with fears that they were poisonous and would render the fruit deleterious if they happened to touch or crawl over it. But such fears are wholly groundless. The sharp, thorn-like tail of this worm, however, if it chances to penetrate the skin, inflicts a painful wound. This is the only thing to be guarded against.

10. TEN-LINED POTATO-BEETLE, *Doryphora 10-lineata*, Say. (Coleoptera. Chrysomelidæ.) Plate 4, figure 6.

Eating the leaves of the potato in immense numbers through the whole summer; a thick, oval beetle nearly half an inch long, and of a pale yellow color with five black stripes on each wing cover, accompanied by its thick-bodied, worm-like larva of a pale yellow color with rows of black dots, and six legs upon its breast and a pro-leg at the pointed end of its body.

In connection with the foregoing potato-worm, some account may here be given of a new enemy which, within the past two or three years, has fallen upon the potato-vines in numerous places all over the Northwestern States, stripping them of every vestige of their foliage and eating the stalks also, and hereby arresting the formation and growth of the tubers. Specimens of this insect are being frequently sent me for information respecting it, whereby I am able to present a description of it in its different stages of life and several important facts respecting it. Fortunately for us, it is not an inhabitant of our State, being found only in the valley of the Mississippi at a distance from our borders.

This insect was first discovered as being common on the Upper Missouri, by Mr. Say, when accompanying Long's Exploring Expedition to the Rocky Mountains. He met with it upon the Arkansas river also. In 1823, he published a description of it (Journal of the Academy of Natural Sciences, vol. iii., p. 453), naming it from the number of the stripes upon its wing-covers, *Doryphora 10-lineata* or the Ten-lined Doryphora—this genus having been separated from the old genus Chrysonela, by Illiger, to include a number of South American species which have the middle portion of the

POTATO-BEETLE. ACCOUNTS OF ITS DESTRUCTIVENESS.

breast prolonged into a horn-like point, wherefore the name; *Doryphorus* being a Greek word meaning a spear-bearer, and particularly memorable as the name of one of the most celebrated statues of the sculptor Polykletus. But our insect and a few other species of this genus are destitute of the sharp, thorny point alluded to. Chevrolat, in Dejean's Catalogue, proposed to form these into a distinct genus, named *Polygramma*—i. e., many-lined. But this step has not been approved of by subsequent authors.

The year after Say described this insect, the distinguished German entomologist Germar also published it, under the name *Dyrophora juncta*, which, of course, will be merely a synonym of the anterior name.

The first notice of this as being an injurious insect, appears in the *Prairie Farmer* of August 29th, 1861 (vol. viii., p. 116), in a letter from J. Edgerton, of Gravity, Iowa, saying that "they made their appearance upon the vines as soon as the potatoes were out of the ground, and there being a cold, wet spell of weather about that time, they devoured them as fast as they were up." They appeared most fond of the Prince Albert variety, doing but little injury to several other kinds. Several generations appeared to grow up in the course of the summer. The specimens were sent to D. Thomas, Esq., of Marion, Williamson county, Ill., who in reply announces them to be the species above named, and says that this same insect "is found in abundance in Southern Illinois; but so far I have only discovered it on worthless weeds and low shrubs; and here it has not proved injurious to useful vegetation," wherefore he thinks it is only accidental that it has fallen upon the potatoes in Mr. Edgerton's vicinity, and that some peculiarity of the plants, state of the atmosphere, or other influence may next year cause it to forsake the potato and take up its residence upon some other plant.

The next year, Thomas Murphy, of Atchison, Kansas, sent a number of the beetles to the *Valley Farmer*, with an accompanying letter, published in that periodical July, 1862 (vol. xiv., p. 209), saying that in August, 1861, "soon after a heavy shower of rain, these bugs suddenly made their appearance in large numbers on the potato vines. They were so numerous that in many instances they would almost cover the whole vine. It is no exaggeration when I tell you that we have often, in a very short time, gathered as many as two bushels of them. When the cold weather set in they disappeared. Early this spring I was setting out some apple trees, and away down in the hard yellow clay, I found these bugs apparently dead, but put them in the sun and they immediately came to life. They have again (May 22) made their appearance in large numbers in my garden. Last year they first ate up everything green on the potato vines, then commenced on the tomatoes, and so on, on everything green. Strange to say, they trouble no one else." Some of the beetles had been forwarded to Benj. D. Walsh, Esq., of Rock Island, Illinois, who communicates their name and a good figure, but is singularly unfortunate, not to say erroneous, in several of his statements made in connection with this subject; for instance, that the New York weevil is "an exclusively western species," "Mr. Murphy's account is the first on record of this beetle occurring in gardens in such

POTATO-BEETLE. ITS EGGS AND LARVA DESCRIBED.

numbers as to be injurious," &c. He regards the fact of Mr. Murphy's finding the beetles under ground in the spring, as full proof that this insect always goes under ground to pass its pupa state; overlooking the additional fact that Mr. M. found these beetles lying dormant and apparently dead, which indicates that no warmth had at that time penetrated the earth sufficient to change them from their pupa to their perfect state. Mr. M's. recital of his observations would seem to make it plain that it is in their perfect, not in their pupa state that they hibernate. He says the beetles were immensely numerous; but when the cold weather set in they disappeared. Early the next spring he again found them away down in the hard yellow clay, apparently dead but immediately reviving when exposed to the sun. And finally, May 22d, they had again made their appearance abroad in large numbers. Everything thus appears to show that these beetles remain abroad in full force until a frosty night cuts off their food and chills them, whereupon they hasten into any crack they can find in the hard clay soil, or under any log or stone lying on the surface. They there become dormant and thus repose through the winter, and with the warmth of returning spring revive and issue from their retreats.

Specimens of this beetle, its eggs and larvæ, we received first from John S. Bowen, Elkhorn city, Nebraska, in May, 1863. Similar remittances have since come to hand from different parts of Iowa. A correspondent at Webster City writes that these insects are "very voracious feeders, not only denuding the vines of every vestige of leaf, but also devouring the stalks. Killing them seems to do no good, they breed so rapidly; and as they fly through the air, they would soon be re-established were they all exterminated from a field. It is now August 1st, and few if any tubers are yet set upon by my potatoes, though the planting was very early." And from New Sharon we are told that some have been discouraged from planting potatoes, the ravages of this potato-bug have been so great.

The beetles though sent from such a great distance have in every instance reached me alive, whilst the larvæ accompanying them have been nearly or quite dead, except in two or three instances. The eggs also uniformly hatch and the young from them perish before they come to hand. Kept in confinement, the beetles usually live so long as they are supplied with food. I have thus kept an individual captured in May, until the frosts of autumn destroyed my supply of potato and tomato leaves. And beetles newly born, if gradually exposed to the cold, will undoubtedly become torpid and dormant, and lying in this state through the winter will revive and return to activity with the return of warm weather.

The female in confinement drops her eggs in little clusters upon the leaves on which she has been feeding. The eggs are bright yellow, smooth and glossy, 0,06 long and 0,035 broad, of an oval form with rounded ends.

The LARVA, when full grown is over a half inch in length and half as thick, being thickest back of the middle and tapering to a point at its tip. It is a thick plump grub, strongly arched above, and when viewed on one

POTATO-BEETLE. THE BEETLE DESCRIBED.

side its outline is nearly the form of a crescent. The head is small and much narrower than the fore part of the body, of a flattened spherical form. Its mouth is furnished with short conical, jointed feelers and large jaws which are blunt at their ends, with little sharp teeth like those of a saw. Immediately above the mouth on each side of the head is a small conical and jointed projection which is the antenna. The thorax has a large transverse space on the top of its first ring, of a firmer and somewhat coriaceous texture and broadly margined with black on its hind side and with dusky at each end. The abdomen is the thickest part of the body and is distinctly divided into nine segments. It is very plump and rounded, but flattened on its underside. It gradually tapers posteriorly into a conical point the apex of which is blunt and serves as a pro-leg, two small vesicular processes on its lower side at the end serving as feet. There are six legs, placed anteriorly, upon the breast, each leg being composed of three joints and ending in a small claw. The larva is of a pale yellow color, often slightly dusky or freckled on the back with minute blackish dots, and along each side are two rows of large black dots, those of the upper row larger, seven in number, not being continued upon the thoracic or the last abdominal rings, each dot having a small breathing pore in its centre. The head is black and shining, and more or less mottled on the face with dull yellowish. The neck or first ring has a black band near its hind edge; the second ring has also either a short black band or two black dots, whilst the third ring usually shows two small black dots on its back. On the narrow tip of the body are two black bands, the anterior one having at its end on each side a small black dot, and beyond this a large black dot which is the last one of the lower row of dots along the sides. On the next ring forward is a transverse row of six small equidistant black dots, in addition to the two large dots on each side, whereof the upper one is the last of the upper lateral row, and the lower the penultimate one of the lower row. The legs are black; and often along the middle of the body, on the underside, is a row of transverse black spots or clouds, and also a row of small black dots upon each side.

The BEETLE or mature insect is 0,40 long and 0,25 thick, the female being slightly larger. It is of a regular oval form, very convex above and flat beneath, of a hard crustaceous texture, smooth and shining, of a bright straw color, the head and thorax being sometimes tawny yellow, which is the color of the underside; and is dotted and marked with black. After death its colors often fade, becoming more dull and dark. The *head* is nearly spherical and little more than half the width of the thorax, into which it is sunk nearly or quite to the eyes. It is sprinkled over with fine punctures and shows on the front an impressed medial line, and on each side of this a wider shallow indentation. On the crown is a triangular black spot. The nose piece or clypeus, occupying the space between the antennæ, is nearly semicircular and placed transversely, and is coarsely and closely punctured. The jaws are coarsely punctured, black at their tips, and have a slender black line along their outer edge. The tips of the palpi or feelers are dark brown. The antennæ reach nearly to the base

POTATO-BEETLE. THE BEETLE DESCRIBED. REMEDIES.

of the thorax when turned backward. They are gradually thickened towards their tips, twelve-jointed, the last joint being quite small, conical, and sunk into the apex of the preceding joint. The five first joints are pale yellow or tawny, obovate, the basal one largest, and the third one longer than either of the other three. The remaining joints are black and somewhat globular. The *thorax* is transverse, twice as broad as long, broadly notched in front for receiving the head, and its hind side convex. Five punctures are scattered over its surface, these punctures becoming more numerous and coarser towards the outer sides. It is commonly margined all round by a slender black line. In the centre are two oblong black spots which diverge forward. Back of these is a small black dot which is often wanting; and on each side are about six small black spots; one towards the base, of an oval form and placed transversely; and two round ones, nearly upon a line forward of this, the three being equidistant from each other; two towards the hind angle, placed close together and often united, the inner one of these being largest of the six; and the sixth one placed half way between the two last and the forward angle. The scutel is dark brown. The *wing-covers* have the sutural edge dark brown, and five equidistant black stripes on each. The first or inner stripe is shortest and tapers backward as it gradually approaches the suture, terminating in a very long slender point a considerable space forward of the apex. The two next stripes are broadest and are united at their tips, beyond which they are sometimes prolonged into the end of the fourth stripe. The outer stripe is the most slender and longest of all, placed on the outer margin but terminating before it attains the apex. The wing covers are also punctured in rows extending along the margin of the stripes, the rows being uneven and the middle ones double; and the outer interspace is also punctured. *Beneath*, the sockets of the legs are black or edged with black, and on the hind breast is a transverse black spot on each side, forward of the insertion of the hind legs, and also a black stripe on the outer margin of the hind breast, outside of which on the parapleura is a triangular black spot. The abdomen is finely punctured on the disk and base, and has a short black band on the middle of the anterior edge of each segment except the last, and near the outer margin a row of six black dots. The *legs* are tawny yellow, with the hips at least of the hind pair black and also the knees and feet.

