FIFTH REPORT

ON THE

NOXIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK.

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INSECTS INFESTING DECIDUOUS FOREST TREES.

Such a multitude of worms and other insects as feed on the leaves and other parts of our deciduous forest trees, I find it will be impossible for me to fully comprise in a single Report. I therefore here present the more common and pernicious ones, with a few others which are less common but whose history has never before been published. The oaks being our most important trees of this class, and attacked by a far greater number of insects than any of our other forest trees, will claim a principal part of our present Report.

1. THE OAKS.—*Quercus alba, etc.*

AFFECTING THE ROOT.

A disease to which the different kinds of oaks, in Europe, are subject, and to a less extent the beech and other forest trees, shows itself in the form of small excrescences or galls about the size of ground nuts, which grow upon the slender thread-like roots of the trees. These excrescences are caused by a small insect which punctures the root and forces an egg into the opening. The irritation which this egg occasions causes an increased flow of sap to the part, whereby it swells and grows into one of these gall-nuts. In the center of each of these nuts lies a small white footless worm, which eventually changes into an insect of the gall-fly kind, but which differs remarkably from all the other insects of the group to which it pertains, in being wholly destitute of wings. It has hence received the specific name *aptera*, and forms a distinct genus named *Biorhiza* by Mr. Westwood. I suppose this name to be derived, not from *βίος*,, *life*, as its orthography would indicate, but from *βία, injury*, and *ῥίζα, a root*, and if so it should be written *Biarhiza* instead of as we find it in books.

The roots of forest trees being so seldom exposed to our view, I know not whether similar excrescences occur upon them in this country. But it is quite probable that they do, since wingless gall-flies occur here, closely resembling that of Europe. I have repeatedly met with these in forests,

upon the surface of the snow, on mild days in the fore part of winter. The warmth of the trunks of the trees melts the snow where it is in contact with them, as every woodman is aware, producing a crevice or vacant space down to the ground immediately around the tree; and I infer that it is through this opening that these insects ascend from the roots of the trees, and wander about upon the snow, to find and pair with their mates, after which they again descend to insert their eggs in the roots; for it is at this period of the year that their eggs are deposited, as we learn from seeing them frequently extruded by recently captured individuals. Their eggs are minute oval white grains, and are coated over with a glutinous white fluid, by which, when the female is impaled, they are held together in a continuous string. And this substance, in which the eggs of these as of other gall-flies are enveloped, is supposed by its acridity to produce the irritation of the vegetable tissues which causes the growth of the singular tubers and excrescences in which the young of these insects are cradled.

The genus *Biarhiza* is defined by authors as being destitute of wings and having the antennæ composed of fourteen joints in the females. It may further be added that these organs are thread-like and nearly as long as the body. The abdomen also is strongly compressed, as it is in the flea, to which insect these wingless gall-flies have considerable resemblance. When viewed in profile the abdomen is broad egg-shaped with its smaller end attached to the thorax; its sutures are marked by fine impressed transverse lines; and its first segment is very large, about equal in length to all the remaining segments. The abdomen is much more smooth and shining than the head and thorax, which are bearded with minute gray hairs, the head being broader than the thorax, and appearing about twice as broad as long when viewed from above.

We have in the State of New York three insects which will pertain to this genus as above characterized. One of these may appropriately be named from its color,

290. The Black gall-fly, *Biarhiza nigra*, new species. (Hymenoptera. Cyniphidæ.)

This is of a black color throughout, including its feet and antennæ, and like the kindred European species, it is destitute of any vestiges of wings. It measures but eight hundredths of an inch (0.08) in length.

The two other species to which I have alluded, possess abortive or rudimentary wings, in the form of small whitish and feebly transparent scales, reaching about a third of the length of the abdomen. These scales are of a long oval shape, rounded at their tips, and are densely covered with minute punctures, and bearded with exceedingly fine short hairs. A straight sub-costal or rib-vein of a brown color, extends about half their length, parallel with the outer margin, and ends abruptly without curving towards the margin. The scales representing the hind wings are shorter and narrower than the forward ones. In addition to the difference now stated, the last segment on the under side of the body, from out the hind edge of which the ovipositor is protruded, is much more strongly elevated

than in the preceding species, forming a kind of sheath for the ovipositor, and is fringed with rather long shining yellowish or golden hairs which project backward, resembling a little tuft or brush when the body is viewed from one side. These differences seem to require that these two insects should be regarded as generically distinct from the first, and I therefore propose the name *Philonix* (φιλος, *a lover*; νιψ, *snow*) for a genus for their reception. This genus coincides with *Biarhiza* in the number of joints to the female antennæ, which is the only sex yet discovered, but differs in having rudimentary wings and the ventral valve more prominently elevated and ciliated with longish hairs. It may further be observed that the jaws of these insects resemble those of an ant, being blunt at their tips, and three-toothed, the inner tooth more slender and deeply separated from the middle one, which latter is divided from the outer one by merely a slight notch. And their feelers or maxillary palpi are four-jointed, the two first joints cylindric, the third shortest and narrowed from its apex to its base, and the last joint slightly thicker than those which precede it, egg-shaped, and clothed with bristles, the two joints next to it also having a whirl of bristles at their tips.

291. Yellow-necked gall-fly, *Philonix fulvicollis*, new species. (Hymenoptera. Cyniphidæ.)

This measures 0.13 to 0.15, and is the species which I have most frequently met with. It is black with the thorax tawny yellow, spotted anteriorly with black, the scutel brighter yellow, and the legs dusky or blackish with the knees and hips of a paler dull yellowish color, the antennæ being black to their bases. The thorax when carefully inspected shows a broad black stripe on its fore part, on each side of which is a small oval black spot, and farther down upon each side, forward of the wing-sockets, is a large triangular black spot.

These insects exhale a perceptible odor, resembling that of ants or bees. They are oftenest met with on the first snows that fall, in the latter part of November and the beginning of December, and wholly disappear, I think, before the close of the latter month. They are found in our forests, associated with the Thick-legged snow-fly, *Chionea valga*, Harris, and the little Snow-born and Mid-winter Boreus, *Boreus nivoriundus et brumalis*, Fitch; and it is a curious fact that these several insects inhabiting the surface of the snow, and pertaining to widely different orders, all correspond with each other in being destitute of wings. Why they are thus deprived it is difficult to conceive. They hereby resemble small spiders in their appearance, several kinds of which occur upon the snow in company with them. And it may be that they thus escape from being noticed and devoured by the birds, a few species of which, pressed by hunger, are industriously foraging our forests in winter.

292. Black-necked gall-fly, *Philonix nigricollis*, new species.

This is smaller than the preceding, being rather less than 0.12 in length, and is black with the basal third of the antennæ and the legs obscure

OAK. TRUNK.

brownish-yellow and the scutel dull yellow. The inner sides of its thighs are slightly dusky.

AFFECTING THE TRUNK.

293. Locust Cossus, *Cossus Robiniæ*, Peck. (Lepidoptera. Hepialidæ.)

Boring large holes in the solid wood of the different kinds of oaks and also in the locust, admitting the air and moisture to the interior of their trunks and causing their decay; a large cylindrical worm of a bright rose red color, with several purple pimples symmetrically arranged, each yielding a hair, its under side greenish white, with sixteen legs, and its head shining black; when fully grown three inches in length and as thick as one's finger, and then appearing of a dull flesh-color instead of red and its head tawny yellow; passing its pupa state in a cocoon in the tree, and coming abroad in June and July, a large thick-bodied moth of a gray color with a black stripe on each side of its thorax, and its fore wings with black clouds and a net-work of black lines, when extended measuring three inches in width; the male smaller and more colored with black, with the hind half of its hind wings bright orange yellow, its width 2.00 to 2.30.

Of all the wood-boring insects in our land this is by far the most pernicious, wounding the trees the most cruelly. The stateliest oaks in our forests are ruined, probably in every instance where one of these borers obtains a lodgment in their trunks. It perforates a hole the size of a half-inch auger, or large enough to admit the little finger, and requiring three or four years for the bark to close together over it. This hole running inward to the heart of the tree, and admitting the water thereto from every shower that passes, causes a decay in the wood to commence, and the tree never regains its previous soundness.

This is also a most prolific insect. The abdomen of the female is so filled and distended with eggs that it becomes unwieldly and inert, falling from side to side as its position is shifted. A specimen which I once obtained, extruded upwards of three hundred eggs within a few hours after its capture, its abdomen becoming diminished hereby to nearly half its previous bulk; and in the analogous European species more than a thousand eggs have been found on dissection. It hence appears that a single one of these insects is capable of ruining a whole forest of oak trees. This calamity, however, is prevented, probably by most of the eggs being destroyed, either by birds or by other insects, for these borers are by no means so common in our trees as the fecundity of their parents would lead us to expect.

An account of this insect was first given in the year 1818, in an article written by the late Prof. Peck, but published anonymously, in the Massachusetts Agricultural Repository, vol. v. pp. 67–73. Having bred the moth from larvæ which he found in the locust (*Robinia Pseud-acacia*) and ascertained its intimate relationship to the European goat-moth, named *Bombyx Cossus* by Linnæus and *Cossus ligniperda* by Fabricius, Prof. Peck bestowed the name *Cossus Robiniæ* upon our insect. Dr. Harris

has also given an account of it in his Treatise, p. 316, under the name *Xyleutes Robiniæ*. This renders a few words of explanation necessary, to unscientific readers, particularly since in one or two instances heretofore I have followed Dr. Harris in sanctioning names which on more mature reflection I regard as invalid.

It is now a well established rule or law with men of science, that a specific name when once validly imposed upon any plant or animal can never afterwards be changed. This rule, however, was disregarded by Fabricius when he formed a separate genus to include the Goat-moth and other similar insects, as he took the name *Cossus* which Linnæus had given to that moth as the name for this new genus and gave another name to this species; thus in effect robbing Linnæus of the honor of having named and described this insect. Hubner, therefore, proposed the name *Xyleutes* for this genus, in order that the name *Cossus* might be restored to its typical species. But, on the other hand, it is to be observed that the law alluded to had no existence in Fabricius' day; the very course which he pursued was at that period the established rule, sanctioned by the example of his illustrious preceptor—Linnæus himself having in repeated instances selected his previous specific names as the names of genera of which those species were the types, hereupon giving new names to the species. Thus our common *Lampyris* (*Photinus*) *corrusca*, Linn., was originally the *Cantharis Lampyris*, Linn. Fabricius, therefore, so far from violating, conformed strictly to the received rules of his day in this matter. And to condemn him now, upon an *ex post facto* law, will be grossly unjust. Moreover, to cancel the several generic names which are in the same category with the one before us, and which have been universally current in our books for nearly a century past, will be too great an innovation to be tolerated, except the propriety and justice of such a step were perfectly clear. We hence regard the name *Cossus* as the legitimate designation of the genus to which the insect before us pertains.

Dr. Boisduval has recently described this moth as a new species, (Annales Soc. Ent., 2d series, vol. x, p. 323,) though under the same name, *Cossus Robiniæ*, he having doubtless found it thus ticketed in some of the Paris collections and being unaware that it had been previously described.

Prof. Peck states that he had repeatedly seen this same locust worm and its burrows in the wood of the black oak. Dr. Harris more cautiously says a larva which cannot be distinguished from this, occurs in the red oak. Having bred several of these moths from larvæ in the white oak, I have ascertained them to be identical with the species described as infesting the locust. And my observations lead me to the belief that, in the State of New-York at least, these insects are bred in the oaks to a much greater extent than in the locust, for I have never seen an instance of their large perforations in the wood of the locust, whilst in the oaks they have been noticed repeatedly, and for many years before I knew what insect was t e culprit that occasioned this serious mischief. I therefore enter it under

this head. Fortunately this insect is not a common one. If it were so, few of the oaks in our forests could escape being ruined by it. From the specimens sent me from the southern and south-western states, I infer it to be more common there than it is with us. And we learn from Boisduval that it also occurs in California.

The European analogue of this insect is popularly termed the Goat or the Goat-moth, this designation having been bestowed upon it in consequence of the strong odor which it exhales, resembling that of the goat. Locust goat-moth might therefore be the most suitable common name for our insect, were it not that it is destitute of the odor alluded to, no perceptible scent being given forth either by the larva, or by the moth, even when the latter has newly burst from its pupa shell. I therefore deem the name Locust Cossus the most appropriate by which to designate this insect in common conversation.

This moth pertains to a small group or family named *Hepialidæ*, which is intermediate in its characters between the twilight or crepuscular moths and the nocturnal, and is usually arranged at the head of the latter in systematic works, preceding the large species forming the Bombyx family. The *Hepialidæ* are distinguished by having the spiral tongue, the palpi or feelers, and the spurs of the hind legs wholly wanting or very small. And the genus *Cossus* may be known by its tapering antennæ, which are as long as the thorax and pectinated or comb-like in both sexes, the branches or teeth being thick and short and continued to the tips of these organs. Authors usually state further that there is but a single row of these teeth to the antennæ; but in this species there are two rows. The name *Cossus* which this genus bears, Pliny states was the name anciently given by the Romans to a worm found under the bark of the oak, which they were accustomed to fatten by feeding it meal, and to eat, it being esteemed a great delicacy.

Our moth comes abroad as already stated in June and the fore part of July. It flies only in the night time, remaining at rest during the day, clinging to the trunks of trees, its gray color being so similar to that of the bark that it usually escapes notice. In repose its wings are held together in the shape of a roof, covering the hind body. From observing her motions in confinement, I think the female does not insert her eggs into the bark, but merely drops them into the cracks and crevices upon its outer surface. They are coated with a glutinous matter which immediately dries and hardens on exposure to the air, whereby they adhere to the spot where they touch; and if the short two-jointed ovipositor be not fully exserted as the egg is passed through it, so as to carry the egg beyond the hair-like scales with which the body is clothed, some of these touching adhere to it, their attachment to the body being so slight.

The eggs are of a broad oval form, and about half the size of a grain of wheat, being the tenth of an inch in length and three-fourths as thick, of a

dirty whitish color with one of the ends black. When highly magnified their surface is seen to be reticulated or occupied by numerous slightly impressed dots arranged in rows like the meshes in a net. From the fact that several worms of the same size are sometimes met with in a single tree, indicating them all to be the progeny of one parent, it appears that the female drops a number of eggs upon each tree that she visits, and probably disposes of her whole supply upon a very few trees. The size of the eggs doubtless renders them a favorite article of food to some of our smaller birds. And a bird on discovering one of these eggs, will be incited thereby to search for others in the same vicinity, which search being successful, will be perseveringly continued so long as an egg can be found upon that or any of the adjacent trees. Thus it may be that of the whole stock of eggs which a female deposits, scarcely one escapes being picked up and devoured. This appears the most probable cause of so few of these worms being met with, although the females are so prolific.

The worm on hatching from the egg sinks itself inward and feeds at first on the soft inner bark, till its jaws acquiring more strength, it penetrates to the harder sap-wood and finally resorts to the solid heart-wood, residing mostly in and around the centre of the trunk, boring the wood here usually in a longitudinal direction, and moving backwards and forth in its burrow, enlarging it by gnawing its walls as it increases in size, whereby the excavation comes to present nearly the same diameter through its whole length. In an oak in which I met with two worms fully grown and several others but half grown, the whole of the central part of the trunk had been extensively mined by preceding generations of this insect and was in a state of incipient decay. And I thus had an opportunity to notice the fact that none of the worms were lying in the decaying wood, all being outside of this, where the wood was still sound. Hence it is evident that it is living healthy trees which this insect prefers, and not those which are sickly and decaying; which latter are preferred by the European Cossus, some authors say, though perhaps their observations have not been exact upon this point; for in the instance here alluded to, it would have been said on a first glance that these worms preferred decaying wood, since the diseased heart of the tree was everywhere traversed with their burrows, and the sound wood showed few of them. And thus no doubt in many other cases we mistake the cause for the effect, and on seeing semi-putrid wood filled with worm-holes we suppose the worms have preferred wood of this character when in truth it is these holes which have caused the decay of the wood.

These worms are probably three years in obtaining their growth. They cast off their skin several times, and after the last of these moultings their color becomes different from what it has previously been.

The LARVA previous to the last change of its skin is of a rose red or a pale cherry red color, often with a faint yellowish stripe along the middle of its back, on all except the three anterior rings. It is of a cylindrical form, slightly broadest anteriorly and a little flattened beneath. It is divided by transverse constrictions resembling broad shallow grooves, into twelve

rings, which are twice as broad as long. On each of these rings are a few pimples of a deep purple color, regularly placed, each giving out a pale brown bristle. Four of these pimples are on the back, placed at the angles of an imaginary square or a trapezoid having its hind side the longest, the two hinder pimples being larger. Small white dots confluent into broken lines may also be perceived, forming a transverse square in which the two anterior pimples are inclosed, and other dots less regularly placed, surrounding the two hind pimples except upon their hind side. Above the breathing pores on each side is also a large pimple, which, upon the four rings bearing the pro-legs, has a white dot in its lower edge, which dot does not appear in the corresponding pimples of the other rings. A minute pimple is also seen forward of the upper end of each breathing pore, below which all the under side of the worm is greenish white. The breathing pores are oval and light yellow, with a rusty brown oval spot in their centre and a dark purple ring around their outer edge. Below them the skin bulges out, forming a longitudinal ridge, or rather two parallel ridges divided by a deep intervening furrow. Upon the upper one of these ridges near the middle of each ring is a round cherry-red spot in which are two small pimples, and on the lower ridge is a single one, placed farther back, whilst four others, equally minute, may be seen farther down and around the anterior base of the pro-legs. The second and third rings are shorter, each with fourteen pimples of different sizes, the larger ones forming a single transverse row. The first ring or neck is polished and of a dark tawny brown color on its upper side, with a white line in its middle disappearing anteriorly in a black two-lobed cloud. The head is but half as broad as the body, and is of a shining black color, tinged more or less with chestnut brown in its middle, with scattered punctures from which arise fine hairs. The antennæ are chestnut brown, conical and three-jointed, the last joint minute, with a bristle beside it given out from the apex of the second joint. The palpi are similar, with two small processes from the summit of their second joint, the outer one of which ends in a minute fourth joint. Of the eight pairs of legs, the three anterior are conical and end in a single chestnut-colored claw. The others are short, thick and retractile, with their soles surrounded by a blackish fringe-like ring composed of a multitude of minute hooks, the last pair, however, having these hooks only around the anterior and outer half of their soles. Placed in a glass or tin vessel this worm is perfectly helpless, being unable to cling with these hooks to a hard smooth surface.

With the last change of its skin it loses its bright red color and is then white, tinged with green at the sutures, and with a pale green stripe along the middle of its back which disappears at the sutures. The pimples are of a pale tawny yellow color with black centres. The head is light tawny yellow varied in its middle with greenish white, its anterior edge blackish and the jaws deep black.

As the moth into which this worm changes possesses no jaws or other implements by which it is possible for it to perforate the wood, it is necessary for the worm to prepare a way for its future escape from the tree. And the provisions which it makes for this end are truly interesting, indicating that the worm has a clear perception of what its future condition and requirements will be, both in its pupa and its perfect state. This is the more surprising when we recur to the fact that since its infancy this creature has been lying deeply bedded in the interior of the tree, the only act of its life having been to crawl lazily around in its cell and gnaw the wood there, when impelled by hunger. How does it now come to do anything different from what it has been doing for months and years before? But, having got its growth and the time drawing near to have it change into a pupa or chrysalis, we see it engaging in a new work. It now bores a passage from the upper end of its cell, outward through the wood and bark till only a thin scale of the brittle dead outer bark remains. It is usually at the bottom of one of the large cracks or furrows in the bark that this passage ends, whereby the hole inside is less liable to be discovered by birds. The worm then diligently lines the walls of this hole with silken

threads interspersed with its chips and forming a rough surface resembling felt, as it withdraws itself backwards for a distance of about three inches, thus placing itself beyond the reach of any bird or other enemy outside of the tree, should its retreat be discovered. And it here incloses itself in a cocoon which it spins of silk, of a long oval form, having the end towards the outer opening much thinner and its threads more loosely woven. In this cocoon it throws off its larva skin and then appears in its nymph or pupa form.

The PUPA is an inch and three-quarters long and half an inch thick, of a dull chestnut color, the rings of its abdomen paler, and on the back near the anterior edge of each ring is a row of angular teeth, resembling those of a saw, of a dark brown color, and all of them inclining backward, these rows of teeth extending downwards upon each side below the breathing pores or about two-thirds of the distance around the body. On the middle of each ring is also a much shorter row of little tubercular points. Finally, upon the under side of the last segment are about four stouter conical teeth, the tips of which are drawn out into sharp points which are curved forward, so that when this last segment, which is tapering and smaller than the others, is bent downwards, these curved points will catch and hold the body from moving forward.

The pupa lies perfectly dormant in its cocoon probably a fortnight or longer. It then awakes from its slumbers and begins to writhe and bend itself from side to side. By this motion the rows of little teeth upon the rings of its abdomen, which incline backward as above described, catch in the threads of the cocoon, first upon one side and then upon the other, and thus move the body forward, whereby its head presses upon the loosely woven end of the cocoon, more and more firmly, until it forces its way through it, and the pupa works itself forward out of its cocoon. And the same writhing motion being continued, the teeth now catch in the threads with which the sides of the hole are lined, and thus though destitute of feet the pupa moves itself along, till it reaches and breaks through the thin scale of bark which hitherto has closed the mouth of its burrow, and pushes itself onward till about three-fourths of its length protrude from the tree, when by curving the tip of its body downward, the four little hooks thereon catch in some of the threads and hold it from advancing further and falling to the ground. By so much motion of the pupa the connections of the inclosed insect with its shell become sundered and the sutures of the shell are probably cracked open, so that the moth readily presses them apart and crawls out therefrom, leaving the empty and now lifeless shell projecting out from the mouth of the hole, with a small mass of worm-dust surrounding it.

The MALE moth is of a gray color from white scales intermixed with black ones. The *head* is furnished upon the crown or vertex with longer or hair-like scales. The antennæ are tapering and many-jointed, their basal joint thickest and covered with black and gray scales, the remaining joints being naked, shining, coal-black, each joint bearing two branches on its front side, forming two rows of coarse teeth like those of a comb, the teeth being six or more times as long as thick, and all of the same length except at the base and tip, where they become shorter, all of them ciliated with fine hairs. The feelers are appressed to the face and reach as high as to the middle of the eyes, and are cylindric, clothed with short appressed scales, the separation of the terminal joint being slightly perceptible. The *thorax* has the shoulder-covers black, forming a stripe of this color along each side, which anteriorly curves

downwards and is continued backward upon the upper side of the breast. Its base is clothed with larger scales, forming tufts upon each side. The *abdomen* is conic and equals the tips of the wings in its length, and is but slightly covered with scales except along each side, where they form a broad stripe, the under side being entirely denuded; it is black and shining, with the sutures dull yellowish. At its tip are three appendages, longer than the last rings of the abdomen. The two lower ones are broad thick flattened processes of a dull brownish yellow color, with their tips rounded and slightly bent inwards towards each other. The upper one is a slender black shining hook or claw of the same length, its tip sharp-pointed and curved downward. Above these appendages and hiding them from view is a brush of black hairs, forming a conical tuft at the end of the abdomen, blunt at its apex. The *legs* are more or less denuded of scales, black and shining, with the hind shanks thicker towards their tips and with two pairs of spurs, the forward shanks having only a single spine which is placed on the middle of their inner sides, the same as in other moths; and the feet are compressed, and five-jointed, with the basal joint longest and the following ones successively shorter. The *fore wings* are black with groups of whitish scales forming gray spots or clouds which are netted with black lines, varying greatly in different individuals. Often a transverse gray spot is situated towards the base and another on the anal angle, the outer and hind margins being gray alternated with black. The *hind wings* are black with their posterior half of a rich marigold yellow color bordered with a black line upon the hind margin, the yellow color being irregularly notched on its anterior side and narrowed to the inner angle, and not extended to the outer angle, the two outer cells being black. The outer or anterior margin, except at its base and tip, is usually gray alternated with transverse black streaks and blotches, and inside of this is a large ash-gray spot occupying the outer anterior part of the disk. The under sides of both wings is similar to their upper surface.

The FEMALE would not be supposed to pertain to the same species with the male, her size is so much larger, her colors so much paler gray, and her hind wings being wholly destitute of the bright yellow coloring which forms so conspicuous a mark in the other sex. The branches of her antennæ are also shorter, being but about four times as long as thick. The ground color of her fore wings is gray, variously netted with black lines dividing the gray in places into small roundish spots and into rings having black centres. The black color usually forms a broad irregular band across the middle of the wings parallel with the hind margin, and another between this and the hind edge, chiefly on the outer half of the wing, the hind edge and fringe being whitish alternated with black spots placed on the tips of the veins. The hind wings are dusky gray and towards their bases blackish, their posterior half being feebly transparent and faintly netted with darker lines. The body is densely coated with gray scales, its under side hoary white; and the legs are gray with black bands on the shanks and black feet with gray rings at their articulations.

We have but a single suggestion to make upon the subject of remedies against this truly formidable though fortunately rare enemy. It is probable that soft soap applied the fore part of June to the bodies of trees will be equally efficacious against this and other borers as it is against that of the apple tree. This remedy may well be resorted to, to protect the locusts and oaks which we value as ornamental trees; and scarce and valuable as timber is becoming in all the older settled sections of our country, I doubt not it will be found to be good economy to bestow similar attention upon the more valuable trees standing in our forests.

It should also be observed that whenever a hole made by a borer is discovered in the trunk of a tree, it should be immediately closed by inserting a plug therein, to exclude the wet which will otherwise be admitted hereby to the interior of the tree and produce a decay of the surrounding wood.

294. OAK COSSUS, *Cossus Querciperda*, new species.

A moth smaller in size than *C. Robiniæ*, with thin and slightly transparent wings which are crossed by numerous black lines, the outer margin

only of the forward pair being opake and of a gray color; the hind wings of the male colorless, with the inner margin broadly blackish and the hind edge coal-black.

This description will suffice to distinguish a species of which the two sexes were recently found at rest upon the trunk of an oak tree in Schoharie, by I. A. Lintner, Esq. It is altogether probable from these facts that it is a borer in the oak, with other habits similar to those of the preceding species. This discovery is the more interesting, since, so far as I am aware, the Locust Cossus has hitherto been the only species of this genus known as inhabiting our country, the *Cossus Pyrini* of Fabricius evidently pertaining to the genus *Zeuzera*.

The PIGEON TREMEX, *T. Columba*, I have met with inserting its eggs in the oak, but being much oftener found in the maple, will be described under that head.

295. NORTHERN BRENTHUS, *Arrhenodes septentrionis*, Herbst. (Coleoptera. Attelabidæ.)

Perforating a cylindrical hole about the tenth of an inch in diameter, transversely through the bark and into the solid wood of standing, and much more often of newly felled trees, and thrusting its chips out at the orifice; a slender cylindrical whitish worm an inch or more in length and scarcely 0.10 in diameter, with three pairs of legs on its breast and a thick fleshy pro-leg at its tip, its last segment horny and dark chestnut colored, and obliquely hollowed at its end, forming a kind of scoop with little teeth along its edge; changing in its burrow to a long yellowish white pupa, having its head bent down under its breast and its long beak lying between its leg and wing-sheaths, its back with transverse rows of little sharp teeth and two sharp spines at its tip; changing into a long cylindrical beetle about 0.60 in length, of a mahogany brown color, it wing-covers usually black and with narrow tawny yellow spots upon the rounded spaces between the furrows, its thorax egg-shaped and highly polished, its head ending in two large jaws in the male, and in the other sex a slender cylindrical beak with small jaws at its tip, whereby it bores into the bark and then pushes an egg into the opening.

Though most common in oaks this beetle is not limited to wood of this kind. On removing the loose bark from fallen trees it will sometimes be seen projecting partly out of its burrow in the wood; but the collector will most readily supply himself with specimens among the piles of sawed oak lumber in mill yards in May and June. It differs remarkably in its size. I have a specimen the total length of which is but 0.25, and which is proportionably slender. It was one of these dwarfs from which Drury described this species under the name *minimus*, long anterior to Herbst. But this being the name of a mere variety, it cannot supplant the name subsequently given, which has been universally adopted and is highly appropriate, since the several species nearest akin to this all inhabit warm climates. And Olivier hence deemed South Carolina to be the northern-

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most extent of the geographical range of this species, and that the name given it by Herbst was therefore inapplicable. He consequently proposed the name *maxillosus* for this species. The insect, however, occurs in all parts of the United States and Canada.

296. GRAY-SIDED WEEVIL, *Pandeletcius hilaris*, Herbst. (Coleoptera. Curculionidæ.)

A smaller perforation than that of the preceding insect, containing a worm resembling that of the plum curculio, and which is the young of a weevil met with upon the leaves of the oak from May till the last of September, 0.20 long and of a pale brown color, its wing-covers on each side usually gray bordered above with black, and sending two gray branches obliquely inwards towards the suture, with very stout fore legs and a short broad beak having a furrow along the middle of its upper side; with its beak boring a hole in the bark and placing an egg therein. See Harris' Treatise, page 61.

297. SILKY TIMBER-BEETLE, *Lymexylon sericeum*, Harris. (Coleoptera. Lymoxylonidæ.)

Boring small long cylindrical burrows in the wood of the oak, probably, and other trees; a slender odd-looking worm with six legs placed on its breast, a prominent hump upon its neck, and a leaf-like fleshy appendage at the end of its back; changing into a long narrow chestnut-brown beetle, 0.50 long, bearded with short, shining, yellowish hairs, giving it a silky lustre, its eyes large and almost meeting together above and below, and its wing-covers tapering and shorter than the body. See Harris' Treatise, p. 51.

298. AMERICAN TIMBER-BEETLE, *Hylecœtus Americanus*, Harris. (Coleoptera. Lymexylonidæ.)

A worm very similar to the preceding, but with a straight sharp-pointed horn at the end of its back in place of a leaf-like appendage; changing into a pale brownish-red beetle 0.40 long, its wing-covers, except at their base, and its breast black, its eyes small and a glassy dot on the middle of its forehead resembling a small eyelet. See Harris' Treatise, p. 51.

This and the preceding are very rare insects, and their larvæ have never been detected, but are inferred by Dr. Harris to inhabit oaks and to have the singular forms above indicated, from the analogy of the perfect insects to two European species. Foreign writers, I see, are misled by Dr. Harris's account, into supposing that it is authentically ascertained that our insects coincide in their larva state with the European species.

299. FEEBLE OAK-BORER, *Goes debilis*, Leconte. (Coleoptera. Cerambycidæ.)

A cylindrical long-horned beetle, which has recently been described by Dr. Le Conte, under the above name, is so uniformly found upon white oak trees in July and August, that I doubt not its larva is a borer in the trunks of these trees, perforating the wood, probably, in a manner similar to that of the marked pine borer. No. 230, and the worm resembling that

in its appearance. This beetle is half an inch long and scarcely a third as broad, of a black color, its wing-covers chestnut red, its surface having a marbled appearance, produced by short prostrate hairs of a dull ochre yellow color, except on the anterior half of the wing-covers, where they are gray, and are here followed by a tawny brown spot destitute of these paler hairs. It has only been found, as yet, in the State of New York, in the northern sections of which it is not rare.

300. Thunderbolt, *Arhopalus fulminans*, Fabricius. (Coleoptera. Cerambycidæ.)

Excavating a burrow in the soft sap-wood, about three inches long and 0.20 in diameter, this burrow having the shape of a much bent bow or a letter U; a worm similar to that of the apple-tree borer, which passes its pupa state in the same cell and produces a long-horned beetle which comes abroad the beginning of July, and is three times as long as broad, varying from a half to nearly three-fourths of an inch in length, of a black color, with transverse zigzag gray lines often broken into small spots on its wing-covers, and readily distinguished from all other species by its thorax, which is nearly globular and gray, with a large egg-shaped coal-black spot on the middle of its upper side.

301. White-banded Phymatodes, *Phymatodes albofasciatus*, now species. (Coleoptera. Cerambycidæ.)

A black long-horned beetle 0.25 in length or slightly less, and about a third as broad, somewhat flattened, clothed with fine erect gray hairs, its wing-covers with two distinct slender white bands which do not reach the suture, the anterior one more slender than the hind one and curved, the antennæ and slender portions of the legs usually chestnut colored.

Several specimens of this beetle were met with a few years since, the last of May, on the trunk of a black oak, in which, it is probable, their younger state had been passed. It is closely related to the black varieties of *P. varius* Fab., but is a third smaller, with the white bands much more slender, and the surface of the wing-covers are perceptibly more rough than in my specimens of that insect, notwithstanding their smaller size. Its thorax is densely punctured, with a short smooth stripe between the centre and the base. One of the specimens varies in having the posterior white band wholly wanting.

Several others of our long-horned beetles are usually found upon oaks, in the trunks or limbs of which the larvæ probably reside.

302. Tooth-legged Buprestis, *Chrysobothris dentipes*, Germar. (Coleoptera. Buprestidæ.)

A slender, winding, serpent-shaped worm-track between the bark and wood of newly felled trees; formed by a white footless grub, its anterior end enormously large, round and flattened; sinking itself probably slightly into the wood to pass its pupa state; producing a flattish oblong purplish-black beetle about 0.50 in length, coppery beneath, its face brassy and

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with two smooth raised dots, its thorax with two smooth raised stripes separated by an intervening groove; often found basking in the sunshine on the bark of the trees in June and July. See Harris's Treatise page 43.

The APPLE BUPRESTIS, No. 3, before apple trees were introduced upon this continent, was cradled in the oaks, and is still frequently found in them. It is also probable that others of the American species of this same genus, of which there are quite a number, whose preparatory state are yet unknown, are nurtured in the oaks.

The larvæ of the HORN-BUG, No. 6—very large, soft white grubs, with their bodies doubled together in the shape of the letter U, their tips, which are thick and of a livid bluish gray color as though discolored from being bruised, being held against their breasts—are quite common in the damp putrid wood in the centre of old trees and in their stumps, and also occur in the decaying sapwood. The larvæ also of the BIG-EYED SNAPPING BEETLE No. 9, and of several other beetles of smaller size than these, are found in the same situations.

303. QUERCITRON BARK BORER, *Graphisurus fasciatus*, Degeer. (Coleoptera. Cerambycidæ.)

Feeding upon and destroying the quercitron bark (the inner bark of the black oak, *Quercus tinctoria*,) of newly felled trees, forming large tracks therein which are filled with worm-dust, and in an oval cavity at the end of these tracks a white footless grub about 0.60 long and a fourth as broad, slightly tapering, and with a transverse oval tawny yellow spot on the middle of each ring above and below; changing to a pupa lying naked in the same cavity, and in June coming out, a long-horned beetle about 0.50 long and a third as broad, of an ash-gray color freckled with blackish spots and punctures, and back of the middle of its wing-covers an irregular oblique black band, the female with a tail-like ovipositor.

The black oak is most highly valued for its bark, the quercitron of commerce, yielding a bright yellow dye. The bark of the dead tree, it is said, is not at all inferior for coloring purposes, to that cut from living trees. But unless this bark is peeled immediately after the tree falls to the ground, it becomes very much worm-eaten and nearly worthless. The worms which burrow in and destroy it are produced by a long-horned beetle differing remarkably from all the other beetles of this group in that the female is furnished with a straight awl-like ovipositor nearly a quarter of an inch in length, projecting horizontally backwards from the end of her body. The importance of this implement becomes manifest when we observe the thickness of the bark of the black oak, with its outer layers so dry and hard that they form as it were a coat of mail, protecting the trunk of the tree against the attacks of its enemies. Equipped as she is, however, the female of this beetle is able to perforate this hard outer bark and sink her eggs through it, placing them where her young will find themselves surrounded with their appropriate food. The worms from these

eggs mine their burrows mostly lengthwise of the grain or fibres of the bark, and the channels which they excavate are so numerous and so filled with worm-dust of the same color with the bark, that it is difficult to trace them. The eggs are deposited the latter part of June, and the worms grow to their full size by the close of the season, and will be found during the winter and spring, lying in the inner layers of the bark, in a small oval flattened cavity about an inch in length, which is usually at the larger end of the track they have travelled.

This LARVA is divided by transverse constrictions into twelve rings, the last one being double. The head is small and retracted more or less into the neck, its base white and shining, and its anterior part deep tawny yellow, and along each side black. The neck or first ring is much longer as well as thicker than any of the others, the two rings next to it being shortest. From the neck the body of the worm is slightly tapered backwards to the middle, from whence it has nearly the same diameter to the tip, where it is bluntly rounded. Upon the upper side of the neck, occupying the basal half of this ring, is a large transverse tawny yellow spot, rounded upon its forward side, but no corresponding spot appears on the under side of this ring. On the middle of all the other rings except the two last, both above and below, is an elevated, rough, transverse, oval spot, of a tawny yellow color.

The BEETLE, like other species of the family to which it pertains, varies greatly in its size, specimens before me being of all lengths, from 0.35 to 0.58. It is of an ash-gray color from short incumbent hairs or scales, which have a faint tinge of tawny yellow except along the suture of the wing-covers. It is also bearded with fine erect blackish hairs which arise from coarsish black punctures which are sprinkled over the thorax and wing-covers, several of which punctures are in the centre of small black dots, which in places are confluent into small irregular spots. The head is of the same width as the anterior end of the thorax, and has a deep narrow furrow along its middle its whole length, and on the crown is an oval blackish spot on each side of this furrow. The face is dark gray, and the antennæ are black with an ash-gray band occupying the basal half of each of the joints. The thorax is narrower than the wing-covers, more broad than long, and thickest across its middle. Upon each side slightly back of the middle is an angular projection or short broad spine, blunt at its tip. On the middle of the back between the centre and the base is a short impressed line, and on each side of this, extending the whole length of the thorax is a wavy blackish stripe, which is suddenly widened towards its hind end, and is sometimes interrupted in its middle. Often, also, there is a blackish spot between the anterior ends of these stripes, extending from the centre of the thorax to its forward end. The scutel is ash-gray in its middle and black upon each side. The wing-covers almost always show a large oblique and irregular triangular spot of black on their outer side forward of the middle, and always behind the middle is an irregular black oblique band, which seldom reaches to the suture, and which has a notch in the middle of its anterior side and opposite to this on its hind side a large angular projection extending backward. Immediately back of this band is an irregular spot of a paler black color, which is sometimes confluent with the band; and there is also a small blackish spot on the outer side of the tips. The tips are cut off, sometimes transversely in a straight line, but usually concavely, and sometimes presenting a slight tooth-like projection on each side. The legs are ash-gray, the thighs with two black spots on their upper side, and the shanks with a black band at their base and another at their tip, these bands being more broad on the hind pair.

On elevating the loose bark of fallen trees the fore part of June, these insects will be found therein, lying in the cavities already mentioned, some of them being still in their pupa state, whilst others are changed to their perfect form, ready with the stout jaws and sharp teeth with which they are furnished, to gnaw their way through the bark and come abroad.

This species occurs throughout the United States and Canada. Different specimens of it, however, vary greatly in their aspect. Even when newly

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born, among the individuals in the bark of the same tree, considerable diversities in size and markings may be noticed. And the beetles found in this situation have their colors so much brighter and their spots and bands so much more distinct and clearly defined, that I supposed them to be a different species from *fasciatus* for several years, and until specimens came to hand showing a gradual transition from these to the older individuals which we usually capture abroad, and meet with preserved in cabinets, in which the colors have become faded and dim and the marks obscure and partially obliterated. In the shape of some of its parts, also, different specimens are liable to vary. And I cannot persuade myself that the species named *pusillus* by Kirby is really distinct from the one under consideration. Dr. Le Conte supposes it may be distinguished by its smaller size, and by the spine on each side of its thorax being smaller and perfectly straight on its hind side, instead of concave. But in the smallest specimen in my collection, measuring but 0.35, this spine is about as prominent as in any of the larger ones, and its hind margin is straight, as it is also in several other examples, one of which is 0.58 in length. This form of the spine, therefore, is not peculiar to the smaller sized specimens. Moreover, in one instance before me, this margin is wavy instead of straight, and in several others it is straight nearly to its outer end, where it suddenly curves outward by reason of the tip of the spine being slightly prolonged or attenuated; whilst in other cases still, this margin is regularly concave or curved through its whole length. We thus, in different specimens, meet with a regular gradation from the straight margined spines of *pusillus* to the concave of *faciatus*, as these species are distinguished by Dr. Le Conte; showing that no such difference as has been supposed, really exists in nature. And we therefore regard the *pusillus* of Kirby as being merely a dwarf variety of this species.