Say mentions a variety of this beetle having the wing-covers white. This is probably always their color when recently disclosed from the pupa.

What will be the best remedies for this new insect enemy can only be ascertained by experiments with it in its native haunts when its habits are more fully observed. We know not whether turkeys and other fowls relish these beetles, whereby they may be employed to aid in lessening their numbers. The large size of the beetles and their sluggish movements favor their being readily noticed and picked from off the vines. But their numbers are so immense as to dishearten from attempts to thus get rid of them unless some way can be devised to gather them rapidly in large quantities. The method that has been resorted to with some success against the blistering flies where they have been numerous on the

potato vines, may be of utility, namely, holding a pan with an inch or two of water in it, under the vines here and there, and shaking and knocking the insects off into it, the water holding them from escaping until a quantity are gathered, when they may be emptied into a bag, and another quantity gathered. They can be killed by immersing the bag in boiling water, and its contents may then be fed to the swine.

11. GARDEN TIGER-MOTH, *Arctia Caja*, Linnæus. (Lepidoptera. Arctiidæ)

Eating the leaves of lettuce, strawberries, &c., a large thick-bodied caterpillar nearly two inches long, of a black color with a row of white shining dots along each side and thickly clothed with long soft hairs which are black upon the back and red on the neck and sides; enclosing itself in a thin pale brown cocoon from which towards the end of July comes a large beautiful brown moth with white spots and many irregular stripes crossing its fore wings, its hind wings ochre yellow with about four large round blue black spots.

This truly elegant insect, named *Caja* or the bride by Linnæus, and the caterpillar of which is popularly called the Garden Tiger in England, is abundant all over Europe, but as yet is quite rare in this country. Several specimens were met with in our State at Trenton Falls, by Mr. Edward Doubleday, in 1837. A male has long been in my collection, which I think was taken the same year at Canajoharie and presented me by Wm. S. Robertson; and when closing these pages for the printer, on the evening of July 27th, 1864, a female came in at the open door of my study, flying slowly around with a rustling of its wings which indicated it to be some moth of a large size and heavy body.

One of Mr. Doubleday's specimens was presented to Dr. Harris, by whom, first in the year 1841, in his Report to the Legislature on the Insects of Massachusetts Injurious to Vegetation, it was described as a new species under the name *Arctia Americana*, although Godart had previously regarded it as identical with the *Caja*, in which opinion Boisduval and other French naturalists have since continued to concur. In Agassiz' Lake Superior, Dr. Harris gives a more full description and a figure of this moth, in which he says the white spots and rivulets on its fore wings are the same as in the European insect, but that it is distinguished from that by the white band margining the thorax in front. But in a European specimen which I have before me, this white band is present and conspicuous as in the American examples, except that it is less broad; which is a circumstance of no importance in an insect subject to such great variations in its colors and marks. Thus we are left without any grounds for regarding this as different from the European species.

This moth measures from two and a half to three inches across its wings when they are extended, the males being a trifle smaller than the females. It is of a rich brown color, the hue of burnt coffee, with some of its parts bright ochre yellow or orange red, and it is variegated with spots and marks of milk white, crimson red, dark blue and black. But it varies astonishingly in its colors and marks. I draw the following description of the spots and markings chiefly from the living specimen before me, in which they appear to occur in their most usual and perfect condition.

The head is brown. The palpi or feelers form two conical points project-

GARDEN TIGER-MOTH. ITS ASTONISHING VARIETIES OF COLOR.

ing obliquely forward and downward from the lower front part of the head, of a darker brown with longer and less dense hairs of a red color along their underside and around the mouth. Coiled up between them is the spiral tongue, of a white color, and only equaling them in length when extended. The antennæ reach a third of the length of the wings. They resemble slender, tapering threads, white, their tips brown, their basal joint red, and a brown stripe along their underside. In the males they are pectinated, each joint sending off two short brown branches. The *thorax* is globular and brown, with a broad white band in front, occupying the base of the collar and extending backward across the shoulders and uniting with the white stripe or spot upon the middle of the base of the wings. The collar is edged all around with crimson red, forming a slender margin along the lower edge of the white band and on each side crossing this band and forming a narrow arched band above it. The base of the thorax is also slenderly margined with red, which color widens on each side into a small spot. The sides of the thorax are pale brown, with a pencil of red hairs in the axilla of the wings. The *abdomen* is bright ochre yellow with a row of brownish black spots along the middle of the back, the spots transverse, four or five in number, the hind ones largest. The underside is pale brown with the edges of the segments yellow. The *wings* are brown, slightly pale towards their hind ends. Their base is white, which color near the middle of each wing is prolonged backwards into a long acute point, forward of which are two long egg-shaped brown spots placed side by side, and on the outer edge are two larger brown spots slightly parted from each other by a curved line, with a fifth spot on the inner edge. Towards the middle of each wing on the outer edge are two large white spots of an irregularly triangular form. Beyond these, crossing the wing transversely from the outer margin to the inner angle is a wavy white band which is thickened at its ends. From the middle of this band a curved branch extends forward and inward to the inner margin; and from the same point on the opposite side of the band another branch extends backward, nearly to the hind edge, when it abruptly turns outward and forward and then outward and backward, reaching the outer margin of the wing forward of the tip. In the closed wings these markings upon their hind part are observed to be beautifully symmetrical, having some resemblance to the Greek letter omega with a bar placed horizontally across its middle. The lower wings are deep ochre yellow with four large round blackish blue spots having a black margin, whereof three are situated in a row forward of the hind margin, the inner one of these being the smallest, and the fourth one, which is slightly transverse, is placed forward of the centre. The undersides are colored and marked similarly but much more pale and dim. The *legs* are brown with the thighs crimson except upon their undersides, and the shanks and hind feet are yellow on their undersides.

In respect to its colors and spots, this moth is truly protean, varying to an extent which is most astonishing. Thus the fore wings are sometimes black instead of brown, with all vestiges of the white spots and rivulets upon them vanished. In other instances they are of the same bright yellow

GARDEN TIGER-MOTH. ITS EGGS. CATERPILLARS DESCRIBED. THE COCOON AND CHRYSALIS. or red color with the hind wings, with a few brown spots upon them; and in still other instances they are white with but a faint tinge of yellow. The hind wings sometimes have their spots diminished and nearly obliterated. In other instances these spots are increased in number and in size; again, they become confluent, forming two broad black bands across the wing; and finally, the whole wing is black and without spots. The *Arctia Parthenos* it cannot be doubted is one of the latter varieties of this species, intermediate between the banded winged and black winged varieties. It is erroneously credited to Kirby in the Smithsonian Catalogue of Lepidoptera. It was described and figured by Dr. Harris, in Agassiz' Lake Superior, and is essentially distinguished as having the base and inner margin of its hind wings black with the remaining portion yellow crossed by a broad black band.

The female moth above mentioned dropped seven hundred and forty-four eggs in the course of four days after her capture. Being so prolific it is evident this insect would very soon become as abundant in our country as it is in Europe if it were not checked in its increase. It must be that nearly all the caterpillars of each generation are destroyed, probably by birds. Judging from the proceedings of the female when in confinement, her eggs are laid upon the surface of leaves and firmly glued thereto in clusters of from fifty to one hundred, the eggs in each cluster being placed for the most part in contact with each other in regular rows. The eggs are quite small, being about 0.034 in diameter. They are globular, shining, white, with a large faint spot on their summit of a watery appearance.

The caterpillars which come from these eggs grow to about two inches in length and have a thick cylindrical body which authors describe as being of a deep black color, densely covered with long soft hairs which arise in bundles from elevated warts. These hairs are of a bright red color on the three first rings and along the sides, and on the rest of the body are black with their ends gray. The warts from which the red hairs arise are of a bluish gray color; those from which the black ones come are blackish brown. Three of these warts of a blue color and placed in a row one above the other on each side of each ring are most obvious to the eye. The breathing pores form a row of shining white dots along each side. The head is shining black; the underside and feet are blackish brown. From all the other caterpillars of our country this is particularly distinguished by the three blue warts on each side of each segment, and the conspicuous row of white dots along each side of the body. As it approaches maturity, however, its unusually large size will alone suffice to point it out. It would appear to be this creature to which Hiawatha is represented to refer, in Longfellow's much admired poem, as

"The mighty caterpillar
Way-muk-kwana, with the bear skin,
King of all the caterpillars!"

When it is fully grown it encloses itself in a grayish brown cocoon of a soft closely woven texture, intermixed with the hairs of its body. In this it changes to a chrysalis, having the form of an elongated egg, of a shining black color with the sutures yellowish brown and the pointed end two-lobed

and studded with little rust-colored points. The insect remains in the cocoon from eighteen to twenty days and then comes forth in its perfect state.

Like other caterpillars of the group to which it belongs, this is a general feeder, subsisting upon low herbaceous plants of almost every kind, and on a pinch feeding also upon the leaves of trees and shrubs. An incident related by Duponchel (Hist. Nat. des Chenilles), shows how able it is to sustain itself upon any substance of a vegetable nature which is sufficiently soft for it to masticate. Having forgotten one of these caterpillars which he had wrapped up in a paper envelope and inclosed in a wooden box, he afterwards discovered it had nourished itself upon the paper, as was proven by the dry pellets of excrement in the box, and had after this completed its transformations, producing a moth which was a dwarf in its size but with very bright colors. Some curious facts are reported, showing the colors of this moth to vary according to the quality of the food on which the caterpillar is nourished. Thus if it be fed upon lettuce or other vegetation of a similar succulent nature, the colors of the moth are more dim and pale than when it is reared on substances which are less watery. The German collectors are said to obtain the variety having the under wings black by forcing the caterpillars to feed exclusively upon the leaves of the walnut. Some of the French, however, are stated to have tried this without success. It may be that some concurring atmospherical influences, some peculiarity of the season, is also necessary to insure the particular result. The species certainly presents a most interesting subject for the experiments of amateurs.

12. CORN CUT-WORM, *Agrotis nigricans*, Linn., Var. *Maizi*. (Lepidoptera. Noctuidæ.) Plate 4, fig. 2, 3.

In June, severing the young Indian corn and other plants, half an inch above the ground, by night, and by day hiding itself slightly under the surface; a thick, cylindrical, gray worm an inch and a quarter long, with rather faint, paler and darker stripes, the top of its neck shining black with three whitish stripes.

The insects from which our farmers experienced the greatest vexation and injury the past season (1863), were the Cut-worms—the same worms which are sometimes called corn-grubs, and which in English agricultural works are termed surface grubs or surface caterpillars. The name Cut-worm, however, is most commonly given to them in this country, both in print and in common conversation, and appears to be the most appropriate and best term by which to designate them, having allusion as it does to a habit which is peculiar to these worms, namely, that of cutting off tender young plants as smoothly as though it was done with a keen-edged knife.

These Cut-worms are among the most important injurious insects of our country. It is mostly in our fields of Indian corn and in our gardens that their depredations are noticed. They are so common as to occasion some losses almost every year; whilst every few years they make their appearance in such numbers as to nearly or quite ruin the corn-fields, obliging the proprietors to plant their ground a second and even a third time, or to re-plow it and sow it with a different crop. Thus, in consequence of the pre-

CUT-WORMS. . . EARLY NOTICES AND RECORDS OF THEIR INJURIES.

sence of this worm in our country, the labor of the husbandman is frequently doubled to obtain from his land a crop either materially diminished in amount or of a less valuable kind from that which he would be able to harvest were it not for this enemy. The attention of the farmers of our State was this past season prominently directed to the rearing of flax, and a breadth of land was given to this crop far exceeding what has ever before been assigned to it. But soon after the young flax appeared above the ground, these Cut-worms began their depredations, feeding upon and wholly consuming the small tender plants to such an extent that many fields had large patches in them which were eaten perfectly bare, whilst in others the crop was totally destroyed.

Many of our injurious insects are new pests which have but recently been observed in our country. But these Cut-worms appear always to have^d been here, depredating upon and despoiling the cultivated crops in centuries gone by, the same that they are now doing. Before European settlers arrived upon this continent, the cornfields of the Indians are said to have been ravaged at times by these worms, this being of all others a disaster to them of which they were most fearful, and one which they felt themselves wholly powerless to avert, their only resort for protecting their fields from this calamity being that indicated in the lines of the poet:

“Draw a magic circle round them,
So that neither bligh^t nor mildew,
Neither burrowing worm nor insect,
Shall pass o'er the magic circle.”

And this is well known to have been a casualty of frequent occurrence all along since the soil of our country has been cultivated by civilized men. In those diaries which have occasionally been kept in different parts of our land by persons who have been curious to preserve a record of local incidents of interest, we are sure to meet ever and anon with the statement, “Indian corn was this year greatly injured by the worms,” “The season was wet and cold, and the worms made extensive ravages on the corn,” and other entries of the same purport. From one of these sources we learn that a century ago there had been a distressing drouth in 1761, followed by an unusually long and severe winter and a late spring. “When at last the corn was planted, millions of worms appeared to eat it up, and the ground must be planted again and again. Thus many fields were utterly ruined.” (Flint's Second Report, Mass. Board of Agriculture, p. 40.) It, however, may have been the Wire-worm which occasioned at least a portion of the destruction here related, for usually when one of these worms is numerous the other is so likewise. It is unnecessary to mention other years in which we have little more than the mere fact stated that these corn worms were very injurious.

In addition to such manuscript mementoes, the published allusions to these pests date far back. Upwards of seventy years ago, when the old Agricultural Society of our State was first organized, in a circular which the Society issued, containing inquiries upon different topics on which information was solicited, the first query respecting insects was, “Is there any

CUT-WORMS. HAVE NEVER YET BEEN INVESTIGATED.

way of destroying the grubs in corn and flax?" No answer to this inquiry, of sufficient importance for publication, was received.

But, although these Cut-worms have always been such a formidable foe in this country, against which the cultivators of the soil have had to contend, they have not, down to the present day, been subjected to any careful scientific examination. It was formerly supposed they were all of but one kind, one species of insect. In our day it has been ascertained that they are of several different kinds, and that they are bred from a particular group or family of millers or moths, of a dark color, which fly about in the night time and remain at rest and hid from our observation during the day—most of them belonging to the genus named *Agrotis* by naturalists. But the observations which have been made upon these Cut-worms have been so hasty and superficial, that, when we see one of these worms cutting off the young corn in our fields or the cabbage plants in our gardens, we are unable to give it its exact name; we are unable to say what particular species of miller or moth it is which has produced that worm.

All that has yet been done towards a scientific investigation of this subject may be narrated in a few words.

Upwards of forty years ago, Mr. Brace, of Litchfield, Ct., in a short article published in the first volume of Silliman's Journal, gave what he evidently regarded as a sufficient elucidation of this matter. It appears that in a patch of ground planted with cabbages, where the worms had been numerous, he found their pupæ to be common, lying a few inches below the surface, just after the worms had disappeared. From some of these pupæ he obtained the miller or moth. In the article alluded to, he merely describes this miller as being the insect which produces the Cut-worm, naming it the *Phalena devastator* or the Devastating miller. As he supposed all the Cut-worms were of one kind, he gives no description of the worm from which this miller is produced. And thus it remains unknown to this day what the characters and appearance of the worm are which belongs to this miller which Mr. Brace described.

Some ten years after this, Dr. Harris, one season, gathered a number of full grown Cut-worms from different situations, to breed the moths from them; but what is most surprising, he took no notes of the differences in the appearance of these worms. He obtained from them four different moths in addition to the one which Mr. Brace had previously obtained. These he names and describes, but is unable to give any account of the worms which belong to either one of these species.

In the Second Report which I presented to this Society, I gave very exact figures of the miller which Mr. Brace described, and of two others of the most common millers of our country belonging to the same group; and I also described five of the Cut-worms which I had noticed as being common kinds in our cornfields and gardens. Finally, in my Third Report I was able to give an account of one of our Cut-worms, and the moth which was raised from it.

And this is the posture in which this subject now stands. Seven of the moths or millers of our country, which produce Cut-worms, have been named

and described. But only one of them is known to us in its larva state. We also know that at least five other Cut-worms, in addition to this one, are formidable enemies to us, depredating every year, more or less, upon the young plants in our fields and gardens, but we know not the species to which they respectively pertain, and consequently are unable to distinguish either of them definitely, by giving to it its correct name.

I have for a great many years regarded these Cut-worms as a most important subject requiring to be elucidated. And accordingly, almost every year, upon meeting with some of these worms, I have written in my notes a particular description of them, and have endeavored to feed and rear them to their perfect state, but without success. They are very intolerant of confinement, especially when they are not grown to their full size. Upon discovering that they are imprisoned, they lose all relish for food, and become intent on one thing only, namely, to find some orifice in their prison walls through which to escape. Accordingly, when the shades of evening arrive, they come out from the earth in the box or pot in which they are placed, and crawl hurriedly and anxiously around and around, the whole night long, as I have found on going to them with a light. The vegetables transplanted into the box for them to feed upon remain untouched. In this manner, they in a few nights wear their lives away, and are found lying stark and stiff on the surface of the dirt of their cage. From the experience I have had, I regard them as among the most difficult insects which I have ever taken in hand to feed and rear from their larva to their perfect state.

It had accordingly become evident to me that a suitable knowledge of these Cut-worms could never be gained in the manner I had attempted—by casual observations made at moments snatched from other investigations. It was only by making them the leading subjects of examination; devoting to them ample time and care and vigilance; studying them as they were growing up in the fields and gardens; watching them from day to day, there, in their natural haunts, until they became fully matured and were done feeding, and then placing them in cages to complete their transformations and reveal to us what they are in their perfect states; I say, it had become evident to me that it was only in this manner that the requisite knowledge of these creatures could be obtained, to prepare such an exact history of them as their importance and the advanced state of science at this day demand.

I have, therefore, for several years, had it in contemplation, when a season occurred in which these worms were numerous, to devote my chief attention to them. And accordingly, on becoming aware last May, that these worms would be quite common in my vicinity, I resolved to make them the subjects of special investigation.

And I now proceed to give a summary account of these insects and their habits, and the progress which the researches of the past season has enabled us to make towards a more full and exact knowledge of them.

It is in midsummer, mostly in the month of July, that the moths or millers come abroad and lay the eggs from which the Cut-worms are bred.

CUT-WORMS. YOUNG WORMS IN AUTUMN. FALL PLOWING TO DESTROY THEM.

The eggs are dropped at the surface of the ground, around the roots of grass and other herbage. The worms hatch and feed during the autumn, coming abroad by night and eating the most tender vegetation which they are able to find, and during the daytime withdrawing themselves under the ground to hide from birds and other enemies, and feeding upon the roots of the vegetation which they there meet with. Grass appears to be their favorite food, and its young, tender blades and rootlets furnish most of these worms their subsistence through the first stages of their lives. During the autumn the earth is so profusely covered with vegetation and these worms are so small that no notice is taken of them or the trifling amount of herbage which they then consume. They become about half grown when the cold and frosty nights of autumn arrive, whereby they are no longer able to come out to feed. They then sink themselves deeper than usual into the ground, going down to a depth of three or four inches; and there, each worm, by turning around and around in the same spot, forms for itself a little cavity in which to lie during the winter; and it there goes to sleep, and lies torpid and motionless as though it were dead. The soil at the depth where these worms are lying very slowly and gradually becomes colder and colder as the winter comes on, and at length freezing, these worms reposing in it are also frozen. And when the warmth of spring returns, the ground thawing and becoming warm in the same gradual manner, these worms slowly thaw and awake from their long sleep and return again to life. The case is analogous to what occurs with ourselves when we have a finger or a foot frozen. On coming into a warm room, if we keep the frost-bitten part covered with snow or immersed in ice-cold water, whereby it very slowly thaws and the circulation gently and gradually returns to it, the part readily recovers; whereas, if instead of this, we hold it to the fire and thaw it suddenly and abruptly, high inflammation and gangrene follows, and we lose the limb. And so, if these Cut-worms lying in the ground should be suddenly frozen or thawed, it would be fatal to them.