304. OAK LEIOPUS, *Leiopus Querci*, new species. (Coleoptera. Cerambycidæ.)

A very small long-horned beetle, which I am unable to refer to any of the described species, I am assured lives at the expense of the red and white oak, from meeting with it upon those trees standing apart from others in fields. As the larvæ of kindred species burrow in the bark of trees, this will probably be found in the same situation in oaks. The beetle is met with upon the leaves of these trees early in July. It is very closely related to the Facetious Leiopus, No. 286.

It is 0.20 long, and black with ash-gray wing-covers, which are punctured and marked with a large black spot on the base of their suture in the form of a cross, and a broad black band slightly back of their middle, which is angulated, somewhat resembling an inverted letter W, this band often having a small ash-gray spot placed in it near its outer ends. Forward of this band are two black dots or short lines on each wing-cover, and sometimes a third dot back of it. There is also a dusky spot, usually, on the tips of the wing-covers, and their deflected outer margin is black. The wing-covers are rounded at their tips. The thorax sometimes shows three faint gray stripes above. It is narrowed anteriorly, and on each side slightly forward of the base is a short, broad, sharp-pointed spine, from the tip of which, for-

ward, the sides are straight. The long thread-like antennæ are dull yellow, with a slight duskiness at the end of each joint. The legs are blackish with the bases of the thighs, and frequently of the shanks also, pale dull yellow, the hind thighs being less thickened towards their tips than the four forward ones.

AFFECTING THE LIMBS AND TWIGS.

305. Oak pruner, *Elaphidion putator*, Peck. (Coleoptera. Cerambycidæ.)

[See Report Third, plate 2, fig. 2.]

The limbs towards their ends cut smoothly off, transversely, the latter part of summer, and found through the autumn and winter lying on the ground beneath the trees with their withered leaves adhering to them; a hole bored in their severed end, and extending up their center, in which lies a white footless worm, over a half inch long and a fourth as broad, slightly tapering and divided into twelve rings by very broad deep constrictions; changing to a somewhat active pupa within the limb, from which in June comes a slender cylindrical long-horned beetle half an inch long, of a dull black color with brownish wing-covers which have two sharp points at their tips and ash-gray hairs forming small spots here and there, its thorax with coarse close punctures and its under side and legs chestnut colored.

The singular habit of this insect of severing the limb in which it is cradled and dropping itself herein to the ground, varying its operations to accord with the size and nature of the limb, renders it one of the most interesting native species of our country. Its biography has never yet been written, that I am aware, except very imperfectly. The leading facts in its life were first made known in the year 1819, by Prof. Peck, in an article published in the Massachusetts Agricultural Repository, vol. v. pp. 307—311, accompanied with a plate; and some slight additions are made thereto, by Dr. Harris, in his Treatise, p. 86.

The purpose for which this insect cuts off the limb, is probably as Prof. Peck, suggests; as the worm is to remain in the limb through the winter, it appears to forsee that, from being wounded as it is, it will perish and become too dry if it remains elevated in the air; it therefore drops it to the earth, where, lying among the fallen leaves and buried beneath the winter's snows, it remains moist and adapted for the development of the insect within it.

The severed limbs are usually but eighteen inches or two feet in length, but Prof. Peck states that limbs an inch in thickness and five feet in length are sometimes found. I have seen a limb cut off by this insect, which was ten feet in length and an inch and a tenth in thickness, and have repeatedly met with them seven and eight feet long, and usually an inch, but in one instance an inch and a quarter in thickness.

The parent beetle seems aware that her progeny, in their infancy, will be too feeble to masticate the hard woody fibres of the limb. She therefore selects one of the small twigs which branch off from it, which is not thicker than a goose quill, with its base composed of soft wood, the growth

of the last year, all the remainder of the twig being the green succulent growth of the present year. She places her egg near the tip of this twig, in the angle where one of the leaf-stalks branch off from it. The young worm which hatches therefrom sinks himself into the center of the twig and feeds upon the soft pulpy tissue around him until it is all consumed, leaving only the green outer bark, which is so thin and tender that it withers and dries up, and ere long becomes broken. By the time this green tender end of the twig is consumed the worm has acquired sufficient size and strength to attack the more solid woody portion forming its lower end. He accordingly eats his way downward in the centre of the twig, consuming the pith, to its base, and onward into the main limb from which this twig grows, extending his burrow obliquely downward to the center of the limb, to a distance of half an inch or an inch below the point where the lateral twig is given off.

The worm being about half grown, is now ready to cut the limb asunder. But this is a most nice and critical operation, requiring much skill and calculation; for the limb must not break and fall whilst he is in the act of gnawing it apart, or he will be crushed by being at the point where it bends and tears asunder, or will fall from the cavity there when it breaks open and separates. To avoid such casualities, therefore, he must after severing it, have time to withdraw himself back into his hole in the limb and plug the opening behind him, before the limb breaks and falls. And this little creature accordingly appears to be so much of a philosopher as to understand the force of the winds and their action upon the limbs of the tree, so that he can bring them into his service. He accordingly severs the limb so far that it will remain in its position until a strong gust of wind strikes it, whereupon it will break off and fall.

But the most astonishing part of this feat remains to be noticed. The limb which he cuts off is sometimes only a foot in length and is, consequently quite light; sometimes ten feet long, loaded with leaves, and very heavy. A man by carefully inspecting the length of the limb, the size of its branches, and the amount of foliage growing upon them, could judge how far it should be severed to insure its being afterwards broken by the winds. But this worm is imprisoned in a dark cell only an inch or two long, in the interior of the limb. How is it possible for this creature, therefore, to know the length and weight of the limb, and how far it should be cut asunder? A man, moreover, on cutting a number of limbs of different lengths, so far that they will be broken by the winds, will find that he has often miscalculated, and that several of the limbs do not break off as he designed they should. This little worm, however, never makes a mistake of this kind. If the limb be short, it severs all the woody fibres, leaving it hanging only by the outer bark. If it be longer, a few of the woody fibres on its upper side are left uncut in addition to the bark. If it be very long and heavy, not more than three-fourths of the wood will be severed. The annexed figures represent the severed ends of limbs of different

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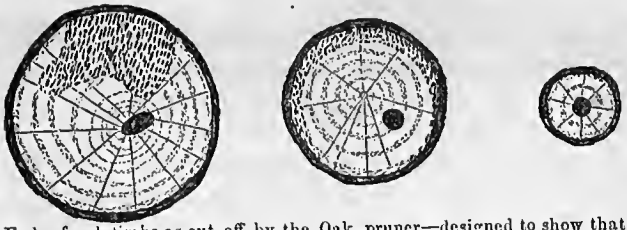

Ends of oak limbs as cut off by the Oak pruner—designed to show that where the limb is small it cuts it all off except the outer bark; when the limb is larger, it leaves a ring of wood on one side, in addition to the bark; and when very large it leaves a large piece of wood unsevered—showing also the hole out of which the worm comes.

sizes, the coarsely dotted parts of the two first indicating the ragged broken ends of the woody fibres, the remainder being the smooth surface cut by the worms, and the large black dot representing the perforation leading up the limb to where the worm lies. The first of these figures was taken from the limb already spoken of as ten feet in length, and here it will be noticed that a portion of the stouter wood towards the center of the limb was preserved, as though the worm had been aware that the weaker sappy fibres outside, next to the bark, could not be relied upon for sustaining a limb of this size, as they are where the limb is smaller. With such consumate skill and seemingly super-terrestrial intelligence does this philosophical little carpenter vary his proceedings to meet the circumstances of his situation in each particular case! But by tracing the next stage of his life we shall be able to see how it is that he probably performs these feats which appear so much beyond his sphere.

Having cut the limb asunder so far that he supposes it will break with the next wind which arises, the worm withdraws himself into his burrow, and that he may not be stunned and drop therefrom should the limb strike the earth with violence when it falls, he closes the opening behind him by inserting therein a wad formed of elastic fibres of wood. He now feeds at his leasure upon the pith of the main limb, hereby extending his burrow up this limb six or twelve inches or more, until he attains his full growth—quietly awaiting the fall of the limb, and his descent therein to the ground. It is quite probable that he does not always sever the limb sufficiently in the first instance, for it to break and fall. Having cut it so much as he deems prudent, he withdraws and commences feeding upon the pith of the limb above the place where it is partially severed, until a high wind occurs. If the limb is not hereby broken, as soon as the weather becomes calm he very probably returns and gnaws off an additional portion of the wood, repeating this act again and again, it may be, until a wind comes which accomplishes the desired result. And this serves to explain to us why it is that the worm severs the limbs at such an early period of his life. For the formidable undertaking of cutting asunder such an extent of hard woody substance, we should expect he would await till he was almost grown and had attained his full strength and vigor. But by entering upon this task when he is but half grown he has ample opportunity to watch the result, and to return and perfect the work if he discovers his first essay fails to accomplish the end he has in view.

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Thus the first part of the life of this worm is passed in a small twig branching off from the main limb. This is so slender and delicate that on being mined as it is by the worm and all its green outer end consumed, it dies and becomes so decayed and brittle that it is usually broken off when the limb falls, whereby it has escaped the notice of writers, hitherto. The remainder of his larva life is passed in the main limb, first cutting off this limb sufficiently for it to break with the force of the winds, and then excavating a burrow upwards in the center of the limb, both before and after it has fallen to the ground, feeding hereon until he has grown to his full size.

It is most frequently the limbs of the red and the black oak that I have met with, severed by the Oak pruner, though it is not rare to find those of the scarlet oak (*Q. coccinea*) and of the white oak lopped off in the same manner. Limbs of the beech and chestnut not unfrequently, and those of the birch, the apple, and probably of other trees, are sometimes similarly severed. Mr. P. Weter, of Tirade, Walworth county, Wisconsin, informs me that the peach in his vicinity, suffers in a similar manner, and to such an extent some years, that the severed limbs, varying from a few inches to two feet in length, are seen lying under almost every tree. We have in our country several species of beetles very closely related to the Oak pruner, but no attempts have yet been made to ascertain their mode of life. It is very probable that they all have this same habit of cutting off the limbs of trees, one perhaps preferring the wood of one kind of tree, another, another. This is the more probable, since there is considerable diversity in their operations, as shown by an examination of the fallen limbs. Thus the scarlet oak, instead of having a hole bored in the severed end of its limbs, commonly has half the wood ate away on one side of the limb for the length of an inch or more, with the cavity thus formed under the bark packed with worm dust, and a cylindrical burrow from the upper end of this cavity running upwards in the centre of the limb, the same as in other cases.

It further appears that the female, when ready to drop an egg, is not always able to find a small twig with a green succulent end adapted to her wants. She then consigns her progeny to the bark of the main limb, and the young worm subsists on the soft pulpy matter between the bark and the wood, excavating a shallow irregular cavity which is packed with worm dust, till it has acquired sufficient strength to gnaw the wood, when it cuts off the limb as in other cases. It may, however, be a different species from the common Oak pruner, which cradles its young thus beneath the bark instead of in a lateral twig. It is usually in the fallen limbs of the beech, though sometimes in those of the oaks also, that I have met with these worm tracks under the bark.

The bark of the beech, it will be recollected, is quite thin and very brittle, so that it will illy serve to hold the limb in its place if the wood underneath is cut off in the usual manner. And accordingly a remarkable modification of this operation will be noticed in the amputated limbs of this tree. The worm eats its way down the limb beneath the bark until

it has acquired sufficient strength to sever the woody fibres. It then passes transversely around the limb beneath the bark, girdling it by cutting off all the softer outer fibers and leaving the harder ones in the middle of the limb uncut, whereby the limb is sustained until the wind strikes it. How surprising that these little creatures have such intelligence given them as enables them to vary their operations to such an extent, according to the circumstances of their situation in each particular case! I should be inclined to think the beech pruner a different species from that of the oak, as it dwells beneath the bark instead of in a lateral twig, and cuts off the outer instead of the inner wood of the limb; but the worm is identical with that of the oak in its external appearance, and one of these worms which I placed in a cage, falling from its fractured burrow in the beech limb, forsook this wood and commenced boring into an oak limb lying beside it.

Not only the limbs but small young trees, at least of the white oak, are sometimes felled by these insects; in which cases the worm, instead of cutting the wood off transversely, severs it in a slanting or oblique direction, as though it were aware the winds would prostrate a perpendicular shoot more readily by its being cut in this manner.

The LARVA grows to a length of 0.60, and is then 0.15 thick across its neck, where it is broadest. It tapers slightly from its neck backwards, the hind part of its body being nearly cylindrical. Is is a soft or fleshy grub, somewhat shining and of a white color, often slightly tinged with yellow, its head, which is small and retracted into the neck, being black in front. It is divided into twelve rings by very deep, wide, transverse grooves. The neck or first ring is much the largest, and shows two very pale tawny yellow bands on its upper side, the anterior one slightly broken asunder in its middle, and on each side beyond the ends of these bands is a spot of the same color. The two or three rings next to the neck are shorter than the others, and less widely separated from each other. A faint stripe of a darker color may be discerned along the middle of the back, widely broken apart at each of the sutures. The last ring is much narrower and more shining than the others, and is cut across by a fine transverse line, dividing it into two parts, of which the hinder one or tip is bearded with small blackish hairs, and a few fine hairs are perceptible upon the other rings. The two last rings are retracted into the ring which precedes them, at the pleasure of the animal, whereby this ring becomes humped and swollen; and it appears to be chiefly by thus enlarging the end of its body that the worm holds and moves itself about in its cell, its feet being so weak and minute that they are scarcely perceptible and can be of little service. It has three pairs of soft conical jointed feet, resembling its antennæ in their size and shape. The first pair is placed on an elevated wrinkle of the skin in the suture between the first and second segments of the thorax, more distant from each other than are those of the second and third pairs, which are situated on the middle of the elevation of the second and third segments.

Some of the worms enter their pupa state the last of autumn, and others not till the following spring. Hence in examining the fallen limbs in the winter, a larva may be found in one, a pupa in another. Preparatory to entering its pupa state, the larva places a small wad of woody fibres, sometimes intermingled with worm-dust, below it, in its burrow, and sometimes another wad above it if the burrow runs far up the limb, thus partitioning off a room one or two inches in length in which to lie during its pupa state. The shrivelled cast skin of the larva will be found at the upper end of this cell, after it has changed to a pupa.

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Usually those insects which undergo a complete metamorphosis, remain at rest, lying dormant and motionless during their pupa state. The Oak pruner, however, is a remarkable exception to this. Whenever its cell is opened it will be seen moving from one end of it to the other with quite as much agility as it shows in its larva state. The sutures of its abdomen have the same deep transverse grooves as in the larvæ, admitting the same amount of motion to this part of its body that it previously had. And lying on its back, it uses the tip of its abdomen as though it were furnished with a pro-leg, the little sharp points with which it is covered being pressed against the rough walls of the cell, and the body pushed forward or drawn backward hereby, step after step, at the will of the animal.

The PUPA is of much the same size with the larva and of a yellowish white color. Its eyes are sometimes white, sometimes blackish brown. The antennæ-sheaths arise in the notch upon the inner side of the eyes and passing directly across the surface of these organs, extend down along each side of the back above the sheaths of the fore and middle pairs of legs, then curving inward they pass back to the eye along the inner side of the same legs, their ends being placed upon the eye slightly inside of their origin. The knees of the hind legs protrude far out from under the upper sides of the wing-sheaths forward of their tips, whilst the feet of these legs occupy the space between the tips of the wing-sheaths. The back of the abdomen shews a distinct pale brown stripe along the middle, on each side of which the surface of the segments is furnished with numerous small erect sharp points of a dark brown color, those on the apical segment being double the length of the others.

Prof. Peck bestowed upon this insect the name *Stenocorus putator*, the latter epithet meaning a pruner or vine-dresser, and he characterizes the beetle thus named, as varying in length from 0.45 to 0.60, the largest individuals being but 0.12 in thickness, and being of a dull or obscure brown color with white hairs, its thorax without spines, its wing-covers two-toothed at their tips, and its antennæ of the length of the body, the two joints next to the base with a small spine at their tips. Dr. Harris adds to this that the surface is sprinkled with gray spots composed of very short close hairs and the scutel is yellowish white. These characters, however, will include what at present stand in the books as several distinct species. I would therefore observe that the specimens which I have obtained from the severed oak limbs of this vicinity and which I therefore regard with confidence as being the true *putator* of Prof. Peck, present the following characters. They are usually from 0.50 to 0.55 in length and 0.12 broad, of a slender cylindrical form, of a dull black color, tinged more or less with brown on the wing covers, more evidently so towards their tips, whilst the antennæ are paler brown, and the under side and legs chestnut colored, sometimes bright, sometimes dark and blackish. The surface is everywhere clothed with shortish prostrate gray hairs, and on the wing-covers these are in places more dense, forming small gray spots, and on each side of the thorax, in the middle, is a whitish dot, formed in the same manner. Sometimes also on the base of the thorax, on each side of its middle, a short gray stripe formed by these hairs, is very obvious, whilst in other individuals no traces of these stripes can be discerned.

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The scutel also is densely covered and gray from these hairs. The surface, above, is occupied by numerous coarse round punctures, those on the thorax being of the same size with those on the wing-covers, but more crowded, many of them running into each other. Towards the tips of the wing-covers these punctures become perceptibly smaller. Among the punctures of the thorax, slightly back of its center, a smooth shining callous-like spot or short line may be discerned; and sometimes, forward of this, on each side of the middle a small dot, smooth and shining, is very distinct, such specimens appearing to constitute the species named *rusticum* by Dr. Le Conte. In some specimens, also, on the wing covers, sometimes one, more often two, slightly elevated, smooth longitudinal lines are very manifest, these appearing to be the *oblitum* of the same author. What I regard as the females of this species, although as yet I have bred no specimens of this kind from oak limbs, differ from the preceding in being of a slightly broader and more robust aspect, with the back more flattened, and the wing covers of a lighter brown color, and sometimes as pale as the antennæ. And in these no smooth callous-like spot back of the center of the thorax is to be perceived, in the few specimens which I at present have in my hands.

Although Prof. Peck and Dr. Harris regard this insect as different from any thing described by Fabricius, our latest authorities place it as a synonym of the *Stenocorus villosus* of this author. There, however, is nothing in the original description of the species thus named, to indicate it as being this more than any one of a half dozen other insects of our country. The *villosus* is merely said to be a slender medium-sized Carolina species of a dull or dusky color, slightly clad with ash-gray down, its thorax unarmed and its wing covers two-toothed. We find nothing in this description whereby it can be decided to which particular one of several species it refers. And if the name *villosus* ought not to be wholly rejected in consequence of this uncertainty, I am disposed to regard it as belonging to a southern species, the same, I suppose, which Dr. Le Conte places under this name, which is larger in size, and with the punctures of its thorax much more fine dense and confused than in our Oak pruner.

This insect is co-generic with a West India species named by Fabricius *Stenocorus irroratus*, for specimens of which and many other interesting species from the same locality, I am indebted to F. J. Barnard, Esq., of Albany. In the year 1833 M. Serville proposed a new genus, named *Elaphidion* (Ann. Soc. Ent. France, ii., 540) for the reception of this species. From the remarks of Rev. F. W. Hope in Trans. London Zool. Soc., iii., 187, it might be inferred that a genus named *Cyclioplcurus*, founded by him upon this same West India species, had been published in the Proceedings of said Society, May, 1833, a few months anterior to Serville. But though an abstract of Mr. Hope's paper was given in the place referred to, this genus is not noticed therein, and did not appear in print till the first volume of the Transactions of the Society was published, two

years later. *Elaphidion*, therefore, appears to be the legitimate name of the genus to which our Oak pruner pertains.

In at least three-fourths of the fallen limbs no worm is to be found; and an examination of them shows that the insect perished at the time the limb was severed, and before it had excavated any burrow upward in its center, no perforation being present except that leading into the lateral twig. It is probable that in many of these instances the limb broke when the worm was in the act of gnawing it asunder, either from its own weight or from a wind arising whilst the work was in progress. And even though the worm may have withdrawn into its hole and plugged the opening behind it, it is frequently discovered here, probably, and devoured by birds. After a violent wind in the summer season, some of our insect-eating birds may always be noticed actively in search of limbs and trees that have thereby been broken, their instinct teaching them that this breakage usually occurs from the wood being weakened by the mining operations of worms therein, whose lurking places are now opened to them. And they will be seen industriously occupied in picking around the fractured ends of the wood, and feasting upon the grubs which they there find. Numbers of our wood-boring larvæ are thus destroyed, and the Oak pruner, notwithstanding the precautions it takes to secrete itself, doubtless frequently falls a prey to these sagacious foragers.

These insects will undoubtedly at times occur in such numbers as to render it important that they be destroyed, at least where they resort to the peach or other valuable trees. And this may readily be effected by gathering and burning the fallen limbs in the winter or the early part of spring.

The SINGLE STRIPED TREE HOPPER, No. 102, is common upon oak limbs, puncturing them and sucking their juices.

306. OAK BLIGHT, *Eriosoma Querci*, new species. (Homoptera. Aphidæ.)

A species of blight, or a wooly aphis upon oak limbs, puncturing them and exhausting them of their sap, was met with in northern Illinois, but I have never seen it in New York. It is very like a similar insect upon the bass-wood. The winged individuals are black throughout, and slightly dusted over with an ash-gray powder resembling mold. The fore wings are clear and glassy, with their stigma-spot dusky and feebly transparent, their rib-vein black, and their third oblique vein abortive nearly or quite to the fork. It is 0.16 long to the tips of its wings. I find no wooly aphis mentioned by European authors as infesting the oak, except the *Eriosoma Quercus* of Sir Oswald Mosley (Gardener's Chronicle, i. 828), which, in the List of Homopterous insects of the British Museum, p. 1083, is supposed to be the *Coccus lanatus* of Geoffroy, and would hence appear to be a very different insect from the one now described.

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307. WHITE OAK SCALE INSECT, *Lecanium Quercifex*, new species. (Homoptera. Coccidæ.)

Adhering to the smooth bark on the under side of the limbs of the white oak, in June, an oval, convex, brownish black scale about 0.30 long and 0.18 wide, its margin paler and dull yellowish, from which come myriads of lice so minute as to be scarcely perceptible to the eye, and which distribute themselves over the surrounding bark, sucking its juices.

I am unable to refer to any description of the European scale insect of the oak, *L. Quercus*, Linn., but as Geoffroy terms that species the Kidney-shaped oak scale (*Quercus reniformis*) I am led to conclude it is different from the regularly rounded-oval scale of the oaks in this country.

308. QUERCITRON OAK SCALE INSECT, *Lecanium Quercitronis*, new species.

On the small limbs of the black oak, a similar scale to the preceding, but smaller and of a nearly hemispherical form, its color varying from brownish black to dull reddish and pale dull yellow, with a more or less distinct stripe of paler yellow along the middle of its back, and the paler individuals usually mottled with black spots or stripes. Length of the larger scales about 0.20, width 0.16.

These scales, the reader will be aware, are the relics of the female, covering and protecting her eggs. Interspersed with them are usually seen other scales and smaller, only 0.10 in length, and of an elliptic form and a glossy black color with a wide margin of pale yellow, which margin has a plaited appearance from fine raised radiating lines. These smaller scales are the pupæ of the males, a small winged fly coming from each of them, whereas the females never acquire wings.

Often a round hole will be noticed in these smaller scales, perforating them near one end. This hole is gnawed by a minute parasite, which has fed internally on the insect and completed its transformations beneath the scale. Of five of these pupæ scales which were gathered on the first day of June, one was found to be already perforated. From another the parasite came out five days afterwards, and a second specimen made its exit from another of the scales five days later. This same parasite also destroys the male pupæ of some of the other species of this genus. It pertains to the family PROCTOTRUPIDÆ, and appears to belong to the genus *Platygaster*. It may be named *P. Lecanii*, or the Scale insect parasite. It is quite small, measuring 0.035, and to the tip of its wings 0.05. It is shining black, with its scutel pale yellow and appearing like a large crescent-shaped spot of this color placed crosswise upon the hind part of its thorax. Its legs are white with the thighs black except at their opposite ends. Its abdomen is slightly smaller than the thorax and shaped like the bowl of a spoon, being deeply hollowed on the back and convex beneath. Its antennæ are thread-like with the joints cylindrical and three times as long as thick, the last one not enlarged. Its wings are clear and glassy, strongly reflecting the colors of the rainbow. They are wholly destitute of veins, except a rib-vein running parallel with the outer margin the

first half of its length and then uniting with the margin to beyond the middle, where it is slightly incurved and ends in an irregular triangular knob.

309. Oak-tumor gall-fly, *Cynips Quercus-tuber*, new species. (Hymenoptera. Cyniphidæ.)

On or near the ends of the small limbs and twigs of the white oak, hard irregular swellings thrice as thick as the twig below them, the bark upon them of a brighter cherry red color than elsewhere, and their substance internally corky and woody; produced by the stings of a small black gall-fly with dull pale yellow antennæ, mouth and legs, its hind shanks and its antennæ towards their tips being dusky, its length 0.08 and to the tips of its wings 0.13.

These tumors or galls are quite common, particularly upon the soft and tender limbs of small young trees. Two distinct varieties in their form will be observed as they grow at the ends of the limbs, or lower down upon their sides. Those upon or near the tips of the limbs are shorter *rounded galls*, little longer than broad, and usually of a deeper red color and a more irregular uneven surface. They are about a half inch in length and a fourth less in thickness. Those growing along the side of the stem are longer *elliptic galls* of about the same width as the preceding, but twice or three times as long, and of a paler though still a deep cherry red color. The whole circumference of the limb is involved in this diseased swelling, except a narrow stripe along its hind side where the bark retains its natural striated appearance. When fully grown the surface of both kinds of these galls becomes glaucous white, as though thinly coated with moldiness. Sometimes two, three or more of these tumors occur on the same limb, placed irregularly one below the other, or running partially into each other. A single one, however, always suffices to kill the limb at and above the point where it is situated, thus arresting its onward growth until one of the lateral shoots below grows to become a leading shoot in place of the one thus destroyed.

On cutting into these galls the small limb on which they grow is found to have its wood thickened or swollen, and over it, forming the chief bulk of the tumor, is a corky substance of a yellowish brown or snuff color, between which and the wood are several small hard grains resembling seeds, each having a cavity in its center, in which, doubled together, lies a soft white footless worm or maggot. This, on completing its growth, changes to a pupa in the same cell, and subsequently to a fly like its parent above described; whereupon, to escape from its confinement, it gnaws out of this hard seed-like envelope and onward through the corky substance and the external bark, thus producing those small perforations like pin-holes, which are always seen in these tumors after the insects have made their exit therefrom.

As several kinds of galls and gall insects are to be noticed in this part

of my Report, some general remarks respecting them should here be introduced for popular information.

The term "gall" is currently understood, and is quite common as a proverbial word in our community, as implying a substance of an extremely bitter taste; and this originally was the true and sole signification of this word. Several of these vegetable excrescences being intensely bitter, they hence came to be called galls and gall-nuts. And thus this term was extended to other similar substances, though destitute of this property, and has now in different languages become the technical designation for all kinds of vegetable swellings, excrescences, and other unnatural growths which are produced by the stings of insects, whether they possess any bitterness or not. Even the knot-like swellings which are formed in the stalks of wheat by the Hessian fly and the Joint worm are true galls in the modern sense of this term. And the insects producing such swellings are called gall-flies. Nearly all of these insects pertain to two families, those which have four wings, like the one now under consideration, constituting the *Cynips* family in the order HYMENOPTERA, and those with two wings forming the *Cecidomyia* group in the order DIPTERA. But as the insects of these two groups have no resemblance to each other, and correspond only in the one particular of producing excrescences by their stings, the latter are more correctly and definitely termed gall-midges, and it is the members of the *Cynips* family only to which the name gall-flies truly belongs.

From differences in their form and in the number of joints in their antennæ, the gall-flies are divided into several genera. Of these genera that which retains the name *Cynips* is much the most numerous in its species. They are mostly very small insects resembling bees or ants of a short thick form, but with their antennæ straight instead of elbowed, and with none of that activity in their movements which belong to the insects named. They are mostly of a coal black color, with pale legs and antennæ, several of the species differing from each other only very slightly in size and in the hue of some particular part, being known with more certainty from the different galls from which they come than from the characters which the flies themselves present. In the several species here noticed, and ranked in the genus *Cynips*, five small longitudinal furrows may be seen on the thorax. Their scutel is rounded and protuberant, with a rough granular surface. Their abdomen is highly polished and shining, in the females compressed and shaped like a lens, its outline being nearly round when viewed in profile, with its hind end usually more or less truncated or cut off in a straight line perpendicularly, with a projecting valve at its lower end, and above this the end of the sting protruding obliquely upward. It is equal in its size to the thorax, but is smaller in the males, and without the projecting sting. The wings are transparent and colorless, the forward pair with three longitudinal veins and two transverse or oblique veinlets. The inner and middle longitudinal veins are abortive, being marked merely by very fine colorless lines, scarcely perceptible in the smaller species, and in strong contrast with the other vein and the veinlets, which are coarse,

often dark colored, and very distinct. The middle longitudinal vein arises from the middle of the anterior veinlet, but is often obliterated at its commencement. It is widely forked, slightly before it reaches the second veinlet sending off a straight and very coarse branch to the outer margin. By the inner end of the second veinlet crossing this fork slightly back of its commencement a small triangular cell is formed in the center of the wing. Westwood, in defining this genus, says this small cell is bounded by veins of equal thickness; but in all the American gall-flies known to me the veins on one or both the anterior sides of this cell are much more slender than the one on its posterior side. Finally, the antennæ are thread-like, or of the same thickness through their entire length, and are about half the length of the body. Their joints are separated by very slight constrictions, whereby they are counted with difficulty by the aid of a common magnifying glass; but this instrument is sufficient to show their number, even in the smaller species. Westwood states the number of joints to be fourteen in the females and one more in the males. Hartig differs with him as to the latter. Brulle (Hymenopt. iv. 635) merely cites these authors without affirming anything on this subject himself. Had he no specimens at hand whereby to determine a point which appears so simple? Doubtless he had, and on examining them found he was unable to decide this matter. For, though the number of these joints appears to be constant in the same species, they differ in different species. Thus, in the gall-flies of the oak here described, of six species of which I possess examples of both the sexes, I find the number of joints to be as stated by Mr. Westwood in three only. In two of the others the females have but thirteen joints. Whilst in the remaining species, which is the Oak-tumor gall-fly now under consideration, the antennæ of the males have only fourteen and those of the females twelve joints. And in a seventh species, only the females of which are known to me, the number of these joints amounts to fifteen. It hence appears that the antennæ of these insects have sometimes one sometimes two more joints in the males than in the opposite sex, and that in the latter the number is from twelve to fifteen in different species.

In all parts of the world the oaks are far more infested with gall-flies than trees of any other kind. The naturalist Bosc during his residence in Carolina observed sixteen different kinds of galls, of which eight grew upon oaks; but all his endeavors to rear the flies from them were futile. My own efforts have been more successful, as will be seen by the accompanying notices. And a number of oak-galls, in addition to those herewith presented, are known to me, from which I have not yet been able to obtain the flies, from some of them parasites having come in their stead. I regret that I am unable to refer to the memoir of Bosc on the insects of this family, long since published in the second volume of the Paris Journal of Natural History, and also the Monograph of Brischke, which appeared a few years since at Berlin. Hence I may perchance here be giving as new, some species which have already been named in this latter work.

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Linnæus, in this group of insects, set us the example of bestowing names which express not merely the kind of tree but the particular part thereof, or the appearance of the gall from which the respective species are produced (*Cynips Quercus baccarum*, Oak berry gall-fly, *C. Quercus ramuli*, Oak twigs, *etc.*), and though such compound names are to be avoided as being inconveniently long, a departure from the general rule may well be permitted in this family, since hereby the names alone, in most instances, definitely indicate the species to which they refer, and these names also serve to diversify and relieve the science somewhat from that wearisome sameness and uniformity which pervades its nomenclature.

Where any of these insects attack a valued tree which it is desired to preserve from their depredations, the remedy is obvious and simple. Before the galls which they produce are so far matured that the inclosed insects have perforated and escaped from them, they should be cut from the tree and burned. Fortunately, it is only small young trees that gall-flies are liable to destroy or greatly injure by their attacks. And their parasitic and other enemies restrain them from multiplying so that it is seldom they will require any interference from man.

310. OAK-TREE GALL-FLY, *Cynips Quercus-arbos*, new species.

Swellings similar to those above described, growing on the tips of the limbs of aged and large white oak trees; producing a small black gall-fly having all its legs and antennæ of a bright pale yellow color, and one more joint in the latter organs than in the preceding species in the males, which sex is 0.06 in length, and to the tips of its wings 0.10.

I have in repeated instances observed these swellings at the tips of the lofty limbs of mature and aged oaks, when the trees were felled and their limbs thus brought within view. But having until this moment supposed these galls the same with the preceding species, I have taken no care to obtain the flies from them.

The fact has heretofore been stated that where trees are standing apart, for furnishing a shade in pastures and other cleared lands, or as ornamental trees in parks and pleasure-grounds, they gather more insects and are hence more stinted and deformed in their growth, than when they are associated together in forests. A large solitary oak which formerly stood in prominent view from the door of my dwelling was noticed for many years as making no perceptible advance in height or in the size of its body and limbs, although apparently healthy and clothed luxuriantly each summer with foliage. One morning in March this tree was observed cut down, and on repairing to it, it was discovered that the extreme ends of all the more vigorous and thrifty limbs and twigs were swollen into knobs or galls, wherefrom these ends would perish and their onward growth be thus arrested, all the other more puny limbs showing on their ends dead and decaying knobs of the same kind, which had grown in preceding years. Thus it was evidently this small gall-fly, which, by killing the ends of all the most vigorous and thrifty shoots, year after year, had been retarding

tho further growth of this majestic tree. The galls were at that time perforated with pin-holes, showing that the fly had come from them the preceding autumn. On a careful search, however, two were found with the insect still in them. These were placed in a glass jar, and a single male fly was obtained from them, which I now discover to be unlike the foregoing species. I hence infer this to infest mature and aged trees, whilst all my specimens of that were reared from the more accessible galls growing on the tender juicy branches of young shoots and saplings.

311. Oak-potato gall-fly, *Cynips Quercus-batatus*, new species.

A large, hard, uneven swelling, three-fourths of an inch thick and twice or thrice as long, resembling a potato in its shape, growing on white oak twigs more distant from their ends than the Oak-tumor; producing a small black gall-fly with the basal joints of its antennæ and its legs dull pale yellow, its thighs and hind shanks black and its middle shanks often dusky, the antennæ in the female with thirteen joints, and the length of this sex 0.09.

This gall might be mistaken for a large example of the Elliptic variety of the one first described, but at each end the swelling arises much more abruptly from the limb, and on all sides of it, whereby the limb is wholly obliterated. Its surface is coated with a glaucous pale blue bloom. Internally it is of a dense corky texture in which are hard woody spots. And the fly which comes from it is readily distinguished from the Oak-tumor fly by the black color of its thighs.

312, 313. Oak-bullet gall-flies. *Callaspidia Quercus-globulus*, new species, and *Cynips oneratus*, Harris.

Smooth globular galls the size of a bullet, growing singly or two, three or more in a cluster, upon white oak twigs, internally of a corky texture, each containing in its center a single worm lying in a oval whitish shell resembling a little egg 0.15 in length; producing sometimes a black gall-fly with tawny-red legs and the second veinlet of its wings elbowed or angularly bent backwards, its length 0.15; sometimes a smaller fly (*C. oneratus*) of a clean pale yellow color, almost white, with a broad black stripe the whole length of its back, which color in the males is more extended, reaching down upon the sides, its length 0.12.

Although Dr. Harris regards these two flies as varieties of one species, they certainly are very distinct, differing in size, clothing, color and structure, insomuch that they pertain to two different genera. The first is bearded over with fine short gray hairs, whilst the other is smooth. Its sting is also evenly bearded with longer coarser hairs, which are wanting in the other. The second veinlet of its wings is bent nearly to a right angle, whilst in the other it is straight. The antennæ have the same number of joints (15 and 14) in the sexes of both, but in the one fly they are black, in the other pale yellow, and with the joints evidently shorter. And

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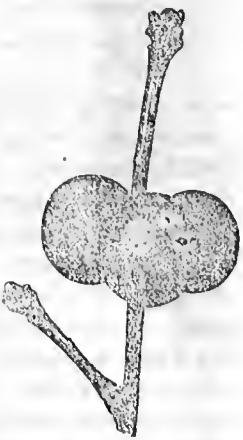
I cannot but think that further researches will show that the galls from which they come grow upon different parts of the white oak, if those of both flies really be produced by this one tree; and that the galls themselves will present some differences in their structure. My specimens of the smaller brighter colored fly were found in a jar in which had been placed quite a number of galls, and which had produced an equal number of the larger flies, and several parasites, whereby it was impossible to ascertain the particular galls from which they respectively came.

I retain the name of Dr. Harris for the species of which he gives an independent description, and which he says comes out in June and July; and present a new name for his dark colored variety, specimens of which I have captured on the wing early in May, and again in September, and which thus appears to be two-brooded, whilst of the other there is probably but one generation annually.

The species which I present as new, is subject to considerable variety in its colors. A broad tawny red ring usually surrounds its eyes, and on each side of its thorax is one or more spots of the same color. Sometimes the scutel is also red, and the under side and tip of the abdomen is frequently of a resin-like red color, instead of black. Its wing veins are black and the second transverse veinlet is margined with smoky along its hind side. This veinlet is angularly bent not only at half the distance from its outer end to the small central cell, but also a second time, where it forms the hind boundary of this cell, and hereby the cell, instead of its usual triangular form, has the shape of a spear head in this species. Its size, its aspect, and some other characters are similar to the Oak-apple and Cloudy-winged gall-flies, under which latter species, § 318, its generic relationship will be more particularly stated.



These bullet-like galls are most common and oftenest noticed of any of the galls on our oaks. When growing they are of a pale greenish color, shaded into bright red upon the side which is most exposed to the light, and with the fading of the leaves in autumn, they also fade to the same pale dull yellow hue with the dead leaves, even though the insect be still inclosed in them, to pass the winter, as it sometimes is.

I have obtained two parasites from these galls. They probably destroy both kinds of these flies indifferently, and also the flies of other galls; for the parasites of these gall insects are not limited, each to a particular species, as we know from frequently obtaining the same parasite from the galls of totally different trees and shrubs. These parasites pertain to the family CHALCIDIDÆ, and resemble gall-flies in their general appearance, but are at once distinguished from the latter group of insects by the absence of veins in their wings. In

addition to the galls from which they are bred, only a brief description will be required to enable one to recognize them.

The OAK-BALL PARASITE, *Macroglenes Querci-globuli*, new species.

This much resembles the gall-fly from which it is named, in its size and general appearance. It is black, with the basal joint of the antennæ and the legs dull white, the thighs pale dull yellow, and the abdomen tinged with this last color along its under side. Length 0.15.

The OAK-BULLET PARASITE, *Pteromalus onerati*, new species.

This is smaller and more beautifully colored than the preceding, being of a brilliant coppery hue with a green reflection, and the under side of its abdomen golden yellow. Its legs are sulphur yellow and its antennæ dark brown with the first joint pale yellowish. It is 0.10 in length, with the females somewhat larger. I have also obtained this species from one of the galls of willow twigs.

314. OAK-FIG GALL-FLY, *Cynips Quercus-ficus*, new species.

Surrounding the twigs of white oaks in a dense cluster, resembling preserved figs packed in boxes, each molded to the shape of those pressing against its sides, hollow bladder-like galls of the pale dull yellow color of a faded oak leaf, each gall producing a small black fly with the lower half of its head, its antennæ and legs pale dull yellow, its hind shanks dusky and its abdomen beneath reddish-brown, its antennæ with fifteen and in the female thirteen joints. Length 0.06, females 0.10, and to the end of their wings 0.14.

These galls are common upon the long slender shoots of young and thriftily growing white oaks. No comparison occurs to me which will give so correct an idea of their appearance, as that of preserved figs, as we see them packed in boxes, each conforming to the shape of those surrounding and pressing against it on every side, and their outer surface showing irregular rounded elevations with intervening hollows and fissures, resembling the convolutions of the brain or of the intestines. These masses of galls sometimes form a roundish ball, a half or three-fourths of an inch in diameter, with the twig passing through its center. But more frequently they extend along the twig three, six or more inches, in an uneven knobby mass.