This brings to our view an important measure which is much practiced for the purpose of destroying these worms and securing the corn crop from their depredations. Our farmers quite generally endeavor to break up their planting ground in the autumn, rather than in the spring, under the idea that they thereby disturb these worms in their winter quarters and expose them to the cold and frost, whereby a considerable portion of them are destroyed. And I believe it is the general experience of our farmers that corn planted upon ground which has been thus broken up in the autumn is less liable to be injured by these worms than where it has been broken up in the spring. But these worms, in common with all other insects, continue to be active in autumn so long as the weather remains warm. It is not till they feel the chill of the autumn frosts that they retire into their winter quarters. Therefore, if the ground be broken up early in autumn, when the weather is still warm and the worms are in full life and activity, it can be of little, if any avail, for the purpose intended, as they will readily crawl into the ground to the depth which they require for their

CUT-WORMS. THEIR HABIT OF SEVERING YOUNG PLANTS.

protection. In order that this fall plowing should be efficacious, it is obvious it should be deferred until near the close of the season, when the worms have withdrawn themselves downwards and are lying torpid and inactive in their winter retreat. If the turf under which they are reposing be then turned up to the surface, they will be incapable of crawling away into any new quarters, and the sudden freezings by night and thawings by day to which they will be alternately exposed, we are confident must destroy a large portion of them.

When the spring has returned and we are engaged in making our gardens, a Cut-worm is occasionally turned up to our view in digging and working in the earth there; and if grass has been permitted to grow and form a turf around the roots of currant bushes or elsewhere, upon digging up and rooting out this grass, we are quite sure of finding a number of these worms nestled among it, indicating to us that grass more than anything else furnishes them with the covert and food which they desire.

Although we thus find these Cut-worms lying in the soil of the garden early in May, it is not until the close of that month and the beginning of June that they begin to attract our notice by the injury they do in our gardens and cornfields. It is when they are grown to about two-thirds of their full size that they commence the work which renders them so pernicious to us,—that of severing the young, tender plants. Previous to this, during all the first period of their lives, as has already been stated, they lie concealed under the ground during the day time, feeding there upon the roots of plants, and only venture out by night to feed upon the green vegetation above ground. Although in England they are called surface grubs, I discover they are not restrained to the surface of the ground, but mount up the stems of young cabbages and beans and eat portions of their leaves. But, about the commencement of June, the nights have become so short and the days so long, and the worms are now grown to such a size and their appetites have become so ravenous, that they are forced to a most singular change of their habits. The insipid roots of plants fail to yield them the amount of nourishment they require during the eighteen hours of daylight. They must either stay out to feed upon green herbage during the daytime, or they must, so to speak, set their wits to work to devise some way by which they can get this herbage down under the ground so that they can there feed upon it. We accordingly see them adopting the curious expedient of cutting off tender young plants in order to draw them into the ground, whereby they may feed upon them during the long hours of the day. Is it not wonderful, that such sluggish, stupid looking creatures as these worms are, should have the intelligence to perform such a feat as this—cutting off the plant, to enable them to get the end of it down into the ground, so that they may cosily lie there and feed upon it in safety—gradually drawing it in, more and more, until by the close of the day the whole of the plant and its leaves are consumed; a feat strikingly analogous to that for which the beaver is so renowned, cutting down small trees and drawing and swimming them away to build a dam with them. Surely we should admire this loathsome-looking worm for such a skillful performance,

CUT-WORMS. THE STRIPED WORM FOLLOWED BY THE LARGER YELLOW-HEADED WORM.

were it not that it is this very act which renders this creature such a pest, such a nuisance to us !

As to the kinds of plants which these worms thus sever to feed upon them, they appear to have but little if any preferences. They relish everything that is young and tender and succulent. Thus they attack the corn, the flax, the potato stalks in our fields, and in our gardens the cabbage plants and beans, cucumber and melon plants, beets and parsnips, and also the red-wood and several other weeds. Nor are they limited to herbaceous plants. Where a sucker starts up from the root of a tree, while it is yet young and tender it is liable to be severed, if one of these worms chances to find it.

They appear to have no discrimination in their taste, but relish equally well the most acrid and bitter plants, with those which are mild and aromatic. Thus the onion stalks in our gardens are about as liable to be cut off as any other plants; and I have known the acrid smart-weed to be severed by them. The past summer, I set out in my garden a few tobacco plants, that I might notice what insects would come upon this filthy weed; and within a few days after, one of these Cut-worms gave me a very palpable reminder that he would not tax me for cabbages and beans if I would only furnish him with what tobacco he wanted to chew. I have known a piece of writing paper to be partially consumed by one of these worms enclosed in a box where it became pressed with hunger. And where several worms are enclosed together in a box of dirt, over night, without any food, it is a common occurrence for the larger ones to devour the smaller ones.

The past season, it was upon the 22d of May, in a hot bed, that I first noticed a plant severed by a Cut-worm; and the query at once arose, how could this worm get into such a close and secure place as that was? The loam forming the top of the bed had been obtained from the garden; and it was evident this worm must have been lying in the soil there, and had been brought from thence, in this soil, when the bed was being made. And the warmth of the bed had quickened the growth of this worm and brought it forward in advance of all its fellows.

Three days later, the first bean plant in the garden was found cut off by another of these worms; and from that time they continued to become more common until about the first of June, when they were out in their full force, both in the fields and in the gardens. At first I supposed the worms in the cornfields were different from those in the gardens. But the more I examined and compared them, the more assured I became that they were all of one species, although they varied greatly, some being pale and others dark, and some having very distinct stripes, whilst others had them scarcely perceptible. It was the same species which I named the Striped Cut-worm, in the Transactions of 1855, p. 545. It continued out in full force, depredating everywhere in the fields of flax and corn and in gardens, for a period of three weeks, when, the worms having got their growth, began to be less numerous, and had all disappeared at the end of the month.

Just as this worm was about to vanish, another one, larger and more voracious, came out to occupy its place and continue the work of destruc-

CUT-WORMS. DIFFERENT OPERATIONS OF THE TWO WORMS.

tion in the fields, none of them being met with in the gardens. It was on the 20th of June that, in examining a cornfield, I first noticed this second worm, lying under the sods, it being of a white or pale smoky color with a bright tawny yellow head, and the same kind which I have heretofore named the Yellow-headed Cut-worm. This cornfield had been broken up just before planting, and the roots of the grass were still juicy, succulent and unwithered, at least in all the larger masses of turf; and this worm evidently preferred these grass-roots to the young corn; for on examining a multitude of the hills of corn in which one or more of the young plants had been cut off, it was invariably the Striped worm first mentioned, which was discovered there; not one of these Yellow-headed worms had as yet molested the corn. Five days afterwards, this same cornfield was again visited. The weather in the interval had been warm and dry, whereby the grass-roots in the clumps of turf had become dry and withered, unadapted for feeding the worms any longer. And now on examining where the blades of young corn had been newly cut off, the mischief was discovered to have been done in nearly half the instances by this Yellow-headed worm, which was found lying in the earth contiguous to the severed plant. Thus, it was sufficiently demonstrated that so long as it could find any roots of grass for its nourishment, this worm did not molest the corn. Therefore the corn remained unattacked by it, until about the date specified, namely, the 25th of June. A few years before, however, I found this same Yellow-headed Cut-worm making severe havoc in a cornfield at the very beginning of June—there probably being no juicy roots of grass in this field, on which it was able to sustain itself. Having the fact thus established, that these worms will not trouble the corn, so long as they are able to find grass in the field on which to nourish themselves, it becomes an important question to be considered, whether, after all, it may not be better to break up our corn ground in the spring than in the fall; so that hereby, a portion of the roots of the turf may remain sufficiently fresh and unwithered to feed these Cut-worms and hereby keep them back from falling upon the corn. This is a difficult subject to determine; and it is only by repeated observations, carefully made, that it can be satisfactorily settled.

The operations of these two worms were so very different that upon seeing a severed plant it was readily told which worm it was that had cut it off, and would be found lying in the ground by its side. The smaller Striped worm, which first appeared, cut off the plants half an inch or an inch above the surface of the ground; and many of the plants, being severed at this height, survive the injury, new leaves pushing up from the centre of the stump. Instances were noticed, in which the worm had cut off the plant below the lower leaf, which leaf remaining, green and thrifty, the plant would thereby be vigorously sustained while new leaves were putting forth from its centre. The larger Yellow-headed worm, on the other hand, severs the plants almost an inch below the surface of the ground, whereby they are effectually killed in every instance. This worm also lies deeper in the ground than the other, it being usually met with about two inches below the surface, whilst the smaller worm only goes down

CUT-WORMS. THEIR PUPA STATE. STRIPED CUT-WORM DESCRIBED.

sufficiently to hide itself from view. It is also much more irritable, more ferocious and combative. If two of them are enclosed in a box together, and one crowds against or attempts to crawl over the other, it spitefully resents this freedom and snappishly tries to bite the intruder.

These Yellow-headed worms continued to cut off the corn for more than a week after the others had disappeared, remaining out till about the close of the first week in July.

When the Cut-worm is done feeding it crawls down into the earth to the depth of three or four inches, where it is not liable to be disturbed by any other worms inhabiting the superficial soil. It here doubles itself together in the shape of a horse-shoe, and by turning around and around in the same spot, presses the soil outward from around it, compacting it into a thin brittle kind of shell which the wet from any showers of rain will not penetrate, forming a large oval cavity with a smooth surface on its inside. In this cavity the worm lies motionless and becomes contracted in size and of a stiff and more firm consistency. The forward part of its body becomes swollen, more and more, till at length the skin bursts open upon the back and the hard shining yellow shell of the pupa begins to protrude from this opening. By slight sudden starts or shrugs, the skin is gradually thrown off and remains in a shrivelled mass at the end of the insect, which is now in its pupa form, without any mouth or feet, its shape being that of an elongated egg of a shining chestnut yellow color, thrice as long as thick, but only half as long as was the full grown worm. This pupa or chrysalis lies quiet and motionless in its oval cell under the ground for about four weeks, when its outer shell-like covering cracks open upon the fore part of the back, and the moth or perfect insect crowds itself out from it, and upward through the loose earth to the surface. The first moth from the Striped Cut-worm presented itself to us this year on the evening of the sixth of July, and upon the evening of the tenth the same moths had become exceedingly numerous. The worms had been so diversified in the depth of their color and the distinctness of their stripes, that I had confidently expected to see a similar diversity in the moths which they produced. I was, therefore, greatly surprised to find the latter remarkably uniform, no differences occurring to my observation this season that were susceptible of being described as varieties.

Now that we have ascertained the moth of this, one of our most common Cut-worms, it is important that we give the most accurate description of it and of the worm from which it comes, that we are able to draw up from the numerous specimens we have examined, and thus place this species on record so distinctly that it may ever hereafter be readily recognized.

The Striped Cut-worm, as we have heretofore termed it, is a cylindrical worm, usually about an inch in length when disturbed beside the severed plants in our gardens and corn fields, and upwards of an inch and a quarter when it is fully grown. Its ground color is dirty white or ash gray, occasionally slightly tinged with yellowish; the top of its neck shining black, with three white or pale longitudinal stripes; a whitish line along the middle of its back between two dark ones; on each side three dark stripes

CUT-WORMS. MOTH OF THE STRIPED WORM DESCRIBED.

separated by two pale ones, whereof the lower one is broader; often a somewhat glaucous white stripe below the lower dark one, and all the underside below this dull white. This is the best concise general description of the worm that I am able to give, the characters stated being sometimes quite faint, but in most instances sufficiently plain and distinct. I proceed to give a more full description of the several parts. The *head* is shining black, with a white stripe in the middle, which stripe is forked, resembling an inverted letter Y. The nose piece and upper lip are whitish, the former being wrinkled or longitudinally striated, and the latter having a transverse row of white bristles. The jaws are black and four-toothed. On each side is usually a white spot, and in other instances the whole head is more or less mottled with white, or is throughout of a tarnished white color with only a dusty streak on each side of its base. The *neck* above is of the same shining black color and horny substance as the head, with a white stripe in the middle, continuous with that upon the head, and a stripe on each side, curving slightly outward at its hind end. The sides of the neck are dull white, with a short double blackish stripe across the middle. The *back* is ash gray, this color forming a stripe along each side of the middle, where are two dusky lines, and between them a whitish line of the same thickness. The *sides* are dark gray or of the same dusky shade as the two lines on the middle of the back, this color being divided into three stripes of equal width by two faint pale lines, the lower one broader and formed of spots mottling the surface. These pale lines sometimes take on a glaucous white appearance, and sometimes adjoining the lower dusky stripe on its underside is a third glaucous white stripe, which is broader than those above it, and along its lower edge are the breathing pores, forming a row of oval coal black dots. The *underside*, including all below the breathing pores, is dull whitish, the legs being varied with smoky brown, and the pro-legs having a ring of this color at their base.

The *MOTH* is represented, plate 4, figure 2, with its wings spread, and figure 3 as we usually see it when at rest and with its wings closed. It measures 0.70 in length and 1.30 across its extended wings, and is of an ash or dusky gray color, and distinguished principally by two coal black spots, one nearly square, placed outside of the centre of the fore wings, and the other nearly triangular, a little forward of it, a roundish nearly white spot separating them. Its *head* is gray, and its palpi or feelers are blackish upon their outer side. These organs are held obliquely forward and upward and are densely covered with erect hairy scales, giving them a short, thick outline of a compressed cylindrical form, and cut off transversely at their ends, with a small naked joint protruding therefrom, little longer than thick, and scarcely a third of the thickness of the joint from which it projects. Coiled up between the palpi and slightly visible on their underside is the long spiral tongue or trunk. The antennæ are slender, thread-like, but tapering towards their tips. They are simple in the females, and in the male are toothed like a saw along their opposite sides, the teeth being sharp and fringed with minute hairs at their tips. The *thorax* is the thickest part of the body and is of a square form, as is very evident when the

CUT-WORMS. WINGS OF THE MOTH DESCRIBED.

wings are spread. It is gray, with a black band in front, edged on its hind side with an ash gray one, paler than the ground; and on the shoulder at the base of the fore wings is usually a small spot of dull pale yellow. The *abdomen* is tapering and somewhat flattened, dusky grayish, paler towards its base, its tip more blunt in the male than in the female and covered with a brush of hairs. The *legs* are blackish gray and hairy on their undersides, the spurs at the end of the middle and hind shanks being black in their middle and white at each end. The feet are five-jointed, long and tapering, the first joint much the longest and the following ones successively shorter. They are gray, gradually passing into black at their ends, each joint having a white ring at its tip. The *wings* in repose are laid flat, one upon the other, in a horizontal position, sometimes so closed together that their opposite sides are parallel, but oftener widening backward (as represented in figure 3), and forming a broad shallow notch at their hind end. The fore wings vary in color from ash gray to dusky gray, and sometimes have a tawny reddish reflection. Their outer edge is grayish black, with irregular alternations of black spots having an ash gray spot between them, and towards the tip are about three equidistant pale gray dots. The costal area or narrow space between the outer edge and the first longitudinal vein is pale ash gray, gradually becoming dull and obscure beyond the middle. At the base, on the outer edge, are two black spots or short transverse streaks, with a pale gray streak between them, and opposite these, on the basal middle of the wing, are similar streaks placed obliquely, which are frequently faded to a blackish cloud-like spot, with a pale gray streak crossing its middle. Outside of the central part of the wing are the stigmas, two large roundish pale gray spots, having a square coal-black spot between them and a triangular one forward of them. The anterior one of these stigmas is broad oval, almost circular, and placed obliquely, with its outer end more towards the base of the wing than is the inner end. It is of a uniform pale gray color, slightly paler than any other part of the wing. Its edge is well defined by the black color surrounding it, except at its outer end, where it is incomplete, being confluent with the ash gray color of the costal area. The hinder stigma is kidney-shaped, being concave on its hind side, and occupying this concavity is a pale gray spot or cloud, quite variable in its size in different specimens, and frequently taking on a buff or cream yellow tinge. This stigma is brownish or watered gray, becoming paler along its anterior edge, its ends, particularly the inner one, being vague and indefinite, blending with the adjacent coloring, sometimes so much so that only its middle portion is distinct. Between these stigmas is a large square spot of a coal-black color, occupying the whole space between the two midveins of the wing, its fore and hind sides made concave by the rotundity of the stigmas which bound it upon these sides. Forward of the anterior stigma is a second black spot of a somewhat triangular form, also occupying the whole space between the two midveins at this point. On its hind side it is concave and cut off obliquely by the obliquity of the stigma, whereby it is prolonged along the inner vein, usually into a long acute

point. Its anterior end is cut off, either transversely, obliquely or irregularly, by a faint pale grey streak, which is a portion of the anterior or extra-basal band. (See generalities preceding the description of the wings of the Tobacco-worm moth). In the best specimens this pale streak is distinctly seen to be prolonged backwards along the outer side of the black spot almost to the stigma, and then suddenly turning at a right angle, it runs obliquely forward and outward in a straight line to the outer margin, between the two small black spots which are here placed on the margin. In the opposite direction this pale streak is also prolonged from the forward end of the black triangular spot, inward and backward and curves slightly forward to the inner longitudinal vein, and beyond this, with another similar curve, is extended to the inner edge of the wing, it being margined on both sides by a black line, that along its hind side being commonly more conspicuous. And a short distance back from this line, equidistant between the inner midvein and the inner vein, may always be seen a black dot or short dash, which is the extreme point of a black stripe called the teliform stigma, which is common upon the wings of the moths of this genus, but in this variety of this species is wholly wanting, except this minute vestige of its apex. And also crossing this inner half of the wing obliquely at about two-thirds of the distance from the base to the hind edge are two other parallel blackish lines, representing the post-medial band. The anterior one of these lines is irregularly wavy and angular, and turns obliquely forward as it approaches the posterior stigma, and appears to pass into the inner hind angle of the square black spot. The posterior line, as traced from the inner edge of the wing, curves slightly backward till it reaches a point a short distance back of the inner end of the hind stigma, when it becomes nearly transverse, and then curves forward and obliquely outward to the outer edge of the wing, ending in the posterior one of the two black spots which are on the outer edge opposite to the anterior side of the hind stigma. This line, in the middle of the wing, is festooned or made up as it were of crescents united at their ends, these ends projecting backwards and forming about four acute angular points; and sometimes this line is made more distinct by a faint pale gray line bordering it on its hind side, at least in the concavities of the crescents. But both these blackish lines are commonly quite faint and entirely vanish in many specimens. Beyond this, a broad space on the hind border of the wing is darker colored and traversed by a whitish line, which is wavy and often broken into a series of small irregular spots, these spots sometimes having larger black cloud-like spots adjoining them on the fore side. Back of the outer end of this line the tip of the wing is occupied by a triangular gray spot. The hind edge is faintly sinuated, with a series of slender black crescents surmounting the sinuosities. The fringe is concolor with the portion of the wing immediately forward of it. The hind wings are smoky whitish, with a broad dusky hind border, dusky veins, and an obscure dusky crescent near the centre. Their fringe is dull white with a dusky band near its middle. On the underside they are clearer white, with a broad, dusky hind border and sprinkled with dusky scales

towards the outer side. The veins are not marked with dusky, except a spot or short streak upon each of them, forming a transverse row forward of the hind border, which row becomes obsolete towards the inner edge and towards the outer edge is confluent, forming a dusky band. The central crescent is more distinct than on the upper side, and on the hind edge is a row of slender black crescents. The fore wings are dusky, of the same shade with the border of the hind pair, becoming slightly paler towards their bases. They show an oblique black streak on the outer edge between the middle and the tip, and immediately beyond this is a very faint band crossing the wing parallel with the hind margin.

The description now given makes it apparent, I think, that this moth is not essentially different from the species of *Agrotis* named *nigricans* by Linnaeus, which species we have upon this continent with the same varieties described by authors as occurring in Europe. In this species the teliform stigma is marked by two parallel lines connected by a rounded mark at their ends. But in the examples which I bred from the Cut-worms of the corn, and all those which I captured that season a mere dot was the only remaining vestige of this stigma. Therefore to facilitate future references to this particular variety of which I have here treated, it may be well to separate it under a distinct name, which I have accordingly done.

The larger Yellow-headed Cut-worm which came out as this was disappearing, produced as I expected, the same moth which was described in my Third Report, under the name *Hadena amputatrix*, the Amputating brocade moth.

Thus it was the larvæ of these two insects which were so numerous and did all the injury to our crops the past season, neither of these being the species which Mr. Brace describes as the insect which produces the Cut-worm. And it is therefore evident that in different years and at different localities, it is sometimes one sometimes another of the insects of this group which becomes multiplied and injurious to us; whereby it will require a series of observations extending through several seasons to obtain a full acquaintance with them.

Before leaving this subject I may advert to one of our most efficient natural destroyers of these Cut-worms, which correspondents are occasionally sending me, for information as to its name, its origin, &c. It is the larva of a large black beetle, (Plate 4, fig. 4), having rows of round dots upon its back resembling burnished gold, the brilliancy of which dots cause it to be frequently noticed as it is wandering about in plowed fields and pastures in search of food, the beetle as well as its larva subsisting upon these Cut-worms. It is the Bold Calosoma, *Calosoma calidum* as it is named in scientific works, and pertains to the order COLEOPTERA and the family CARABIDÆ.