It is interesting to notice the first commencement and subsequent growth of these galls, which is as follows: The female pierces the bark with her sting and inserts a number of eggs at short distances from each other, sinking them

into the wood beneath the bark, it would appear, for a little discolored spongy spot runs inward from each gall to the pith of the limb. The wounds of the bark from these punctures become so entirely healed that no indications of them can be detected with a magnifying glass. But a little smooth round swelling or elevation of the bark soon commences above each egg, which swelling increases, until at length the bark bursts and a small round granule, the size of a pin's head, protrudes from the opening. These grow more and more, resembling a cluster of grapes when they have attained half their size and are beginning to crowd one against another. They finally attain from a quarter to a half inch in diameter. Their outer surface is covered with fine short hairs, which become rubbed off from their more exposed parts. The worm lies in a small oval cavity at the base of each gall, the walls of this cavity being whitish, tough and leathery, resembling a small seed, from the outer surface of which numerous crinkled, brittle, wooly fibers of a rusty yellow color radiate to the outer envelope of the gall, which is a thin paper-like membrane, soft and flexible when moist but brittle and breaking from a slight pressure when dried. Most of these galls are found perforated in the winter season, when they and all other excrescences are more particularly noticed, the fall of the leaves then exposing them to view; but particular clusters will at that season be discovered with the insects still remaining in them, to come forth the following June. There hence appears to be two broods of this fly annually, one having come from the perforated galls the preceding summer, whose eggs have produced the unperforated galls in which the insects repose during the winter.

The fly from these galls is very similar to that of the Oak tumor, differing from that species only in being slightly larger, with its abdomen paler beneath, and in having more joints in its antennæ.

315. Wool-sower gall-fly, *Cynips seminator*, Harris.

A round mass resembling wool, from the size of a walnut to that of a goose egg, growing on the side of or surrounding white oak twigs, in June of a pure white color or tinged or speckled with rose red, and in autumn the color of sponge; producing small shining black gall-flies with bright tawny yellow legs and antennæ and in the female the head and thorax cinnamon red; their antennæ of fifteen and fourteen joints, length 0.08 and the females 0.11.

These galls first show themselves on the thriftiest young succulent shoots in the month of June, and they then resemble a lock of fine soft wool of a pure white color or with a delicate rose red tinge upon one side, or sometimes they are clean white with numerous elevated points of deep rose red, and are then truly beautiful in their appearance. From these galls I have obtained the flies the fore part of July. These flies immediately sow their eggs for another crop, and the oak twigs having now become harder and more woody, the galls growing on them are of a coarser

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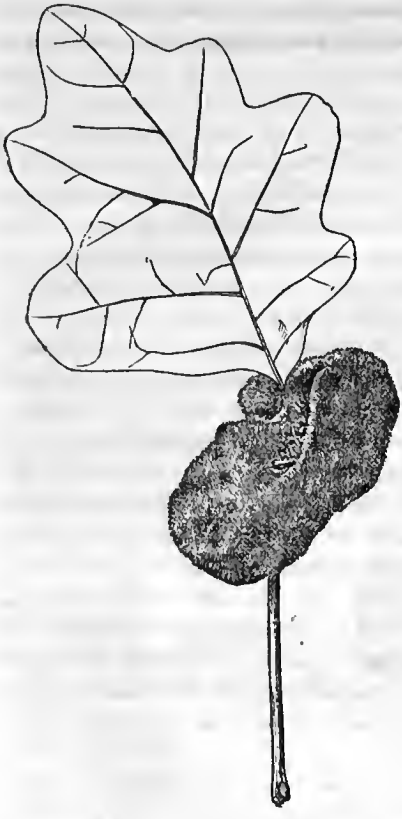

texture and duller color, resembling a ball of sponge rather than wool. These remain through the winter, though their attachment to the twig is so slight that birds picking into them, they are often torn off and fall to the ground. Internally, adjoining the twig, they consist of a mass of white hard grains resembling seeds, each of which yields a fly.

The two sexes differ remarkably in their colors, the head and thorax being black in the male, with the mouth only cinnamon red, whilst in the female the whole of these parts is of this color, the abdomen only being black. It is the male only which is described by Dr. Harris, and a person with specimens of the female in his hands would not suspect them to be the species of which he treats. The female is much the most common. A single gall gave me forty specimens of this sex and only one male.

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316. Oak-wool gall-fly, *Cynips Quercus-lana*, new species.

A round mass resembling wool, the size of a hazelnut or walnut, and of a white or buff color, growing upon one of the principal veins on the under side of white oak leaves, and producing several small black flies with white or straw colored heads, antennæ and legs, and with shining smoky yellow abdomens, having a black or blackish cloud occupying their back and sides, the females with fifteen-jointed antennæ, and their length 0.09.

It is not a little curious that two insects so nearly identical as the Oak-tumor and the Oak-fig gall-flies, should produce galls which are totally dissimilar—the one being merely a smooth swelling of the bark, the other a mass of semi-collapsed bladders the size of acorns crowded together around the limb—whilst here, on the other hand, we have two insects which have little resemblance to each other, yet producing galls which can scarcely be distinguished the one from the other. No one noticing on our white oaks these little round bunches of buff colored wool in which the young of the Wool-sower and of the Oak-wool gall-flies are cradled, growing perhaps but a few inches apart, one on a leaf the other on a twig, would suspect

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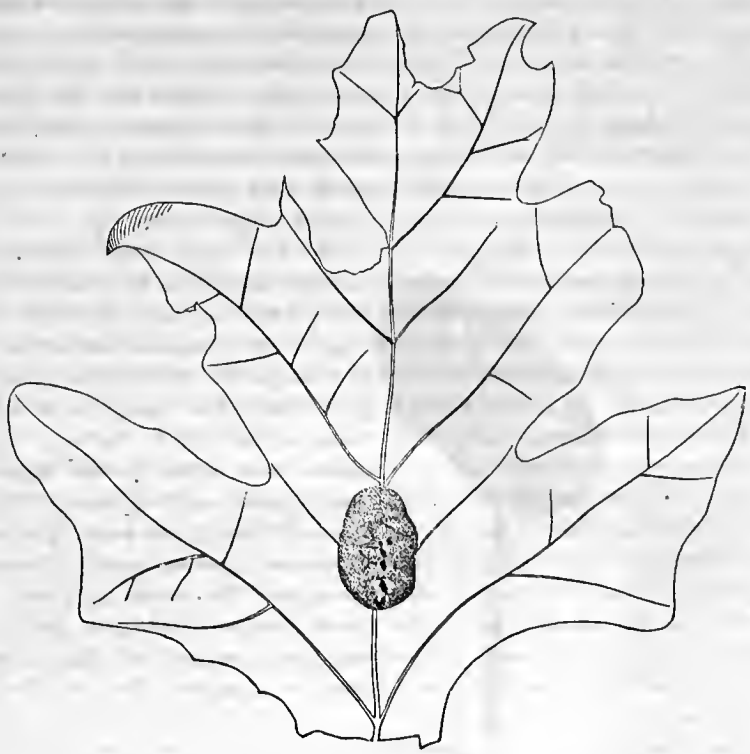
anything else than that both were the same thing, produced very probably by a single insect puncturing and inserting a part of its eggs in the vein of



the leaf and then moving a short distance aside and bestowing the remainder on the adjacent twig—dividing them thus, as do many other insects, to increase the chances for a portion of its young to escape destruction should any casualty befall them in the one or the other place. And if a person were curious to know the kind of insect which with such maternal care had formed these velvety little beds for the secure and comfortable repose of its young, he would scarcely deem it worth his while to gather but one of the two bunches; though to make the research more certain of a successful issue he might perchance secure them both. And on placing them in a covered tumbler and moistening them occasionally, till after a time a multitude of little black flies made their appearance in the glass, what would be his astonishment to find there were four different kinds of insects there, when he had expected to see but one. The result would be a riddle, a perfect paradox to him, unless from being somewhat versed in the habits and aspects of this class of creatures, he would be able to discern that two of these kinds being gall makers must have come one from the one wad of wool and the other from the other—thus showing these two little tufts of wool to be in reality two distinct natural substances, although the only

perceptible difference between them is that one grows upon the leaves and the other upon the twigs. And the other flies in the glass being found of the parasitic kind, he would perceive they must have subsisted on and destroyed other individuals of these gall makers, and had thus come out of the galls in their stead. Thus, where he supposed he had simply one vegetable production from which a single kind of insect would come, he finds nature has actually formed two of the former and four of the latter. With such astonishing profusion and seeming superabundance is every little corner and recess in the domain of nature diversified and teeming with life.

Internally in these little masses of wool are numerous hard seeds about the size of grains of wheat, of a bright chestnut color, crowded together and attached by their lower ends to the vein of the leaf. In each of these is a worm, which, on completing its transformations, gnaws off the upper end of its cell, and eats directly outward through the wool and escapes from its confinement, hereby making the same pin-hole perforations in these soft wooly galls that are seen in the other harder kinds when the insects have evacuated them.

I have not succeeded in obtaining the males of this species, its galls having in all but one instance yielded me parasites only. This is the more remarkable, since, from the very similar galls of the wool-sower growing on the twigs, I have never obtained any insects of this kind. And it would hence appear that the one gall being firmly fixed whilst the other vibrates and swings with the leaf, nature has left the multiplication of the one to be checked by the birds, and they being unable to pick into the other, these parasitic destroyers have here been formed and commissioned to execute the same work.

Like most of the other parasites which infest this group, these pertain to the family CHALCIDIDÆ, belonging to the same order of insects with the gall-flies. They may be named and distinguished as follows:

The OAK-WOOL PARASITE, *Spalangia Querci-lanæ*, new species.

Black, with the face, antennæ, sides of the collar, and legs whitish or greenish-yellow. Length 0.08 to 0.10. Some individuals have the upper side of the hind thighs and of the first joint of the antennæ black. The abdomen is smooth and polished, its under side of a tawny red color, and it is separated from the thorax by a pedicel. The stigma of its fore wings is a semicircular black shining spot with a small appendage on the inner side of its hind end and its base slightly separated from the robust rib-vein, which vein is of a dark brown or black color. Its cubical head, which is about as long as wide, indicates its relationship to *Spalangia*, though in some other respects it does not appear to fully coincide with the characters assigned to this genus.

Specimens frequently occur, so very different in their colors that they might almost be deemed a distinct species. They may be termed the Line-backed variety (*dorsalis*) of the Oak-wool parasite. In them the thorax

is pale greenish yellow, with a black stripe along its middle, and the abdomen is yellow, with the back black, and commonly with black bands upon its sides.

The WOOL-TUFT PARASITE, *Eurytoma lanulæ*, new species.

This is black throughout, with only its feet white and their tips dusky, and the abdomen smooth and polished. It is 0.08 long. This is less common than the preceding, and is obtained as frequently from galls on willows, as from these wooly galls on oak leaves.

317. OAK-APPLE GALL-FLY, *Callaspidia confluenta*, Harris.

Large smooth globular galls resembling apples, growing on the larger veins on the under side of the leaves of the red oak, each gall producing a large black gall-fly with deep tawny red legs, and its wings with a smoky brown spot margining the second veinlet on its hind side, the female antennæ with thirteen joints, her length 0.25.

This is our largest kind of gall-fly. There are probably two generations of it annually, for early in June the galls are found upon the trees grown to their full size, which varies from an inch to an inch and three-quarters in diameter. Their attachment to the leaf is so slight and brittle that when the leaves are agitated with a strong wind numbers of them break off and fall, so that the ground under particular trees is copiously scattered with them, even when they are but half or two-thirds grown, the latter part of May. They then resemble large nice smooth gooseberries, being of a lively pale green color, freckled with large blackish or purplish brown dots, and clear and semi-transparent when held between the eye and the light, with an opake cloud-like spot in their center. Cut open, this central spot is seen to be a pale greenish yellow ball the size of a pea, with numerous white threads beautifully radiating from its surface to the outer wall, and holding this ball in its place in the otherwise vacant cavity. On cutting this ball asunder it is found to be very juicy and white internally, with a round cavity in its center, in which lies a small plump white maggot, curved into the shape of a crescent, and lying motionless and without any signs of life. The exterior wall is 0.05 thick, or about the thickness of the rind usually taken from an apple when it is peeled, and of a similar succulent juicy texture.

These green immature galls, so smooth, plump and semi-transparent, have a most tempting appearance, as though they were some fine juicy fruit, of which the taste will be delicious. But though so tender and succulent they are perfectly tasteless, neither the outer rind nor the central ball having any perceptible flavor. But their luscious aspect, in connection with their popular name of "Oak apples," excites the children in many neighborhoods all over our country, to gather and eat them, rejecting the central core containing the worm. They are probably inert and destitute of any effect when thus eaten. Certainly they are not deleteri-

ous. A school teacher who was recently employed in Michigan, in a school house which was surrounded with shrub oaks which were loaded with these galls, informs me that for many days the pupils at every recess were filling their pockets with them, and eating them almost incessantly, yet without ill effects therefrom in any instance.

318. CLOUDY-WINGED GALL-FLY, *Callaspidia nubilipennis*, Harris.

Galls like the preceding, but only the size of a hazelnut or grape, growing through the leafy expansion of the red oak, a third of the sphere projecting from the upper surface of the leaf and the remainder opposite on its under side; producing a large black gall-fly with tawny yellow legs and its wings smoky on their disk and tips, with none of the veins continued into the margin, the antennæ thirteen-jointed in the female, which is 0.20 long, and to the tips of her wings 0.30.

I met with this fly among fallen oak leaves early in April, where it might have been reposing through the winter; and from the brief, indefinite notice which Dr. Harris gives of it and its gall, I infer it to be from the gall above described, which I have only found after the fly had escaped. Galls perfectly the same, however, except that they show no vestiges of any attachment to a leaf, being smooth and even on every side, are sometimes found among fallen leaves, perforated, early in the spring.

This species and the Oak-apple gall-fly, having none of the wing veins prolonged into the margin, and the scutel obtuse and rough, will belong to Dalman's genus *Callaspidia*. But while the antennæ are thread-like in the Oak-apple gall-fly, they are slightly thicker towards their tips in the present species, and are also shorter, not reaching the base of the thorax. The second veinlet of the fore wings is curved like a bow in both these species, which appears to be a generic character of much value. And I do not hesitate in referring the Oak-bullet gall-fly (*C. Quercus-globulus*) to this genus also, notwithstanding the one additional joint in its antennæ, its aspect being so very like that of the Oak-apple gall-fly, as Dr. Harris has observed. Its size, its pubescence, its second veinlet edged with smoky along its hind side and angularly bent, show its greater affinity to these than to the species of the genus *Cynips*. And the outer longitudinal or subcostal vein does not fully reach the margin, although it is much less widely separated therefrom than in the two other species. On the whole, it should probably be regarded as forming the type of a new genus.

319. OAK-PEA GALL-FLY, *Cynips Quercus-pisum*, new species.

On a vein on the under side of white oak leaves, a globular gall resembling a pea, its surface finely netted with fissures or cracks and intervening elevated points like the surface of a strawberry, usually with two cavities in its center divided by a thin partition; producing a black gall-fly with legs, antennæ and the valve of the lower tip of its abdomen pale dull yellow or straw color, and also the face and mouth in the males, the antennæ

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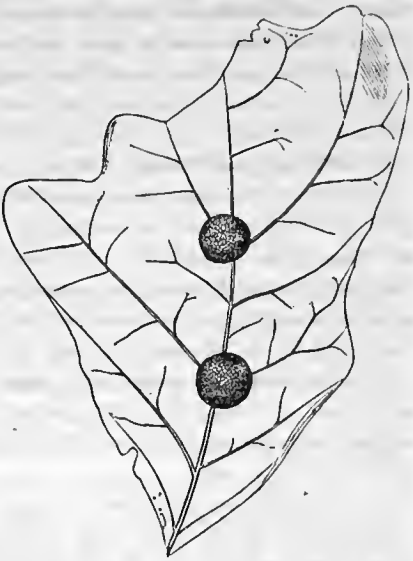
fifteen-jointed, in the females thirteen and dusky towards their tips. Length 0.08. female 0.11 and to the end of her wings 0.16.



These galls are not rare, and in the same situation a similar though somewhat smaller gall occurs, the surface of which is smooth; but from these I have not yet succeeded in obtaining the fly. When young the surface of these galls is rough, but not cracked into the net-work of lines that is afterwards seen. The interstices between these cracks are sometimes flat but oftener show an elevated point or pimple in their center. The galls are carried to the ground with the leaves when they fall in autumn, the insects remaining in them till the following spring. They are of a pale greenish yellow color tinged on one side with red, when growing, but fade in autumn to the same color as the dead leaves.

In addition to gall-flies the two following parasites come from these galls, hatching therefrom as early as the middle or latter part of April. The first of these is oftenest obtained, and what appears to be the same species comes also from galls upon whortleberry bushes.

The OAK-PEA PARASITE, *Macroglenes Querci-pisi*, new species.

Black, the feet white, the hind thighs black and their shanks black in the middle, the four anterior thighs black or brown in the middle and their shanks white but often in the middle brown, the eyes red. Length 0.10 to 0.13.

The OAK-PILL PARASITE, *Pteromalus Querci-pilulæ*, new species.

Brilliant green tinged with coppery, the legs light tawny yellow, their thighs brilliant green in front, black behind, the middle pair tawny yellow with a green-black stripe above and another beneath, the feet dull white with black tips, the abdomen with a fine gray beard, its conical tip purple black. Length 0.18.

The gall from which this parasite came had but a single cavity in its center, instead of the two usually found there; and I suspect that having consumed one of the larvæ of the gall-fly, it breaks through the thin partition dividing the cells, and then feeds upon the other, this amount of nourishment being apparently necessary to complete its growth to a size so much larger than that of the gall-fly and the other parasite which subsists upon it.

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320. CHINQUAPIN-OAK GALL-FLY, *Figites Chinquapin*, new species.

Arising perpendicularly or obliquely from the upper surface of the leaves of the Chinquapin oak (*Quercus Chinquapin*), like pins inserted therein, little slender club-shaped galls nearly a half inch long, formed of a pale green elliptic head like a minute pod, tapering into a slender dull brown stalk twice as long as the head, the surface thinly clothed with fine short hairs; producing a small black gall-fly with bright tawny yellow antennæ and legs, its length 0.10.

These singular little galls are met with in May, one or more growing upon the same leaf. The walls of the little pod at their summit are exceedingly thin and the fly comes out through a round hole which it gnaws near the upper end. It is remarkably large in comparison with the small delicate gall in which it is nurtured. Its antennæ in the female, the only sex known to me, are thirteen jointed, thicker towards their ends, and do not reach the base of the thorax. The second veinlet of its wings is angularly bent. Its scutel has a slight furrow in its middle; and the suture, on each side of its base, is widened into a small roundish excavation.

OAK SPANGLES, perfectly the same as noticed by Westwood, Introduction, vol. ii, p. 130, occur on the under surface of the white oak leaves in this country. These are small circular flat scales, less than a quarter of an inch in diameter, varying from a pale to a bright vivid rose red color, fading to dull red in autumn, and are attached to the leaf by a short slender footstalk. So much do they resemble a parasitic plant growing upon the leaf that they have been a subject of much controversy among writers. I have not as yet succeeded in obtaining the flies from them; but they will no doubt yield a species different from that of Europe. For, it may have been observed, that several of the galls above described appear to be the same with some of those growing on the oaks of the old world, yet the insects coming from them are manifestly different.

321. FOREST CATERPILLAR, *Clisiosampa silvatica*, Harris. (Lepidoptera. Bombycidæ.)

A caterpillar closely resembling that of the Apple-tree, §28, but at once distinguished from it by having a row of diamond-shaped or oval white spots along the middle of its back instead of a white stripe; living in large societies, under a slight thinly-woven cobweb-like nest placed lengthwise against the side of the tree, and coming out to feed upon the leaves; when nearly grown dispersing themselves and wandering about; spinning a cocoon like that of the Apple-tree caterpillar, in which it lies twenty days, the moths appearing abroad the fore part of July, these being pale umber brown or cinnamon color, their fore wings gray and crossed by two narrow oblique bands, parallel with each other and with the hind margin, these bands dark brown instead of whitish as in the Apple-tree moth, and often obliterated by the whole space between them being dark brown; its width 1.25 and the female 1.75.

This caterpillar is particularly interesting from its close similarity in

appearance and habits to our common and well known Apple-tree caterpillar. Its nests, however, are very seldom seen, even though diligently sought, being of so slight a texture and placed along the side of the trunk or of one of the larger limbs of the tree, and hereby rendered inconspicuous. It is only after the worms leave their nests and are leisurely rambling about singly, that they come to our notice. Almost every year, the fore part of June, some three or four of these wanderers may be observed, and occasionally a season arrives when they are remarked as much more common, but never numerous. This, in brief, has been their history, within the sphere of my own observation. Abbot states (Insects of Georgia, p. 117,) that they are "sometimes so plentiful in Virginia as to strip the oak-trees bare." He was probably misinformed, however, upon this point; for Dr. Morris, of Baltimore, informs me they are no more common in that district than I represent them to be here in New York, and nothing approaching to the statement of Abbot has ever been known there, at least by the present generation. In his own vicinity in Georgia, Abbot says it is rare. It thus appears that this caterpillar is about equally diffused throughout our country and is nowhere common.

The CATERPILLAR, as seen after it has forsaken its nest and is wandering about, is an inch and a half long and 0.20 thick. It is cylindrical and of a pale blue color, tinged low down on each side with greenish gray, and is everywhere sprinkled over with black points and dots. Along its back is a row of ten or eleven oval or diamond-shaped white spots which are similarly sprinkled with black points and dots, and are placed one on the fore part of each segment. Behind each of these spots, is a much smaller white spot, occupying the middle of each segment. The intervening space is black, which color also forms a border surrounding each of the spots, and on each side is an elevated black dot from which arises usually four long black hairs. The hind part of each segment is occupied by three crinkled and more or less interrupted pale orange yellow lines, which are edged with black. And on each side is a continuous and somewhat broader stripe of the same yellow color, similarly edged on each of its sides with black. Lower down upon each side is a paler yellow or cream colored stripe the edges of which are more jagged and irregular than those of the one above it, and this stripe also is bordered with black, broadly and unevenly on its upper side and very narrowly on its lower side. The back is clothed with numerous fine fox-colored hairs, and low down on each side are numerous coarser whitish ones. On the under side is a large oval black spot on each segment except the anterior ones. The legs and prolegs are black and clothed with short whitish hairs. The head is of a dark bluish color freckled with numerous black dots and clothed with short blackish and fox-colored hairs. The second segment or neck is edged anteriorly with cream white, which color is more broad upon the sides. The third and fourth segments have each a large black spot on each side. The instant it is immersed in spirits the blue color of this caterpillar vanishes and it becomes black.

Several of these caterpillars found abroad upon the last days of May and inclosed in a cage ate scarcely anything afterwards, yet did not spin their cocoons until the 16th and 18th of June, and the moths come out therefrom twenty days afterwards on the 6th and 8th of July. It selects a sheltered spot for its cocoon, such as a corner or angle formed by the meeting of two or three sides. Across this angle it first draws a curtain, which is thinly woven of white silk threads, nearly two inches in length and width. Under the space thus inclosed similar threads are crossed in all directions, in the center of which the inner pod-like cocoon is sus-

pended. This is about an inch in length and half as broad, and is placed perpendicularly, obliquely, and probably horizontally also, according to the direction of the angle in which it is situated. It is more closely and evenly woven than the parts exterior to it, and like similar fine muslin fabrics from human looms, it is "starched" by the manufacturer, to render it more stiff, smooth and substantial, the meshes between the threads being filled with a thin yellowish paste from the mouth of the caterpillar, which dried, gives the cocoon the appearance of being thinly dusted with powdered sulphur. The inclosed insect can be faintly seen through its walls. The moth issues from the upper end of the cocoon, by crowding the threads there apart after it has softened and loosened them by wetting them with a fluid from its mouth, which imparts a pale brown tinge to the orifice thus formed.

The MALE MOTH usually measures 1.20 across its spread wings. Its thorax is densely coated with soft hairs of a nankin yellow color. Its abdomen is covered with shorter hairs which are light umber or cinnamon brown on the back and tip and paler or nankin yellow on the sides. The antennæ are gray, freckled with brown scales, and their branches are very dark brown. The face is brown with the tips of the feelers pale gray. The fore wings are gray, varied more or less with nankin yellow, and they are divided into three nearly equal portions by two straight dark brown lines which cross them obliquely, parallel with each other and with the hind margin. The space between these lines is usually brownish and darker than the rest of the wing, being quite often of the same dark brown color as the lines, whereby they become wholly lost. Sometimes the hind stripe is perceptibly margined on its hind side by a pale yellowish line. The fringe is of the same dark brown color with the oblique lines, with two whitish alternations towards its outer end. But sometimes it is of the same color with the wings and edged along its tip with whitish. The hind wings are of a uniform pale umber or cinnamon brown, sometimes broadly grayish on the outer margin, and across their middle a faint darker brown band is usually perceptible, its edges on each side indefinite. The fringe is of the same color with the wings or slightly darker and is tipped with whitish. The under side is paler umber brown, the hind wings often gray, and both pairs are sometimes crossed by a narrow dark brown band, which on the hind wings are curved outside of the middle. All back of this band, on both wings, is often paler, and more so near the band.

The FEMALE is 1.75 in width, and in addition to the shortness of the branches of her antennæ, differs from the male in her fore wings, which are proportionally narrower and longer, with their hind margin cut off more obliquely and slightly wavy along its edge. Hence also the dark brown lines cross the wings more obliquely, the hind one in particular forming a much more acute angle with the outer margin. And all the wing back of this line is sometimes paler or of a brownish ashy color. And the fringe of these wings has not the two whitish alternations which are often so conspicuous in the male. The head and fore part of the thorax is cinnamon brown. The abdomen is black, clothed with brown hairs, though very thinly so on the anterior part of each segment, where these hairs are intermingled with silvery gray scales.

The scales of the wings of this moth are very slightly attached, rubbing off with the gentlest touch, as though they were mere dust that had fallen upon the wings Hence it is almost impossible to secure specimens which are perfect and uneffaced, the insect fluttering with such strength and extreme vivacity when captured. And individuals taken when abroad in the forests are usually worthless for the cabinet, all traces of their marks being obliterated and the wings having become more or less transparent from this loss of their scales.

In addition to the oak this caterpillar is found upon the apple and cherry,

the walnut and other trees. On the apple-tree it is said to be more voracious and injurious than the common caterpillar, often nibbling the stems of the young apples and causing them to wither and fall.

Other caterpillars and large thick-bodied worms occurring on oaks are the larvæ of

The HICKORY TUSSOCK MOTH, § 183.
The AMERICAN LAPPET MOTH, § 84.
The IO EMPEROR MOTH, § 81, and
The POLYPHEMUS MOTH, § 181.

322. SENATORIAL DRYOCAMPA, or YELLOW-STRIPED OAK-WORM, *Dryocampa senatoria*, Smith and Abbot. (Lepidoptera. Bombycidæ.)

In August, consuming the leaves, a black worm with four orange yellow stripes upon the back and two along each side, with two long black horns back of its neck and the rings of its body with two black prickles above and two on each side; burying itself some five inches below the surface and the following June producing a large bright ochre yellow moth, its wings often freckled with blackish spots, the forward pair having a large white dot near the center and a faint purple streak from the middle of their inner edge to the tip; its width 2.50; the male much smaller, 1.75 wide, and its wings of a much darker purplish red color, but with the same white dot and dark streak.

These worms occasionally become quite numerous in particular neighborhoods. The latter part of August, 1858, I observed them in greater numbers than I had ever before seen, in the cemetery at Saratoga Springs, where they had stripped most of the oaks of their leaves, and were then descended from the trees, probably in search of food elsewhere, as few of them appeared to be grown to their full size. They were everywhere crawling sluggishly about, upon the surface of the dry sandy soil and up the sides of the monuments. In the paths, the dresses of the ladies sweeping over them, these worms frequently adhered to and crawled up them, to the great annoyance of every one and the alarm of the more timorous. Nor was this alarm altogether groundless. The prickles of these worms, if they happen to penetrate the skin, produce a stinging sensation like that of nettles and a slight redness of the spot, both these symptoms, however, lasting but a short time, as in the case of nettle stings. Relief in all such cases is speedily obtained by bathing the part with tincture of opium (laudanum), or with spirits of camphor.

The LARVA when full grown is two inches long and about the thickness of a lead pencil, cylindric, and of a coal black color in stripes alternating with orange yellow, as follows: Along the middle of the back is a black stripe with a yellow one of the same width on each side of it. Outside of these is a broader black stripe followed by a yellow one on each side of the back slightly broader than the two middle ones. Below these is another black stripe still wider than the one above, and below this along the sides are two yellow stripes with a black one between them in which the breathing pores are placed. The upper of these two last yellow stripes is somewhat wavy and less smooth than those on the back, and the lower one is often widened on the fore part of each segment, or sends off a branch downward and backward. Below this is an oblong yellow spot on each segment, which is sometimes lengthened to unite its anterior end to the lower yellow stripe. The under side is black with a yellow

stripe along the middle, which is more or less interrupted. The legs and prolegs are black. The yellow stripes are not prolonged upon the posterior and the two anterior rings, but are here often replaced by small yellow spots. The head is black. The skin is tough and leathery, with numerous small elevated smooth grains, of which two on the fore part of each segment, placed in the yellow stripes, are larger and are sometimes elevated into small prickle-like points, and two others, similar to these, also occur posteriorly on each segment, but placed further apart. In addition to these there are six larger, black, shining, conical prickles in a transverse row around the middle of each ring, some of which are occasionally forked at their tips into two sharp points. On the second ring in place of the two upper prickles are two black curved cylindrical horns, equalling two of the rings in length, and usually standing obliquely upwards and forwards, their tips blunt and shining. The last segment is rough from several prickle-like points of different sizes.

The moth is quite simple in its colors and marks, compared with its larva, presenting nothing to notice in addition to what has already been given above, except those structural characters which belong to other species of the genus in common with it.

323. Spotted-winged Dryocampa, or Thorny oak-worm, *Dryocampa stigma*, Fabricius.

Eating the leaves in September, a worm like the preceding, but of a bright tawny or orange color with a dusky stripe along its back and bands on its sides, and its prickles lengthened into thorn-like points; producing a moth with similar colors and marks, but having in addition thereto a slight purplish streak across the middle of its hind wings and a curved purple band near the base of the fore ones, and both pairs always freckled with blackish, its width 2.50 to 3.00, the male 1.75 and its wings ochre yellow.

The skin of this worm has numerous white elevated points or granules of different sizes, as in the following species, but differs from that and the other species of this genus in not having its colors arranged in stripes, except the single dusky one along the back. On the hind part of each ring is a dusky band, which is widened at the breathing pores. The prickles also are longer in this than in the other species, forming thorn-like points, of which those of the two rows upon the back are the tenth of an inch long, with one, two or three smaller prickles branching from them. The two horns back of the neck have the same blunt shining tips as in the preceding species.

The female moth has the fore wings usually of a purplish red color forward of the anterior band and behind the posterior one, and this color is frequently tinged more or less with glaucous-like gray. The anterior band is strongly curved, or rather, is abruptly bent slightly outside of its middle. This band is obliterated in many specimens. The narrow cloud-like streak of darker purplish red across the middle of the hind wings is sometimes quite distinct, and in other instances its presence can merely be discerned. Thus this moth sometimes can scarcely be distinguished from the preceding.

324. Clear-winged Dryocampa, or Olive-gray oak-worm, *Dryocampa pellucida*, Smith and Abbot.

Eating the leaves in July, a two-horned prickly worm of an obscure

olive gray or greenish color with dull brownish yellow stripes and its skin rough from white granules; remaining under ground in its pupa state through the winter, and the fore part of June producing a large ochre-yellow moth with thin and semi-transparent wings of a purplish red color throughout, with a very large white dot near the center of the fore pair and a faint darker streak; its width 2.50; the male 1.75, with the fore wings hyaline except on their margin.

For many years this worm has been common on the white oaks in my own vicinity, where the preceding has seldom been seen; and though the Yellow-striped oak-worm is so abundant only twenty-five miles distant from my residence, I have never met with it here.

When full grown, these worms are two inches long and as thick as a pipe stem. They vary somewhat in their colors, being oftenest obscure grayish yellow or grayish green, but sometimes blackish. Along the back is a broad stripe of this color, interrupted at the sutures by pale brownish yellow, and with a narrow blackish line on the middle of the back. Each side of this is a dull brownish stripe, below which is a broader one of the same color with that on the back, and having a whitish streak along its middle and the breathing pores in its lower margin. Below this is a second broad dull yellowish stripe, followed by a narrower dark olive green or blackish one, occupying the base of the prolegs, which below this stripe are black with a few small white granules, similar to those with which the surface is everywhere covered. The six anterior legs and the head are dull olive yellow. In a transverse row on the middle of each segment are six short polished black prickles, two above and two on each side, those on the hind segments being somewhat longer, and the two on the back are sometimes replaced on most of the segments by black dots. The two horns on the top of the second ring are the same as in the two preceding species. In smaller individuals, probably before the last change of their skin, these horns have been observed to have short branching prickles.

When alarmed the worm holds its anterior end rigidly upward and forward, with the horns extending obliquely forward and outward. Several of the worms are usually found near each other on the same limb, up to the time of their leaving the tree. They mostly enter the ground early in August, though some individuals may be seen on the trees as late as the middle of the following month.

325. Triple white-spot measure-worm, *Amilapis triplipunctata*, new species. (Lepidoptera. Geometridæ.)

Eating the leaves the fore part of June, a cylindrical gray measure-worm, 1.40 long, sprinkled with blackish dots and short lines, its head and neck slightly thicker than its body, each ring with a small squarish white spot above on its hind edge and with two blackish parallel lines on each side of this spot, its six anterior feet with a slight tinge of rose red; its pupa lying naked between the leaves, fastened by its tip; the beginning of July producing an ash-gray moth thickly sprinkled over with black dots and small brown spots, with the broad hind border of both wings dusky, which color is bounded on its fore edge by a somewhat scalloped narrow black band running parallel with the hind margin and having on its hind side near the outer margin of the fore wings three large contiguous white dots, whereof the outer one is largest and most distinct; its width 1.50.

This moth is so very similar in the cut and designs of its wings to the

unipunctata of Haworth, that it may prove to be only a variety of that species, which I have never met with in this State, and know only from specimens received from Dr. Morris of Baltimore, and the figures and descriptions of authors. In these I discern no traces of but the one white spot, whilst here there are three, in a transverse row, contiguous and somewhat confluent with each other, their edges illy defined and the inner two less clear and bright, yet perfectly distinct. The colors also are gray and blackish, without any tinge of rusty yellow. The fore wings, as in *unipunctata*, show faintly a curved darker band near the base, and a straight cloud-like streak still more faint from the middle of the inner to the middle of the outer margin, in which is a faint black crescent-shaped spot near the center, and the black band or line margining the dusky hind border has back of its inner end a curved transverse gray spot, and at its outer end a broader one of the same color, occupying the space between the outer white spot and the outer margin. The larva, moreover, of this moth, appears to be unlike that of *unipunctata*, as described by Guenée* from a drawing of Abbot's; though there can be but limited confidence in the accuracy of descriptions thus obtained. And furthermore, the Single white-spot moth is said to come abroad at the end of the season.

Authors are discordant and in doubt with respect to the place of these moths in the family to which they pertain. I am inclined to think their true location is beside the genus *Hyperetis* of Guenée.

326. Oak-leaf Tortrix, *Argyrolepia Quercifoliana*, new species. (Lepidoptera. Tortricidæ.)

The fore part of June, the sides of particular leaves curved upward and drawn slightly together by numerous cobweb-like threads, beneath which lies a slender grass-green sixteen-footed worm, about three-fourths of an inch long and the thickness of a rye straw, which eats the end of the leaf, and passes its pupa state in the same situation; about the first of July giving out a small moth of a pale straw color with its body and hind wings glossy white, its fore wings prettily speckled with numerous small rusty yellow spots which run together in many transverse bands, leaving a space at their tips more vacant; its width 0.70.

The moth here noticed may frequently be captured in our forests the fore part of July. Its larva resides under a thin cobweb covering which it constructs over the upper surface of the leaf towards its end, hereby drawing the sides somewhat together into a concave shape. As it merely eats off the end of the leaf, transversely, moving its quarters further back as it thus consumes successive portions of it, it is obviously liable to do no sensible amount of injury, unless like some of its kindred, it has the habit

* I regret that the important volumes of this author on the nocturnal Lepidoptera (Suites a Buffon) have not been in my hands a sufficient time for me to avail myself of them but slightly in the present Report. Hence, also, a number of species which I had prepared for insertion herein, are withdrawn, until their nomenclature can be revised and compared with that of these volumes.

at times of becoming excessively multiplied. But as the history of so very few of these small moths is at present known, I avail myself of this opportunity to place this species on record; and I add such a description of it as will henceforth serve for its clear identification.

The LARVA is grass green throughout, or towards each end and beneath of a slightly paler apple-green color, and along its back is a narrow stripe of a deeper green, produced by the internal viscera. It tapers slightly posteriorly and less so anteriorly. On each of its rings small pimples are symmetrically placed, from each of which grows a short white hair; and low down on each side is a slight fold of the skin, forming a slender elevated line. The head is round and slightly flattened and as thick as the neck into which it is sunk. If expelled from its retreat, it wriggles violently about, and by means of a fine thread drops itself very suddenly towards the ground and hangs suspended, till the disturbance ceases, whereupon it climbs up again to its former quarters.

The MOTH has fore wings which are twice as long as wide, their opposite sides parallel, their outer side very nearly straight with an inward curve at the base, their hind ends cut off somewhat obliquely and rounded like a slightly bent bow. Their surface is feebly glossy and about equally occupied by straw yellow and tawny or light brownish yellow, this latter color forming numerous small spots which are confluent into broken and irregular bands, the bands also running into each other. Two of these bands are more distinct and continuous, and when viewed vertically are of the same tawny yellow color with the other marks, but when viewed obliquely they are of a darker leaden or silvery brown hue, and are imperfectly edged with lines of a deeper brown color. One of these bands extends from the middle of the inner to the fore part of the outer margin. The other is almost parallel with this, running from the hind margin near the inner angle to the outer margin, where it is usually thickened or forked. The space back of this last band is slightly paler and less densely spotted, its only marks frequently being a broad oblique stripe from near the middle of the band to the tip, crossed by a curved band running nearly parallel with the hind margin, both these marks having the same leaden brown reflection with the two bands. Back of this on the hind edge and base of the fringe is a smooth tawny yellow band. The head is rough from loose scales, the feelers projecting in front like a short conical beak, their apical joint being small but distinct; and the spiral trunk is quite short, when uncoiled reaching but little beyond the tips of the feelers.

327. OAK LEAF-MINER, *Argyromiges Quercifoliella*, new species. (Lepidoptera. Yponomeutidæ.)

A whitish blister-like spot half an inch long and showing upon both surfaces of the leaves of the white oak, this spot on the upper side elevated into a fold, forming a cavity in the interior of the leaf, in which lies a small white flattened worm abruptly thicker at its fore end, which feeds on the interior of the leaf, and passes its pupa state in the same cavity, finally producing a minute snow-white moth, its fore wings pale golden yellow with a black dot on their tips, a white stripe on their outer side at base, and four triangular silvery white spots along the outer and two larger ones upon the inner margin, its width 0.30.

This leaf-miner is a minute worm which subsists upon the parenchyma or green pulpy substance inside of the leaf. This it consumes, leaving the cuticle or thin outer skin which covers it entire. The worm is flattened and little thicker than writing paper, appearing as though it had been distorted from being pressed between the two surfaces of the leaf. Upon the under side of the leaf its cell resembles a blistered spot of a dull nankin yellow color and an irregular oval form, half an inch long or a little more

and half as broad. In smallish leaves this cell extends from near the mid-vein quite to the outer margin, where it is most elevated, the margin being often drawn together into a plait or fold as though it had been pinched between the fingers. Thus at this blistered spot a deep cavity is formed between the flat skin of the under side and the elevated fold of skin upon the upper side of the leaf. On this latter side the spot is white, more or less stained with dirty yellow and showing upon its surface a net-work of dirty yellow lines which are the veinlets of the leaves, made thus conspicuous by the parenchyma in the cells between them having been consumed. This dirty yellow stain renders the spot so opake that the worm inside can seldom be seen. This concealment is the more necessary, to enable the inclosed insect to elude the search of its enemies. It remains in this cell till near the end of its pupa state, held near the center of the cavity by a number of fine threads like cobwebs irregularly crossed in every direction. And when ready to disclose the moth, the pupa breaks through the thin dry skin of the under surface of the cell and crowds itself out till it is only held by its tip, when its shell cracks apart and the moth evacuates it. Sometimes a spider's web may be noticed on the under side of the blistered leaf, placed there with the evident purpose of entrapping this pupa when it breaks from its cell.