Its larva (Plate 4, fig. 5,) is a flattened, black, worm-like creature, having six legs inserted upon its breast, and a pair of sharp hook-like jaws projecting in front of its head, giving it, in connection with the agility of its movements, a very ferocious and formidable appearance. It is curious to watch this little creature when it is upon a hunting excursion, in pursuit

of its prey. It wanders about over the plowed land, until it comes upon a spot where it perceives the surface has been newly disturbed. This indicates to it that a worm has probably crawled down into the ground at that spot. It immediately thereupon roots down into this loosened dirt, and disappears from view, the motion of the dirt indicating its movements, as it pushes itself along. At times it lies perfectly still, to discover if any worm is moving in the dirt anywheres near it. Now it is the habit of the Cut-worm, the same as of most other worms, when any other creature approaches and disturbs it, to give at short intervals a sudden, spiteful jerk, to menace and frighten away the intruder. But now, aware by the brisk motion made in the dirt near it, of the proximity of its mortal foe, it restrains itself from its wonted habit, and lies as still as though it were dead. It is only by some motion in the dirt, or by coming abruptly against it with its head and feelers, that this destroyer can discover the worm, for I have seen it draw the hind part of its body along the side of a worm which was lying perfectly still, and crawl away, without being made aware of the worm's presence by touching it in this manner.

One of the most interesting and wonderful exhibitions of insect economy which the world affords, is this *Calosoma* larva murdering a Cut-worm. The larva it may be is young and less than half the size of the worm, but the little hero never shrinks from the encounter. Upon discovering a worm he is instantly on the alert, all vivacity and as if crazy with excitement. The worm perhaps holds its head bent down stiffly upon its breast. The larva hereupon briskly roots and pushes the worm about and pinches it with its jaws, whereby he gets it to throw back its head, whereupon he instantly grasps the worm by its throat, sinking his sharp jaws through the skin, and clinging thereto with the grip and pertinacity of a bull dog. The worm maddened by the pain, writhes and rolls over and over and thrashes his tormentor furiously about to break him off from his hold; he coils his body like a *Boa constrictor* tightly around him to pull him away: he bends himself into a ring with a small orifice in the centre, and then briskly revolving, draws him through and through this orifice to tear him off; but every expedient of the poor worm fails. The larva clings to his grip upon the worm's throat, till the latter, exhausted by his violent struggles, gradually relaxes his efforts, becomes more and more weak and powerless, and finally succumbs to his fate. Having thus killed the worm the larva leisurely proceeds to feed upon it, biting two or three holes through the skin in different places to suck out its contents. It is occupied three or four hours in completing this work. And the larva becomes so gorged hereby that its own skin is distended almost to bursting. It then crawls slightly under ground, and there lies and sleeps off its surfeit, and then comes out and wanders off in search of another meal of the same kind.

When this larva is small a single Cut-worm suffices it for one or two days; but as it approaches maturity it devours one or two worms daily.

13. NEBRASKA BEE-KILLER, *Trupcnea Apivora*, new species. (Diptera, Asilidæ.) Plate 4, fig. 7.

Killing the honey bee in Nebraska; a large slender-bodied two-winged fly, an inch long.

Whilst we are occupied in closing this Report to place it in the printer's hands, July, 1864, a new insect comes under our examination, of such an interesting character that we herewith present a figure of it, and the following account, the principal portion of which we have also communicated to the *Country Gentleman*.

R. O. Thompson, Esq., Florist and Nurseryman, in a note dated Nursery Hill, Otoe county, Nebraska, June 28th, 1864, says: "I send you to-day four insects or animals that are very destructive to the honey bee, killing a great number of them, and also of the Rose bugs. What are they? Many wish to know what this Bee-killer is. Is it the male or the female that has the three-pronged sting?"

The specimens, two of each sex, laid between pledgets of cotton wool in a small pasteboard box and forwarded by mail, came to hand in good condition, admitting of a very satisfactory examination. They are a large two-winged fly, having a long and rather slender and tapering body, about an inch in length, with small three-jointed antennæ, the last joint being shorter than the first, and giving out from its end, and not from its side, a slender bristle. The ends of its feet are furnished on the underside with two cushion-like soles, and the crown of its head is hollowed out or concave, and in this hollow is seen three little glassy dots or eyelets. These characters show it to pertain to the order DIPTERA, and to the group which Linnæus a century ago separated as a genus, under the name *Asilus*, but which is now divided into several genera, forming the family *Asilidæ*. On inspecting its wings we see the two veins which end one on each side of the tip of the wing are perfect and unbroken, and towards the middle of the outer one they are connected together by a small veinlet or short transverse vein. This indicates these flies to pertain to the genus named *Trupanea* by Macquart.

About a half dozen species inhabiting the United States and pertaining to this genus have been described by Wiedemann, Say, and others. This Nebraska fly appears to be different from either of those, and I am, therefore, led to regard it as a new insect, hitherto unknown to the world. And a more appropriate name cannot be given it than that by which it is called by Mr. Thompson and his neighbors, the Bee-killer or *Trupanea Apivora*. The general definition of this species, or its brief essential characters will be, that it is dull black with the head yellow, the fore body butternut brown, the hind body on its underside and the legs pale dull yellow, the thighs being black on their foresides, and it is coated over with hairs which are gray in the female and grayish yellow in the male, the end of the body in the latter sex having a conspicuous silvery white spot.

In this *Asilus* group of flies the species are separated from each other by marks which are often very slight and obscure. It is, therefore, important that a detailed description of these Nebraska flies should here be

given, that they may not be confounded with any other species which may be closely similar to them.

They measure to the end of the wings 0.85 to one inch, and to the end of the body 0.95 to 1.15, the males being rather smaller than the females. The *head* is short and broad, shaped like a plano-convex lens, flat on its hind side and convex in front. Its summit or crown is deeply excavated, leaving a vacant space between the upper part of the eyes, in the middle of which excavation are the ocelli or eyelets, appearing like three black glassy dots placed at the corners of a triangle. The ground color of the head is yellow. All the face below the antennæ is covered with long hairs forming a moustache of a light yellow color, with a tuft of short black bristles at the mouth, and on each side are whiskers of a yellowish gray color. The base of the head has a sort of collar formed of radiating gray hairs, and behind the upper part of each eye is a row of black bristles. The eyes are large and protuberant, occupying two-thirds of the surface of the head, and are finely reticulated or divided into an immense number of minute facets. The antennæ are inserted at the anterior edge of the excavation in the crown of the head. They are small, scarcely reaching to the base of the head if turned backward. They are black and composed of three joints, the first one longest and cylindrical; the second shortest and obconic; the third thickest and egg-shaped, its apex ending in a bristle which is about equal to the antenna in length, and is slightly more slender towards its tip, where it becomes a little thickened. The trunk or proboscis is as long as the head, its end projecting out from the bristles of the face. It appears like a long, tapering tube of a hard crustaceous texture, black and shining, blunt at the end, with a fringe of hairs around the orifice. In one specimen the tongue protrudes from the orifice in the end of the trunk, sharp pointed and like the blade of a lancet in shape, hard, shining and black. The *thorax* or fore body is the broadest part of the insect, and is of a short oval form, with bluntly rounded ends. It is of a tarnished yellowish brown or butternut color, with two faint gray stripes along the middle of the back, alternating with three darker brown ones. It is bearded with black hairs and posteriorly with long yellowish gray ones, which are interspersed with black bristles. The *abdomen* or hind body is long, slender and tapering from its base in the male, and is more broad and somewhat flattened in the female. It is black above and covered with prostrate hairs, which are dull yellow in the male and gray in the female. On the sides and beneath the ground color is dull yellow in the male and gray in the female, and clothed with gray hairs in both sexes. The two last segments, the eighth and ninth, are conspicuously protruded, making two or three more segments than are usually visible externally in insects. In the female these segments taper to an acute point, and are black and shining. In the male they appear like a cylindrical tube with a projecting valve underneath at the base, and are coated over with dull yellow hairs, and on the upper side with silvery white ones, pressed to the surface and forming a conspicuous oblong spot of this color, which is two-lobed or notched at its ends. And in the dead specimens before me three bristle like processes

BEE-KILLER. LEGS AND WINGS DESCRIBED. DELIGHTS IN THE SUNSHINE.

over a tenth of an inch in length, of a tawny yellow color, polished and shining, project from the blunt end of the body. These are termed a three-pronged sting in the above letter. But the magnifying glass shows they are abruptly cut off at their ends and do not taper to a sharp point capable of piercing the human skin. The *legs* are long and stout and of a pale, dull yellowish color. The thighs in the males are chestnut brown, and on their anterior sides they are dull black in both sexes, the hind pair being entirely black, except a stripe of dull yellowish along the under side. The hind shanks also are frequently black on their anterior sides. The legs are covered with gray hairs and have several black bristles in rows running lengthwise. In the males the four anterior shanks and feet have the hairs yellow, and on the feet the bristles also are of this color. The *wings* are long and narrow, and in repose are laid flat, one upon the other. They are transparent, with a smoky tinge, and are perceptibly darker at their tips. Their veins are black, except the parallel ones in the outer border, which are dull yellowish brown. The broad pane or panel at the tip of the wings, which is technically termed the second sub-marginal cell, rapidly narrows as it extends forward into the wing, for two-thirds of its length, the remaining third being quite narrow, with its opposite sides parallel. Along the vein which forms the boundary of this cell on its outer side, is a perceptible smokiness, which is not seen along the sides of the other veins. This vein is slightly bent in the form of a bow two-thirds the length of the cell, when it abruptly curves in the opposite direction, and is then straight the remainder of its length. A veinlet connects it to the next longitudinal vein, thus forming between the anterior portions of these two veins a third sub-marginal cell, which is very long and narrow.

The arrangement of the veins in the wings, forming three submarginal cells as above described, induces me to refer this species without hesitation to Macquart's genus *Trupanea*; although the silvery white spot on the tip of the male abdomen would indicate it to pertain to the genus *Erax*, as restricted by the same author.

The brief note of our correspondent gives us no particular information upon the habits of these flies or the manner in which they attack and kill the bees. But the members of this *Asilus* group are all so similar in their habits that we are aware what the operations of this species will be. And some account of the habits of these insects may be of sufficient interest to the reader to be here related.

These *Asilus* flies, like some other of our most rapacious insects, particularly delight in the hot sunshine. One or two evidences of this may here be adduced.

Flies of this kind are rare in my vicinity. I suppose I might hunt for days without being able to find a living specimen. And I do not recollect to have ever seen one of them, hitherto, about my house or yard. Three days ago, however, when occupied in preparing this account, I casually spread some damp newspapers before my door to dry in the hot sun. On stepping out to gather up these papers I was most agreeably surprised to see alighted upon one of them and basking in the sun, what proves to be a

BEE-KILLER. ITS FETID ODOR. CRUEL MODE OF KILLING ITS PREY.

species of *Trupanea* which I had never met with before, and which is closely like though probably distinct from this Nebraska Bee-killer. The genial warmth reflected from the white surface of the paper lying in the clear sun had evidently attracted it to this unusual situation.