It is the latter part of summer when these blister spots begin to appear on the oak leaves. They occur upon the topmost leaves of the tallest trees as well as on those that are lower and near the ground. After the leaves have fallen in autumn, a portion of these blisters will be found empty, whilst others have pupæ or sometimes larvæ in them; showing that the moths come out from them in autumn and also in the spring.

The LARVA is white with a dusky or cinnamon brown stripe along its middle from internal alimentary matter, and the tips of its jaws are bright cinnamon brown. It is sparsely clothed with fine long white hairs. Its shape is analagous to that of a Buprestis larva, the segments of its thorax being much broader than those of the abdomen, which are of equal width. It has three pairs of legs anteriorly and three pairs of very small prolegs placed on the third, fourth and fifth narrowed abdominal rings.

The PUPA lies naked in the centre of the fine threads which the larva spins across its cell, without inclosing itself in a cocoon. It is at first pale yellow throughout, but the sheaths of its wings and legs afterwards become dusky and its head blackish. When disturbed in its cell it writhes or turns itself over and over, with much strength and vivacity.

The MOTH is snowy white with the antennæ and feet a little dusky. Its fore wings are pale golden or shining tawny yellow, with five white streaks on the outer margin, of which the first is longitudinal, placed on the margin and widened towards its hind end; the others are triangular and margined on their fore sides by a black line, the second and third ones being more transverse, and the fourth or last one is directed obliquely forward and inward. The two spots on the inner margin are also edged with black on their fore sides. The first of these spots forms with its opposite when the wings are closed a large crescent-shaped spot across the middle of the back, and the second forms a transverse diamond-shaped spot. The fringe is white with a dusky line on its base, and its outer half dusky also along the tip. The hind wings are white or cream yellow, and their fringe silvery white.

328. WHITE-OAK LEAF-MINER, *Argyromiges Querci-albella*, new species.

Eating the interior of White-oak leaves and hereby producing a white

blister-like spot on their under sides, a minute flattened pale yellow worm which is gradually narrowed from before backwards, 0.18 long when mature, surrounding itself with a thin membrane-like wall forming an oval cell in the center of the cavity, in which it remains during its pupa state; producing a minute snow white and silvery moth, its fore wings pale golden yellow posteriorly, where are three black lines on the outer and two on the inner margin radiating from a common center and bordered with silvery white on their hind sides, and with a large black dot on the tip and a blackish stripe at the base; width 0.28.

The white blister-like spot of this leaf-miner appears on the under side of the leaf, with but slight, if any traces of its presence on the opposite side. It is broad oval and a half or three-fourths of an inch long. Among the fallen leaves in autumn those thus blistered may be found, some having the insect in its larva, others in its pupa state. The larva is very much flattened and tapers gradually from before backwards. It is divided into thirteen very distinct segments, including the head, by deeply impressed transverse lines. It is of a pale yellow color, with a deeper orange yellow band on the middle of each segment, and it also sometimes shows a dusky longitudinal stripe along the middle, from internal visceral matter. Its head is small, and its legs the same as in the preceding species. If ejected from its cell, it wriggles and lets itself down by a fine thread which it spins from its mouth. When it has finished feeding it stations itself in the middle of its burrow and then weaves around itself a curtain, from the floor to the roof, of a fine dense texture resembling the paper of bank bills. It thus forms a little oval cell nearly a half inch long and two-thirds as wide, and almost a tenth of an inch in height, the floor and roof being concave, as though they had been pressed outwards, thus making the apartment more roomy. In this cell the insect reposes during its pupa state, with its cast-off larva skin beside it, the black grains or castings of the worm and all other rubbish being outside of this in the burrow. The pupa is of a uniform dull orange yellow color, and of the same length with the larva.

The moth appears to be closely like the European *Argyromiges Clerckella*, but possessing some marks not mentioned by authors as present in that species. Its fore wings are snow white on their anterior half, with a shining silvery luster, and with a blackish stripe inside of their outer edge. Their posterior half is of a pale golden yellow color, with a large black dot at the tip and three or four triangular spots on the outer and two on the inner margin, each spot with a black streak on its anterior edge, which streaks radiate from a common center. On the hind margin is a black band. The fringe is white, tipped with blackish on the outer half of the wing. The long narrow hind wings and their long fringes are silvery white. I have captured these moths abroad in the woods the latter part of May.

2. THE LOCUST.—*Robinia Pseudacacia.*

AFFECTING THE TRUNK AND LIMBS.

329. Locust-tree borer, *Clytus Robiniæ*, Forster. (Coleoptera. Cerambycidæ.)

Boring a hole nearly a quarter of an inch in diameter, beneath the bark and more or less deeply into the wood, usually in an upward direction; ejecting its chips and worm-dust through an orifice in the bark; a yellowish white worm similar in its appearance to the Oak pruner, § 305; passing its pupa state in its burrow, and beginning to be seen abroad soon after the middle of August, and often seen during the autumn on Golden rod and other flowers; a black nearly cylindrical long-horned beetle from a half to three-fourths of an inch long, its legs and sometimes its antennæ tawny yellow, its globular thorax and its wing-covers ornamented with several bright lemon-yellow bands, of which the second one back of the base of the wing-covers forms a letter W.

This is a common insect, and the greatest obstacle to the cultivation of the locust-tree with which we have to contend. An instance of the devastation it is liable to cause may here be recorded. One of the principal thoroughfares leading east from the city of Utica, was formerly planted on its south side for some distance with locust-trees. These had become so large and ornamental as to render this one of the most admired avenues in the suburbs of that city, when, some thirty years since, these trees were invaded by this insect, to such an extent that in the course of two or three seasons they were totally ruined, many of them being killed outright and the remainder having their limbs and branches so lopped off that they could never recover from the deformity. We learn from Michaux that fifty years since, this insect had become so destructive that many in different parts of our country were discouraged from planting the locust. Hitherto it appears to have been a pest chiefly in the older settled sections of our country. But it will no doubt in time show itself equally destructive in the newer districts. And in those parts of the western States where, to supply in some measure the natural deficiency of wood and timber, plantations of the locust are extensively made, it will probably yet prove to be a greater evil than it has ever hitherto been.

This insect abounds in all parts of the United States. A recent writer, in one of our agricultural periodicals, says it has not yet made its appearance on the west side of the Mississippi river; but from the number of specimens sent me year after year, by Wm. S. Robertson, from the Indian territory west of the State of Arkansas, it would appear to be more common there than in this section of the country. And it in all probability occurs over all that portion of our continent in which the locust grows.

Another writer says, it "is not of more than thirty years introduction into the United States." But Drury informs us he "received it from New York, where it is found on the locust-tree." And Forster says, it "inhabits the *Robinia Pseudacacia* in the province of New York." It hence appears that this beetle and its habits were known in our State almost a century ago. And fifty years anterior to these writers, Petiver gave a figure and description of it, in his "Gazophylacium," published in London in 1702, this being the first notice of it, probably, which has ever appeared. Moreover, as this beetle has never been found in any other part of the world, it was not introduced, but is undoubtedly a native species which has always existed here.

From our American authorities, one would be at a loss to know by what scientific name to designate this insect. It is the *Clytus pictus* of Dr. Harris's Treatise, the *Clytus Robiniæ* of Prof. Haldeman's Monograph, the *Arhopalus Robiniæ* of Dr. Le Conte's Monograph, though changed in the *errata* to *Arhopalus pictus*, and still later, in the Smithsonian Catalogue of Coleoptera, *Clytus flexuosus* is its preferred name. It fortunately happens in this instance, that of the several names the species has received, that which is preferable and most appropriate is that which also has the priority. It is circumstanced like another species which I have heretofore noticed. It was figured and described by Drury in 1770 but no name was then given to it. In 1771 Forster described it, naming it *Leptura Robiniæ*. Drury, in the appendix to his second volume, which was published in 1773, supplied the names which had been omitted in his first volume, terming this species *Leptura picta*. And two years after this, Fabricius, in his Systema Entomologia, first noticed this species, naming it *Callidium flexuosum*, removing it into his new genus *Clytus* twenty-five years afterwards. Dr. Le Conte refers it to the genus *Arhopalus* of Serville, making this genus more comprehensive than its author originally proposed, Serville himself placing it under *Clytus*. Which is the better generic arrangement I do not pretend to decide.

This beetle is so prettily and peculiarly marked that it will readily be recognized, from the short description given in the opening paragraph above. It is subject to some variations. The antennæ are either black or tawny yellow. Sometimes the base of the wing covers are tawny yellow. Sometimes the zigzag band resembling the letter W is white instead of yellow; and specimens even occur in which all the bands are white. This insect breeds in the black walnut as well as the locust, and it is said to be individuals reared in this tree which have the bands more or less white.

The only feasible method of checking the multiplication and destructiveness of these borers, which I am able to suggest, is, to plant a small patch of the Golden rod (*Solidago*) where locust trees are grown, that the beetles when they issue from the tree may resort to the flowers, as is their habit. They can readily be found thereon and captured and destroyed. It will be a pastime to the children of the household, whose sharp eyes qualify them

LOCUST. TRUNK.

well for this employment, to search these flowers, more or less frequently as the search is more or less successful, varying as it will with the commonness or rarity of the insects in different years, gathering and destroying all that are found thereon.

The LOCUST COSSUS, already described, § 294, bores similar but still larger holes and more in the interior of the tree. Fortunately it is a much less common insect than the Locust borer.

AFFECTING THE LEAVES AND TWIGS.

The IO EMPEROR MOTH, already described, § 81, I find is frequently reared upon the locust, and is the largest worm known to us feeding on the leaves of this tree. The parent moth deposits her eggs in a cluster side by side, glueing them to the under surface of a particular leaf, which leaf sometimes fades and turns yellow, probably in consequence of the weight thus placed upon it. The eggs hatch soon after the middle of July, and the young worms for two or three days remain huddled together upon the under side of the same leaf, feeding upon the shells of their eggs till they are wholly consumed, before they commence eating the leaves. They are at first of a totally different color from the large worm which we afterwards see, being dull yellow with black heads and small black prickles like the points of needles. They remain at rest during the day, and feed by night, all repairing to a leaf adjacent to that on which they were born, and eating its end off transversely till a third or more of it is consumed, when they repair to another leaf in the same vicinity. But if the leaf on which they are resting be touched by the hand, or if they in any other manner discover they are noticed, they on the following night migrate to another part of the tree, there clustering together again on the underside of a single leaf. But they soon grow to such a size that a single small leaf of the locust cannot hold the whole brood, when they begin to separate. After they have grown to a half inch or more in length they prefer the small young leafets at the end of the main stems, all of which leafets they eat, together with the tender succulent end of the stem, for a short distance downwards, and then leave it and repair to the end of another stem, feeding now some of the time by day. When they become so large that the under side of a leaf is quite too small to cover and conceal them, each worm draws three or four leaves around it with a few silken threads, forming a kind of loose basket open at the top, in which the worm lies when it is not feeding. Sometimes two worms unite in forming and occupying one of these baskets.

The HICKORY TUSSOCK MOTH larva, § 183, or a caterpillar very similar to it, is also sometimes found on the locust.

330. TITYRUS SKIPPER, *Eudamus Tityrus*, Fabricius. (Lepidoptera. Hesperidæ.)

The last of July, under a folded edge of a leaf when small, afterwards in two or more leaves drawn together in a kind of pod, a pale green worm with darker green bands, red neck and rough dull red head, 2.00 long

when full grown; the pupa wintering in a slight cocoon coated outside with shreds of dead leaves; the middle of the following June giving out a dark brown butterfly with a yellow glossy band on the middle of its fore wings and a broad silvery white one narrowing outwardly, across the middle of the hind ones on their under side, its width 2.00. See Harris's Treatise, p. 243.

331. BLACK LOCUST MIDGE, *Cecidomyia Pseudacaciæ*, new species. (Diptera. Tipulidæ.)

In July and August, the tender young leafets near the tip of the stem folded together like a little pod, the cavity inside containing from one to three small milk-white maggots, which descend below the surface of the ground, remaining there in their pupa state about ten days, and then hatch a small blackish midge, the base of its thorax tawny yellow, its abdomen pale yellowish with the tip dusky and clothed with fine hairs as is the neck also, its legs black with the thighs pale except at their tips, its wings dusky, feebly hyaline, with the fringe short, its antennæ with thirteen short cylindrical joints separated by short pedicels, its length 0.065 to the tip of the body in the females, which is the sex now described.

Before the small young leafets, which put forth along the opposite sides of the main leaf stalks at their tips, become expanded, they are closed together like two leaves of a book; and it is probably at this time that the female midge inserts her eggs in the cleft between them, the irritation from which and from the small maggots which hatch from them, keeps the leafet permanently closed, a slight cavity forming within, in which the worms reside, the leafet hereby coming to resemble in its shape a small bivalve shell, of the genus *Chama*, the margin being usually more or less wavy. The surface remains unchanged outside, but within it assumes a pale greenish yellow color. The larvæ are milk-white and somewhat glossy, with a light green cloud along the middle of their bodies from alimentary matter internally in the viscera. When menaced with danger, they have the faculty of throwing themselves away with a sudden skip, the same as the larvæ of the Wheat midge. The attachment of the leafets to the stalk becomes so weakened when infested by these worms, that I presume they are generally broken off by the wind and the worms are thus carried to the ground, instead of crawling down the stalks by night as is the habit of the Wheat midge.

I notice these pod-like leafets every summer, upon the locusts in my yard, as well as the deformity produced by the following species; but neither of these insects have ever been so numerous as to injure the trees in any sensible degree, in my vicinity.

332. YELLOW LOCUST MIDGE, *Cecidomyia Robiniæ*, Haldeman.

In July and August a portion of the edges of the leaves rolled inwards on their under sides and thickened, inclosing one or two very small white maggots which are varied more or less with orange yellow; producing a

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pale orange midge with the sides of its thorax and often three oval stripes on the back and the wings dusky, its antennæ blackish and of fourteen joints in the females, twenty-four in the males, its length 0.12.

In midsummer the margins of many of the leafets of the locust may be noticed rolled inwards upon their under sides for a length varying from over a quarter to a half inch, the upper side showing a concavity or rounded hollow at this point. This rolled portion is changed in its color to a paler yellowish green, and its texture is thickened and succulent. The same leaf sometimes has two or more of these folds along different parts of its margin. The worm concealed therein is colorless-watery when young, becoming, as it approaches maturity, opake and milk-white varied more or less with bright yellow. It is long oval, broadest in the middle and tapering thence to a sharp point anteriorly, the opposite end being bluntly rounded, and is divided into thirteen segments by transverse impressed lines.

Prof. Haldeman, who described this species in Emmons's Journal of Agriculture and Science, October, 1847, says it, in conjunction with the following species, had been so numerous in south-eastern Pennsylvania, the two preceding summers, as to kill the leaves upon the locusts, the trees in August appearing as though they had been destroyed by dry weather.

333. Locust Hispa, *Anoplitis scutellaris*, Olivier. (Coleoptera. Hispidæ.)

In July, blister-like spots appearing upon the leaves, within which is a small flattened whitish worm, attaining a quarter of an inch in length, tapering from before backwards, with projections along each side like the teeth of a saw, and with only three pairs of feet, which are placed on its breast; eating the parenchyma and leaving the skin of the leaf entire; remaining only a week in its pupa state, in the leaf, and towards the middle of August, coming out therefrom a small oblong flattish beetle of a black color with the thorax and wing covers, except along their suture, tawny yellow, its length 0.25.

This is the *Hispa suturalis* of Dr. Harris, (Boston Journal of Natural History, i, 147, and Treatise on Injurious Insects, p. 107,) but cannot be the species thus named by Fabricius and Olivier, which is stated to have the head, under side and legs, yellow or testaceous. It is very plainly described by Olivier under the name *scutellaris*. Though the species is common in the southern part of New York, I have never met with it in the eastern section of the State, where the following which much resembles it in its habits and larva, is common.

334. Flattened locust leaf-miner, *Anacampsis Robiniella*, new species. (Lepidoptera. Yponomeutidæ.)

In July, white blister-like spots on the under side of the leaves, occupying about a fourth of the surface or half the space on one side of the midvein, containing within a flattened pale green or whitish worm, tapering

posteriorly, with a darker green streak along its middle; passing its pupa state in the leaf, which falls to the ground, and the following June gives out a minute moth 0.45 wide across its spread wings, which are blackish brown on their outer half, tawny yellow on their inner side, and marked with an oblique white band before the middle, a broad grayish white band or large triangular spot on the middle, and half way from this to the tip a white spot on the outer and a pale rose red one opposite it on the inner margin, and also a small white spot on the tip and on the base.

Of the seventeen small leaves or leafets which commonly form each compound leaf of the locust, usually two or three, and frequently double that number, show these white blisters on their under sides. And it is not rare to see two or three of them upon the same leafet, which usually turns yellow and drops prematurely from the tree, when thus severely invaded. But where it has only one insect preying upon it, it usually remains green and survives the attack. For of the two layers of parenchyma in the leaves, it is only the lower that is ate by these worms, the upper one being left entire, whereby the upper surface of the leaf remains green, or is but slightly discolored with a yellowish cloud at this place. The white separated skin of the under surface is very thin and delicate, so much so that frequently the worm may be perceived beneath it, sometimes feeding at the outer edge of the spot, but more commonly at rest towards its centre, or turning its head with a sudden spiteful jerk, first to one side and then to the other, being evidently aware that it is interfered with, and resorting to this motion to frighten away the intruder. And not unfrequently two worms are seen occupying the same cavity.

The LARVA when young and as found in the smaller spots, is of a very pale green or white color with a darker green or a pale brown streak along its middle. It is very much flattened, and is broadest anteriorly across its neck, gradually taporing from thence to the tip. It is divided into thirteen segments by deep transverse constrictions, giving it a serrated appearance along each side, and from the tip of each of the projecting teeth arises a short white hair. When full grown it measures 0.18 in length and then presents a somewhat different aspect, the middle of the body being now as broad or slightly broader than the anterior end, with the sutures more deeply impressed, and the projecting teeth along each side are rounded and not so angular at their ends as before, and are of a yellow color, at least those at each end. And now small retractile legs are perceptible, enabling the worm to move about with more facility than when it was young. There are three pairs of small conical watery-white legs placed on the three thoracic segments, and on the third, fourth and fifth abdominal segments is a pair of minute pro-legs, scarcely to be discerned except when the worm is crawling.

The pupa lies in a small, broad, oval cocoon, 0.18 long, and 0.12 thick, woven of exceedingly fine white silk, through the sides of which the insect within is seen, of a pale yellowish color. This cocoon is suspended near the centre of the cavity, by a few threads of fine silk, crossing irregularly in different directions; the cavity in the leaf having now become much more deep and spacious than when it was first mined by the worm. The manner in which nature has so adjusted her work, here, as to cause this cavity to grow more deep and roomy, is truly curious. We have already stated that it is only the lower layer of the parenchyma of the leaf on

which this worm feeds. This being consumed from the mid-vein to the outer margin, the thin membrane of the under surface of the leaf which is hereby separated, loses its vitality and ceases to grow; whilst the upper layer of parenchyma, being uninjured, continues to expand. But the dead membrane on its under side holds it, like a bridle, from expanding further outwards, and it hence bulges upward, convexly. Thus the cavity in the leaf assumes the shape of an oven, its floor flat and its roof arched or concave. Thus ample room is furnished for the cocoon to be suspended, like a hammock, in the centre of the cavity.

Frequently, instead of the cavity in the leaf being occupied with a few fine threads supporting a cocoon in the centre, we meet with one or two smaller and much narrower snow-white cocoons, promiscuously placed. They are 0.12 long and a fourth as broad. In due time the ends of these cocoons are raised, like a lid, and a minute parasitic fly comes from them, the larva of which have subsisted upon and destroyed the larva of this leaf miner. It pertains to the family *Braconidæ*, and the genus *Microgaster*, and may be called

THE LOCUST LEAF-MINER PARASITE, *Microgaster Robiniæ*.—It is cream yellow or straw yellow, with the antennæ and legs pure white, the female being deeper yellow or orange, with the tip of the abdomen often dusky. Its wings are pellucid whitish, with colorless veins, the small central cellule being open on its hind side. The male is 0.07 long, and to the tip of its wings 0.11, its antennæ being 0.10.

335. SLENDER LOCUST LEAF-MINER, *Argyromiges Pseudacaciella*, new species. (Lepidoptera. Yponomeutidæ.)

In similar white blister-like spots, a much more slender worm, not flattened, very deeply constricted at the sutures and resembling a string of beads; producing a minute moth only 0.24 in width, its fore wings golden yellow with four white bands on their outer side, the forward ones oblique, broader and edged with black lines, and also three or four similar white bands on their inner side and a large black dot on their tip half encircled with whitish.

This larva occurs in the blister-like spots of locust leaves at the same time as the preceding, but is at once distinguished from it by its more slender form, very little tapering from before backwards, and not at all flattened. Its legs are also much larger and more distinct, showing three pairs anteriorly, three on the middle abdominal segments and one pair at the tip. A few soft hairs are scattered over its body. Its head is small and is sometimes wholly retracted within the neck. It is divided into twelve rings by very wide deep constrictions, giving to the worm a striking resemblance to a string of very small beads, usually of a watery whitish color with a brown line along the middle, but sometimes curiously diversified from internal alimentary substances in different stages of digestion. Thus a worm was in one instance noticed as having the three first rings

white, the four following ones light green, the next, or eighth of the series, light yellow, the ninth and tenth pale brownish green, the eleventh blackish, and the last semi-transparent and like colorless glass—as though it were designed to imitate a string of beads of different colors. Its length when full grown is 0.18. The convex upper side of its cell forms a kind of fold or plait, in which the worm spins its cocoon, which is snow-white and more closely woven than that of the preceding species, and the pupa enclosed therein is of a darker or dusky color. A portion of these pupæ probably remain unhatched during the winter, lying in their burrows in the dead fallen leaves. Others give out the moths in autumn, and as cold weather comes on these delicate tiny creatures creep into the crevices under the loose scales of bark upon the trunks of trees, and similar situations, where they remain in a torpid state through the winter, and if so fortunate as to escape the notice of the spiders which hide themselves in the same places, they come abroad again upon the wing the following spring.

The genus *Argyromeges* of Mr. Curtis, to which this and two species on oaks described in the preceding pages pertain, comprises quite a number of very minute moths, as will be inferred from their larvæ occupying such a narrow space as half the thickness of leaves so thin as those of the locust. But what they lack in size is in many of the species compensated in the brilliancy of their colors and the prettiness of their adornment. Men have often exerted themselves to write the Lord's prayer or the decalogue within the compass of a sixpence, and it would seem that in these minutest kinds of moths as in many other insects Nature had aimed to show how much splendor and elegance she could include within the smallest limits. In this genus the fore wings are frequently of the most brilliant golden and silvery hues and marked with oblique streaks. They are narrow and rolled around the body when at rest. The hind wings are very narrow and fringed on both sides with long fine hairs. Their heads have a rough uncombed appearance from a tuft of dense erect and radiating bristles placed upon the crown.

This species is allied to *Klemannella* and other similar European moths of this genus in its colors and marks. Its fore wings are of a uniform brilliant golden color, with four silvery white triangular spots or bands on their outer half, which are bordered with black and are placed at nearly equal distances from each other, the anterior two being larger and placed obliquely and the others transverse. On the inner half of these wings are also three or four similar bands, the two last ones with their inner ends running into the ends of the two hind ones of the outer side. On their tips is a large black dot with a broad whitish border on its hind side, followed by a curved black band on the hind edge of the wing, beyond which comes the fringe which is of a smoky gray color. Often a longitudinal black indentation or short stripe occurs on the middle of these wings forward of the black dot and between the inner ends of the second and third bands. The hind wings are blackish with a smoky gray fringe. The legs are alternately banded with white and black.

I have sometimes met with numbers of these moths in their winter quarters beneath the large loose scales of bark on hickory trees, and at such a distance from any locust trees as to render it probable they had

been nurtured in the leaves of some other tree, perhaps those of the hickory. Minute moths of several other species are met with, in company with them in this situation, some of them of this same genus and so closely resembling the locust leaf-miner that they merit a notice in connection with it, although I know not the kind of leaves in which they are reared.

336. MORRIS'S LEAF-MINER, *Argyromiges Morrisella*, new species.

This moth is similar to the preceding in its size and marks, but the entire inner half of the fore wings is black, slightly tinged posteriorly with golden yellow, and interrupted at equal distances by three white spots or short bands narrowing towards their inner ends, and between each of these is a less distinct white spot or cloud. Forward of the anterior white spot the color is more pure and coal-black, forming an oblong square spot occupying the inner half the base of the wing, which spot is bordered along its inner side by a slender white stripe placed upon the middle of the wing at its base, its hind end uniting with the inner end of the anterior white spot.

337. UHLER'S LEAF-MINER, *Argyromiges Uhlerella*, new species.

This resembles *Pseudacaciella*, but is throughout of paler colors, the fore wings being golden gray, with five white spots along their outer sides, of which the hindmost ones are small, the others quite large and bordered with blackish upon their anterior sides; and the black dot on the tip of the wings is here replaced by a short black stripe thrice as long as it is wide; whilst the hind wings and their fringes are pale silvery gray. These marks will suffice to distinguish this from the two preceding species.

333. OSTENSACKEN'S LEAF-MINER, *Argyromiges Ostensackenella*, new species.

Another moth of this genus, which comes abroad in July and August and sometimes enters opened windows in the evening, alighting around the lighted lamps upon our tables, I here introduce to notice, it having much similarity to those above described. Its body, hind wings and all the under side is black, its head silvery white, and its fore wings of a deep orange tint with the brilliancy of gold. These wings are crossed by four equidistant straight broad silvery white bands, each edged on its fore side with a black line, the second of these bands being placed in the middle of the wing and the two hind ones having an interruption in their middle. There is no black dot on the tips as in the preceding species, but on their hind edge is a curved black line. Its width when the wings are spread is but 0.20.

Numerous other leaf-mining moths of our State pertaining to this and kindred genera are known to me, some of them rivalling or surpassing the preceding in their highly burnished metallic colors and the elegance of their marks, but as they have less resemblance to the Locust leaf-miner, there is no occasion for a particular notice of them in this connection.

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339. SAY'S WEEVIL, *Apion Sayii*, Schonherr. (Coleoptera. Attelabidæ.)

From June till September, eating numerous small round holes in the leaves, a little black weevil with a slender projecting beak, its thorax with close coarse punctures and an oval or longitudinal indentation back of its centre, and the furrows of its wing-covers with coarse punctures, its length 0.09 and to the end of its beak 0.12.

This species is common throughout the United States and is perhaps the most numerous of any beetle of the weevil kind which we have in our country, but being so very small it is seldom observed. It probably breeds in the seeds of the locust and of various other species of the Natural Order *Leguminosæ*, Dr. Harris having met with it in all its stages in the seeds of the Baptisia or wild indigo. It would be regarded with confidence as forming two or three distinct species were specimens in the cabinet alone examined. Thus, among a number of individuals taken upon the leaves of the locust, some will usually be met with in which the indentation back of the centre of the thorax is round and appearing like an impression made by the head of a pin, instead of being oval or oblong. And in others this indentation is prolonged, forming a small furrow along the middle of the thorax its whole length. It is quite customary at the present day to regard all such differences in the sculpture of beetles as sufficient characters by which to separate them into distinct species. We however cannot but deem that a large portion of the species which are thus founded will eventually be discovered to have no valid existence in the domain of nature.

340. TWO-SPOTTED TREE-HOPPER, *Thelia bimaculata*, Fabricius. (Homoptera. Membracidæ.)

In September, puncturing the twigs and sucking their juices, a brown triangular tree-hopper 0.50 long and having a form analagous to that of a beech-nut, with a long horn running obliquely forward and upward overhanging the head and compressed and rounded at its end, a large oblong bright yellow or dull gray spot on each side, widening anteriorly, its thorax as long as the wings, sharp-pointed at its tip and with elevated lines posteriorly.

I have never met with this species north of Albany, although it is not rare in the southern part of this State and of New England, and extends from thence through the southern and south-western States.

The BUFFALO TREE-HOPPER, § 21, is also common upon the locust, stationing itself in the axilla or angle where the leaf stalk arises from the limb. In August, upon the green succulent twigs it is not rare to find one of these tree-hoppers thus stationed, at the base of almost every leaf.

3. THE ELM—*Ulmus Americana et fulva.*

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341. TRIDENT SAPERDA, *Saperda tridentata*, Olivier. (Coleoptera, Cerambycidæ.)

Consuming the inner bark of the slippery elm, (*Ulmus fulva*,) in decaying and dead trees, a white grub about half an inch long, slightly tapering and with strongly constricted sutures dividing it into twelve rings, of which

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the first is largest and has a flattened tawny space above covered with minute rust colored dots; its pupa lying in an oval cavity in the bark and the latter part of May coming out, a cylindrical blackish long-horned beetle with an orange yellow or red stripe along each side of the body, which on the wing-covers sends three equidistant branches inward towards the suture, the two hind ones oblique, its length 0.38 to 0.55.

Where the slippery elm trees are killed, as they all are in my own vicinity, by having the bark peeled from around their trunks for medicinal purposes, the remaining bark immediately becomes filled with these worms, by which all its inner layers are consumed within a few months and changed to worm-dust. The beetle deposits its eggs upon the bark in June, and the young larvæ therefrom nearly complete their growth before winter, and soon after warm weather arrives the following spring they pass into their pupa state.

The LARVA when mature is about 0.55 long and 0.12 broad across the anterior end where it is broadest and slightly tapers from thence backward. It is divided into twelve segments in addition to the head, separated from each other by deep wide constrictions, the last segment being double or having a small additional segment received into its apex. Along the middle of the back is an impressed line or furrow. It is of a white color and clothed with fine short hairs. Its head is tawny yellow and sunk into the neck, the jaws black and slightly notched at their tips or two-toothed. The neck or first ring is the longest one in the series and has a flattened space on its upper side of a tawny tinge and covered with numerous minute rust-colored points but showing no impressed line along its middle, and on its under side in the middle is a faint transverse oval spot with similar rusty dots, and upon each side is a shining impressed crescent-shaped spot of a tawny tinge. The two segments following this are shorter than those beyond them.

The surface of the beetle is occupied with small punctures from which numerous fine short hairs arise, which stand erect. This surface is of a glaucous grayish tinge, and on each side of the thorax below the orange stripe are two black dots. All the specimens which I have seen from the southern part of the State have an aspect so different from those of my own vicinity, that in the collections of amateurs they may frequently be noticed arranged as distinct species. They are of a darker livid gray hue, and their marks are dark orange red, instead of ochre or orange yellow, and on the wing-covers these marks are more prolonged, the middle one extending to the suture. This may be named the Red-marked (*rubro-notata*) variety.

Another variety is sometimes seen, in which the branches from the lateral stripe upon the wing-covers are of a gray hue, and so very faint that they are scarcely perceptible. This may be named the Intermediate, (*intermedia*,) it being so slightly different from the following species as to excite doubts whether it is a hybrid produced by a crossing of these two species, or whether these insects are not in reality one species, varying merely from being reared in different species of the elm.

342. LATERAL SAPERDA, *Saperda lateralis*, Fabricius.

Mining the inner bark of dead trees and logs of the common elm, a grub in every respect the same with that last described above, and about

the first of June producing a similar beetle, differing in being destitute of the transverse bands branching from the lateral stripe upon the wing-covers, its length varying from 0.35 to 0.55.

Two varieties of this beetle may be noticed, the one (*abbreviata*) having the stripe along the outer side of the wing-covers narrow and not extending to their tips, the other (*suturalis*) showing a slender orange colored line along the inner edge of the wing-covers their whole length.

343. Six-banded Dryobius, *Dryobius, 6-fasciatus,* Say. (Coleoptera. Cerambycidæ.)

A similar but larger worm than the preceding, found in the same situation, producing a black beetle of similar form, with the margins of its thorax yellow, and also its scutel and four equidistant oblique bands on its wing-covers, the last one placed on their tips, its length about 0.70. This species is exceedingly rare, but probably occurs in all parts of the Union.

The Elm bark-beetle, § 60, produces small pin-hole perforations in the bark; and the Pigeon Tremex, which will be described under the Maple, bores in the wood of this tree.

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Quite a number of different worms are met with upon the elm, eating its leaves; but nearly all of these are oftener seen upon other trees, under which their description more properly belongs, and to most of them has already been given. A word or two as to the general appearance of these is all that will be required in this place.

Of *large thick-bodied worms*, there is found on this tree

The Polyphemus moth larva, § 181, of an apple green color, with bright orange points and a row of oblique pale yellow stripes along each side.

The Io emperor moth larva, § 81, apple green, with branching prickles and a brick red or orange stripe along each side.

The Ash Sphinx (*Sphinx quadricornis*) larva, a cylindrical green worm with a pale blue or green horn at the end of its back. See Ash insects.

The American Cimbex larva, a cylindrical glaucous yellowish white worm, coiled like a snail's shell and having two black lines along its back; much more common on willows, under which it will be described.

Of more *slender bodied thorny worms* there are

The White-bordered butterfly larva, black, with a row of rust-red spots on the back, and more often met with on willows, which see.

The Progne, § 142, and the White-C. butterfly, § 143, similar but paler colored worms.

Of *hairy-bodied caterpillars* there are

The Fall web worm, § 81, in cobweb-like nests the latter part of summer.

The Vaporer moth larva, § 32, with pencils of long black hairs, and on its back short yellow brush-like tufts.

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Of *measure worms*, having but ten feet, there are

The CANKER WORM, § 38, the V-MARKED MEASURE WORM, § 39, and the NEW YORK MEASURE WORM, (*Erannis subsignaria*, Hubner,) which has been so noted a pest for many years in the metropolis of our State, and is most destructive to the lindens, under which the description of it will be given.

Of worms which are peculiar to the elm, or are more common on this than other trees, there are several, which are not yet known to me in their perfect state, and I have but one species to present at this time. This is an inhabitant of northern Europe, and has not been known hitherto as occurring also upon this continent.

344. NOVEMBER MOTH, *Oporabia dilutata*, Schifferrmyller. (Lepidoptera. Goometridæ.)

Feeding on the leaves in spring, a dirty green measure worm, beneath paler bluish white, its breathing pores forming a row of orange red dots along each side, where is sometimes a yellow line also; living openly exposed upon the leaves and in the summer entering the ground to pass its pupa state; the moth coming out in November, its wings usually as thin as bank note paper and semi-transparent, very pale gray, the fore pair with faint indistinct transverse marks of a darker color, whereof two near to and parallel with the hind edge are commonly the most distinct, and two others extending from the middle of the inner margin to a small dusky streak in the centre of the wing, the hind wings fringed all around with whitish hairs. Width about 1.30.

Slowly flying among the leafless bushes upon mild days in November I have met with this moth. It coincides so perfectly with the figures and accounts given of the European November moth, as it is termed in English works, that I cannot deem it anything else than the same species. A more accurate representation of my specimens could scarcely be made, than is the figure of the pale variety of this species, in Westwood and Humphrey's British moths. It is often more fully and distinctly marked, according to the statements of authors, than in the specimens from which the above description was taken. So extremely variable is it, that nearly a dozen species have been made from its varieties, by different writers.

345. LADDER CHRYSOMELA, *Chrysomela, scalaris*, Le Conte. (Coleoptera. Chrysomelidæ.)

Feeding upon the leaves throughout the season, a shining hemispherical bottle green beetle with silvery white wing-covers, on which are several bottle green spots and a broad jagged stripe on their suture, its wings rose red and its antennæ and legs rusty yellow. Length 0.30 to 0.40. Common also upon willows.

346. ELM GALERUCA, *Galeruca Calmariensis*, Linnæus. (Coleoptera. Galerucidæ.)

An oblong oval beetle 0.25 long, of a grayish yellow color with three small black spots on its thorax, a broad black stripe on the outer part

of its wing-covers and a small oblong spot near their base, though originally named by Linnæus from a small seaport town of Sweden, is common over the chief part of Europe, feeding upon the leaves of the elm, to which it is sometimes very destructive. It has been introduced from thence into this country, and on its first appearance in the city of Baltimore some twenty years ago, it and its larvæ, which are thick cylindical blackish six-footed grubs, wholly denuded the elms of their leaves, for several successive seasons.

The following incident, verbally communicated to me by the Rev. John G. Morris, D. D., of Baltimore, merits to be related in this connection, it being one of the prominent popular errors prevailing in our country with respect to insects, to regard them as a unit, all alike in their nature and habits, and hence, if a remedy is discovered to be efficacious against one particular insect, the experimenter at once concludes, with the fullest confidence, that it will be similarly efficacious against all other insects.

Soon after this beetle commenced its destructive career in Baltimore, a representation of the evil was communicated to one of the most eminent and justly distinguished men of science in our country, with a request that he would inform them of some remedy for it. He, not being versed in this particular branch of Natural History, inferred the insect to be the Canker worm, which had not long before made very similar havoc upon the elms in his own neighborhood; and he accordingly replied, informing them that if they would surround the trunks of their trees with collar-like troughs and keep these filled with fish-oil, he doubted not they would find it an effectual remedy. With much care and at some expense this measure, coming from such a respectable source, was extensively resorted to. But they soon learned that what is sauce for the goose is not always sauce for the gander, or in other words, that what is an effectual remedy for one insect on elms is not equally efficacious for all other insects upon the same tree. As some had predicted who had informed themselves of the habits of this beetle, the protected trees received not the slightest benefit from this measure.

The GRAPE-VINE FLEA-BEETLE, § 128, a very small greenish-blue or purple jumping beetle, and the GOLDSMITH-BEETLE, § 57, a large shining lemon yellow beetle, also inhabit the elm, eating the leaves.

347. ELM GALL-LOUSE, *Byrsocrypta Ulmicola*, new species. (Homoptera. Aphidæ.)

In June, an excrescence or follicle like a cock's comb, arising abruptly from the upper surface of the leaf, usually about an inch long and a quarter of an inch high, compressed and its sides wrinkled perpendicularly and its summit irregularly gashed and toothed, of a paler green color than the leaf and more or less red on the side exposed to the sun; opening on the under side of the leaf by a long slit-like orifice; inside wrinkled perpendicularly into deep plaits and occupied by one female and a number of her young, some of which are often strolling outside upon the under surface of the leaf,

minute oval yellowish white lice 0.02 long, with blackish legs, the female more or less coated with white meal on her back, 0.07 long, oval and pale yellow with blackish legs and antennæ. Though I have not yet met with winged individuals, they in all probability pertain to the genus to which I have referred this species above. The galls may frequently be noticed on elm leaves. By the middle of summer they become tenantless, dry and hard and of a blackish brown color.

4. THE POPLAR—*Populus grandidentata, etc.*

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348. Broad-necked Prionus, *Prionus laticollis*, Drury. (Coleoptera. Cerambycidæ.)

In the wood of the trunk and roots of different poplars, a white soft grub as thick as one's thumb and otherwise similar to that of the Chestnut-brown or Pennsylvania Prionus, § 234*; producing an oval moderately convex black long-horned beetle 0.90 to 1.50 long and less than half as broad, its wing-covers rough from confluent irregular punctures and with two or three raised lines, its thorax with three irregular teeth along each side, and its antennæ of twelve joints resembling little conical cups placed one within the other and projecting upon their lower side like the teeth of a saw; appearing abroad in July.

349. Poplar-borer, *Saperda calcarata*, Say. (Coleoptera. Cerambycidæ.)

Beneath the bark and in the interior of the wood boring a hole 0.45 wide and less than half as high, a yellowish white footless grub 1.75 long, slightly tapering and divided by strong constrictions into twelve rings, the first one largest and with its upper side flattened, tawny and sloping forwards, and in all other respects resembling the Apple-tree borer, § 2; passing its pupa state in the tree and coming out in August and September, a pale bluish gray long-horned beetle, about an inch long and a fourth as broad, finely dotted with black, its scutel ochre yellow and also three stripes on its thorax and several spots on its wing-covers. See Harris' Treatise, p. 93.

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350. White-S Clostera, *Clostera albosigma*, Fitch. (Lepidoptera. Notodontidæ.)

Early in July, eating the leaves and reposing in a cavity formed of leaves drawn together like a ball, a large black caterpillar with white and yellow dots and stripes and a hump on the back of its fourth and eleventh rings; its pupa lying in a cocoon attached among the leaves, and in ten days giving out the moth the latter part of July; the moth grayish-brown, its fore wings crossed by three faint paler streaks, the two first parallel, the hind one with its outer half silvery white and strongly waved in the shape of the letter S; width 1.50. See Transactions, 1855, p. 506.

* Since my last report was in print I have ascertained that the fifth volume of Degeer's work was not published till 1775. Forster's name of this insect consequently has the priority, and Chestnut-brown Prionus, *Orthosoma brunnea*, Forster, should be substituted for the name I have in that place given.