So late as the month of October, ten years ago, upon a clear warm day, in a sunny nook upon the south side of a forest, I came upon quite a number of the *Erax rufibarbis*, flying about and alighting upon the leaves—a species I have never met with except in that instance. They were warmed into such quickness of motion, and were so extremely vigilant and shy of my approach, that with my utmost skill I was able to capture but two individuals which were impeded in their movements from being paired together. I infer these Nebraska flies to be common and far less wary than the species alluded to—else our correspondent would have been unable to secure two individuals of each sex to transmit to us. And I suspect these specimens were obtained when they were copulated. If so, it is probable that the three sting-like bristles which I have described above, are not protruded and visible externally, except at such times.

In flying, these insects make a very loud humming sound, which can scarcely be distinguished from that of the bumble-bee; and when involved within the folds of a net, they utter the same piping note of distress as does that insect. This very probably contributed to impress our correspondent with the thought that the three bristles which are extruded by the male are a formidable three-pronged sting.

Another fact which I do not see alluded to by any author, is the fetid carion-like odor which some of these *Asilus* flies exhale. I noticed this odor in the *Erax rufibarbis* which was captured as above related. And in these Nebraska specimens, though they have now been dead a fortnight and freely exposed to the air the latter half of that time, this disgusting scent still remains, and so powerful is it that on two occasions nausea has been produced when they have happened to be left upon the table beside me. As the newly captured fly above mentioned is wholly destitute of this fetor, it may be that it is only at the period of sexual intercourse that it occurs.

These flies are inhuman murderers. They are the savages of the insect world, putting their captives to death with merciless cruelty. Their large eyes divided into such a multitude of facets, probably give them most acute and accurate vision for espying and seizing their prey; and their long stout legs, their bearded and bristly head, their whole aspect indicates them to be of a predatory and ferocious character. Like the hawk they swoop upon their prey, and grasping it securely between their fore feet they violently bear it away. They have no teeth and jaws wherewith to bite, gnaw and masticate their food, but are furnished instead with an apparatus which answers them equally well for nourishing themselves. It is well known what maddening pain the horse flies occasion to horses and cattle, in wounding them and sucking their blood. These *Asilus* flies possess similar organs, but larger and more simple in their structure, more firm, stout and powerful. In the horse flies the trunk or proboscis is soft, flexible and sen-

sitive. Here it is hard and destitute of feeling—a large, tapering, horn-like tube, inclosing a sharp lance or spear-pointed tongue to dart out from its end and cut a wound for it to enter, this end, moreover, being fringed and bearded around with stiff bristles to bend backward and thus hold it securely in the wound into which it is crowded. The proboscis of the horse flies is tormenting, but this of the *Asilus* flies is torturing. That presses its soft cushion-like lips to the wound to suck the blood from it; this crowds its hard prickly knob into the wound to pump the juices therefrom. It is said these *Asilus* flies sometimes attack cattle and horses, but other writers disbelieve this. Should any of our Nebraska friends see one of these bee-killers alighting upon and actually wounding horses or cattle, we hope they will inform us of the fact, that this mooted point may be definitely settled. Certain it is that these flies nourish themselves principally upon other insects, attacking all that they are sufficiently large and strong to overpower. Even the hard crustaceous shell with which the beetles are covered fails to protect them from the butchery of these barbarians. And formidably as the bee is equipped for punishing any intruder which ventures to molest it, it here finds itself overmatched and its sting powerless against the horny proboscis of its murderer. These flies appear to be particularly prone to attack the bees. Robineau Desvoidy states that he had repeatedly seen the *Asilus diadema*, a European species somewhat smaller than this of Nebraska, flying with a bee in its hold. But it probably does not relish these more than it does other insects. We presume it to be because it finds them in such abundance, as enables it to make a meal upon them most readily, and with the least exertion, that these Nebraska flies fall upon the bees and the rose bugs. And so large as they are, a single one will require perhaps a hundred bees per day for its nourishment. If these flies are common, therefore, they will inevitably occasion great losses to the bee keepers in that part of our country.

No feasible mode of destroying this fly or protecting the bees from it at present occurs to me. Indeed such an accurate knowledge of the particular habits of this species as we do not at present possess, is necessary, to show in what manner it can be most successfully combatted.

Since the foregoing account was written, Mr. Thompson has favored us with another communication, giving some most interesting observations upon the habits and destructiveness of this insect, which we here append in his own words. He says, My attention was first called to this fly destroying the honey bee by a little boy, a son of D. C. Utty, Esq., of this place. After sending you the specimens I watched its proceedings and habits with much care, and find that, in addition to the honey bee and rose bugs, it devours many other kinds of beetles, bugs and flies, some of which are as large again as itself. It appears to be in the months of June and July that it is abroad upon the wing, destroying the bees. None of them are now (August 2d) to be seen. When in pursuit of its prey it makes quite rapid dashes, always capturing the bee on the wing. When once secured by wrapping its legs about it, pressing it tightly to its own body, it immediately seeks a bush or tall weed, upon which it alights and commences

§ BEE-KILLER. ITS TENACITY OF LIFE.

devouring its prey by eating (piercing) a hole into the body and in a short time entirely consuming it (sucking out the fluids and soft internal viscera) and leaving only the hard outer skin or shell of the bee. Upon the ground beneath some favorable perch for the fly near the apiary, hundreds of these shells of bees are found accumulated in a single day—whether the work of one fly or of several I am not able to say. I have just returned from a professional tour through the northern portion of our Territory, taking Nursery orders; and in many things this business and the apiary are closely connected. In no case have I found a hive of bees that has thrown off a swarm this season! The dry weather, bad pasture and other reasons were assigned as the cause. But many persons, since they have found this fly at his work of destruction, now believe it to be the cause of the non-swarming of their bees; and I am led to the same opinion. I have only to add further, that this Bee-killer delights in hot, dry weather, and is very invulnerable and tenacious of life. I have observed the honey bee and also the hornet sting it repeatedly, but with no other effect than to cause it to tighten its hold upon them. Once when I forced the assassin to release his prey, he gave me such a wound in the hand as has learned me ever since to be cautious how I interfered with him. He will live an hour with a pin thrust through his body which has been dipped in the solution of cyanuret of Potassium.

THE HOP APHIS.

From an Address delivered before the Annual Meeting of the State Agricultural Society
Albany, February 8th, 1865.

The insect which the past season attracted the most notice and did the most damage in our State, was the Aphis or Plant-louse upon the hops. Although the hop has been growing, both wild and cultivated, in this country, from time immemorial, I am not aware that this enemy has ever attacked or been observed upon it, until two summers ago, when it suddenly made its appearance in excessive numbers; and in consequence of its advent, the two past years have been the most disastrous to the extensive hop growers in the central section of our State, which they have ever experienced. In some yards the hops have not been picked, and in other yards a portion of those that have been gathered, it is said, ought never to have been dried and put up for market, they are so small and worthless; whilst the best that have been grown are of an inferior quality, the bitter principle, on which their value depends, being deficient, according to the published reports, to the extent of from 15 to 25 per cent.

The newspapers and agricultural periodicals have abounded with notices of this failure of the hop crop. From the extended accounts which some of these publications have given, it would appear that there are three different maladies with which the hop vines have recently become affected, namely, the Aphis or plant-lice, the honey dew, and the black blight. The plant-lice are soft pale yellowish-green insects, not so large as the head of a pin, which remain stationary upon the under sides of the leaves, crowded together and wholly covering the surface. The honey dew appears on the upper surface of the leaves, as a shining, clear and transparent fluid, sticky, like honey smeared over the surface. The black blight also occurs on the upper sides of the leaves and resembles coal dust sifted upon and adhering firmly to them, or the leaves look as though they had been held in the smoke of a chimney until they had become blackened over with soot. This black blight is deemed to be a kind of fungus growing from the leaves, analogous to the rust and smut in grain, and it is stated that in some hop yards sulphur has been dusted over the leaves to kill or check its growth, but without having the slightest effect upon it.

Which of these maladies is the most pernicious, it would be difficult to judge from the published accounts, one writer seeming to regard the Aphis as the principal evil, whilst another wholly ignores this insect and dwells upon the black blight as being the cause of the failure of the crop. And it is not a little amusing to observe how very wise the reporters to some of the newspapers appear in giving an account of these diseases, and what a display of scientific lore they make, when their statements betray to us

the fact that they have not the first correct idea upon the subject on which they are writing.

The truth is, these three maladies, about one and another of which so much has been said, are all one thing—differing merely as cause and effect. If there were no lice on hops there would be no honey dew and no black blight. I am aware the hop growers will be much surprised at this statement, and will scarcely credit it, they have been so accustomed to regard these things as distinct from and in no wise connected with each other—deeming the honey dew to be a fluid which has exuded from the leaves in consequence of some disease therein, and the black blight to be, as already stated, a kind of fungus growing from the leaves, whilst the plant lice, occurring only on the opposite or under side of the leaves, appear to be wholly separated from these substances upon their upper surface. But I am perfectly assured of the correctness of what I say, and can produce specimens which will demonstrate that I am correct. I regret that this subject did not occur to my mind last summer, or I would have had such specimens for exhibition here at this time. Upon the first opportunity, I will procure and place in the Museum of our Society, specimen of leaves showing this honey dew upon them, and others showing the black blight; and by the side of these leaves I will place white paste-board cards having the same honey dew and the same black blight upon them—thus demonstrating that these substances do not exude and grow from the leaves unless they also exude and grow from the paste-board cards.

I will now briefly explain how these two substances come upon the leaves.

Each Aphis has two little horns projecting from the hind part of its back, which horns are termed the honey tubes. From these tubes the fluid called honey dew is ejected, in the form of minute drops, like particles of dew, which, falling upon the leaves beneath them, the upper surface of the leaves becomes coated over with this fluid, more or less copiously as the Aphides producing it are more or less numerous. And now, this deposit of honey dew being exposed to the action of the atmosphere and alternately moistened by the dews at night and dried by the sun by day, is gradually decomposed, changing from a clear, shining, transparent fluid, to an opaque, black substance resembling soot, and it is then the black blight. In this simple manner do we account for and explain these phenomena—these three important diseases of the hop, about which so much has been said and such erudition has been displayed by some of the writers in our newspapers.

These same phenomena, called honey dew and black blight, are not peculiar to the hop, but occur on other kinds of vegetation when infested by plant-lice; and an abundance of authority will substantiate my statement that this honey dew is caused by these insects. But I find no allusion to the black blight in any author, and what I state of that is the result of my own observations. It is proper, therefore, that I here adduce some of the evidence which I have, upon this particular point.