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351. American Clostera, *Clostera Americana*, Harris.

Consuming the leaves in summer, a pale yellow caterpillar with two little black warts close together on the back of its fourth and eleventh rings, three slender black lines on its back and three in a broad dusky stripe along each side; its pupa passing the winter in a cocoon under leaves or rubbish on the ground; the middle of June giving out a pale grayish moth more or less varied with brown, its fore wings with three whitish bands, the first transverse and dislocated, the second oblique and giving off a transverse branch from its middle which runs to the inner margin uniting with the third band, the two thus forming a letter V, a faint whitish band across the middle of the hind wings; width about 1.35. See Harris' Treatise, p. 334.

The *Clostera suffusa* of Stephens was very probably described from a specimen of this species which found its way accidentally into the collection from whence he obtained it. Our moth shows a whitish spot or stigma near the center of the fore wings, this spot being sometimes dusky in its middle, as represented on the left side in Stephens' figure. Were the first band in this figure dislocated with its outer half carried somewhat towards the base of the wing, and the pale shade across the middle of the hind wings less angularly bent, all doubts upon this subject would be removed.

352. V-marked Clostera, *Clostera vau*, new species.

A moth which is very similar to the preceding, but darker colored and smallar, with the bands more slender and distinct, may be readily distinguished from that species by its having the first band not dislocated but in its middle strongly curved backwards, the apex of the curve usually forming an acute point. The last band also is much more strongly undulated near its outer end, curving backwards almost in a semicircle, and is of a much more vivid white color, and broadly bordered on its hind side with bright rust-red. Its hind wings also are destitute of the paler band across their middle. Its width is about 1.20.

I am unacquainted with its larva, but like the other species of this genus, it doubtless feeds on the poplars and willows. Though quite rare in my own vicinity, it is oftener met with than the two other species.

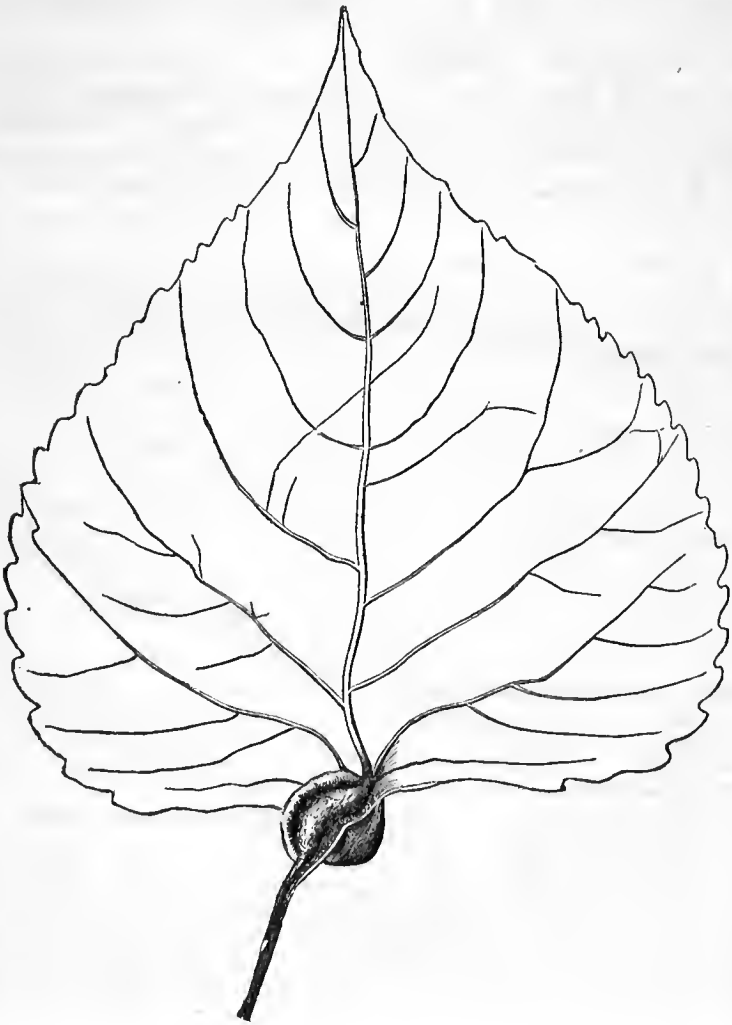
Other worms feeding on the leaves of poplars are larvæ of the Io emperor moth § 81, the White-bordered butterfly, oftenest met with on willows, the New York measure-worm more attached to the linden, and others which are yet unknown in their perfect state.

353. Poplar-stem gall-louse, *Pemphigus Populicaulis*, new species. (Homoptera. Aphidæ.)

Forming imperfectly globular galls the size of a bullet at the junction of the leaf with its stalk, these galls having a mouth-like orifice on their under side, and a large cavity within, crowded with small dull white lice and their white cast skins, and with winged lice of a blue black color, their antennæ reaching beyond the base of their wings, the rib-vein of their

fore wings black, thick, much thicker at its apex along the inner margin of the stigma-spot, and the short veinlet bounding the anterior end of this spot more slender than the rib-vein; its length 0.10, and to the tips of its wings 0.15.

This insect is attracting much notice in the city of Albany at the time these pages are passing through the press. The latter part of June, an article appeared in one of the daily papers of the city, directing attention to the remarkable phenomenon presented by the poplars in a particular yard on the opposite side of the river in Greenbush, most of the leaves having at their base a little ball filled with insects. Several of the leaves of these trees were kindly procured and forwarded to me by L. A. Orcutt, Esq. Visiting the city personally a fortnight after, I was informed the



same bullet-like excrescences were then growing on the poplars everywhere in and around the city, and were so numerous on particular trees that scarcely a leaf could be found which was destitute of them. The specimens shown me were taken from the River poplar or Cotton tree, (*Populus lævigata*, Aiton.)

Three years since, on the twenty-seventh of June, a leaf which had fallen from a Lombardy poplar in my yard, was found wilted and somewhat shrivelled, which showed on the middle of its stalk, a bullet-like gall, of which, and the insects within it, full memoranda were taken, which describe these Albany leaves perfectly; and when the leaves fell from this tree in autumn, a few were found among them, more faded than the others and having these same excrescences, but placed at the base of the leaf instead of on the middle of its stem, and the galls having now become black, dry and hard.

These excrescences are about a half inch in diameter and somewhat more long than thick. They are of a pale green color, similar to that of the stalk on which they grow. At their base they are wrinkled with parallel plaits running from the excrescence a short distance downwards upon the stem on which they grow, which stem is slightly thickened at this point. On their upper side the surface is rough from numerous small smooth elevations resembling pimples, some of them round, others oblong, which are green at first, but soon become whitish and remain of this color after the gall is dead and black. They are of a weak leathery texture, having a large cavity inside, the walls being the thickness of thin leather. The cavity within is completely filled with a confused mass of little lice, sprinkled over and obscured by a white meal-like powder, and intermingled with them are a multitude of white shrivelled cast skins. These lice when more particularly examined, are found to be of three different kinds, namely, larvæ, pupæ, and perfect or winged flies. In the first gall which I inspected more than a hundred and fifty of these insects were counted.

The LARVÆ, or smallest insects in these galls, are about 0.03 long, but variable in size. They are of a dull white color with the knees a little dusky and the eyes blackish. They are oval, slightly narrower anteriorly, with their sutures well marked by transverse impressed lines.

The PUPÆ are similar to the larvæ in color and form, but of a larger size, and particularly distinguished by having little oval scales, which are the wings in their rudimentary state, pressed against each side of the body. Their feet as well as their knees are dusky, of a much darker shade in some than in others, and in some individuals the head and thorax have a reddish tinge. Their length is about 0.07. These were far the most numerous individuals in the gall first examined.

The WINGED FLIES are of a blue black color throughout, sometimes with the base of the abdomen and of the legs dull brownish yellow, and when newly hatched the under side or even the whole of the abdomen is dusky lurid greenish. The wings are closed together horizontally upon the back before the fly has left the gall, but after it has used them, they are held together above the back in a steep roof. They are whitish hyaline, not clear, being like the body so dusted over and dimmed with white meal-like powder that they appear almost opake until this extraneous matter is brushed off. The vein forming the outer margin is coarse and blue-black from the base to the commencement of the stigma, and very fine and slender beyond that point. The rib-vein also has the same color and is still more thick and

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coarse till it reaches the stigma, where it is widened to twice its previous thickness, forming a broad blue-black margin along the inner side of the stigma to its tip, whilst the branch running to the outer margin and bounding the anterior end of the stigma is much more fine and slender. The stigma is dull whitish and much more opake than the rest of the wing. It has an elliptic outline, its length about double its width and slightly wider than the space forward of it between the rib-vein and the outer margin. The obliquo veins are pale yellowish and towards their tips slightly thicker and dusky. Around the origin of the two first a slight duskiness is perceptible upon the inner side of the rib-vein. The first obliquo vein is straight. The second arises almost in contact with it, and is straight till near its tip, where it perceptibly curves towards the inner margin. The third veiu is abortive or invisible through the first fourth of its length. The fourth, which arises from the middle of the inner side of the stigma, at first slightly approaches the third vein and then curves gently towards the outer margin, and at its tip bends again in the opposite direction. Its tip is somewhat nearer the tip of the third vein than this is to the second, the tips of the first and second being still more distant from each other and about the same distance that the tip of the fourth is from that of the rib-vein. The antennæ are rather thick and thread-like. The body varies in length from 0.08 to 0.10, but to the tip of the wings it is more uniform, measuring 0.15. These individuals are winged females, producing larvæ of a pale yellow color.

Galls analagous to those here described grow upon the leaf stalks of the Lombardy and the Black poplar in Europe, from the attacks of the *Pemphigus bursarius* of Linnæus; but I judge our insect to be different from that, from specimens of the fly and its gall received from Dr. Signoret, and the full description of it in its different stages given by M. Fonscolomb (Ann. Soc. Ent., France, x, 193), the fly being paler in its color, and its gall spirally coiled somewhat like the shell of a snail.

The manner in which these insects produce these galls on poplar leaves is described by Mr. Rennie in his Insect Architecture, and may here be repeated, as the process is no doubt the same in ours that it is in the European species.

Often when the galls are opened a single individual is noticed therein much exceeding any of the others in its size and destitute of wings. This is the female parent from which the whole brood in each gall is descended. After wandering about upon the limbs and leaves during the first period of her life, she becomes stationary at this point on the leaf stalk, occupied first in erecting a house for her shelter and protection and then rearing her family therein. As she turns herself around, she makes a number of punctures in the leaf-stalk with her sharp needle-like beak. The sap which issues from these wounds, by its exposure to the air becomes thickened and curdled, whereby a thick fleshy wall of a living vegetable substance grows up around her, intermediate in its texture as in its situation between the wood and the leaf, being softer than the former and harder than the latter. And by puncturing this at its summit, a further exudation of the sap occurs, whereby the wall closes together over her, thus forming a little globe the size of a pea, within which the insect is securely sheltered from birds and predaceous insects. If in want of food she has only to insert her beak in the side of her cell and suck therefrom the nourishment she requires. Her eggs are next strewed around upon the inner surface of this gall, although the cavity has only sufficient space to contain them and the parent. But

the young insects hatching therefrom, puncturing and drawing their sustenance from the same surface, cause the gall to increase gradually in its size, in the exact ratio in which the family within grow to require additional room. I observed no orifice in the smaller galls; but when a portion of the inclosed insects have acquired wings and are ready to come abroad, a longitudinal slit is formed upon the under side of the gall, like a mouth with the lips closed, and the gall then has some similarity to a bivalve shell, as that on the European poplars has to a univalve. Through this orifice the flies coming out into the light of day, open their wings a few times to air and strengthen them, and then mount upon them and pass away. If two or three of the galls happen to be laid upon a table, on the adjacent window will soon be found a multitude of these flies which have been arrested in their flight outwards. As already stated, at least a portion of the flies which begin to issue from these galls the last of June, are females giving birth to living young instead of eggs. But their further history and in what state they pass through the winter and till another crop of leaves put forth for their accommodation yet remains to be investigated.

In some instances two females fix themselves at the base of the same leaf, whereby their galls grow into each other, making an excrescence of double the usual size, in which are two cavities and two orifices.

Secluded as these insects are within the tough leathery walls of these galls, they are but little molested by those numerous insect enemies whereby the forces of the Aphides are so often routed and infested vegetation is cleansed from these pests. In one instance, however, the larva of a lady-bird (*Coccinella*) was noticed standing like a vigilant sentinel at the orifice of a gall, occupying himself no doubt in seizing and devouring the flies one after another as they issued therefrom, before their wings had acquired the requisite suppleness to enable them to fly away.

Although the leaves at whose bases these galls grow retain a healthy vigorous aspect till after the insects have escaped, they are undoubtedly weakened from having such an amount of their juice drawn away for the support of these galls and the insects within them, and will prematurely wither and fall from the trees. And when these insects become so numerous as they at present are around Albany, the trees will be enfeebled by them. But as it is merely the leaf stems which they infest, the life of a thrifty tree will be jeopardized only by their continuance in force through a series of years, and that they will thus continue is not to be expected.

354. Poplar gall-louse, *Pemphigus Popularia*, new species.

Late in autumn, wandering up and down the trunk of the Balsam poplar, a gall-louse closely like the preceding, but its abdomen green, its antennæ short, reaching but two-thirds the distance to the wing sockets, and the rib-vein of its wings not thicker along the inner margin of the stigma; its length 0.13 to the tip of its wings.

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In connection with the Poplar-stem gall-louse I introduce this species, it is so very similar, although I know nothing of its habits, beyond the fact that it was noticed in great numbers upon a Balsam poplar, *P. balsamifera*, Linn., upon a warm sunny day in the middle of October, wandering up and down the trunk of the tree, in company with a species of Aphis. These were winged females, one of which was observed to extrude a small larva 0.02 in length, of a pale yellow color with watery white head and legs.

As noticed at that time, these flies were black, slightly dusted over with a glaucous gray powder; the abdomen dull green with a small coating of white flocculent wool, its opposite sides parallel and its tip abruptly rounded; the antennæ short, thick and thread-like; the wings dull hyaline, their rib-vein black and the oblique veins slender and blackish with the basal third of the third vein abortive and the fourth vein perceptibly thicker towards its base; and the small branch of the rib-vein bounding the anterior end of the stigma having nearly the same thickness with the rib-vein.

355. POPLAR-BULLET GALL-LOUSE, *Pemphigus Populi-globuli*, new species.

In July, on the leaves of the Balsam poplar slightly above their base, an irregular globular apple green gall the size of a bullet, projecting from the upper surface of the leaf, with a curved mouth-like orifice on the under side, the cavity within containing numerous small pale green and smaller dusky lice with the end of their bodies covered with short white cotton-like threads, and larger winged ones which are of a black color, with the abdomen dusted over with white meal and with thin white woolly fibres on the back, and their antennæ reaching the base of the wings, which are clear hyaline, their veins slender and white or colorless, except the outer marginal vein which is black to the end of the stigma, and also the rib-vein, which is much thicker at its apex; their length 0.07 and to the tip of the wings 0.11.

I find several galls of this kind on a Balsam poplar in my yard, at the moment of sending these pages to the press. That I might render the history of the preceding species more complete, I wanted to think I here had the same insect at its summer employment which I had previously met with in autumn after its work for the season was closed. But on placing the two side by side I see some differences between them, so slight that it may not be in our power to distingish them with any degree of confidence in preserved specimens in the cabinet, yet so palpable that I am compelled to regard them as distinct species. And as in the gall-flies on oaks so also in the gall-lice on poplars it would seem that Nature designed to show how closely alike she could make several of these minute insects, and then placed them in dissimilar galls that the observer of her works might be assured they were really different the one from the other.

Those flies differ from those of *P. Popularia* in being uniformly a size smaller, with wings more clear and glassy, their veins more slender and quite colorless, the stigma less opake than in that and other species of these insects, and the rib-vein more thick where it bounds the inner margin of the stigma and especially at its apex. The oblique branch of the rib-vein bounding the anterior end of the stigma is more slender than the marginal vein.

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The fourth oblique vein is slightly thicker at its base, where it is also a little dusky. The abortive basal third of the third vein is traced by a very slender line, which here appears to be more distinct than in any of the kindred species. The inner margin shows the same duskiness for a short distance at and forward from the tip of the first vein that is common to the insects of this family. The abdomen is dusted over with a white mealy powder, with a black band on the hind part of each segment from the absence of this powder.

The gall grows from the midvein of the leaf slightly above the point where it passes into the stem, instead of at or slightly below this point where the Poplar-stem gall first described is situated. And hereby this gall has a narrow portion of the base of the leaf below it. It grows either wholly upon the upper side of the leaf, or with a small portion protruding outwards from the under side. It is of a spherical form, but more or less irregular and with the surface uneven. It varies from a little over a quarter to a half inch in diameter, and is of a pale apple green color, sometimes with a deep carmine red cloud on the side most exposed to the light. Its walls are nearly a tenth of an inch thick and very juicy and brittle, but become, as in other galls, more dry, wilted, and leather-like when old. The midvein where the gall is situated becomes thickened and curved or otherwise distorted, and the orifice of the gall opening along its side partakes of this curve.

The winged flies are females, producing eggs of a dull wax color, the eyes of the inclosed larva appearing like two black dots near one end, as in other instances in this genus. These eggs hatch within a few moments after they are extruded. Before they leave the interior of the gall these flies are mostly of a pale lurid green color with the knees and feet dusky, and only the antennæ and the thickened tip of the rib-veins are then of the black hue which the body acquires after its exposure to the light. And after they have come abroad the under side of the abdomen often retains this same lurid green color.

365. Poplar-vein gall-louse, *Pemphigus Populi-venæ*, new species.

In July an oblong compressed excrescence like a cock's comb, of a light red color varied with pale yellow, growing from the midvein of Balsam poplar leaves on their upper side with an orifice on the opposite under side; a cavity within containing a multitude of lice and their white cast skins, interspersed with a whitish meal-like powder; those with wings being black, with coarse thread-like antennæ reaching to the base of the wings, which, with their oblique veins, are pellucid and colorless, the coarse rib-vein being blackish and more thick at its tip along the inner margin of the stigma, and the vein of the outer margin being blackish and somewhat coarse from its base to the stigma; its length 0.05 and to the tip of the wings 0.08.

A number of these galls may sometimes be observed upon the leaves of particular trees. They are nearly semicircular and half as high as long, being usually over a half inch in length, with an uneven surface, their walls thick, brittle and succulent. They are commonly placed near the

base of the leaf, but sometimes in its middle. Among the insects in the cavity inside may be found the larvæ, pupæ and perfect insects of both sexes, which sexes can be distinguished in all the stages of their growth by their colors, the females being dusky and the males dull green with whitish legs and antennæ. A single wingless individual, larger than any of the others in the gall, is the parent or at least the progenitor of the entire family. As an instance of the tenacity of life which insects possess in their pupa beyond any other period of their existence, it may be observed that a wingless female with a larva and a pupa of this species, having been attached with gum to a slip of card, the two first were noticed twenty-four hours afterwards dead and shrivelled to mere shapeless specks, whilst the pupa remained alive, plump and strong, actively engaged in efforts to break its feet from the dried gum wherein they were fettered.

The FEMALE LARVÆ are dusky on the body and legs, with a tuft of white flocculent cotton-like fibres projecting backward from the end of the body, and a coating of white mealy powder over the rest of the surface. They are quite small, measuring about 0.025 in length, straight along each side and slightly narrowing from behind forward.

The MALE LARVÆ are less numerous than those of the female and double their size. They are very pale dull green with whitish antennæ and legs, the feet sometimes slightly dusky. They are coated with white meal and tufted at the tip like the female, but their bodies are more tapering forward and show the impressed sutures quite distinct.

The MALE PUPÆ are oval with the head and first segment of the thorax narrower. They are dull pale green with the second segment of the thorax and the wing-scales paler and watery in their appearance, and the sutures of the abdomen less distinct than in the larvæ, which they slightly exceed in their size.

The FEMALE PUPÆ are dusky like their larvæ, with the wing-scales and the thorax between them of an obscure whitish or pale watery color.

The WINGLESS FEMALE, the parent of the colony, is as broad as long, measuring 0.04 to 0.05 in length, the hind end being usually concave or notched, and the abdomen elevated or humped in its middle, resembling that of some spiders. She is pale dusky with two rows of snow white dots formed of a mealy or pruinose substance, along each side of the back, the dots of the inner row being more numerous. Her head is darker and her legs dull pale yellowish with the feet dusky.

As some of the gall-lice now described may every year be met with upon the poplars planted in the grounds around our dwellings, I have given a somewhat extended account of them, thinking some of the persons into whose hands this Report will come, will, with the aid thus furnished them, be curious to examine these insects, whose habits are in many respects so interesting and truly remarkable. In addition to those which have now been noticed, several other species of the Aphis family dwell more openly exposed upon the leaves and green twigs of our poplars. I refrain from presenting these and similar insects belonging to oaks and other trees, until I shall have re-examined them in their living state, and compared them with the figures in the beautiful Monograph of Koch, that I may assure myself more fully whether several of them be not, as I suppose them, identical with those occurring upon similar vegetation in Europe.

5. THE BIRCH—*Betula lenta, etc.*

AFFECTING THE LEAVES.

The several kinds of birch appear to be the least infested by insects of any of our forest trees of the deciduous class. This fact recommends them strongly to public favor as ornamental trees for parks and pleasure grounds, they being also easy of cultivation though rather slow in their growth. They probably owe their immunity from insects to the spicy essential oil which imparts to their bark so pleasant a flavor. I know of no borer in the wood or bark of the birch, and very few worms which feed upon its leaves. Occasionally the V-MARKED measure worm, § 39 has been noticed in this situation and two or three other larvæ of small moths whose perfect state is not yet known. A few insects which puncture the leaves and green succulent twigs to sip their juices and a single beetle eating the leaves, are, according to my observations, the only insects which are oftener met with upon birch than on other trees, and are therefore to be considered under this head.

357. TRIPLE-ROWED CRIOCERIS, *Syneta tripla*, Say. (Coleoptera. Crioceridæ.)

In May and the fore part of June, eating the leaves of this and various other trees, an oblong chestnut-brown and closely punctured beetle, with wing-covers usually pale dull yellowish except on their suture and their punctures forming about three rows between each of the three raised lines, its length 0.25 and about a third as wide. A common insect in our State.

358. VARIABLE LEAF-HOPPER, *Athysanus variabilis*, Fitch. (Homoptera. Tettigonidæ.)

Puncturing the leaves and succulent shoots and extracting their juices, from the middle of June till the middle of July, an oblong oval leaf-hopper of a sulphur yellow color, its wing-covers commonly with an oblique black stripe, their tips hyaline, its thorax and scutel often tawny yellow or black, its length 0.20.

This insect may every year be met with in numbers upon birch trees and also upon alders. It was once found literally swarming upon a white birch standing apart from other trees.

359. SMALLER LEAF-HOPPER, *Athysanus minor*, Fitch.

From the middle of June till the middle of August, a similar leaf-hopper to the preceding, but of a cinnamon color, including its face, and having a colorless hyaline spot on the middle of its wing-covers and a larger one on their tips, its length 0.18 to 0.20.

360. WINDOWED LEAF-HOPPER, *Athysanus fenestratus*, Fitch.

From the middle of June till the last of July, a leaf-hopper resembling the foregoing species, but with blackish wing-covers with similar hyaline spots and a smaller third one placed on the middle of the inner margin,

and its forehead black with a pale yellow band between the eyes, its length 0.20.

The SPRUCE LEAF-HOPPER § 282 is also frequent upon the birch, and a few additional species which are common to this and the hornbeam and alder may hereafter be noticed under these last. The BUTTERNUT TINGIS, § 193 is also common on birch leaves.

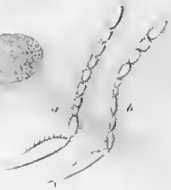
ERRATA.

Page 416, 1st line, "sods," not rods,
Page 426, 9th line from top, "hole," not pole.
Page 433, lowest line, "above," not alone.
Page 437, 18th line from top, "style of board fence."
Page 454, top line, "the side," not aside.
Page 465, and other places, "bowlders," not bolders.
Page 466, 21st line from top, "leveled off," not beveled.
Page 467, 8th line from bottom, "to be built."
Page 472, 10th line from bottom, "sheeves," not sheers.
Page 475, figs. 63, 64, 65, 66, 67, are reversed.
Page 483, 16th line from top, "pin them," not pin in.
Page 489, 5th line from top, "vise," not vice.
Page 492, 21st line from top, "animals," not animal.
Page 501, 9th line from bottom, "full of doubt," not free from.
Page 476, fig. 63 reversed.

Some other typographical errors have escaped notice in the correction of the proof, but will readily be corrected by the reader.

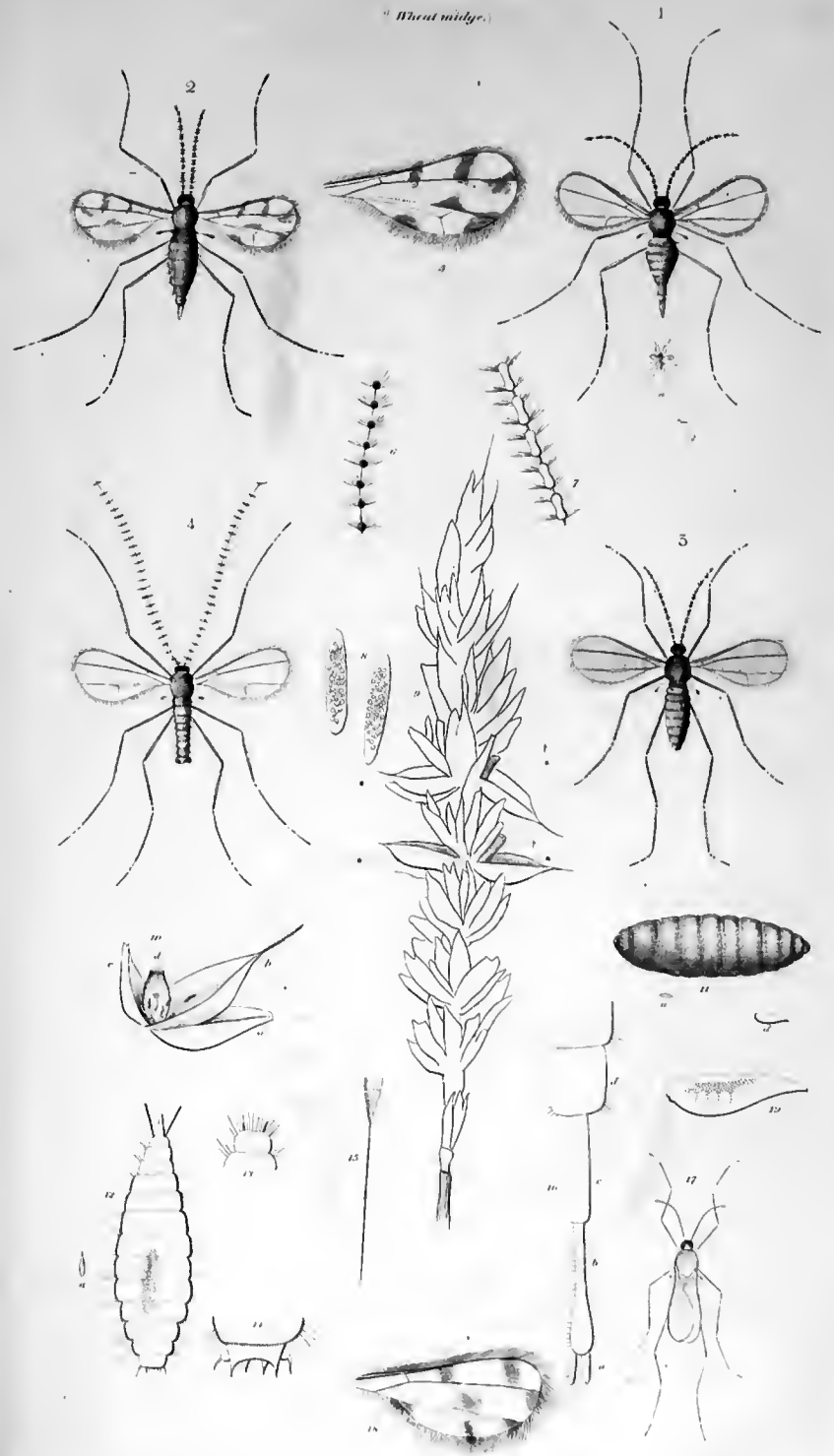
INSECTS - PLATE 1.

Gram aphis &c.



INSECTS - PLATE 2.

(Wheat midge.)



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J.E Gavell Sc.

SIXTH REPORT

ON THE

NOXIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK.

By ASA FITCH, M. D.

ENTOMOLOGIST OF THE NEW YORK STATE AGRICULTURAL SOCIETY.

INSECTS INFESTING GRAIN CROPS.

For the most part the same insects are common to the several cereals, wheat, barley, rye and oats. Wheat as being the most delicate and nutritious of these grains suffers most severely from the attacks of these enemies. Rye being the most hardy and rapid in its growth escapes with the least injury. After treating upon the insects infesting the wheat crop, therefore we shall find very few species remaining to be separately considered as belonging exclusively to the other grain crops mentioned.

1. WHEAT.—*Triticum vulgare.*

1. WHEAT MIDGE, *Cecidomyia Tritici*, Kirby. (Diptera, Tipulidæ.) Plate ii, fig. 1, 4.

Minute orange yellow maggots lying inside of the chaff upon the surface of the young kernels, causing them to be dwarfish and shrunken when ripe; these maggots descending into the ground and forming very minute cocoons, from which in the following June come bright orange colored flies or midges 0.10 long with clear glass-like wings.

Among the insects infesting our grain crops the Wheat midge is entitled to take precedence. It has in this country and in our own day fully vindicated its claim to the character assigned it upon another continent nearly a century ago—"These little insects are the wheat crop's greatest enemy." The experience which the generation which is now passing off the world's stage has had with this insect, has been such that every tiller of the

soil throughout the Northern States of the American Union and the adjoining British Provinces will with one consent respond to the truth of this maxim.

It is now sixteen years ago, that, being solicited by an esteemed friend to contribute to a scientific journal which he was publishing, I furnished an Essay on this insect, which was also inserted in the Transactions of this Society for the year 1845. It was my first effort at authorship in this science, undertaken after the observations of but one season. It was necessarily an imperfect production, and I have for a long time intended to write the history of this important insect anew, that I might present it in a more correct and complete manner than was done in this early performance. I now come to execute this design; and I propose first to give a summary view of the history of this insect and its depredations abroad and in our own country, and then to present a description of the insect and an account of its habits and transformations, so far as they have at this date become known to me.

Its Foreign History.

The first notice which we find of the Wheat midge, carries us back to those days of ignorance when every remarkable phenomenon in the natural world was superstitiously regarded as an omen of some impending calamity. In the winter of 1740 the cold was so intense from Christmas till the middle of February, that the Thames was frozen over at London so solidly, that a fair was held on the ice of that river. We are told in Ellis' Modern Husbandman, that, "After this, we had a melancholy sight, for as soon as the wheat had done blooming, vast numbers of black flies attacked the wheat ears, and blowed a little yellow maggot which ate up some of the kernels, in others part of them, and which caused multitudes of ears to miss of their fulness, acting in some measure like a sort of locust, till rain fell and washed them off; and though this evil has happened in other summers to the wheat in some degree, and not done much harm, yet if the good providence of God had not hindered it, they might have ruined all the crops of wheat in the nation." (Hind's Essay, page 76.) The knowledge which we now possess of this insect, renders the crude ideas respecting it which we meet with in this extract, doubly interesting. The "black flies"

we recognize as the parasitic destroyers, hosts of which everywhere accompany the midge in its native countries. And the yellow larvæ washed from the wheat ears by the rains reminds us of their evacuating the grain when the straw is wet, being unable to adhere to and crawl down it when dry.

Thirty years later, a more correct knowledge of this insect had been obtained, as appears from a brief notice of it, given by Christopher Gullet, in a letter, "On the effects of elder in preserving growing plants from insects and flies," published in the Philosophical Transactions of the Royal Society for 1772. This letter shows the writer to have been a careful and intelligent observer. Under the third head, "The preservation of the crops of wheat from the yellows and destructive insects," he says—"What the farmers call the yellows in wheat, and which they consider as a kind of mildew, is in fact occasioned by a small yellow fly with (iridescent-) blue wings, about the size of a gnat. This blows in the ear of the corn, and produces a worm, almost invisible to the naked eye; but being seen through a pocket microscope, it appears a large yellow maggot, of the color and gloss of amber, and is so prolific that I last week distinctly counted forty-one living yellow maggots in the husk of one single grain of wheat—a number sufficient to eat up and destroy the corn in a whole ear. * * * These small insects are the crop's greatest enemy. One of these yellow flies laid at least eight or ten eggs of an oblong shape on my thumb, only while carrying by the wing across three or four ridges."

Some twenty-five years after this, when all Europe had become alarmed by the accounts of the appaling ravages of the Hessian fly in the wheat crops of America, and men of science were examining the grain fields to discover if any such insect existed there, Mr. Marsham, in the year 1795, brought the wheat midge to public notice, in an article published in the Transactions of the Linnæan Society, vol. iii, p. 142, and a subsequent one in vol. iv, p. 224; and the Rev. William Kirby, now in the dawn of his entemological eminence, gave quite an interesting and for the most part a very accurate account of its economy and habits, and its parasitic destroyers, in the same publication, vol. iv, p. 230, and vol. v, p. 96, describing the midge scientifically under the name *Tipula Tritici*, and naming its three parasites the *Ichneumon Tipulæ*, *I. inserens* and *I. punctiger*, by which names they continue

to be known, except that the advance of science has since led to a separation of numerous generic groups from *Tipula* and *Ichneumon*, whereby these insects now fall in genera bearing other names than these. As we shall have frequent occasion to refer to these articles in the following pages, a more particular statement of their contents in this place is unnecessary.

Little further notice was afterwards excited by this insect till about the year 1828, when, simultaneously with the commencement of its destructive career in our own country, it for a few seasons became very injurious in several parts of Scotland and England. East Lothian, so celebrated for its heavy crops, we see is stated by the North British Agriculturist to have yielded but fifteen bushels of wheat to the acre, in the years 1827–'8–'9–'30 and '31, in consequence of the wheat midge and mildew, whilst the four following years, from 1832 to '35, thirty-five bushels per acre was its average crop. (Cultivator, 1854, p. 69.) Its visit at this time elicited several communications in Loudon's Magazine of Natural History and other periodicals, by Messrs. Gorrie, Bell, Shirreff and others, which were soon after followed by Prof. Henslow's able account of it, in his Report on the diseases of wheat in the Journal of the Royal Agricultural Society, vol. ii, and subsequently, in the sixth volume of the same publication, appeared the invaluable articles and illustrations of this insect and its parasites, by Mr. Curtis, to which we shall also have frequent occasion to refer.

Upon the continent of Europe, the wheat midge appears to have been rarely met with and was scarcely known to exist there, at least as an injurious insect, till recently. In France it was first noticed in 1842, by M. Herpin, who met with yellow larvæ in the wheat ears, which were subsequently ascertained by M. Amyot to be this insect, as I shall more fully state hereafter. At several points in the north of France the harvests of 1854 and 1855 were unusually deficient. This untoward result was currently imputed to late frosts, fogs, excessive heat of the sun, and mildew. But M. Charles Bazin, of Fumerault in the department of the Yonne, upon directing his attention to this subject, immediately discovered in the wheat fields numbers of this yellow midge with yet greater numbers of another insect which appeared to be its parasitic destroyer; and he became convinced that this was the chief if not the sole cause of the deficiency in their wheat crops.

(Bulletins Soc. Entom. 1856, p. viii.) M. Bazin is assiduously continuing his observations upon the habits of these wheat insects, submitting specimens of them to Dr. Sichel and M. Amyot, distinguished entomologists of Paris, for the authentic determination of their scientific names. He has heretofore done me the favor of forwarding to me specimens of these insects, and the past winter, with another suite of specimens from him came one of the most precious remittances which could be made me from abroad for aiding me in the researches in which I am now engaged. This was a vial filled with different insects just as they are promiscuously gathered by the net in the wheat fields of France. I am hereby enabled quite accurately to compare the insect enemies which the cultivators of this grain in Europe have to contend against, with those which we are obliged to encounter here. And the result of this comparison as contained in a subsequent page of this report cannot fail of deeply interesting the reader.

Its American History.

Previous to the arrival of the wheat midge upon the American continent, a malady in the wheat appears to have sometimes occurred, which produced a similar appearance in the grain to that now caused by this insect. One of my neighbors has heretofore informed me he has a very clear recollection of the fact, that in his youth a field of wheat on his father's farm upwards of forty years ago presented the same aspect with which we are now familiar in fields infested by the midge—this field yielding but a scanty crop of very inferior grain. I have supposed it was probably some similar appearance seen in the wheat, that has led Mr. Elner Rowell to state that the midge occasioned injury in some places in Athens county, Ohio, in the year 1827. (Pat. Off. Report, 1852–'3, p. 252.) And to see if any further light could be obtained on this subject, in the Circular soliciting information upon the wheat midge issued by the State Agricultural Society in May, 1858, the query was inserted—"Before the midge came in your vicinity, is any instance remembered thirty years ago or more, in which a field of wheat was badly injured in the same manner it now is by this insect—with the heads rough and ragged and the kernels shrivelled? If so, state the year and the particulars so far as remembered." A negative response was

returned to this inquiry in all except two instances. John Johnston states that a number of years ago, perhaps about thirty, the heads of wheat were injured, resembling the heads injured by midge, but it was not midge, but a small white worm, which did considerable damage. The following year we still had a few, but since I have never seen them. (Transactions, 1848, p. 295.) Joseph Watson states that in Schoharie county about the year 1835–'6, a worm a quarter of an inch long, white with a brown head, appeared in the wheat heads, and roughed them, or the birds did it in catching the worms, but they have not appeared since. (Trans. 1848, p. 301.)

As this insect first attracted notice on this continent in the northwestern part of Vermont bordering on Canada, it has heretofore been a mystery to me how it could have become introduced so far into the interior of the country, some two hundred miles from the sea-coast, and fifty miles from Montreal, the nearest inland port open to the sea. A statement which we meet with in a letter from Hon. James S. Wadsworth, throws important light on this subject. He says that Mr. Coverdale, a neighbor of his, an Englishman by birth, resided in the year 1828 upon the St. Lawrence, forty miles above Quebec, and met with the wheat midge there, recognizing it as the same insect he had previously seen in England. (Transactions, 1858, p. 300.) Hence there is every probability that this insect was originally brought from Great Britain to Quebec, when lying in its larva state in some unthreshed wheat; and that it extended itself from thence along the St. Lawrence and Chambly (Sorelle) rivers, and thus reached Vermont—the inhabitants along those rivers being so little intelligent and the wheat crop there so scanty and uncertain, that any injury which the insect occasioned failed to excite public attention.

A letter in the New England Farmer (vol. xix, p. 301) from Solomon W. Jewett of Weybridge, Vt., one of the most distinguished farmers in his state at that period and a frequent contributor to our agricultural periodicals, forms our earliest record of the appearance of the wheat midge upon this continent. He states that it was first seen in northwestern Vermont in the year 1820, though it was not until 1828 and '29 that it became so numerous and destructive as to attract public attention. And all the other early accounts concur in representing it as having overspread the surrounding country from that point.

MIDGE. ARRIVES IN EASTERN NEW YORK AND MAINE.

Here in Washington county, N. Y., ono hundrod and fifty miles south of Canada line, previous to the arrival of the midge wo had intelligonce of its cutting off tho wheat crops to the north of us in Vermont, and that it was steadily advancing towards us. The larvæ or little yellow worms wore found in our wheat hore in 1830, and in 1832 they had so multiplied as to completely dostroy the crop in many fields. This was the year in which the malignant cholora swopt ovor our land, and it was a common romark that what the pestilence sparod famino bade fair to destroy.

It was currently reported that by mowing the whoat and drying it for hay whilo it was yet green and the worms were small, it would destroy them. This practice was rosorted to in numerous instances, in fields where such multitudes of worms were found in tho wheat ears as to rendor it evidont that none of the kernels would fill. But no benefit was perceived to result from this measure. For two or three years the wheat crop continued to be ravaged in this manner, when furthor attompts to raise this grain wore abandoned, only small patchos of wheat being afterwards seen here and there, in this quartor of tho country.

Previous to the arrival of this insect, a considerablo quantity of wheat was annually sent to markot from this county, but at no time since has it been able to grow but a small fraction of the amount it has needed for its own consumption.

Some two years later the midge was progressing on its way south, through the adjoining counties of Rensselaer and Saratoga, devastating the wheat fields there in the same manner it had done here. I well remember the merriment that was occasioned in one of the villages of the latter county in tho year 1834, by an aged and respectable though illiterate farmer, reporting through tho place that "thom pesky *weasels* had destroyed all his whoat." Yet thousands of our people continue to this day to speak of this insect under a name that originated in ignorance little less gross.

In the year last mentioned, the midge having advanced eastward across Vermont and New Hampshire, began to show itself in the state of Maine; and in tho opposite direction, it had become so numerous around Montreal as to injure tho crop there.

In 1835 and '6, over all the territory to which it had now extended and where wheat still continued to be sowed, it was so extremely destructive, that further attempts to cultivato this

grain were abandoned. Less interest was consequently taken in this subject, and for a few of the following years we notice but little on record respecting it, except that it continued to advance in our state west up the Mohawk river, and south along the Hudson, occupying Columbia and Dutchess counties. Though I see it occasionally mentioned as occurring on Long Island, I infer from the letter of Hon. J. B. Smith (Transactions of 1858, p. 297) that it has never invaded the eastern part of that island, and that probably at the southern extremity of our state the midge reaches a climate too warm and where the wheat crop comes forward too early for it to thrive and be destructive as it is farther north.

Having advanced up the St. Lawrence to Lake Ontario, it in 1849–'50 commenced its destructive career in the counties along the north side of that lake, travelling westward it is said at the rate of about nine miles each year. At the same time it was making a similar progress on the opposite side of the lake into the great grain growing district of our own state. Having extended itself through central New York, it was quite injurious in Seneca county in 1849, and appeared in Wayne county in the following year.

We now come to a remarkable period in our experience with this insect, showing how very tantalizing it is, and how unable we are from the indications of one or two years to form any correct judgment of what its numbers will be the succeeding year.

In 1852, although in those districts at the west where it had newly arrived it continued to do formidable injury, over all the territory where it had been longer established it appears to have occasioned but slight losses. And the following year, 1853, we were the most exempt from it that we had been at any time before, since its arrival. Here in my own vicinity, although the yellow larvæ were to be found in the wheat ears of some of our fields, they were so very few that it was the current report that no injury whatever had been done by this insect. This led to a much more extensive sowing of wheat than had been customary.

But the year 1854 proved to be one of the most disastrous to the wheat crop over the whole country, that had yet been experienced. It was devastated as it never had been before except when the insect had newly arrived, and in some localities it was even more destructive now than it had been then. When many

of the wasted fields were still remaining in public view, at the August meeting of the American Institute, Mr. Solon Robinson pronounced this insect to be the most terrible pest ever encountered by wheat growers. In my own vicinity many of the fields were not harvested. As illustrating the personal losses sustained by our agricultural population from this scourge, I may here state that one of my neighbors had sowed fourteen acres to wheat, on lands in excellent condition for this crop. But at harvest time there was nothing to gather therefrom, save the yellow larvæ, of which a handful, or at least a palmful might be obtained on slightly rubbing any one of the ears; and after toiling to feed and fatten the vermin he demurred against granting them the additional favor of a shelter within his barn. But for the midge his land would have yielded at least fifteen bushels per acre, showing his loss from this pest that year to have been upwards of two hundred dollars, estimating wheat at its usual price. And this is only an ordinary case, every neighborhood through the country abounding in similar instances among our common farmers, whilst on the larger farms where fifty and a hundred acres or more are customarily sowed to this grain the individual losses have been greater in the same ratio.

And when we attempt to reckon up the amount of damage sustained by the State of New York from this minute and seemingly powerless and insignificant insect, we almost distrust the evidence of statistics and figures, they present us with sums which appear so fabulous. The wheat crop of the State, notwithstanding the diminution it was receiving from the midge, amounted in 1850, according to the census of that year, to over thirteen millions of bushels (13,121,498). Now, if we suppose only one-third of this amount to have been wasted by the midge in 1854, estimating the wheat at $2.15 per bushel, which was its average value in our markets during the autumn and early winter of that year, it presents us with over nine million four hundred and three thousand dollars as the loss sustained. But this amount, enormous as it appears, is but an approach to the real loss, as we perceive when we recur to the facts that the crop on which this estimate is based was itself materially diminished by this insect, that a much larger crop was sowed in 1854 than in 1849-50, and that far more than a third of the crop was probably destroyed, since many fields were totally lost and others scarcely

repaid the expense of harvesting, whilst those from which anything that could be regarded as a fair crop was obtained were few indeed. Over large sections of the State it was reported that not a third or a fourth of an ordinary yield was received. Robert Howell, Esq., writing me this year from Tioga county, says—"This insect has done more mischief in this vicinity this year than ever before. A number of fields of wheat were not cut at all. The crop is not one-sixth of an ordinary one." And the statements from many other places were of the same purport with this. The most authentic information probably that this subject is susceptible of was obtained by the State Agricultural Society, which, in gathering the agricultural statistics of that year, inserted in its circular the query: "To what extent was the wheat crop in your vicinity injured by the midge?" The Secretary of the Society informed me, that on getting together all the replies to this inquiry, and placing everything at the lowest figure, so as to be certain the estimate was within the truth, the wheat which this insect had that year destroyed in our State, at its then current market price, exceeded in value *fifteen millions of dollars!* This amount would be more than a third larger, if estimated at the price to which wheat afterwards arose that winter. Indeed, the more we examine this subject the more we become impressed with the justness of the remark of Mr. J. Watson of Wayne county, who says, "the loss or damage to our country caused by this yellow mite it is hard to *over-estimate.*"

Through Western Pennsylvania, Ohio and along the eastern side of Indiana, the wheat is reported this year to have been cut off to a great extent by the midge. How it passed by Western New York and Canada West to reach these States and become so widely distributed over them, as it appears to have done, I know not. Its presence there, however, is too well authenticated to be doubted. Mr. Robert Richardson, who was familiar with this insect as it had appeared in my own vicinity, from whence he removed to Marion county in the central part of Ohio, this year (1854), informs me the larvæ of the midge had been noticed in the wheat of that vicinity about five years, he was told, their numbers being very few at first, but gradually increasing, till this year they made nearly a clean sweep of the crop. Many fields were not harvested and others were scarcely worth harvesting, one man obtaining but a bushel per acre. Mr.

J. H. Klippart, Secretary of the Ohio Board of Agriculture, reports the wheat crop of the State this year to have been less than twelve millions of bushels, whilst it was over seventeen millions the preceding and nineteen and a half the following year. From this it will be perceived that the amount of loss this year in Ohio closely corresponds with what is above stated of New York.

The Canadas also suffered in the same manner. This and the following years the wheat is stated to have been much injured by this insect along the Saguenay river some eighty miles beyond Quebec, this being the most northern point of its extent within our knowledge. About this time we see it is also spoken of in Nova Scotia as being "the most destructive of all wheat blight."

In consequence of the disastrous results of the year 1854 much less wheat was sowed in 1855 and '56, and the crops of those years in the eastern section of our State sustained but little injury. But in Canada the destructiveness continued without abatement, the loss there being estimated to exceed two and a half millions of dollars in 1856 (Hind's Essay).

The granary of our State, Monroe and Livingston counties, producing two and a half million bushels of the choicest quality of wheat, was now invaded. Mr. Wadsworth gives a succinct view of its career here, from which we extract as follows: The midge was seen here a little in 1854; it came from the east; more were seen in 1855, doing no material damage in Livingston but considerable in Monroe. But in 1856 the midge took from one-half to two-thirds of the crops in Livingston on the uplands and nearly all on the flats. At least two thousand acres, on flats which would have yielded thirty bushels per acre, were not harvested. It was still worse in 1857, taking over two-thirds of the crop. And in 1858, of the white wheats there were very little to harvest. Spring barley also was very much injured this year by midge, in some fields half to two-thirds of the crop being taken. Very little white wheat is now sown in western New York and the midge has reduced the value of all the wheat lands at least forty per cent. Lands which sold here readily for seventy dollars can now be bought for forty dollars per acre. (Transactions 1858, p. 300.) No words of ours can add anything to this graphic picture of the doings of this tiny insect.

In Canada the midge had in 1856 extended itself through the

counties along the lake shore west of Toronto and those bordering on the Niagara river, committing excessive ravages in the latter. It is also reported as having been seen this year at different points to the west of this and found common though not destructive along the Detroit river. On the Michigan side of this river it is said to have made its appearance previously, in 1853 (Hind's Essay.)

In 1857 this insect was again excessively numerous and destructive. Here in Washington county the wheat was so badly injured that many fields were not harvested. An intelligent farmer of Granville, whose business rendered him well acquainted with that town, informed me that full two-thirds if not three-fourths of the crop there was destroyed; and other towns were little if any more fortunate. Its ravages in the Genesee district (Monroe and Livingston counties) have already been mentioned. Through the state the loss this year probably exceeded what it was in 1854, the important western section now participating with the rest of the state in this calamity. In Canada it was also terribly destructive, taking one-third of the entire wheat crop of the province it is said, or about eight millions of bushels.

There was no wheat sowed in my neighborhood in 1858, the only time such an event has occurred, within my memory. A field of barley within my observation was as badly infested by the midge as wheat commonly is. Though this insect was prevalent over the country generally, this year, it does not appear to have occasioned important losses except in those western counties where it had newly arrived.

Early in 1859 we had exulting accounts from Seneca county that the midge had almost totally disappeared there, it being conjectured that the heavy frost on the night of June 4th, occurring when the insect was about changing to its perfect state, had destroyed it. It is more probable that having had its period of extreme destructiveness after its first arrival, it had now declined and measurably vanished, the same as noticed of it in so many other places. For other parts of the state to which the frost had equally extended had no such exemption. Here at the east the midge was certainly as common as it ordinarily is, and some fields were materially injured by it, although over the state generally the wheat crop of this year was a remarkably fine one.

One of the most unexpected and remarkable vicissitudes that has

ever been noticed in the history of this insect, took place within my observation in the following year, 1860. The flies made their appearance as usual in June. Reading by lamp light near an open window each evening, in order to observe the date of their coming abroad, it was on the 13th of the month this year that the first midge was seen alighted upon the paper before me. And the weather being oppressively warm and sultry, quite a number were noticed upon the two following evenings, in the same situation, and also smothered by the heat of the lamp's chimney and lying dead upon the table around it among a multitude of other midges, gnats and other small insects, this species being readily distinguished among them by its bright yellow color. The succeeding evenings were more cool and no more of the flies were seen. Not doubting but that they had all gathered into the wheat fields and that I should find their progeny there a few weeks later, no further notice was given them.

But, to my surprise, on going to the wheat fields in July, I could find none of the midge's larvæ there. I was quite solicitous of obtaining some of these larvæ, for further observations and experiments, preparatory to writing this account. I had never before experienced any difficulty in finding them. Common as I knew them to have been the year before, I felt confident that a few of them at least could be found now. But on examining the fields in different directions to a distance of four and five miles, not a single one could I anywhere discover. Now becoming eager to know if other places were similarly exempt, as the wheat was ripening and almost ready for the harvest, I made an excursion northward into Vermont to a distance of some fifty miles, looking closely at every wheat field along the roadside, and plucking and examining the ears of every variety of aspect that I could select upon the margin of many of the fields. But not one of the yellow larvæ could I find, and nowhere could a wheat head be seen that was ragged and torn by the yellow birds to feed on these larvæ therein. The ears of wheat were everywhere noticed as being remarkably large, plump and smooth; and wherever it had chanced to be sowed, through all this district, such a yield of wheat was this year obtained as only persons who were now in the decline of life recollected to have been produced on the same farms in their youth. Our local newspapers contained frequent notices of the large amount of

wheat to the acre which had been grown by one person and another in their vicinity. Thus there was every indication that this great evil had left us. As one of our leading city papers, the New York Tribune, was suggesting the importance of importing the parasitic destroyers of the midge from Europe, as the most feasible means of subduing this enemy that was occasioning such vast losses in our state and country, that periodical was informed that from the present indications the measure it was proposing would be unnecessary. On maturely considering all the facts, the opinion to which I arrived at this time, and which I expressed both publicly and in private was, that it must not be supposed that this insect had wholly left us. Scattered here and there in the wheat heads, so sparsely as to elude detection, it was probable that a few of these larvæ had been present, sufficient to continue the species. But if so, its numbers were so extremely limited, that it would be impossible for it to come abroad the following summer in sufficient force to do any appreciable injury to the wheat crop. Therefore this grain might be liberally sowed, in the eastern section of the state at least; for, though other casualties might perchance occur to prevent so abundant a yield as had now been obtained, we had every assurance that this most dreaded of all enemies, the midge, could not multiply sufficiently to molest this crop to any sensible degree the following year.

Beyond the sphere of my own observation, it appeared from the statistics returned to the State Agricultural Society, and from information given me by persons assembled from the different sections of the state at the annual meeting of the Society, that a few of the yellow larvæ had certainly been present in the wheat this year, in Seneca, Madison and other central counties of the state, whilst farther west, particularly in the Genesee district, they had been quite abundant, though probably, from the season having favored a vigorous growth of this crop, a good yield of wheat had been obtained, notwithstanding their presence.

It was with the liveliest interest that I awaited the developments of this present year, 1861. I thought it doubtful whether I should see any flies of the wheat midge this year. But, punctually as the period for their coming forth returned they made their appearance, two being seen around the lamp, June 11th, and several more the following evening. And June 14th, upon repairing to a field of winter wheat, now little more than knee high and with

the heads just protruded from their sheaths, to my astonishment I found the flies present thereon in abundance, and already busily engaged in depositing their eggs. Of no fact was I ever better assured—there had not been a sufficient number of larvæ last summer in all the wheat fields in this neighborhood to produce one-tenth of the number of flies which I there beheld. The conclusion is irresistible, therefore, that these insects had been nurtured in some other situation than in the wheat. And for nearly a month this field continued to be thronged with these flies; their larvæ soon appeared in the wheat ears; the yellow birds somewhat later commenced opening the chaff to feed upon these larvæ, and everything took place in its customary round. Though as these pages are closing for the press, the wheat is not ripe for the harvest, enough is revealed to show that the crop in this field will be severely injured, and that other fields in the neighborhood will suffer to a considerable extent. A person in passing my door, calls to make enquiries on this subject, saying that through his town they find the yellow larvæ so numerous in the wheat ears they fear the crop will be ruined. Beyond this I have no intelligence as yet of what the result of this year's harvest promises to be.

The first arrival of the wheat midge at any locality is discovered by a few of the larvæ occurring in the heads of the growing wheat after it has flowered and before it is fully ripe. The next year these are found to be much more numerous. And usually by the third year it becomes so multiplied as to almost totally destroy the crop. And this destruction continues, so long as its purveyor, man, will furnish it the amount of food which its legions require. But man soon tires of laboring exclusively for its benefit, and after two or three years he abandons the cultivation of wheat. The insect now appears to nearly vanish. The few small patches of wheat which continue to be grown are but little molested, and the idea becomes current that the insect is "starved out." The growing of wheat is thereupon ventured upon somewhat more extensively, when it soon becomes evident that the enemy is still there in full force. Every few years a season peculiarly favorable to it occurs, when the wheat crop is everywhere devastated by it. In the intervening periods its depredations vary from light to severe. And no one is able to foresee when it is safe to give his land and

labor to this crop. Though the insects are very few one year, they may be excessively numerous the following year. And from no circumstance can it be known at the time of sowing wheat whether the crop will be remunerative or a total failure.

Wherever the midge arrives it permanently remains, laying the wheat crop largely under contribution for its support, and rendering the cultivation of this grain too uncertain to be hazarded except to a very limited extent. Thus throughout the older settled portions of the Northern States and British Provinces, the breadth of land sowed to wheat at present makes no approach to what was customary before this insect invaded us. Every farmer then made it a matter of pride to raise at least all he required for bread for his own family, and every district sent a considerable surplus each year to market. But in consequence of the presence of this insect, over all the New England States and all New York and Canada except their western parts, wheat has wholly ceased to be a staple product, and in its stead wool growing and dairying have become the leading pursuits. These require more land and fewer laborers than grain culture. And thus this insect has done much towards rendering our population stationary and declining, as it has been for a few of the last decades, in the rural districts through all the vast region alluded to. It has been one prominent cause of that extensive emigration to the new lands of the west which has been going on during the past thirty years. Men have disdained remaining here, tilling lands which would no longer yield them the bread they required for their own sustenance. And it is with a melancholy interest that we contemplate the changes which this insect has thus in many instances effected. Upon one of the Vermont hills within sight of my residence, from which in former years seven stalwart men regularly made their appearance at the militia musters and other public gatherings of their town, the hearth fires are now all extinguished, the humble dwellings are demolished, and only the bleating of sheep greets the ear where the merry prattle of children was then heard—by a command as imperative as that of the angel to Lot in Sodom, these men, one after another, having been impelled to seek elsewhere that bread for their wives and little ones, which they found they could no longer glean upon that hallowed spot, "wedded love's first home."

The Fly and its Habits.

It is a little before the middle of June, in Eastern New York, that the fly of the wheat midge comes abroad each year, to deposit its eggs in the wheat ears. Straggling individuals may sometimes be seen, several days before the time of the general hatching of the brood. Thus, I once met with one of these flies upon the first day of June. I have frequently noticed that about the twelfth day of June, two or three very hot sultry days occurred, bringing these flies out suddenly in full force. This is the time when our farmers are usually engaged in the first hoeing of their Indian corn, the leaves of which are but a few inches high. The white flowers on the locust trees are now fading and beginning to drop to the ground. And the same sultry evening air which brings the midge abroad, also brings out the earliest fire-flies. In different years I have observed that it was upon the same evening on which the first solitary sparkling of this insect was seen that the first midge was also noticed alighted around the lamp. These marks will probably serve better than the date at a particular locality, to indicate the time when the flies of the wheat midge are making their appearance, as they doubtless come out somewhat earlier to the south and later to the north of us. And if the weather be equable, with no very warm days towards the middle of June, their hatching will no doubt be more gradual, new individuals continuing to come forth for a week or more.

I suppose it to be mostly in the night time that the flies are disclosed from their pupæ, coming out in those fields where wheat was grown the preceding year; and they are immediately flying about, everywhere, in search of the fields where wheat is now growing, in which fields they become gathered, mostly within twenty-four hours, it is probable, after they are hatched. The sexes in the meantime having paired, very few males ever accompany the females to the wheat fields. Hence, in addition to their other crimes, these insects have been supposed to be most gross polygamists, as not one male could be found among the wheat where were hundreds of females. But the few flies I have bred from the larvæ, have given a much less disproportion in the relative numbers of the sexes than has hitherto been supposed. I have captured male flies among the wheat in only a

few instances, and these, so far as I can recollect, have always been where wheat was reared upon the adjoining lands the year before. Collectors will probably supply themselves with the males most readily, by searching for them in the last year's wheat fields, at the time when the females first begin to appear abroad.

Each fly probably lives about three weeks, under ordinary circumstances. Thus they continue to be seen abroad about a month, their numbers lessening in July till towards the middle of that month, when the last ones disappear. But in years when this fly is very numerous, and especially if the season be a very wet one, they continue much longer. Thus, in the year 1845 a few of them continued to be met with upon the window panes, almost daily, until the sixteenth day of August.

Many persons have the idea that these insects always come abroad at a particular time in the year, regardless of the state of the atmosphere. Hence, when warm genial weather brings vegetation rapidly forward in May or the early part of June, we frequently hear it remarked, that the wheat will hereby be so much forwarded, probably, that it will escape injury from the midge. But the truth is, the same temperature which advances or retards the progress of vegetation operates similarly and to an equal degree upon the insect tribes. A warm season hastens, a cold season retards insects and vegetation alike. Consequently each particular insect comes forth at the very time when the vegetation on which it preys is so advanced as to be adapted to its wants. Of this, as a general law of nature there is the fullest evidence. And that these small delicate insects are no exception to this law is quite certain.

In order to demonstrate the influence of temperature in maturing and bringing forth this group of insects to which the wheat midge pertains, on the sixteenth of March, when the Willow gall midge (*Cecidomyia Salicis*, Fitch) was passing from its larva into its pupa state, I gathered a quantity of the galls containing this insect, and inclosed them in three glass bottles, putting ten galls in each bottle. One of these bottles I placed in a room warmed night and day to a temperature of about 70 degrees of Fahrenheit's scale; the second I placed out doors, in the shade; the third bottle was placed on the surface of ice in an ice house. In ten days six flies had hatched from the galls in the warmed room, the

other galls in this first bottle giving out parasites afterwards. In forty-five days after they were inclosed, (May 1st) five flies came out in the bottle out doors, their parasites subsequently appearing as in the first case. From the bottle in the ice house, four galls were now taken and placed out doors in a separate bottle. From these two flies hatched fifteen days afterwards. Finally, the bottle in the ice house with the six remaining galls was taken thence and placed out doors on the first of June, and a fly came out therein on the twelfth of June, nothing more coming from these galls afterwards.

Thus it will be seen that the Willow gall midge, which naturally comes abroad about the first of May, can by cold be delayed in its appearance till some six weeks after that time, or by warmth it can be brought out six weeks before its time. Indeed, it may be brought out at any time during the winter, by placing the galls in a warm room, as I have repeatedly done.

It is also worthy of notice, that these insects had made no advance during the ten weeks they were lying in the ice house, as the galls were twelve days in giving out their insects in June, when the temperature out doors was near what it was within doors in March, where they had hatched in ten days time. It thus appears that when they are in a temperature which is down nearly to the freezing point, these midges and probably most other insects remain stationary.

The most important characteristic of this fly of the wheat midge is its extreme sensitiveness to the hygrometric condition of the atmosphere. Moisture is its life; dryness smothers and suffocates it. It is active and perfectly at home in a humid atmosphere; a dry atmosphere it cannot breathe, it cannot endure. This statement is confirmed by numerous observations, and this simple fact serves to explain most of the other things which have been noticed and recorded in the economy and habits of these insects.

In consequence of this sensitiveness the fly is unable to remain about the wheat heads during the day time in ordinary weather. The warmth of the sun renders the atmosphere so dry there that it cannot abide it. It therefore drops itself down to the lower part of the stalks of the grain, in which shaded situation the humidity arising from the ground renders the atmosphere congenial to it. It there remains at rest during the heat of the day,

standing upon the grain stalks with its head upward. As the sun declines and the dews of evening are beginning to fall, it leaves its retreat and returns to its operations upon the wheat heads. Whilst the sun is yet shining, numbers of them may be seen returned to their work upon the wheat heads, indicating that it is not the light of the sun's rays as has heretofore been supposed that they avoid, so much as the drying heat of those rays. Upon damp cloudy days, also, the insect remains at its work upon the heads as active as during the night. Or if a tree be standing in the field, or a forest borders it upon one side, within the shade thus produced it continues its operations more or less during the day. And hence, as has often been noticed, those spots which are shaded by trees have been severely devastated or even destroyed when all the rest of the field was but little injured.

Hence also, wheat fields upon low lands, in the valleys and upon the flats along rivers, are always more injured by the midge than those upon the more dry uplands and hills. This has been noticed everywhere. And where a field has low marshy spots within or adjoining it, the grain adjacent to such spots is very perceptibly injured worse than it is elsewhere.

As it is from the middle to the end of June that this fly is abroad and actively engaged in depositing its eggs, if the weather at that time is extremely dry the wheat crop that year escapes injury; whilst, on the other hand, if the last half of June is unusually wet, cloudy and showery, this grain will be severely devastated. From the close observation I have been giving to this subject the past and present years, the one having a dry the other a wet June, as fully narrated on a preceding page, I do not doubt but that I am safe in stating the above as a general rule, although I have not at hand such meteorological records as enable me to be fully assured that such has been the state of the weather in June, in every instance when this insect has been very numerous on the one hand or very sparse on the other. The few notes, however, touching upon this matter, which I am able to meet with among my memoranda, are probably of sufficient value to be here presented. I find it noticed in 1852, that it was remarkably dry and our streams of water were all unusually low the last of June; and in 1853, that the weather was very dry in June but not afterwards. Upon referring to the foregoing history I have prepared of this insect, I find I have stated that in these two

years the midge had so nearly vanished that our farmers thought they might sow wheat without fears of its injury by this enemy. And then came the disastrous year of 1854. I find I have made a note of this year as having been one of the driest ever known through the Northern States. But did this drouth commence before July? Records which I have not at hand will show. With the views I have confidently formed, the last of June this year could not have been dry. (P. S. I find in the Cultivator of October 1854 (p. 307) a record of S. B. Buckley, showing that at Dryden, N. Y. this year April was a wet month, seven inches and 80.100ths of rain falling; in May 2.82; June 3.58; July about one inch; on the second of August half an inch, and none afterwards that season. This corroborates the opinion I had formed.)

I next come to consider the marks by which we recognize an insect to be the wheat midge. What are the characters by which we can distinguish this fly from all others? To answer this question would embarrass Linnæus himself. In the present state of our knowledge we are quite unable to erect such landmarks and draw such lines as will clearly include all the flies of this species and exclude all others. We doubt whether it will ever be possible to do this.

I may say in general terms, that, as I now no more meet with individuals having spotted wings, I regard all the bright yellow midges which occur in our wheat fields during the latter half of June as being this species. And this is the most simple and clear definition of the wheat midge I am able to give. But in the swarms of this insect which occur upon wheat, particular individuals will be found varying so far from the others, that, were they captured anywhere else, we could scarcely deem them to be this species. Thus dwarfs are met with, not more than half the usual size. Their color varies, many being paler, of a lemon rather than an orange yellow, or as pale even as cream color. The wings, generally perfectly clear and glassy, are in some individuals perceptibly smoky. And when we come to minutely examine particular organs and members, the antennæ for instance, or the veins of the wings, we so frequently meet with portions of them which are abortive or atrophied and so abnormal, that we despair of finding in parts subject to such defects, any characters which can serve to rigidly distinguish this from other species. How much then is our embarrassment increased when we take in

hand specimens which we gather in other situations than on wheat, those which we sweep from grass and weeds, or capture from the window panes in our dwellings, where this species occurs imperfectly developed perhaps, from having been nurtured in the grasses on aliment less nutricious and palatable to it than that of the wheat, and where we find it in company with other midges similar to it in their color and size. Every one will be sensible, from these remarks, that when found in other situations than on the wheat it will often be impossible to determine whether a specimen we have in hand is this or some kindred species. We can only recognize it then, as being the wheat midge, when it clearly shows certain characters, which we regard as the essential marks of this species, all of which marks no other species except this can possess. And the marks whereby I pronounce a specimen found elsewhere than on wheat to be this species, are

The body nearly one-tenth of an inch long, bright orange or lemon yellow, and tarnished or slightly smoky on the back forward of the wings; the wings clear and glassy and having a small cross-vein near their base; the antennæ about as long as the body and composed of twelve oblong joints which are narrower in their middles and separated by short pedicels.

We are assured a midge-fly is this species when it possesses all these characters. But many flies also pertain to this species which do not fully possess them, some departing from the standard in one, others in another particular, whereby it happens that no one of these characters is constant and found in all the members of this species.

We proceed next to describe the different parts of this insect, as they appear in the FEMALE (Plate ii, fig. 1,) this alone being the sex which we meet with in the wheat fields.

Its LENGTH is usually about 0.08, but dwarfs are common, as small as 0.05, and I have even met with individuals which alive measured but 0.03.

The HEAD is of a spheroidal or flattened globular form and is held in a vertical position. The eyes are very large, occupying two-thirds of the surface of the head. They are of a coal black color and are separated from each other above, merely by a slight slender cleft, so that when viewed in front they appear like a continuous broad black band surrounding the head and interrupted only below at the mouth. The face is pale yellow. The antennæ are of a deep brown or black color, less intense than the eyes. They are about equal to the body in length, and are composed of twelve regular joints, in addition to the spherical pale yellow eminences on which they are inserted, and which should perhaps be regarded as forming an additional joint, although so dissimilar in shape and color. Each joint (see Plate ii, fig. 7,) is oblong, with a very obvious contraction in its middle, and is surrounded by a whirl or row of hairs near its base and another near its apex. The joints are about thrice as long as they are broad, their thickness being a little less than that of the legs. They are connected together by slender threads or pedicels intervening between each joint, which pedicels are about a fourth as long as the joints. The palpi are pale yellow and clothed with shortish hairs.

The THORAX or forebody is egg-shaped and broadest immediately back of the wing-sockets.

It is pale yellow on the breast and on the back ochre or tawny yellow, darker anteriorly and often smoky, this color sometimes appearing as three short stripes or longitudinal spots forward of the middle. The poisers are large, with oval honey-yellow heads.

The ABDOMEN or hind body varies greatly in its size and form as it is more or less distended with eggs and aliment. Its normal forms appears to be oval, as represented in fig. 3 of plate ii, when it is often but little longer than the thorax, and closely resembles the larva (fig. 11) in its shape and sutures, having also the same granular surface. It is seven-jointed, the joints of a square form, much more broad than long, except the last joint which often appears round like a ball, as represented in fig. 2, or if this joint is a little more protruded it becomes obovate. But when the abdomen is distended with eggs and the fly is engaged in depositing them, its hind part becomes prolonged and narrowed, as represented in fig. 1, this being the shape it usually has as we see it in the wheat fields, two small additional joints now protruding more or less from the round joint above mentioned. These two additional joints will be noticed more particularly hereafter when we come to describe the manner in which the eggs are deposited. The ends of two minute appendages are also commonly seen protruded more or less from the tip of the abdomen. In color, the abdomen is usually of a uniform bright orange, more inclining to red than to yellow; and when the insect is crushed on white cloth or paper it imparts this orange stain to it, which however fades and wholly disappears after a time.

The LEGS are very long and slender, the thighs, shanks and second joint of the feet being about equal to each other in their length, whilst the third, fourth and fifth joints of the feet are successively shorter and the first joint shortest of all, being little longer than thick. The legs are of a dull opake clay yellow color, sometimes with the ends of the feet or bands on some of the legs of a rose red. The legs and body are clothed with minute, slender, longish hairs.

The WINGS are a little more than twice as long as wide, and are hyaline and colorless, resembling thin plates of glass or mica, and reflecting the colors of the rainbow, particularly the violet, when the light falls on them in certain directions. Their margins are densely fringed with longish hairs and their surface is covered with very minute pubescence. Four *veins* may be distinguished, running lengthwise of the wing, the same as in all the other species of Cecidomyia, though in some species they are much more distinct and fully developed than in others. I shall carefully describe these veins here, so that when I speak of them in other places I may be definitely understood. The four veins (see the enlarged wing, fig. 5, plate ii) are an outer, an inner, and two middle ones. The outer, or *submarginal* vein as it is usually termed by entomologists, is but slightly separated from the outer edge or side of the wing, with which it becomes united before it reaches half the length of this side. The next or middle vein, which is the principal one, being more coarse and distinct than the others, and corresponding with what I have usually termed the midvein in other insects, and in the leaves of plants, is named the *postcostal* by most entomologists, but by some the *mediastinal* and by others the *externo-medial*. This runs straight or with a scarcely perceptible curve, to the end of the wing, where it frequently causes a small notch in the margin. Towards its base it is slightly bent at one point, and here it sends off a small veinlet or cross-vein, which runs obliquely outward and slightly forward, connecting this middle vein with the outer vein near its middle. The next or inner one of these two middle veins, and which may therefore be termed the inner middle vein, is technically named the *internomedial* or by some simply the *medial*. This is the most faint of all the veins, being only perceptible when the wing is held for the light to fall upon it in a particular direction. It is then seen to be straight, coming off from the midvein near its base and running to the inner margin of the wing at a point three-fourths the distance from the base to the tip. The first half of its length is less distinct and can seldom be traced to the point where it originates. The inner or *anal* vein is but slightly distant from the preceding, and is quite slender, but perfectly distinct. It slightly diverges from the middle vein as it extends backward in a straight course about half the length of the wing, when it abruptly forks, one branch running straight in a nearly transverse direction to the inner margin, and the other branch, which is more faint and obscure, curving outward and backward till it approaches quite near the inner middle vein, parallel with which it then extends onward to the margin, although here

only one of these veins is seen in the same incidence of the light, for as the wing is gradually turned to bring the other vein into view it causes the first to vanish.

The MALE (Plate ii, fig. 4), has so successfully eluded the search of collectors that it has only been discovered in a few instances. Mr. Kirby was unable to find this sex, and Mr. Curtis states he has never seen it. The first season of my observations, as an occasional individual of this sex which I discovered among the hosts of females in a wheat field corresponded with one bred in a vial from larvæ disinterred from among the stubble in an old wheat field in March, I was assured that these were the true males of this species, notwithstanding they differed so greatly from the females in their antennæ and the form of their bodies. The antennæ in this sex are remarkably long, slender and delicate. They are double the length of the body, and are composed of twenty-four joints of a very exact globular form (Plate ii, fig. 6), resembling a row of beads parted from each other on a string, each joint being separated widely from its fellows, the pedicel or thread between being about twice the length of the joint itself. A single row of hairs surrounds each joint, in a whirl. The abdomen, instead of being oval or egg-shaped and narrowed at its base as it is in the female, is here broadest at the base, and thence tapers gradually, though slightly, towards the apex. Its last joint, however, is broader than the one or two preceding it, and is kidney-shaped or convex in front and concave behind. The male is also smaller in size than the female. In all other respects, such as color, the veins of its wings, &c., it corresponds with that sex.

Now that I have come to speak of the wings of the wheat midge and their veins, or nerves as they are often but I think less correctly termed, it is necessary that I should recur to a topic of considerable interest which has arisen from some of the representations of these parts which were made in my first essay on this insect.

When that essay was prepared, this new and terrible enemy of our wheat crops had been prominent in public notice some twenty-five years. Much diversity of opinion existed with respect to it; and what was its real name and nature, whether it was an animalcule, a worm, or the larva of an insect, was a subject of much discussion and earnest enquiry, no one in the whole country feeling himself competent to investigate and decide this mooted topic. I, locally known as a collector of insects, was repeatedly applied to for an opinion, which, being only acquainted with insects in their perfect form, I was unable to give. It was first suggested that it was the English *Cecidomyia Tritici* by the late Judge Buel, who, in a report on this enemy, presented to the State Agricultural Convention at Albany, February 1st, 1838, stated it as his belief that it was that insect, and cited the short notices contained in Kirby and Spence's Entomology and Low's Elements of Practical Agriculture as the ground of his belief (Cultivator, vol. v, p. 27). And three years afterwards, Dr. Harris, in the first edition of his Treatise, p. 439, gave our insect as "resembling in its destructive habits" the *C. Tritici.*

This is briefly the posture in which this matter stood, when, as

already stated, I was desired to contribute entomological articles to a scientific journal, I selected this as a subject which of all others would most interest the public and stood in the most need of any elucidation I might be able to give it.

Upon considering the facts, that in this country from the time of its first settlement wheat had been the leading staple crop and was in universal cultivation with no malady like this ever known to molest it until this creature suddenly appeared at a particular point and from thence gradually spread itself in all directions, I could not doubt that it had been newly introduced here from some foreign country. And Britain as being the country with which we had the largest commercial intercourse was evidently the source from whence it would be most apt to be brought. Therefore, if there was any depredator on the wheat similar to this in Great Britain, there would obviously be a strong probability that this was the same thing. And thereupon instituting a most careful comparison of our insect and its habits with all the particulars given in Mr. Kirby's original papers on the *C. Tritici*, and what I could glean in addition thereto from other sources, I became sufficiently assured that it was the same species. And further, when I came to know that it was common for the larvæ of this insect to lie quiescent in the ears of ripened wheat for several months without losing their vitality, and that an ear of wheat therefore could not be brought from England to this country without being liable to bring a dozen of these larvæ lurking in it, I saw that its arrival here was inevitable; and my only surprise was that it had not reached this country long before it did. Finally, my drawings of this insect had been completed and sent to the engraver and my descriptions had been written, whereby all the minute particulars of the structure of its different parts were perfectly fresh and distinct in my mind, when Mr. Curtis's article and the invaluable illustrations accompanying it came into my hands. The peculiar form of the joints of the antennæ and several other details not stated in Mr. Kirby's description but which I had carefully noticed in our insect, were so exactly represented by Mr. Curtis that assurance now became doubly sure. Everything thus concurred to convince and render me positive that our insect was identical with the *Cecidomyia Tritici* of England. And it is seldom that a decision has been

pronounced on a subject of this kind upon grounds more clear and strong than I think I possessed in this case.

This same subject was at that time in much the same posture in France that it was in this country. M. Herpin in his interesting Memoir on divers noxious insects, published in the Memoirs of the Royal and Central Society of Agriculture for the year 1842, gave a short account (page 366) of some little yellow larvæ which he found near Paris in the ears of wheat at the time of their flowering, and which appeared to him to be closely analogous to those of Mr. Kirby's *C. Tritici*. It thus became known that an insect similar to the wheat midge existed in the wheat of France, but whether it actually was that species remained in doubt, until one of the Paris entomologists, with whose published works I have for many years been familiarly acquainted, and have thereby come to esteem him as one of the most eminent of my cotemporaries in this science, M. C. J. B. Amyot, sought to determine what insect this was. In 1850, going to the locality mentioned by M. Herpin, he discovered the same larvæ in the wheat ears, and says of them, their perfect resemblance to that which M. Asa Fitch has figured (alluding to fig. 11 on plate ii) does not permit me to doubt their being the same species which has caused so great damages in America and England, or at least a species very near it and having the same destructive habits. The following year M. Amyot received from M. Herpin upwards of twenty specimens of the perfect insect, which had been gathered five years before and preserved in a vial of alcohol. Now, on most carefully scrutinizing these specimens and comparing them with Mr. Curtis's figure of the British and mine of the American insect, he noticed in my figures a short transverse veinlet represented as connecting the middle vein of the wings with the outer vein. This veinlet is not represented in Mr. Curtis's figure, nor could M. Amyot detect it as occurring in any of the specimens before him. He hence came to the conclusion that the French insect was identical with the English and was the true *Cecidomyia Tritici* of Mr. Kirby, and that I was in error in pronouncing our American insect to be the same species. A full statement of this examination and its results he communicated to the Entomological Society of France, accompanied with an extended summary of the contents of my Essay, which was published in the Bulletins of the Society for the year 1851, pages lvi–lxii.

That this subject might be more conclusively determined, M. Amyot wrote to me, requesting me to send him specimens of our insect. But his letters failed to reach me, and I remained wholly ignorant of the matter above stated, till the year 1855, when tidings of them and of M. Amyot's desire of specimens from this country came to me through my valued friend and correspondent, Dr. Signoret. Not knowing the ground on which M. Amyot had distrusted the correctness of my determination and inferring it most probably to be on the general principle that the insects of the two continents are different, and that it was not to be supposed that such a small delicate fly as this could make its way across the Atlantic, I aimed to send from my almost exhausted supply, specimens which would most readily show the *facies* or general aspect of this insect. I accordingly forwarded to Dr. Signoret for him two of my best displayed examples, glued upon small pieces of card; though I am now aware it would have been better had I sent him specimens on pins, that he might examine their wings by transmitted instead of reflected light.

The result of M. Amyot's examination of these specimens he communicated to the Entomological Society at its meeting November 14th, 1855 (Bulletins page civ,) from which I make the following extract:

"I have submitted these specimens to a most scrupulous examination; I have compared them with those which I gave four years ago to the Paris Museum of Natural History and which M. H. Lucas has had the care to preserve perfectly in alcohol. They have been placed side by side under the microscope. M. Lucas and I have noticed them with the closest possible attention, and all our doubts have hereupon vanished as to the real identity of the American species with ours. M. Asa Fitch therefore was not mistaken. This terrible plague of the crops in America has really come from Europe; it is a gift which the old world has unfortunately made to the new, with civilization.

"The difficulties which I saw in recognizing the identity in question arose from the figure of the wings given by M. Fitch, particularly from the transverse nervure, which in that figure unites what I have called the *post-costal* nervure to the side. It is in this manner that this difficulty disappears—this transverse nervure does not exist in nature. M. Fitch must have been misled, we think, by a mere indication; there is a slight *elbow* to the

post-costal norvure at the point where he thinks he has seen that transverse nervure. This, we think, has been the cause of his error. This kind of *elbow* appears also in our European specimens, but it is plain that the transverse norvure supposed by M. Fitch to occur hore, does not exist. M. Curtis, moreover, has not figured it, as we have already said in our communication relative to this subject. Will M. Fitch vouch, after a new examination, that it does really oxist? In that case, he will also state, we doubt not, why neither M. Curtis, M. Lucas, nor I, have seen it."