It is over twenty years ago that I first noticed this blackness as being occasioned by plant-lice. Among several willow trees by the side of a stream near my residence, there was one so thronged with the willow aphid

that I went several times to that tree to contemplate the spectacle which these insects presented. And all through the following winter, no person passing within sight of that tree could fail of noticing the blackness of its trunk and limbs, it being the more remarkable as none of the other willow trees around it had any tinge of this color. The thought thereupon became impressed upon my mind, that it was the plant-lice with which this tree had been so overrun the preceding summer, which had in some way imparted this blackness to its bark. Two or three winters afterwards, I noticed the same blackened appearance to a pine tree, which tree I knew had been thronged with Aphides the summer before. I need not specify the several other instances of this phenomena which I have noticed. Several years since, when I was investigating the Aphis of the apple tree, I discovered that, in addition to the bark of trees, the leaves also acquired this sooty appearance, from these insects; and then, upon giving this subject a particular examination, I became assured that this black substance was merely the honey dew in a decomposed state.

Some writers have remarked that dry weather causes the several kinds of plant-lice to increase and become pests to the different species of vegetation which they respectively inhabit; and my own observations incline me to regard this remark as being correct. During the dry period in June which frequently succeeds the spring rains, I have in particular years noticed these insects as occurring in unusual numbers, whereupon I have apprehended that, having acquired such a start so early in the season, they would prove to be the most pernicious insects of the year; but rainy weather coming on after this, they have seemed thereupon to decline and have ceased to attract further attention. Hence I think it true as a general rule, that dry weather favors and wet weather retards their increase. And at first thought, this view is further strengthened by the fact that this Aphis upon the hops was so excessively numerous the past summer, when we experienced a drouth of such protracted length and severity. But, on the other hand, these insects were similarly numerous the year before, when the summer was unusually wet. We are thus assured there is some influence more potent than the hygrometric state of the atmosphere, which has brought them forth in such hosts upon the hops.

Perhaps in no other group or family of insects are the different species so very closely akin to each other as in this of the Aphides. So nearly identical are most of them, both in their appearance and habits, that we know them to be distinct species only from the fact that they inhabit different plants, each one being unable to sustain itself upon any other than the plant to which it belongs. Being thus intimately related, we should confidently expect that the same atmospherical or other influence which causes one species to suddenly multiply and become extremely numerous, would operate upon and similarly affect the other species also. But this is by no means the case. As every one will remember, in the summer of 1861, all our fields of grain suddenly became so thronged with the Grain Aphis as to throw the whole country into alarm. Why did not the same cause which brought that insect upon us in such a remarkable manner, operate also to bring this insect upon the hops at that time, instead of

two years later? Or, if this insect was not then in our country, when it did appear in such vast numbers two years ago, why was not the same influence which occasioned its surprising multiplication then, felt also by the Grain Aphis, causing it to re-appear in our grain fields? The two insects being so intimately related, it is a mystery beyond the reach of human comprehension, how some hidden influence comes to operate upon the one, causing it to multiply and increase so astonishingly, whilst the other remains passive and not in the least affected by it.

This insect is not limited to the extensive hop plantations in the central parts of this State, but appears to have everywhere overrun the hop vines, both wild and cultivated. It was abundant the past summer in my own neighborhood, and specimens were also sent me from St. Lawrence county, whereby we know that its range extends to the eastern and northern confines of the State, but farther than this we do not possess any definite information.

This Aphis appears to be identical with that which has long been known in Europe as the worst enemy of the hop, and which sixty-five years ago received its scientific name, *Aphis Humuli* or the Hop Aphis, from the German naturalist Schrank (*Fauna Boica*, vol. ii, p. 110.) Messrs. Kirby and Spence, in their introduction to Entomology (American edition, p. 135,) speak of the damage inflicted by this insect as follows: "Upon the presence or absence of Aphides, the crop of every year depends; so that the hop-grower is wholly at the mercy of these insects. They are the barometer that indicates the rise and fall of his wealth, as of a very important branch of the revenue, the difference in the amount of the duty on hops being often as much as £200,000 per annum, more or less, in proportion as this fly prevails or the contrary." This statement forcibly shows what a direct interest our own government has in patronizing these investigations in which I am employed—this one little insect, in years when it is numerous, taking from the revenue of the British government half a million of dollars!

My own researches upon this insect are obviously too limited as yet, to enable me to give such a particular history of its habits and operations, as its importance merits. I therefore present the following account from the London Gardener's Chronicle, for the year 1854, page 429:

"As soon as the Aphides settle upon the hops, they suck the underside of the leaves, and immediately deposit their young, which are viviparous, and have the singular faculty of propagating their species within a few hours after their birth; and in this manner many generations are produced without the intervention of the fully formed Aphis fly; indeed, upon one hill of hops, millions of lice are born and die, neither parents nor progeny having ever attained the condition of the perfect insect. When the first attack of these flies upon the hops is severe, and early in the season, the growth of the plant is commonly stopped in the course of three or four weeks. If the attack be late, that is about mid-summer or afterwards, the vine has then attained so much strength that it struggles on against the blight, to its disadvantage, and the result is a total failure of the crop at least; for the leaves fall off, and the fruit branches being already formed,

there is no chance of recovery. At this time, and in this condition, the stench from the hop plantation is most offensive. * * * *

“The progress and usual termination of the Aphis blight may be thus described: The flies, as before remarked, on their first arrival, immediately suck the underside of the upper small leaves of the vine, and thus they there deposit their young, upon the most succulent part of the plant. The multiplication of the lice is so rapid, that the leaves become so thickly covered as scarcely to allow a pin to be thrust between them. They quickly abstract the juices of the vine, so that the leaves assume a sickly, brown hue, and curl up, and the vine itself ceases to grow, and falls from the pole, the lice continuing till they perish for want of food; and thus the crop is destroyed, and the grower may often consider himself fortunate if the plant recovers a due amount of vitality to produce a crop in the following year, for occasionally the hills are killed by the severity of the attack. This description, of course, applies only to the most severe and unusual blights.”

The Aphides are the most evanescent of all insects. They spring up suddenly, in such immense numbers as to threaten the utter destruction of the vegetation on which they subsist, and ere long they vanish with equal suddenness—sometimes continuing but a few weeks, and rarely remaining in force longer than through one year. It thus appears, that, so long as the atmospherical or other influence which favors their increase, continues to operate upon them, they thrive and prosper, and when this influence passes away they rapidly decline. The writer in the *Gardener's Chronicle*, cited above, remarks of this Aphis on the hops, “These insects are remarkably susceptible of atmospherical and electrical changes, and on a sudden alteration of the weather we have known them perish by myriads in a night. This was specially exemplified in the Farnham district, about the middle of June, 1846, which suddenly recovered from a most severe attack, and afterwards produced the largest crop ever known in that quarter. We know, also, several instances in East Kent, which occurred in the same year, when the planters sold their growths on the poles at a few shillings per acre, and these same plantations so far recovered that many of them afterwards produced a crop worth from 30*l.* to 50*l.* per acre.”

The decline and disappearance of these plant lice is greatly expedited by other insects which destroy them; and in many instances it is to these destroyers rather than to any atmospherical change, that the vegetation on which they abound becomes so suddenly released from them. No other tribe of insects has so many enemies of its own class as the plant lice. The different species of *Coccinella* or lady-bugs which are everywhere so common, live exclusively upon the aphides, as do also the larvæ of the two-winged *Syrphus* flies and the four-winged Golden-eyed flies. Superadded to these destroyers the plant lice also have their internal parasites—exceedingly minute worms or maggots residing within their bodies and feeding upon till they kill them. Thus, whenever a tree or shrub becomes thronged with plant lice, these destroyers gather among and around them, in rapidly augmenting numbers, and subsist upon them until they have wholly exterminated them. Kirby and Spence (page 187) state that in the

year 1807 the sea shore at Brighton and all the watering places on the south coast of England, was literally covered with lady bugs, to the great surprise; and even alarm, of the inhabitants, who were ignorant that their little visitors were emigrants from the neighboring hop-grounds, where each had slain his thousands and tens of thousands of the aphids.

These several kinds of destroyers of the plant lice were everywhere common upon the hop vines the past summer. I believe that in every instance in which leaves with the lice upon them were sent me by correspondents, I found one or more of these destroyers also upon the leaves; and in one box that came to me, not one of the lice was remaining, all having been devoured by several of these enemies which had happened to be inclosed in the box. These destroyers having been so common, it is quite probable that they have now subdued these lice to such an extent that the coming season the crop will be much less if at all damaged by them.

It is of great importance that we should have some remedy, whereby, when these insects do fall upon the hop vines in such myriads as they have done the past two years, we may be able to promptly destroy them.

As the lice remain stationary upon the undersides of the leaves and are so very tender and delicate that the slightest pressure suffices to crush and kill them, Mr. Kirby recommends to take the leaf between the thumb and finger, and move the finger so as to gently rub over the under surface of the leaf, whereby every aphid upon it will be destroyed. He thinks women and children can be employed for a small compensation to do this work, taking every leaf in succession between the thumb and finger, and thus wholly ridding the vines from these vermin. But we all know it will be an immense labor to thus take hold of every leaf upon the vines occupying whole acres of ground. Many of the leaves, too, are quite large, being five or six inches broad, and the finger is but three inches long. It will therefore require one hand to hold the leaf steady, whilst the thumb and finger of the other are drawn several times along it, mowing down the vermin by successive swaths. Moreover, the veins on the underside of these large leaves are studded with prickles, whereby I doubt if a dozen leaves can thus be rubbed over before the skin of the finger will be cut through to the quick. I need not specify other obstacles which occur to my mind, all concurring to convince me that this proposed remedy, of the success of which Mr. Kirby is quite sanguine, is wholly impracticable.

Washing and syringing the plants with strong soap suds has been often recommended for destroying the aphids upon them. I have recently been experimenting with this remedy, upon the plant lice which so badly infest the beautiful verbenas of our Flower Gardens, and I find it to be of but partial efficacy. It only kills the young, tender lice; those which are mature are so robust that they are not destroyed, even though the infested stems and leaves are immersed in a strong solution of soap.

There is one remedy, and one only, which we know to be efficacious and perfectly sure for destroying the different species of plant lice. This is the smoke of tobacco. It operates like a charm. It never fails. But to apply it, it is necessary to place a box or barrel over the plant, burning the tobacco in a cup underneath, until its smoke has filled the inclosed space

and penetrated all the interstices between the leaves. Hereby the rose bushes and other shrubs and plants in our gardens are with ease wholly cleansed from these vermin. To render it available for destroying these insects upon the hops, probably a piece of canvas or other large cloth can be thrown over them or some other apparatus devised whereby they can be fumigated for a few moments in the same thorough manner.



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