As the all-important point, the identity of our insect with that of Europe, was so fully settled by this communication, and as my attention was at that period wholly occupied with the insects on fruit and forest trees, from which I expected in one or two seasons to pass again to those on grain crops, I deferred the examination to which I was invited by M. Amyot's closing remarks, until I should reach this subject, and have fresh specimens in my hands, like those from which my figures were originally taken. Hereby the proposed examination has come to be deferred much longer than I anticipated; but fortunately, by this delay, additional materials have come into my hands, whereby I have now been able to render it more complete and satisfactory than I could have done at any previous period.

That the common reader may distinctly understand the subject under consideration, let him turn to the enlarged figures of wings on plate ii, figs. 5 and 18. You here see a vein represented as running straight to the end of the wing. This is what I have termed the middle or post-costal vein. At one point towards its base you notice it is slightly bent, like your *elbow* when your arm is held almost straight, and hereby this middle vein, as it runs backward from its commencement, slightly approaches the side of the wing till it comes to this bend or elbow, after which it gradually recedes from the side. And from this elbow you see a small veinlet or cross-vein is represented as running to the side of the wing, or rather to the outer vein, which so closely approximates the side that it appears merely as a split in the vein or rib which forms the outer edge of the wing. This cross-vein is the same in these figures now as it was originally, except that I have directed the engraver to make it more small and slender, and I have not yet seen the revised proofs of the plate thus amended.

Now, the question at issue is, does this small veinlet, cross-vein, or transverse nervure, exist in the wing of the wheat midge? In my figure of the willow gall-midge, published a few months before this, as an introductory to my essay on this insect, no such veinlet was represented, nor in my figures of the Hessian fly, published the year after. But, as just stated, it was represented in these figures of the wheat midge, and in the text of my essay, in describing the outer vein or nerve, I said, "From its middle it sends a small connecting nerve backward to the post-costal." Mr. Curtis, however, does not represent any such veinlet, nor could M. Amyot or M. Lucas detect it on a most careful scrutiny, either in several French specimens preserved in alcohol, or in two specimens sent from me gummed upon card. In the insects of both countries M. Amyot perceives the slight elbow to the middle vein, which my enlarged figures show, and is led to think I may have supposed from this circumstance that a veinlet was given off at this point.

I, on the other hand, may well ask, how an elbow comes to be formed here, if no veinlet is given off at this point? For, so far as I have observed, in all those species of Cecidomyia in which there is no veinlet the middle vein is perfectly straight; whilst in those having a veinlet, this vein is always perceptibly elbowed. I may add that the bend or elbow in the middle vein appears to be slightest where the veinlet is placed transversely, greater where it is oblique, and greatest where it is longitudinal, the angle formed at this elbow being about 135 degrees in one species known to me, in which the veinlet forms a perfectly straight line with that portion of the middle vein which is back of it.*

* The species alluded to probably should be described in this place; and it may well be named in honor of one who has brought this cross-veinlet so prominently to notice, as furnishing an important distinctive mark of the species in this large and difficult genus.

Cecidomyia Amyotii.—Female, 0.08 long; wax yellow; thorax anteriorly dusky or with three dusky stripes; antennæ one-third the length of the body, black, of eighteen (?) joints, not separated by pedicels, the joints globular, those towards the base becoming longer and turbinate; legs blackish, inside yellowish gray; wings smoky, with a veinlet, which is longitudinal and rectilinear with the middle vein back of it. Three individuals taken June 13th, in the evening, around a lamp.

In this species the outer vein is bent like a bow, whereby the cubital cell is elliptic and pointed at its base the same as at its apex. The middle vein forward of the elbow is flexuous, running from the elbow first inward and forward to its junction with the inner middle vein, in a straight line with which it then extends forward and slightly outward till near its base it again curves inward. Hereby the basal cell is broader towards each end than in its middle. The inner middle vein is straight, and very distinct where it is given off from the middle

MIDGE. FLY. THE VEINLET IN THIS SPECIES.

But to carefully reëxamine the subject in question, when these insects first made their appearance this year, I gathered numerous individuals from the wheat ears, inclosing them in small vials, closely stopped with corks. Next day, they being dead, I submitted them to a particular examination, entering in my manuscripts a figure and description of the exact appearances of this portion of the wing under the microscope in one individual after another, until I became fully satisfied upon this subject. And I will now state the result.

In a dwarf individual of a pale color the middle vein in both wings was defective or atrophied for a short distance here at the elbow, without any indications of a cross veinlet. In other small sized individuals the middle vein was perfect and upon its outer side at the elbow was found sometimes an acute pointed tooth, at other times a blunt stump-like projection, its length equalling or exceeding the diameter of the middle vein. But in individuals of the ordinary size, in every instance examined, I found the veinlet in question, extending from the elbow of the middle vein across to the outer vein. It is usually slender, its diameter only about a third the diameter of the middle vein, and frequently its junction with the outer vein appears to be somewhat imperfect. Instances occur, however, in which this veinlet is thicker, sometimes even equaling the middle vein in its diameter. Moreover, this veinlet, however slender it may be, I perceive, perfectly distinctly with a common magnifying glass, on holding the wing between my eye and the light.

After examining a number of these recently gathered specimens, I opened the vial of dried French specimens, gathered by M. Bazin, and sent to me by him, very probably on M. Amyot's suggestion. I select one having a wing unbroken, and on holding it between my eye and the light, I with the magnifier see this veinlet quite as plainly as it had appeared in the fresh specimens. Under the microscope it is equally distinct, having a third of the diameter of the middle vein. I next open to some specimens from England, sent me by Mr. Westwood many years ago. These are glued upon card, but in a good light, with a magnifier I see this

vein; but gradually becomes more faint, and wholly vanishes before it attains the margin. The inner vein is also quite distinct, except the transverse portion at its apex, which is exceedingly slender and scarcely perceptible. The antennæ were so dried and entangled before examination that I could not definitely ascertain the number of their joints. In one instance there seemed to be only twelve.

same veinlet in them. Finally, on examining two male specimens in my cabinet, the magnifier shows this veinlet in them also.

Several months have now passed since the above examinations were made, and to M. Amyot's question, why have not I seen this veinlet if it really exists? I have supposed I could only reply, Look, and you certainly can see it. But yesterday, taking up the first specimen that came to hand, the magnifier showed this veinlet in the wings fully as distinct as the longitudinal veins, and apparently of the same thickness with them. I thereupon immersed this specimen in alcohol, and looking at it now as it lies in the alcohol in a white saucer, I am wholly unable to see this veinlet, although the longitudinal veins are perfectly plain. On a most careful inspection, I should say decidedly, there is no such veinlet there. I now drain off the alcohol and dry the specimen, and still as it lies undisturbed on the white surface of the saucer, the space between the longitudinal veins appears perfectly hyaline with not the slightest indications of a veinlet crossing it, that I am able to discern; and now I really begin to fear my yesterday's inspection was not made with sufficient care. Finally, on carefully separating the wing from the surface of the saucer and holding it up between my eye and the light, lo, there is this same veinlet again, exactly as I remember it looked before, as thick as the longitudinal veins and of the same dark color and opacity, although but a half minute ago the space it occupies appeared perfectly hyaline and colorless.

Now I cease to wonder why M. Amyot did not see this veinlet. Looking at the same specimens which he did, as they were lying in alcohol, I know I would have said as decidedly as he did, that there was no cross veinlet in their wings, and therefore they could not be the species which I had figured. But I am very sure M. Amyot cannot examine a half dozen specimens of this insect, preserved as we usually have them in our collections, without becoming perfectly assured that this veinlet does exist in their wings.

Before leaving this subject it will probably be expected that I say a few words upon two other points alluded to by M. Amyot as having strengthened him in the opinion that our American insect was different from the European. These points are the width and roundness of the ends of the wings, and the thickness of the body in my figure of the female, as compared with the figure of it given by Mr. Curtis. As I refer so frequently to Mr.

MIDGE. FLY. WIDTH OF ITS WINGS AND BODY.

Curtis in my Essay, M. Amyot evidently supposes I had Mr. Curtis's figure before me when my drawings were made, and that I therefore varied therefrom to represent our American insect more exactly than Mr. Curtis's figure represented it. I may therefore state that my acquaintance with Mr. Curtis's paper was limited to a perusal and notes taken from it in the city of Albany where it had been newly received when I was writing out my Essay for the press. My drawings were made when the flies were abroad among the wheat in June 1845, at which time the half volume containing Mr. Curtis's article had not issued from the press in London, as appears from a notice in the Appendix, page ix. I had no pattern to aid me in this work except the rude figure accompanying Mr. Kirby's articles. It was probably to represent their veins distinctly that I somewhat exaggerated the width of the wings. Their true dimensions appear to be intermediate between Mr. Curtis's figure and mine. As nearly as I can ascertain, a wing placed between slips of glass to remove the wrinkles it acquires on drying, and laid upon a scale, measures .080 by .035. My figure reduced to the size of nature would indicate it as .080 by .040; Mr. Curtis's .080 by .030. And as to the shape of the wings, whilst I notice that their inner margin is more curved and rounded in the figure than it appears in nature, I do not so clearly perceive that the ends are so.

Upon the other point mentioned, the thickness given to the body in this figure, I may remark that we all know how greatly the abdomen varies as it is more or less distended with eggs and aliment in the insects of this Order. In the text it was stated of this part that it scarcely equals the thorax in its diameter. As we meet with this fly upon the wheat depositing its eggs, it is not rare to see individuals with the abdomen as it is here represented. It was my particular endeavor to picture this fly as it appears when abroad upon the wheat, so that others would be able to recognize it on seeing it there. I therefore aimed to give it its plump living aspect, and avoid the shrunken dead appearance which it presents as preserved in our cabinets. I am gratified to know the figure has served the purpose for which it was designed. In instances not a few, strangers on being introduced to me have adverted to their having known me since they first discovered this fly by means of the figure I had given, they had so much admired the exactness with which it was represented.

And on coming to re-issue it now, I have not deemed it so faulty in the points stated as to desire it to be changed.

We come next to consider the manner and place in which the midge deposits its eggs and the apparatus by which this operation is performed.

Mr. Kirby gives an interesting recital of this subject in the following words, (Linnæan Transactions, vol. v., p. 99.)

"It is very entertaining to observe the method to which these insects have recourse in order to deposit their eggs in a situation where the larvæ may soon arrive at their food: when engaged in this employment they are not soon disturbed; which circumstance affords the observer an excellent opportunity of examination. As I hinted before, a number may be seen at the same time upon one ear: they place themselves in such a position that their anus stands nearly at right angles with the margin of the glume of that floret which they mean to pierce. But how are they to introduce their eggs within the floret, for they deposit them between the exterior and interior valvules of the corolla? To look at them when they are not engaged in this employment, their anus appears to be furnished with no instrument adapted to so nice an operation; but upon pressure it exserts a long retractile tube or *vagina*, which unsheaths an *aculeus* (if I may so term it) as fine as a hair and very long. This aculeus it introduces into the floret, and there deposits its eggs, which it usually places upon the interior valvule of the corolla, just above the stigmata. After she has done laying her eggs, the insect withdraws her aculeus with great caution and deliberation: yet it sometimes happens that she is unable to effect this; in which case she is detained a prisoner until some enemy devour her. In this situation I have found them more than once in my morning walks. I was very desirous of seeing the eggs pass through the vagina, but my first attempts were unsuccessful; at length I was gratified with this pleasing spectacle. I gathered an ear upon which some of the *Tipulæ* were busy, and held it so as to let a sunbeam fall upon one of them, examining its operations under the three glasses of a pocket microscope: I could then very distinctly perceive the eggs passing one after another, like minute air-bubbles, through the vagina, the aculeus being wholly inserted into the floret. I examined this process for full ten minutes before the patient little animal disengaged itself, and at last it was through

my violence that she discontinued her employment, and flew away."

Mr. Shirriff, in an "Account of the Wheat-fly" published in Loudon's Magazine of Natural History, vol. ii, pp. 448–451, also describes the ovipositor or tube through which the eggs are passed, as being "of considerable length, perhaps four times that of the body, and so minute, that it appears doubtful whether the eggs pass along the interior or exterior surface. It can be extended or withdrawn at pleasure, and is seldom visible unless the fly is depositing its eggs."

These statements gave me a very erroneous idea of the ovipositor of this midge, as being a long fine bristle, like that of an Ichneumon fly, and employed in the same manner, to "pierce" as Mr. Kirby terms it, the chaff of the wheat, in order to introduce the eggs into the interior of the flower. Accordingly, when in the evening, by the light of a lantern, I saw these flies standing upon the back or outer surface of the chaff, with the tip of the abdomen fastened to the surface, and eggs evidently passing through it, I had no thought but that a hair-like sting was pierced through the chaff, conducting these eggs into the interior of the flower. I accordingly represented it to be thus. I also noticed then, as at many times since, small discolored points on the chaff of the green wheat, which I inferred to be wounds remaining where the sting of the midge had been inserted. And when I came to see the figure of Mr. Curtis, from which our fig. 15 plate ii was copied, the existence of this hair-like sting appeared to be placed beyond all doubt.

I had often thought of it however, as being a remarkable anomaly, that in two insects so closely related as the wheat midge and Hessian fly, one should take such particular and toilsome care to place its eggs in the very situation where its young are to feed, whilst the other merely drops them on the leaves, necessitating its young to crawl quite a distance thence to reach the place where it is to nourish itself.

But that the views which were universally entertained on this subject were correct, I entertained not a particle of doubt, until recently. On a cloudy day, happening to observe a midge depositing its eggs in a wheat ear, I was not a little astonished to observe that by the place and position in which it stood, its eggs could not pass into the interior of the flower. And glanc-

ing thence to another individual, I noticed it to thrust the tip of its abdomen into a crevice of the chaffs and extrude an egg and withdraw the end of its body again so quickly, that I was certain no long hair-like ovipositor could be exserted from and again retracted into the body in so short a time without my seeing at least a portion of it. Now, on coming to reflect that in all the multitudes of these midges I had seen, not one had ever occurred with any part of this hair-like sting visibly extruded, I began to be skeptical respecting its real existence. And I thereupon determined to examine the insect and ascertain what the structure of its ovipositor was. That examination resulted as I will now relate.

When the abdomen is in its perfectly normal state, as it is when the fly first hatches from the pupa, it has the oval form represented in fig. 3 of plate ii, and is composed of seven joints. Upon gently pressing upon it, there first protrudes from its tip the ends of two minute processes, which are shaped much like two fingers. It is seldom that we meet with the midge in nature, that it does not show these two points, projecting more or less, although they have not been noticed by any previous writer. On increasing the pressure upon the abdomen, after these finger-like processes are fully extruded, the rounded end of a small joint to which they are joined begins to appear, and soon after the square end of another joint is protruded also. The hind part of the abdomen now has the appearance represented in fig. 1 of plate ii, this being its usual appearance after the insect has begun to lay eggs. Thus we may tell on seeing one of these flies whether it has commenced dropping its eggs or not, by noticing whether the end of its body is blunt as in fig. 3 or drawn out to a long point as in fig. 1.

On grasping the pointed tip of the abdomen with forceps and drawing these two small joints fully out, they present the appearance shown in fig. 16 of plate ii. (I regret that the engraver overlooked my directions to reduce this figure to half the size of the drawing, in transferring it to the plate.) We here see at *a* the two small finger-like processes first mentioned, and *b* and *c*, the two small joints, here seen to be long slender tubes, which shut one into the other like the joints of a telescope, and are then withdrawn in the same manner into the abdomen, the last two joints of which are shown at *d*. The first or basal one of these joints of the ovipositor, *c*, is but a third as thick as the last joint of the abdomen, and is of a cylindrical form with a smooth sur-

face. The other or apical joint, *b*, is long and slender, thickened towards its tip, and its whole surface is evenly but thinly bearded with fine short erect bristles. The two small finger-like processes at its end, *a*, are cylindrical and four times as long as thick, and are also bearded on all sides with erect fine short bristles.

At the end of the joint *b* between the bases of the two processes *a* I have several times observed a short fine hair, which I had always supposed to be the protruded end of the sting or long bristle mentioned by Kirby and figured by Curtis. I now sought to grasp this hair with the point of the forceps, to ascertain if it could be drawn out, but I found it and its surroundings so exceedingly minute that to manipulate it in the proposed manner was impossible, or at least required implements more delicate and a hand more steady than mine, or than I think Mr. Kirby could have possessed when he examined these parts. And I conclude the hair I had so particularly noticed was merely one of those with which the surface of this joint is everywhere thinly bearded.

Next, on grasping the finger-like processes with the forceps and gently drawing upon them, I found these two telescopic joints of the ovipositor to be remarkably extensile, stretching and elongating as though they were formed of India rubber (caoutchouc). In a young and pliant-skinned fly they may thus be drawn out to thrice or four times the length of the body, and when thus extended and attenuated, their exposure to the air immediately renders them dry and rigid, whereby they remain in this form, resembling a slender hair. And thus, should the ovipositor be confined in its middle and extension happen to be made only on its last joint, this joint would be elongated to resemble a fine hair. But I cannot think Mr. Kirby could be thus deceived, supposing he was drawing a fine long hair more and more out of the body when he was merely elongating this joint; though from the minuteness of these parts there is some liability to such a mistake.

Again, in an aged fly in which the skin is less supple and extensile, on grasping the end of the ovipositor and drawing upon it, it sometimes tears asunder, whereupon a smooth slender tube may be drawn out from the body to twice or three times its length. But this tube is plainly the intestine. Nor do I detect any slender hair accompanying it, either externally or internally.

I am therefore convinced that nothing answering to Mr. Kirby's term and description, "an aculeus as fine as a hair and very

long," forms a part of the ovipositor of this insect. And I am obliged to think the words mentioned have misled Mr. Curtis in the same manner they misled me; in consequence of which, although he had never seen this hair-like sting, he was induced to figure it as being an important part of the insect, not doubting from Mr. Kirby's statement but that it belonged there.

In justice to Mr. Kirby, however, I must add, that, since making my examination of this ovipositor, I have referred to the volume containing the illustrations with which his paper on this subject was originally accompanied, whereby I find his representation to be less erroneous than it appeared when I had only the words of his description before me. His figure of the ovipositor with the eggs passing through it, is not unlike the joints *b* and *c* of my fig. 16, except that the joint *b* is not represented as being enlarged at its lower end, and the finger-like processes *a* are omitted. And by the aid of this figure we learn that what he terms the aculeus, is not a slender hair projecting from the end of the joint *b*, as I had supposed from Mr. Curtis's representation (fig. 15), but the joint *b* is itself the aculeus and the joint *c* the vagina of Mr. Kirby's description. But how could a careful observer like Mr. Kirby, and the peer of any of us in scholarship and erudition, apply the term *aculeus* (*i. e.*, a sting) to such a soft, flexile, bearded and blunt-pointed part as we find this to be, and say that it was as fine as a hair and very long! I think I see how this error has come. Mr. Kirby might well suppose the structure of this implement would be best shown when it was fully extruded and in operation, with the eggs passing through it. He accordingly selected a fly which was in the act of depositing its eggs, and taking hold of it he carefully pulled it off from the wheat ear. But this terminal joint of the body, hid from view by being inserted in the crevice between two scales of the chaff, and adhering thereto by its bearded and prickly surface, only yielded to this force and was drawn out from the crevice as it became stretched, slender and elongated. Mr. Kirby, without a suspicion but that this was its natural form, described it accordingly. It was thus, I doubt not, that this error originated, whereby it has been universally supposed from that day till this, that the ovipositor of this insect was a long, fine, hair-like sting.

Now that we know the instrument with which this fly deposits

its eggs we proceed next to show where it places them. And to distinctly understand the situations in which these eggs are found, as well as numerous other particulars in the operations and economy of this and other insects which infest the ears of wheat, it is essential that the structure of the ears should be clearly understood. A few words on this subject are therefore necessary.

On looking at a head or ear of wheat (the *spike* as it is termed by botanists) we see it is formed of a number of headlets or little heads (*spikelets*) which are placed alternately one above the other along the opposite sides of the central stalk or stem, in two flattened rows, rendering the head somewhat four-sided in its shape. Each of these little heads is made up of five florets or little flowers, crowded together side by side. Each of the two outer flowers on each side of the headlet usually perfects a kernel of grain, while the inner or upper flower is always false or abortive. But in a poor soil, where the heads are not well filled, the flowers on one or on both sides of this central one will be false also. Thus, as the grain ripens, each of these little heads usually comes to be formed of four kernels and their chaffs, placed compactly together side by side. Let us now part these chaffs from each other and from the kernels, to see how many scales or valves there are enveloping each kernel, and how we may designate them when we wish to speak of a particular one. Beginning as you always will, on the side of one of the headlets, we first separate the chaff *a* (see fig. 10, plate ii,) which is always blunt at its end, much as though its point had been cut off. Next we come to the chaff *b*, which is the largest one, and from the end of which grows the awn or beard. Then we reach the kernel, *d*, which is always placed with its grooved side facing the next chaff *c*. Passing then to the next kernel, we find it has only two chaffs, one having the beard at its end, corresponding with *b*, the other like *c*. And next we reach the little false flower in the middle of the headlet, in which no kernel is ever developed. We thus see that each of the kernels is enclosed in two chaffs or scales, *b* and *c*, and that the two outer kernels of each headlet have in addition to these a third scale *a*. Botanists heretofore and in Mr. Kirby's day distinguished the two scales *b* and *c* as forming the *corol* and *a* as being the *calyx* of the flowers, whilst the term *glume* was applied to all these scales, like our word chaff.

But now the name *glume* is given to the outer scale only, whilst the other two are termed the *palea*. It will probably be best understood by most of my readers if I designate *a* the outermost chaff, *b* the bearded and *c* the inner chaff.

In the paragraph quoted from Mr. Kirby a few pages back, he tells us that the eggs are placed inside of the valves of the corol, usually upon the inner face of the inner valve, above the end of the kernel. This is the truth, but it is by no means the whole truth, as will sufficiently appear by a few extracts from my memoranda, which will also give some view of the appearance and movements of the flies as we see them upon the wheat.

June 14th. Towards the close of a cloudy afternoon I visit A's winter wheat, now about two and a half feet high, with the heads just protruded from the sheath at the top of tho stalks, many of them being still inclosed in the sheath except upon one side. On first glancing at it I noticed nothing and thought it was too young yet for the midge to collect upon it. But swinging the not two or three times to and fro against the heads I found some dozens of the flies were gathered into it. And now, on looking sharply, I see they are plenty enough, flying lazily about among the wheat heads and a greater number alighted on the heads. I see none down on the lower part of the stalks, the cloudy weather having brought them all up to the heads. They stand with their heads upward, most of them moving about a little, now and then, upon the wheat heads. Some seem to be very leisurely placing their eggs within the edges of the chaffs at or near their tips, for their ovipositors are partly protruded and I see them applying their tips to the upper part of the chaffs, but cannot get a good view of what takes place, for on approaching the magnifying glass to them, they become shy and walk around to the other side of the ear. If alarmed, they hold the ovipositor out from the ear, to be ready to take wing; but unalarmed they press it against the chaffs as they walk over them, and coming to the top of a headlet, they make a stand and work the ovipositor around, probing the crevices with it as if to discover a suitablo spot for placing their eggs. Ono I saw with the end of its body sunk in between the ends of two chaffs for several moments. I pluck this ear, and examine it after my return, as follows:

With the magnifier I can see no eggs externally on any part of

the wheat head. In one spot, at one side of the outermost chaff near its apex, I perceive, through the slight transparency of the chaff, a discoloration, caused by a substance beneath, of a wax yellow color. On parting this chaff from the back of the bearded chaff to come at this substance, I only discern with the magnifier that it is a glossy speck or little scale of yellow matter. But placed under the microscope, it is seen to be five eggs of the midge glued together side by side, but quite irregularly, whereby their ends are as uneven as those of the fingers and thumb of the hand when held together. And a smaller yellow speck just beside this one, proves to be two more eggs; they lie loose in the interstice between the two chaffs, not at all glued to them, although adhering to each other.

In two other florets I detect similar clusters of eggs in the same situation, near the upper corner of the outermost chaff, not more than the length of the eggs inside of the lateral edge of the chaff, and about three times as far below its upper edge. Now, how were they placed here? The lateral edge of the chaff appears to be too closely pressed to the back of the bearded chaff to allow the eggs to be crowded directly in under its edge, and if crowded in thus, their position would be crosswise of the chaff instead of lengthwise, as we find it to be. We notice that the elevated ridge or keel along the middle of the back of the chaff forms a corresponding groove or plait opposite on the inner side; and the upper end of the chaff being cut square off instead of prolonged to a point, a little orifice is formed there by this groove. It is into this orifice that the ovipositor is evidently inserted and crowded out laterally as far as possible, to place the eggs in the situation above mentioned.

In another instance I find a cluster of eggs on the back of the bearded chaff, slightly to one side of its keel, perhaps from the interstice between the chaffs not being sufficiently roomy in this case to allow the ovipositor to be crowded any further out towards the side. Finally, two eggs were also discovered, placed inside of the edge of the bearded chaff, where this edge was pressed to the back of the adjoining floret and outside of the inner chaff, they being thus in the interstice between the two florets, in which situation I also find them in other headlets.

It appears from the examination now related, that the only aim of the fly is to place its eggs in some crevice of the headlet where

no spiders or other enemies will be apt to find them to destroy them, and where they will be sheltered from the sun and air which would dry and shrivel them before they have time to hatch. Looking at the shape of the ovipositor, fig. 16, and knowing its substance to be soft and flaccid, it is evident it can only enter some open crevice; it has not firmness and solidity whereby it can be crowded between the edges of the chaffs where these edges are closed and pressed together. And therefore when the midge first comes abroad, which is some few days before the fall sowed wheat begins to bloom, the flowers are so closed that it cannot insert its eggs into their interior. But finding the little orifice above mentioned, at the summit of the outermost chaff, it crowds its ovipositor into it and there places its eggs. And it continues to place them here, as long as it has eggs to deposit. It also places them between the florets, and in short, in any narrow crevice upon the headlets which it is able to discover. And thus, when the flowers swell preparatory to putting out their thread-like stamens, the bearded and inner chaffs become parted asunder at their summit, whereupon the midge commences inserting its eggs between them also. But this is probably the most insecure situation of any in which it places its eggs. For as the anthers grow and push themselves out from between these two chaffs they frequently displace and carry out these eggs with them. It is thus that I account for the occurrence of the eggs upon the anthers, the little yellow knobs which hang by slender threads from the wheat ears when they are in bloom. I have sometimes noticed eggs adhering to the anthers, and Mr. Kirby met with newly hatched larvæ upon them, from whence he concluded that the pollen or fine dust which is scattered from the anthers was the food on which these larvæ subsist. But in our view their presence in this situation is merely accidental, and occasioned in the manner stated. And the eggs thus exposed to the air probably become dried and shrink up as they do when they are dropped on the sides of vials in which the flies are imprisoned; or if they are ready to hatch when they become thus exposed, it is very doubtful whether the young larvæ from them, swinging about as the anthers do with every breath of the wind, are able to find their way back into the interior of the flowers.

The last joint of the ovipositor is wholly inserted into the crevice where the eggs are placed, and is thus hid from the view,

the first joint remaining outside. The bearded surface of this last joint being thus in contact with the rough surface of the chaffs, no doubt fixes it securely in one position whilst the eggs are passing through it; whilst the much smaller size of the finger-like processes at its end allows them sufficient motion to guide each succeeding egg slightly aside from its predecessor, whereby a number of eggs can be placed without blocking up the point of their exit. Sometimes a single egg is found, but they are usually in small clusters of from two to ten, this being the number which the fly has in readiness to deposit at one time, and which it extrudes with one introduction of its ovipositor. In damp cloudy weather, when it can remain at this work all day, it is more slow and leisurely in its motions. But in dry sunshiny weather, when it is obliged to leave the wheat heads and rest during the day, it becomes overburthened with its eggs and is then very active and busy in disposing of them when the humid air of evening arrives, enabling it to return to its work. Thus it continues industriously at this employment day after day; this disposing of its eggs being the main business of its life.

When it has for the time exhausted its supply of eggs, it is a laborious operation for the fly to disengage and withdraw its roughly bearded ovipositor from the crevice in which it is inserted, and Mr. Kirby observes, she is sometimes unable to accomplish this, and is held a prisoner till she dies or till some enemy devours her. It is common to meet with the midge, dead and suspended in this manner by its ovipositor. But it is only when the fly has completed its operations and is feeble with age and ready to perish, that it becomes thus fastened. I have particularly observed the fact, that we never see any flies thus suspended in the month of June; it is not till into July when their labors are drawing to a close that this phenomenon occurs and then becomes common.

The eggs, (Plate ii, fig. 8) scarcely exceed the hundredth part of an inch in length. They are about six times as long as thick, and are of a long oval form, very near cylindrical with rounded ends. Their surface is smooth and shining, and they are almost colorless-watery with a faint tinge of pale red. When several are together in a mass they appear of a deeper reddish yellow color. On being highly magnified they have the appearance

represented in our figure, looking as if they wore filled with little bubbles of air of a reddish tint, with a small portion of each end clear and colorless.

The Larva.

In their natural situation in the wheat ears, it is scarcely practicable to observe the eggs so closely as to ascertain precisely the time which elapses after they are laid, till they hatch. We only know in relation to this point, that when the midge first appears and its eggs begin to become common in the wheat ears, we begin to find the young larvæ there a week later. We therefore conclude this to be about the length of time the insect continues in the egg state.

When they first come from the egg, the larvæ are exceedingly small, less thau the hundredth of an inch in length. I see in different places in my manuscripts, I havo on measuring them set down their length as being 0.0075. They are very soft, feebly hyaline and of a dull watery white color, without any tinge of yellow. They in fact appear closely like the eggs from which they come, being of much the same shape, size and color; but fine transverse lines are perceptible upon their bodies dividing them into joints or segments, whereby we are able with certainty to distinguish a larva from an egg.

As the eggs from which they hatch are scattered about in different crevices of the chaffs around as well as within the florets, it is evident the infantile worm must crawl from these several situations to the germ or young kernel from which it is to suck its nourishment. Even where tho eggs aro inserted within the floret, it is always near the upper ends of the chaffs and at a small distance above the germ that they are dropped, for the length of the ovipositor does not enable the fly to reach so far into the floret as to place them upon the germ. Hence all the worms when they hatch must make at least a short journey from the egg to reach their feeding place.

There is thus an evident correspondence in tho habits of the newly born larva of the wheat midge and that of the Hessian fly. The Hessian fly larva hatching on the surface of the leaf travels down it to its base, where it enters tho crevice between the central stalk and the sheath surrounding it, down which crevice it crowds itself till it reaches its base. The midge larva

from the summit of the floret passes down till it comes to the germ or young kernel, which is closely enveloped by the chaffs, whereupon entering this crevice between the chaffs and the kernel, it crowds onward as nearly to the very base of the kernel as it is able to push itself.

Thus, on parting the chaffs, we find these larvæ on the surface of the young kernels (Plate ii, fig. 10, *d*). The minute newly hatched larvæ are first seen, from one to a dozen or more, crowded far down, usually to the very base of the kernels, which are then small, soft, and milky within. They lie with their heads or pointed ends downward and seem to be in a state of repose, seldom one of them moving a little as we are inspecting them.

Mr. Kirby, as I have already noticed, conjectured it was the pollen of the anthers on which these larvæ feed, in part at least, and that it was by consuming this fertilizing dust that they rendered the germs so shrunken and abortive. This view was plausible with the facts which Mr. Kirby had before him, but more extended observations sufficiently indicate it to be erroneous. We have already stated how the eggs and young larvæ happen to be sometimes found upon the anthers. The fly, however, appears to avoid placing her eggs on these organs, as we should not expect her to if they contained the food of her young. I have repeatedly noticed that where some of the anthers happened to be inclosed in vials with the flies, the latter invariably drop their eggs on the sides or the cork stopper of the vials and not on the anthers. Moreover, the flies continue to deposit their eggs in the wheat ears after all the anthers have withered and fallen from them, whereby we know the larvæ from these late eggs can find no pollen on which to feed. Everything, in short, concurs to show that these larvæ derive their sustenance exclusively from the young kernels, on the juices of which they appear to be nourishing themselves from the time the flowers first begin to put forth until the ripening of the crop renders them dry and hard.

As to the manner in which these larvæ nourish themselves, I may remark that in this as in all the other larvæ of Cecidomyia, on the under side near the fore end a very short black line of minute size may be seen with the magnifying glass, having the appearance of a sliver under the skin. This line is perceived to be split at its anterior end, commonly, whereby it resembles a

letter Y, and sometimes it is parted its whole length, like the letter V. This is the two jaws of the larva as they are more or less opened apart. They are movable, backward and forward, and I have sometimes seen them when they were advaneed to the very point of the fore end, where there is a small round orifiee or mouth. And seeing this structure and its motions, leads me to think this mouth is applied to the surfaee of the soft young kernel, and these minute jaws then move forward and puneture or serateh the surfaee, whereupon the mouth sueks in the milky juiee whieh flows from the wonnd. But the wounds thus made are so extremely slight that nothing like a gnawing or erosion of the surfaee of the kernel is ever pereeptible.

When the young larvæ are grown to double their original size, and measure about 0.02 in length, a yellow eloudiness begins to be perceptiblo in the eentre of their watery whitish bodies. This yellowness gradually beeomes more bright and distinet, often appearing as a band aeross the middle. And when the worm is about a third grown it has ehanged to be wholly of a bright yellow eolor, and is now usually withdrawn further up upon the kernel, as its larger size requires more room. It now has the color and form whieh it afterwards retains.

On taking one of the largest larvæ whieh we find in the wheat ears and laying it upon paper for examination, it is usually quieseent and motionless, and appears as represented, plate ii, fig. 11, its natural size boing indieated at *a*.

Tho QUIESCENT LARVA, as thus seen, is ahout three times as long os broad, meosuring 0.08 by 0.03, and is oval, thickest in the middle and slightly tapering in each direetion, the ends being rounded or but faintly angular-pointed. It is slightly depressed and on the under side very perceptibly flattened, but with no indications of feet. Its surfaee is minutely granular, like that of the eommon earth worm of our gardens, and also appears to be slightly coated over with a glutinous seeretion, wherehy it odheres to a needle which touches it, and often when two or more worms are placed in contact they in drying heeomo glued to oach other. Its joints are indieated by very fine impressed transverse lines, whereby it is divided into ten or twelvo segments of equal lengtb, exeept at tho ends where it is difficult to definitely distinguish them. It is of a rich yellow color, varying in different individuals from lemon to orange yellow; and usually a small greenish or blackish cloud is seon placed lengthwise in the middle of the body on its under side, which is ovidently eaused by internal alimentary matter.

Dropped into oleohol it sinks at once to the bottom, elongates itself and tries to crawl. It then appears hyaline whitish, with a broad yellow stripe along the middle.

If the quieseent larva above deseribed be plaeed in a small drop of water upon glass or any othor smooth surfaee, it immediately awakes from its seeming sleep, and protruding its head and horns, it commences erawling, by alternately contraet-

ing and elongating itself. When thus wet and in motion several parts of its structure which were not perceptible before become plainly visible, and it now presents the appearance shown by fig. 12 of the same plate.

The MOVING LARVA is of a more elongated and elliptic form, tapering to an acute point at its fore end and much more blunt behind. Thirteen segments are now plainly to be seen. Of these the three first and the last have a smooth surface and are whitish and semi-transparent, only the nine intervening ones being yellow and with their surface granulated. Each segment is fringed at its end with a row of small hairs like eyelashes. We only perceive these hairs at the corners of the segments in the view we have in fig. 12. But when the head is retracted, bringing the anterior edge of the next segment into view as in fig. 13, we find these hairs are continued along the whole length of the edge. The head is conical, more long than broad, tapering to an acute point in front, and has a depression on each side near the middle, where is inserted a short thread-like process, forming with its fellow a pair of horns, which are articulated at their bases. The last segment is cut off transversely in a straight line; but as the worm crawls, when it draws the hind part of its body forward with each step it takes, this hind end becomes strongly concave. When the worm is dry and endeavoring to crawl on a dry surface, this end of its body becomes wholly different, appearing as seen in fig. 14. It is here strongly concave, its angles acute and tooth-like, with two similar teeth between them, which may be of the same size or retracted and showing their points only. And on each side of this last segment a rounded tubercle is sometimes protruded out from beneath, bearing a conical point and resembling a pro-leg. Under the same circumstances the anterior end also becomes as represented in fig. 13, the head being wholly retracted and leaving only the ends of its horns visible.

When the larva is coated over with a pellicle of water it moves with perfect facility by alternately contracting and elongating itself. Stretching itself forward it attaches the fore part of its body to the surface and then draws up the hind part and attaches this by the last segment, at the same time raising the middle of its body slightly upward from the surface. With each step it takes the dusky spot in the centre of its body moves backward and forward a distance equal to its usual length. If it is a slanting surface on which it is moving it always takes the downward direction, evidently aware that is the direction in which the earth it is to enter will soonest be reached, and if a different inclination is given to the surface it immediately perceives it and changes its course accordingly.

When the pellicle of water in which it is enveloped evaporates, its locomotive powers are gone. It still essays to advance that it may get to the ground, but does this in a most awkward, bungling manner, making but little progress with much labor. It now protrudes the sharp teeth from the tip of its body, represented in fig. 14, and curving this end of the body under, it presses these teeth to the surface, and then by straightening pushes itself along. Its head at the same time is drawn back

into its neck, leaving only the ends of its horns projecting, as shown in fig. 13. It bends its neck down and presses these points of its horns to the surface to hold its body from being drawn backward whilst it again curves the hind end under and fixes the teeth there as before, when, letting go in front, it gives itself another shove. The worm shows in its every feature that this is most fatiguing work, taxing its energies to their utmost and yet making but little progress. Becoming wearied, it changes its operations. Now pressing its anterior end to the surface it curves this end under its breast as if making a very humble bow, hereby drawing its body forward; and then using the teeth at its tip merely to prevent its sliding back again while it reaches forward and again fastens its fore end to make another bow. Thus by pulling and by pushing it persistently endeavors to move forward, but with very indifferent success. Yet, notwithstanding the embarrassment of this worm in thus crawling on a dry surface, if a watch crystal is placed over it, it is able to cling to and move about on the under side of the glass with its back downward, never losing its foothold and falling unless it is disturbed.

But on being thus exposed to the atmosphere the worm is gradually losing its suppleness and becoming more dried and stiff. Getting impatient perhaps at the little it accomplishes with so much exertion, it resorts to another curious expedient. It doubles itself together, bringing the tip of its body in contact with its throat, and fastening it here by some mechanism which I have not been able to perceive. Then it puts forth its strength to straighten its body; the fastening suddenly gives way, and like a bent spring straightening itself, the body striking the surface violently, bounds away, to a distance it may be of some inches. Finding it does not yet drop upon the ground, this operation of *skipping* is slowly repeated, again and again. At length its skin becomes so dried and stiff it ceases its efforts, draws in each end of its body and again becomes a quiescent larva such as we first saw it.

We now place it, say in a saucer, and set it aside. Observing it a day or two afterwards, we find it has become so dried, so stiff and hard, it is wholly unable to bend or move. And continuing in this dry situation its body shrinks and shortens, whereby after a few days it ceases to fill its outer skin. It has

now become what is termed a CASED LARVA. It is analogous to a pillow enclosed in a pillow-case. Its outer skin forms a thin and nearly transparent case, a bladder-like pod or bag, within which the worm lies. And the yellow worm it is plainly to be seen does not fill this case. A whitish transparent space is seen sometimes at one, sometimes at both ends, extending beyond the ends of the yellow worm inside. This transparent portion increases in length as the worm within becomes more dried and shortenod, whereby it sometimes forms a fourth or a third of the total length. And thus the worm will remain dry, stiff and quiescent in this case, for several months, without any further change and without losing its vitality. But on placing it upon a wet cloth it revives. It absorbs the moisture and hereby swells out to its former size and becomes soft and flexible. The following note of an examination of one of these cased larvæ when it was revived by moisture and beginning to move again, I here present. "With the magnifier I see it swells itself out to almost fill the case, and then contracts, leaving a large vacancy at one end of the case, and then expands itself again. I now place it in a drop of water on glass, and examine it under the microscope. The inclosed worm has the same appearance and parts as in the figuro of the moving larva (fig. 12), and the tip at times shows the four sharp teeth and the round concavity the same as figured (fig. 14). I see the transparent case is fractured, whereby it has an irregular opening on one side near its fore end, and the inclosed worm protrudes its head and horns from this opening, and feels around, slowly and cautiously, as if fearful the same violence which caused this rent might still be lurking there to do it further injury; and on the slightest disturbance it draws back into the case again. Next I notico it with the point of its head feeling all about the head end of the case forward of the opening, as if to ascertain if there was any other injury there. Then again it protrudes its head from the opening, examining around on the outside as before. It repeats these movements several times, till I become weary of noticing them." Tho worm eventually crawls out of this caso or outer skin and disappears.

Now that we have seen this larva under its three different forms of a quiescent, a moving and a cased larva, and have observed how readily it crawls when wet or placed on a surface

bedewed with moisture, and how difficult it is for it to move on a dry surface, we shall more readily understand its somewhat diversified proceedings from the time it is done feeding in the wheat ears until it enters the ground.

The wheat is for the most part nearly ripe and the ears and straw nearly juiceless and dry about the same time that the chief portion of the larvæ it has nurtured have become mature and ready to descend to the earth. But until a rain occurs to wet the straw and thus enable them to crawl down it to the ground, they are obliged to remain in their retreats within the ears. Thus multitudes of them ere they have the opportunity to make the descent, dry and shrink and become cased larvæ. When a rain at length comes on, saturating the wheat ears with moisture, these larvæ become active, and breaking out from their cases, descend to the ground, leaving these transparent whitish cases or cast skins within the florets from which they respectively came.

I have heretofore thought that like the larvæ of the Willow gall fly, these larvæ of the wheat midge did not moult or cast their skins; and I still am confident it is only under certain circumstances that they do this. In repeated instances, on placing what appeared to be cased larvæ between the folds of wet cloth, I have observed them to swell out and fill their cases, which also became pliant and supple from the moisture, and then crawl away without leaving any traces of these cast skins behind them. To be more fully assured of this fact, I a few days since took from a wheat head which has been lying dry within doors upwards of three months, six larvæ, all showing a transparent space at one or both ends of their bodies. I placed them in a row side by side on a wet cloth, whereby I was sure as one after another moved off I could detect any relics of a cast skin they might leave behind. In one larva I perceived the end of its case was broken. This was the first one to crawl away, leaving its case plainly to be seen in the spot where it had laid. Another has gone, leaving no vestiges of its case to be found. The remaining four fill their skins so perfectly that I think they too will retain them when they come to move off. Furthermore, the number of cast skins which we find in the wheat heads bears no proportion to the number of larvæ which have been nurtured in the same heads. Some years we may search many heads where the dwarfed kernels

attest that numerous larvæ have been nourished therein, yet without finding one of these cast skins therein. We usually meet with but one, sometimes two, rarely so many as three or four of these cast skins in a single floret, although the diminutive kernel indicates that four times as many larvæ as this have nestled there. Again, when a larva first reaches maturity, with its skin still soft and pliant, if a fall of rain occurs whereby it may at once descend to the ground, will it not do so, without tarrying an uncertain length of time for its skin to dry and separate? I think it will, and that when it once reaches the moist ground its skin will not afterwards dry and harden to be cast off. Finally, when the grain ripens there are often multitudes of larvæ in it which are not yet grown. But the kernels having become dry and hard, they can obtain no more sustenance from them and therefore can grow no larger. And these immature larvæ never became cased on drying, as I have noticed in numerous instances. They dry without the ends of their bodies becoming in the least transparent. They shrink up and become shapeless and hard, and you think they are all dead; but place them in a wet cloth, you are astonished to find what vitality these little creatures possess, and how they revive and crawl away, only a few of the minutest ones remaining and after a long time becoming mouldy, whereby you are assured they are really dead. You thus see that neither starvation nor drouth is able to kill any of these larvæ except the mere infants and pigmies of their race. And upon observing the larvæ which are crawling down the wet straw from the ripened grain, you notice numbers among them which are dwarfs, some of them but half the usual size. Have these ever been cased larvæ? Have they changed their skins? I trow they have not. Yet they enter the earth, and the next June we see them again, as I think, in the numerous dwarf midges we meet with on the wheat ears, some of them being less than half the normal size of their species.

To the question then, do these larvæ of the midge moult, do they cast their skins? I reply, they do and they do not. The subject reminds me of Shakespeare's description of wine. It's an equivocator. And I have not been able to investigate it sufficiently to determine the exact circumstances under which this moulting does and does not occur. Where the skin of a cased larva becomes fractured or torn, admitting the external air

MIDGE. LARVA. CRAWLS ABOUT ON THE WHEAT EARS.

inside, thus toughening the inner skin of the worm, there the outer skin is always cast off. Whether it is cast off under any other circumstances I am yet in doubt.

Before they become matured some of the larvæ it is probable leave the florets in which they are nestled and crawl about upon the wheat heads and enter other florets. Thus I think it comes to pass that we sometimes meet with one or two large larvæ in the same floret with a company of minute ones. It no doubt sometimes happens that a floret becomes overstocked with more larvæ than the kernel can sustain, whereupon part of them forsake it on discovering they must starve if they remain there. Coming out probably when the grain is wet with rains or heavy night dews, they wander over the heads till they find and enter other florets in which they can be better accommodated. Where there are but few larvæ in a head they are found upon the two outer kernels of the headlets, rarely on either of the two inner ones. But where the larvæ are numerous all the kernels share alike in supporting them.

After the grain ripens and they have done feeding upon it, on the coming on of a rain moistening the heads of the wheat and rendering the bodies of the larvæ within them soft and pliant, they leave the florets, one after another coming out and wandering over the outer surface of the chaffs and out upon their beards, as though by this exercise to become more limber and expert in crawling before they attempt to descend the straw. And if the rain passes over and the heads begin to become dry, they hasten back into their lurking-places between the chaffs. And if wheat heads be placed in a glass or earthen jar and exposed to the rain, whereby the larvæ descend from them, when the water collected in the jar is poured off or evaporates, the larvæ wandering about and discovering there is no earth there for them to enter will all crawl back again, ascending the straws and re-entering the heads. Thus, by leaving but one ear in the jar, all the larvæ from a number of ears may be herded together in this one; or by substituting a perfect ear in its stead we may produce the paradoxical phenomenon of a wheat ear thronged with these larvæ and yet not one of the kernels in it shrunken.

A powerful rain which is unattended with wind, especially if it occurs in the night time, brings the larvæ out of the ears of

the ripe grain in the greatest abundance. Very few will leave their retreats when the wheat ears are agitated by the wind. And it is only a portion of the larvæ contained in the ears that come forth at one time, a large reserve corps always remaining to descend at subsequent periods. A wheat field therefore which is so injured that it is not harvested will have hosts of these larvæ descending from the ears with every rain which occurs during the autumn. The following experiment will more plainly illustrate this fact:

Twenty wheat heads were gathered soon after the middle of July and tied in two bundles of ten in each, and were placed in separate jars for the purpose of exposing them to each rain that occurred, so long as any larvæ continued to descend from them. Jar No. 1 was placed out for the first time on the tenth of August, jar No. 2 two months later, on the eighth of October. No. 1 was not exposed on this last date, my aim being to ascertain if as many larvæ would not then come at once from No. 2 as had previously come at different times from No. 1. The number of larvæ found in each jar after each rain was as follows:

		No. 1	No. 2
Aug.	10	34	
	23	4	
Sept.	12	46	
Oct.	8		88
	13	27	45
	20	31	15
	23	74	32
		216	180

It merits to be stated that the individuals which descended on the last dates were mostly small sized and dwarfs; thus showing that those larvæ which are not full grown when the wheat ripens are prone to linger in the ears till the very last, as though they were looking for the kernels to become soft again whereby they might feed further upon them, and only abandoning this hope when the rains become so cold as to apprise them they must make no longer delay in secreting themselves in the earth and wrapping their blanket around them to protect them from the vicissitudes of the coming winter.

Many persons entertain the opinion that it is only the larvæ

which go into the ground before harvest that live and produce the flies of the following year; and that those larvæ which remain in the wheat ears and are carried into the barn become dried and dead if the grain is not threshed until winter. This opinion is probably derived from the dried, shrunken, hard and motionless appearance of the larvæ which they see upon the threshing floor. It was one leading object of the experiment above reported, to obtain some evidence upon this important point. And it will be noticed that those wheat heads which had been kept perfectly dry for nearly three months gave out about the same number of live larvæ as those which had been occasionally wetted; indicating that none had perished from being dried three months, and that few if any therefore would be dead, probably, at the end of six months.

Upon the soft young kernels the larvæ grow to their full size in about three weeks. When the kernels are becoming dry and hard they will be longer in feeding upon them. I have seen these larvæ matured and descending to the ground as early as the eleventh of July, some of the parent flies being still at work depositing their eggs in the ears from which these larvæ were coming.

There are three different modes by which it passes from the wheat ears to the ground, viz., 1st, by jumping down; 2d, by crawling, and 3d, by riding down.

1st. By jumping. Some of them crawl out upon the beards and with a skip throw themselves thence to the earth. I have not seen it descending thus, sufficiently often to speak with confidence as to the circumstances which induce it to resort to this mode. It appears to be when the heads are overcrowded and no rain occurring to enable them to crawl down the straw, that, if a moderate sprinkling rain or a mist comes on, it suffices to enable a portion of them to crawl out upon the beards and skip from thence in the manner stated.

2d. By crawling down. When a rain drenches the straw with moisture, causing its surface to be covered with small particles like a heavy dew resting thereon, whereby the worm as it crawls downward is kept wet and enveloped in a pellicle of water, it readily adheres to the straw, as it cannot do when the straw is dry; and by alternately contracting and elongating itself as has heretofore been described, it moves down the surface of the straw with the utmost facility. And this is the mode in which we usually see it making its descent.

MIDGE, LARVA. RIDING DOWN THE STRAW.

Natura maxime miranda in minimis. In the works of nature we find the most to admire in their minutest particulars. Why, after it has finished feeding in the wheat ears, does this little yellow maggot of the midge, to reach its resting place in the earth prefer moving down the wetted straw in a globule of water, to the much shorter journey of crawling out on the beards of the wheat ear and with a skip throwing itself from thence to the ground? I can conceive of but one reason for this. It is because in the globule of water it is shielded from being stung by its mortal foe, the *Platygaster Tipulæ.* The antennæ of this parasite, which guide it in selecting suitable worms for it to puncture, lose their extreme sensitiveness no doubt when they are wet, and therefore it can only approach and sting worms which are dry and moving on a surface not bedewed with moisture. Thus, although here in America the midge has not been molested by a parasite for forty generations, it still remembers its old foe upon the other side of the ocean. It still dreads to take the short walk from its supper table to its lodging room unless it can put on its cloak, so fearful is it that if it ventures out doors without this disguise, its mortal enemy will meet it on the way and deal it its death wound.

3d. By riding. The mode of passing to the ground which this larva evidently prefers to all others, is the third one I have named, that of riding down the straw. If the material therefor be in its way it puts it together, forming a kind of locomotive carriage, into which it enters, and then joggling it to give it a start, the vehicle runs down the side of the straw, carrying this little creature to the ground with such speed that it can now defy all its enemies to pursue and overtake it. In other words, if it finds the surface of the straw sufficiently bedewed with moisture, the worm instead of crawling directly downwards travels around diagonally and in a serpentine track, hereby increasing the globule of water in which it is moving until it becomes so large it is upon the point of running down the straw, its gravitation so nearly overbalances its adhesion. The worm now lets go its hold upon the straw and sinks to the lower side of this drop. Then by slightly wriggling its body it causes the drop to move a little further whereby a few more particles are added to it, so increasing its weight that it now starts and runs down the straw, carrying the worm in it. In this way these

larvæ may always be seen to descend, when the surface of the straw is so heavily coated with dew-like particles as to enable them to gather the moisture into a large drop. And it is its fondness for this mode of passing to the ground that appears to cause it to leave the ears in the greatest numbers in a heavy rain, when the wet gathered in the heads of the wheat is every moment dripping down the straw in little rivulets, whereby all the worms which place themselves in the way are speedily carried to the earth.

The astonishing vitality of this insect has already been adverted to. When a larva is but half grown, we have seen that though deprived of food it does not die, and though kept from moisture for many months it does not dry up so as to perish. Thus no extremity of hunger or of thirst seems to have power to kill it. And we now come to show that water does not drown it. Heretofore it had occurred to me that where wheat was growing on stiff clay lands and a retentive soil, the same rains which bring the larvæ out from the wheat ears would also form pools of water on the surface, into which many of the larvæ would descend and would consequently be drowned. And among the possible remedies for this insect, I had thought of this: that if a wheat field after harvest could be flowed with water, like those in which rice is cultivated, the larvæ in the ground might all be destroyed thereby. I am now aware this measure, were it practicable, would be both in its nature and its results a parallel to that whereby the sages of Gotham are reported to have essayed the destruction of an eel. For I find these larvæ are perfectly amphibious and live as readily in water as out of it. My attention was turned to this subject from noticing that a larva, crawling about in a globule of water was so enveloped therein that it appeared impossible for it to be breathing the external air. I thereupon placed a large drop of water in its way, on coming to which, it was floated into its centre and there laid perfectly quiescent and without making any effort to crawl out. An hour later, I took it out and placed it on dry paper, whereupon it began to writhe and crawl away. I thereupon dropped it and also a eased larva into a vial of water. Next day I could not distinguish the one from the other. Laying one of them upon paper I found it was alive, whereupon it was replaced in the vial. Examining them in this same way occasionally, I found

that although sunk thus in water they were alive at the end of fifty days. Satisfied with the experiment the vial was set aside, and four months afterwards, happening to look at it, both worms were then found to be dead and semiputrid.

The Cocoons and Pupa.

We next come to trace the history of these insects onward, so far as our present knowledge enables us to do this, after they enter the ground.

It is now sixteen years since I took my first step in investigating the wheat midge. That step was as follows: Early in March, 1845, soon after the snows of winter had melted away, I examined the earth in a field where wheat had been grown the summer before, which had been considerably infested by the midge; and I found slightly under the surface and under fragments of dead straws and leaves lying on the surface, a few bright yellow larvæ, identical in their appearance with those which are seen in the heads of wheat. I hence inferred with confidence that the larvæ laid naked, dormant and inactive, slightly within the ground, during the autumn and winter, changing probably to pupæ only a few weeks before they give out the flies in June.

The larvæ which I found were placed in moist earth in a vial, and other engagements drawing off my attention, ere I was aware of it this earth had become so dried that I doubted not the worms therein were dead, and no further attention therefore was given to them. The following June, however, when I discovered the flies of the midge in our wheat fields, on looking at this vial I found there were in it two or three dead flies of the same kind. The pupæ cases from which these flies had come were also there; but on a most careful examination of the dry earth in the vial I could detect no vestiges of larva skins. I therefore concluded that the larva which I placed in the vial must have taken on the pupa form without casting off their skins, the same that the Willow gall midge has the strongest indications of doing also. And this opinion acquiring additional strength from further observations, I fully expressed in an article on the wheat midge, published January 26th, 1856, in the Rural New Yorker, vol. vii, p. 29. From galls containing the larva of the Willow midge which I transmitted to the late Dr. T. W. Harris, he also became

assured that my views upon this subject were correct, as he has stated in the second edition of his Treatise on Injurious Insects, page 451.

But, as I was aware it was contrary to all previous observations for the larva skin of an insect to become its pupa skin, I have been most anxious to disinter these larvæ of the wheat midge again, early in the spring, that I might closely inspect them from that time onwards till they became flies, and thus correct my views if I was in error, or confirm them if correct. I accordingly have sought for these dormant larvæ in the earth of old wheat fields, faithfully and perseveringly. In repeated instances I have noticed the places where, at and before harvest, immense numbers of them descended to the ground, and have repaired to the same spots the following spring and with a penknife blade carefully scraped and searched the surface of the ground, assured that there must be multitudes of these yellow worms lurking somewhere there, yet not one of them could I find. And for many years past it has been a mystery to me how I came to discover these larvæ in the ground the first time I ever searched for them, and yet could never meet with them in the same situation again.

Being thus unsuccessful, I have latterly been endeavoring to follow these larvæ from the time they enter the ground, and thus ascertain what became of them that I could not find them in the spring. But my experiments hitherto have failed, for want as I have supposed of suitable care in conducting them when my attention was principally required in other directions. Larvæ buried in the dirt in flower pots and in vials I have been unable to find afterwards. Finally, that I might have them in a space so narrow that they could not elude detection, the eighty-four first larvæ already mentioned as having come from ten wheat heads in August and September, were placed in a small vial, having moist earth in its bottom to the depth of half an inch, in which they all soon disappeared. Four weeks afterwards, on the eighth of October, upon examining portions of the earth taken from this vial, I could find none of these yellow larvæ in it. So totally had all traces of them vanished that the conclusion became strongly impressed on my mind, that the large number which I had placed in this small lump of earth had all perished and

decayed, probably from being overcrowded and smothered like the prisoners in the Black Hole of Calcutta. With a magnifying glass I then sought for some of their slimy remains, and soon detected what I felt assured was one of these dead worms, faded and contracted to a little globule scarcely the size of a mustard seed. I was now called off from this examination and on returning to it again a few days later I found the little globule had become dry and hard. Pressing upon it with the point of a needle it cracked asunder, showing inside the bright yellow larva of the wheat midge doubled and pressed compactly together into a little ball. The truth of the matter was now evident, and the interesting discovery was thus made, that these larvæ inclose themselves in cocoons, they do not remain naked in the ground as I have all along supposed them to. Others of these minute cocoons were now found with the aid of the magnifying glass, on examining another fragment of earth taken from the vial.

But if these larvæ, soon after they descend from the wheat into the ground, inclose themselves in cocoons in which to repose through the winter and till they are ready to become flies the following June, how did I come to find larvæ naked in the earth when the snows melted away in March? We might suspect such larvæ had been stung by parasites and thus rendered too weak and diseased to form cocoons; but as flies hatched from the major part of them we know this was not the case. Another casualty might retard them from forming cocoons. If on leaving the wheat they chanced to fall into a pool of water, we know they would lie passive and quiescent therein, without perishing, for months or till the water dried away from them. They might thus remain in water from harvest time till cold weather arrived and further suspended their operations till the return of spring. But the soil of the spot where I found the larvæ in question is so porous and sandy that I am quite sure no depressions in its surface could retain water but a brief time. And the most plausible conjecture I can form, whereby to account for the fact stated, is the following: Upon going to the spot where I met with these larvæ, I discover it is but eight rods distant from the barn in which the midge infested wheat which grew on this ground was housed and threshed. The screenings of the fanning mill were doubtless made up in part of larvæ which remained in the wheat ears at the time of harvest, and if these screenings

chanced to be emptied out the door upon a blustering winter's day or at a time when the surface of the fields were crusted with ice from falling rain and sleet, a portion of them might readily be driven by the winds or carried in drifting snows to this distance from the barn. I therefore suspect the larvæ which I found were not larvæ which had come before harvest from out the wheat growing there, but that they had been conveyed into the barn, from whence they were casually returned to this spot after cold weather had suspended their operations for the season. And this well illustrates how facts themselves may be false and may thus lead us unsuspectingly into errors.

The cocoons resemble little round grains smaller than a mustard or a turnip seed. They are usually a very little longer than broad and measure about 0.05 in length, though sometimes no more than 0.03. When their surface is clean of dirt they are of a dull pale yellow color when moist, and gray when dry. They are so dense and opake that the bright yellow worm within cannot be discerned through their walls. When dried they are brittle, breaking like the shell of an egg in small irregular fragments. Yet they are evidently formed of exceedingly fine threads which the worm spins; for when two cocoons are found lying close together it is common for them to be united by loose fibres on the surface of the one woven into the surface of the other. Most of them also have particles of dirt so woven into their surface that it is difficult to wash them clean. This tenacious coating of dirt and their exceedingly small size will render it almost impossible to discover these cocoons, even with the aid of a magnifying glass, where they lie in their natural situation in the ground of old wheat fields. Even when numerously crowded into a small quantity of earth in a vial, it is only by washing this earth in a saucer of water with a camel's hair pencil that I readily detect them.

Several of these cocoons thus obtained happened to be inclosed in a vial over night. Next morning one of the larvæ was found to have forsaken its cocoon and was slowly crawling around in the vial, differing in no respect then, that I perceived, from the larvæ as they appear when they are entering the ground. To come out, it had crowded off one end of the cocoon in the form of a little hemispherical cup or lid, with its edge smoothly cut, a number of fibres on one side being unsevered and serving as a

hinge to hold this lid to the cocoon, tho same as we see in th cocoons of multitudes of other insects.

From the analogy furnished by other species of Cecidomyi we infer that the larva of the wheat midge will remain in it cocoon through the winter and till the following May, when i will assume its pupa form. And in June, when ready to becom a fly, this pupa will crowd open the little lid above mentioned from the end of the cocoon, and work itself up nearly out of th ground, when its skin will part asunder on the anterior end o its back and the fly will withdraw itself from it.

Kept in vials in a warm room, I doubt not my cocoons wil give out the flies much earlier than June, probably before the close of winter. And though the flies naturally come abroad only in June and July, with the knowledge I have now obtained, I am perfectly confident I can with the utmost facility so manage the larvæ and cocoons as to produce the flies in every month of the year.

I must not leave this subject without describing the manner in which the insects of this genus Cecidomyia effect the change from their larva to their pupa form, as this is a point which has occupied much of my attention since I first began to investigate these insects, and on which important light has recently been obtained.

As has already been mentioned, some larvæ of the wheat midge found in March were placed in a vial of earth and in June the flies therefrom were found in this vial, and also the pupæ skins from which these flies had hatched, but on a most careful search no traces of the cast skins of the larvæ could be discovered; wherefore it appeared that the larvæ must have changed to pupæ without throwing off their skins. And this view that these insects do not cast off a skin in becoming pupæ was strongly corroborated by the Willow gall midge, to which allusion has already been repeatedly made. This is a large robust species, double the size of the wheat midge and therefore of much easier examination. It forms a gall the size of a bird's egg on or near the ends of willow twigs, through the middle of which gall is a cylindrical cell as large as the cavity in a rye straw, in which cell the larva resides, and when done feeding it weaves a thin partition across its cell whereby it incloses itself in its lower end and there takes on its pupa form. It

would seem that a species so large and hardy as this is, if it moulted, must throw off a skin of such a coarse texture that some traces of it at least would be found in its cell. But I have carefully opened these galls in instances without number, coming to the pupa without being able to detect any refuse matter in its cell to indicate that a skin had been thrown off. And some of these galls forwarded to the late Dr. Harris, as stated a few pages back, convinced him also that these larvæ changed to pupæ without moulting. Still, that an insect could do this was so contrary to all previous observations, that I determined I would see this larva when it was in the very act of undergoing this change to a pupa, and thus know how this change was effected. And for ten years I have been endeavoring to find one of these insects when it was thus changing, opening numbers of the galls every year. As I have thus become perfectly familiar with the appearance of this insect at this period of its life, I would observe that a state occurs which is distinct from its larva and its pupa state, as has indeed been noticed by authors in other instances, at which time it may appropriately be termed an EMBRYO-PUPA.

This Willow gall midge is usually found in this state between the 8th and 16th of March, and remains under this form a week or more. It at this time appears very much as though the anterior end of the larva had been bruised and had swollen into a watery blister from the injury. This vesicle is translucent and of a pale blood red color, becoming darker and more opake as it becomes older. The skin covering it is smooth and slightly glossy, the transverse sutures being marked upon its surface faintly by slender impressed lines instead of the broad deep furrows which previously existed here. It extends farther down on the front or under side than on the back, here occupying a fourth of the length of the worm and leaving only seven segments uninvolved in it while on the back there are nine. The apex or former mouth is now a short broad tubercle and in front a little below this the jaws still appear as two minute black lines meeting in form of a letter V. The remainder of the worm not occupied by this vesicle is not changed in any respect from what it previously was in the larva.

In this embryo-pupa I had in two or three instances discerned the wing sheaths of the pupa in their incipient state, faintly

traced, apparently in and not under the skin of this vesicle; whence it seemed that this skin gradually grew to form these sheaths. But in these and other instances this embryo-pupa would become altered to its perfect pupa form in the night time, whereby all my efforts to find one passing through this change in the light of day so that I could closely observe it, were unsuccessful, and I at length became aware I should never see it in the act of undergoing this change, unless I could master the insect and make it change into a pupa when I wanted it to and not when it wanted to. Accordingly, in March last, I opened several galls to expose this embryo-pupa lying in its cell. I placed these galls by day in a warm room and removed them by night into a cold room where their tenants would be so chilled as to remain stationary, until they were brought back again next morning into the warm room. I thus at last succeeded in observing what for so many years I had been striving to see—one of these embryo-pupæ passing into its perfect pupa form.

Without reciting the various minute details which I noted down during the two and a half hours this change was progressing, I will endeavor in a more brief and general manner to state the leading facts which were observed. The reader by referring to Plate III, fig. 1 will see a pupa represented in its perfectly developed form, the lines running lengthwise upon the middle of the figure being the *leg sheaths*, which come out from under and from between the *wing sheaths*, and along the inner edge of these wing sheaths he will perceive, if his eyesight is good, a beaded line, which is the *antennæ sheaths*. In this embryo-pupa I first noticed that the wing sheaths were faintly perceptible, the thin skin over them appearing to form their exterior surface, with a remarkable depression of the breast between them, where no depression had previously existed. This anterior part of the worm now began to gently writhe and bend, without any intervals of repose; perhaps by this exercise, as I first thought, to force the circulating fluids more briskly and copiously into the appropriate channels to develop and expand the several sheaths; the surface hereby being raised in slight waves or wrinkles, which would again subside. The wing sheaths were now noticed to become more obscure and scarcely perceptible; while at the anterior end the bases of the antennæ sheaths began to appear, becoming longer, as it seemed, as the fluids were forced farther in to

fill and expand them; the fore part of the wing sheaths also were next noticed to become more plump and distinct than they had previously been. And now, another phenomenon served to show me the real nature of the change which was occurring, but for which I should probably have failed of detecting what was actually passing directly under my eye. The space between the black V mark of the jaws and the anterior end had been observed to gradually expand and become more considerable, till at length this black mark had moved down to be in a line with the ends of the wing sheaths. It was evident these jaws could only be moved as they had been in but one manner. A membrane or film so exceedingly thin, delicate and transparent that I had wholly failed to perceive it, had been gradually crowded backward, these jaws being attached to it and carried along with it, till the anterior part of the body was now wholly released from it. On carefully looking I could now perceive the wrinkled folds of this membrane beyond the ends of the wing sheaths, producing a very slight constriction of the body at that point. It was moved no further, but on becoming dry was in the course of the day broken into shreds and flakes which the motions of the pupa caused to separate and drop off; whilst over all the remaining front part of the body an extremely fine scurf was discerned to separate and scale off, like dandruff, but on the back I was unable to detect any exfoliation whatever.

Thus, from these observations we obtain a pretty full and distinct view of the processes whereby the insects of this genus Cecidomyia become changed from larvæ to pupæ, by this transformation losing the mouth and jaws of the worm and acquiring the rudimentary wings and legs of the fly. As the first step of this change, at the anterior end of the larva the *cutis* or opake inner skin becomes wholly broken up and dissolved into a watery fluid, whereby the thin transparent outer skin or *cuticle* is elevated like a vesicle or blister, which occupies about a fourth of the length of the worm on its under side but is much shorter on its back. The insect is now in its embryo-pupa state, having lost its larva form and having not yet assumed its pupa form. In the fluid contained in this vesicle the wings, legs and antennæ of the future fly now begin to be developed, whereby the sheaths of the wings at length come to be discerned immediately under the skin. This skin is exceedingly thin, delicate and transparent,

like the *tunica arachnoides* of the human brain, a mere film as thin as a spider's web. Eventually, the insect by gently writhing ruptures this film at its anterior end and gradually crowds it off downward to the lower end of the vesicle, carrying the minute black jaws of the larva with it. It there remains, becoming dry and torn into shreds which flake and fall off by the continued motions of the insect. At the same time, from the remainder of the surface not occupied by this vesicle, a still more slight and delicate film, appearing as though the worm had been wet in milk which had dried upon it, forming an exceedingly thin pellicle or scurf, becomes separated by the same motions of the insect and drops off in minute scales scarcely to be perceived with a magnifying glass. And now the insect has acquired its perfect pupa form, the moulting which occurs in this change being, not a throwing off of an entire skin like that which the larva often parts with when it is done feeding, and that which the pupa always leaves when it changes to a fly, but only a slight scurf-like exfoliation from the surface.—so slight that in a small delicate species like the wheat midge it is doubtful whether any indications of it can be perceived.

Its Parasites and other natural destroyers.

In its native haunts on the eastern continent the wheat midge appears to be preyed upon by several other insects. Earwigs devour the larvæ, and the ravenous two-winged flies of the genus *Empis* seize and carry them away to suck out their juices. But by far the most important and serviceable of these destroyers are its parasitic foes. These are small four-winged flies having some resemblance to little winged ants, and are at a glance distinguished from the yellow flies of the midge by their black color. Their young subsist within and destroy the larvæ and eggs of the midge. And these insects increase or diminish in numbers in the same ratio with the supply of food which they are able to find for their young. Hence, when the midge chances to become numerous these parasites also rapidly multiply and thus immediately quell and subdue it, reducing it back within the sphere it was designed to occupy in the domain of nature; the same as the Hessian fly, once so frightfully destructive to our wheat crops here in America, has become subdued by its parasites, whereby it is seldom noticed now, or known to be present in our country,

although it can be found almost every year in our wheat fields, showing it is still with us, everywhere ready to again increase and become destructive, were it not constantly repressed and kept down by its parasitic foes. And as illustrating the efficiency of these parasites on the wheat midge, it has been stated that persons who have been desirous of seeing and obtaining specimens of the midge, on repairing to places where it had been plenty have been unable to find it, nothing but swarms of these parasitic destroyers coming out in the wheat fields in its stead. Mr. Curtis remarks, these parasites so effectually execute their mission, that it has often happened, a year or two after the midges were in excess, not a specimen could be found. And being usually present upon the wheat in so much greater abundance than the midge fly, it is often overlooked, and these black flies it is hence supposed must be the parents of the yellow maggots which occur in the ears. Thus Mr. Kirby remarks, it is singular, but most people who are acquainted with the larva of the midge mistake these friendly parasites for its parent, and thus imputo all the mischief to the very creature which is appointed to prevent it. Even in our own times this same mistake continues to occur, as we are made aware by a writer in Loudon's Magazine of Natural History (vol. ii, p. 292), who, after describing the appearance of the yellow larvæ in the wheat ears, goes on to state that they become transformed into small black flies which appear in myriads on the outside of the ears and are not half the size of the yellow fly figured by Mr. Kirby; though in a subsequent communication (p. 323) he corrects his error, on coming to find that the yellow flies which he had not seen before also occurred on the wheat.

In England Mr. Kirby found three of these parasitic insects which he was sufficiently assured were destroyers of the wheat midge. That which he first noticed as being the most abundant, and which is regarded as the most important and useful, is the midge larva parasite, named *Ichneumon Tipulæ*, by Mr. Kirby. It now pertains to the genus *Platygaster* in the family *Proctotrupidæ* and order *Hymenoptera*. It is black and shining; its antennæ (see plate i, fig. 4, *b*,) are pale dull yellow and nearly as long as the body, becoming thicker towards their tips, composed of ten joints, of which the fifth and sixth are minute; its scutel is prolonged into a conspicuous conical spine of a rusty yellow

color; its abdomen is scarcely larger than the thorax, somewhat flattened and obovate; its legs are pale dull yellow with the shanks very much thickened towards their tips. Its length is 0.05, or to the ends of its wings, 0.07.

Mr. Kirby gives the following interesting account of the operations of this insect when depositing its eggs. "To see our little Ichneumon deposit its egg in the caterpillar of the wheat fly is a very entertaining sight. In order to enjoy this pleasure I placed a number of the latter upon a sheet of white paper, at no great distance from each other, and then set an Ichneumon down in the midst of them. She began immediately to march about, vibrating her antennæ very briskly; a larva was soon discovered, upon which she fixed herself, the vibratory motion of her antennæ increasing to an intense degree; then bending her body obliquely under her breast, she applied her anus to the larva, and during the insertion of her aculeus and the depositing of the egg her antennæ became perfectly still and motionless. Whilst this operation was performing, the larva appeared to feel a momentary sensation of pain, for it gave a violent wriggle. When all was finished, the little Ichneumon marched off to seek for a second, which was obliged to undergo the same operation, and so on to as many as it could find in which no egg had been before deposited, for it commits only a single egg to each larva. I have seen it frequently mount one which had been pricked before, but it soon discovered its mistake and left it. The size of it is so near that of the wheat-fly, that I imagine the larva of the latter could not support more than one of the former, and therefore, instinct directs it to deposit only a single egg in each; besides, by this means one Ichneumon will destroy an infinite number of larvæ."

Mr. Shirreff reports that he saw one of these parasites sting a larva a second time. The maggot writhed in seeming agony and straggled from the wheat ear on to his thumb nail, where it was again stung, three times by the same fly, and in another encounter both fell to the ground. But I cannot think an egg was inserted only in the puncture first made. The other stings were very likely made to drive the larva to wriggle and fall to the ground, lest if it remained, exposed as it then was, some other enemy should happen along and devour it and the offspring of the parasite with it. It is much to be regretted that this deeply

interesting subject, these parasites of the wheat midge, has never been more fully investigated, all we yet know of them being the little furnished us by Mr. Kirby.

The second or egg parasite, named *Inostemma inserens*, pertains to the same family and is of the same size and color with the preceding, from which it is most readily distinguished by the color of its legs, which are black with only the feet and the ends of the fore shanks rusty yellowish. Its antennæ are elbowed, having the first joint long, stout and club shaped, the second joint larger than the following ones and oval, the four next joints minute and globular, and the four remaining ones compacted together into a large egg shaped club. Its abdomen is shaped like the head of a spear and ends in a sharp point, and is furnished with a very long ovipositor resembling a fine hair.

This makes its appearance on the wheat ears quite as soon as the midge does, and before there are any larvæ for it to puncture. Mr. Kirby saw it inserting its long sting between the chaffs, at the top of the florets. Its eggs are quite unlike those of the midge, being extremely minute and globular. They are supposed to be inserted into those of the midge, and Mr. Kirby remarks it must require more than one egg of the midge for the growth of its larvæ, such is the size of this insect. But it is more probable that it is analogous to the egg parasite of the Hessian fly, which, as Mr. Herrick has discovered, does not prevent the egg from hatching nor its larva from growing so far as to elaborate the amount of nourishment which the parasitic larva requires for its own growth. Again we cannot but regret that so little is positively known and so much is left to conjecture with regard to the economy of this parasite.

The third pasasite pertains to the family *Chalcididæ*, and is the species on which Mr. Westwood has founded the genus *Macroglenes*. Hereby this species comes to be designated the *Macroglenes penetrans*. It is slightly larger than the other two and may be distinguished from them by being of a dark blue instead of a black color. Its antennæ are shorter than the thorax, elbowed, club shaped, ten-jointed, the three last joints being compacted into an egg shaped or conical knob. Its abdomen is compressed, and in the female is cut off in a straight line at its end, where are two projecting valves with a short sting visible between them.

Of this species our knowledge is still more meager than in the case of the other two. Mr. Kirby states that it made its appearance on the wheat on the same day with the larva parasite, and he saw it piercing the outermost chaff with its sting. Though he was not able to ascertain the fact positively, he presumes it lays its eggs in the larva of the midge. But as many of its kindred are now known to be parasitic destroyers of other parasitic larvæ, we are not without suspicions it may prove to be a destroyer of one or the other of the two foregoing species, and thus be in reality a friend of the wheat midge intead of an enemy.

Now that we thus know the parasites which attend the wheat midge on the island of Great Britain, let us next inquire what insects of this kind are found accompanying it on the continent of Europe. For an examination of this subject, the remittance of M. Bazin, heretofore mentioned, has placed in my hands materials which are most important and precious.

Upon opening the vial containing insects as they were promiscuously gathered by the net from the wheat at the time it was in bloom in the department of the Yonne in France, in the year 1860, and emptying a portion of its contents upon a sheet of white paper, what first arrests our notice is the excessive numbers of a minute black fly which we everywhere see in the mass, fully corroborating M. Bazin's statement that this fly exists in myriads on the wheat in all the fields he examined. Dr. Siebel has ascertained that this fly is the species named *Inostemma punctiger* by Nees d'Esenbeck, one of the first authorities of our day upon the minute insects of the Ichneumon tribe. And Dr. Siebel further states that according to the figure of Mr. Curtis it is also the same species with the *I. inserens* of the British entomologists. I see but one circumstance of so much importance as to excite a doubt as to this fly being the *inserens*. Mounted specimens sent me by M. Bazin have the sting or ovipositor of the female beautifully displayed, showing it when thus drawn out, to resemble a very fine slender hair more than twice as long as the body of the insect, and enlarged at its end into a conspicuous flattened spear-shaped head, which is black, the hair being rusty yellowish. Mr. Kirby, whose figures and description are copied by Mr. Curtis, does not represent the end of the sting as being thus enlarged in his species. And other examples from M. Bazin have the sting shorter and without this enlargement at its end, these correspond-

ing perfectly with Mr. Kirby's figure. It therefore appears that it is only when special care is taken to fully extend the sting that this spear head becomes expanded and visible at its end; and thus it might readily escape Mr. Kirby's notice. In all other respects, his description so fully coincides with these insects upon the French wheat that I am obliged to think they are the same, and that the *Inostemma punctiger* of Nees is therefore only a synonym of the *I. inserens* of Kirby.

The next species which we observe among these specimens is that which Dr. Siebel has determined to be the *Platygaster scutellaris* of Nees, a name evidently imposed from the circumstance of its having the scutel prolonged into a thorn-like point. In this character and also in the shape and colors of its body and legs, it is so strikingly like the *Platygaster Tipulæ* of Mr. Kirby that I am persuaded it is nothing else than the same species.

On looking over these specimens still further, I detect among them another species which the magnifying glass readily distinguishes from the two preceding by its blue black instead of pure coal black color. Its abdomen is also noticed to be strongly compressed and sharp edged along the top of the back instead of having the broad egg shaped and oval form of the others. The antennæ are also shorter, the feet are dull white, and the wings show a thick rib vein which is united with the outer edge along the middle, from whence it sends off a short branch almost in a transverse direction, this branch ending in a round head in the female while in the larger sized male this head is oval or thick lunate. This species it is very clear is the *Macroglenes penetrans* of Kirby and Curtis.

Thus, as the result of this examination, we learn that the same three parasites which Mr. Kirby found associated with the wheat midge in England upwards of sixty years ago, are common with it in the wheat fields of France at the present time.

Another most interesting enquiry presents itself in this connection. What is the relative number of these parasitic destroyers to the midge on which they prey, and what proportion does the midge itself bear to the other injurious insects upon the French wheat? Upon emptying one small parcel after another from this vial upon paper and then separating the specimens, placing each kind by itself and counting their number, until some hundreds have been enumerated, we obtain the following result:

Insects on the wheat in France at the time it was in bloom in the year 1860.

Wheat midge,		7 per cent.
Another Cecidomyia of a black color,		2 "
Egg parasite, *I. inserens*,	66	
Larva parasite, *P. Tipulæ*,	11	
Macroglenes penetrans,	8	
Total of parasites,	85	"
Other small flies, Thrips, &c.,	6	"

It thus appears that the midge was the most numerous of any injurious insect upon this wheat; but its parasites were vastly in excess of it, having been present in such numbers as would seem sufficient to immediately overwhelm and exterminate it.

On seeing the above results we at once are desirous of knowing how the insects in the wheat fields of our own country compare with them. In what proportion is the midge to the other insects on our American wheat, and what part of our insects are parasites? I may remark that I have many times swept the net against the heads of wheat when it gathered no insects whatever but the midge; and often on seeing such a heap of these little rascals there, I have grasped the bottom of the net in my hand to crush and destroy them, whereby the net has acquired a yellow stain from their juices. To obtain the fairest comparison the case admits of, I aimed to sweep the wheat when it was at that stage of its bloom that the net would collect the anthers of the flowers and the insects in about the same proportions to each other that I found them in the vial from M. Bazin. It should however be observed that the present year has been a peculiar one, in that our wheat has been thronged with the grain aphis, whereby it has been impossible to sweep the wheat heads anywhere without gathering numbers of this insect which we have never had on our grain before. Although this insect had not become so multiplied as to attract notice the latter part of June, it was sufficiently common then to make the gatherings of the net different from what they would have been in any previous year. I would also state that I found the most common parasite upon our wheat to be so exceedingly active that it escaped from the vials if they were not instantly closed on receiving it or were opened afterwards; and thus it was only by giving particular care to

secure it regardless of everything else that accompanied it in the net that I was able to obtain a fair proportion of these insects. By collecting in this way nearly a thousand insects from the wheat heads, and counting the numbers of each kind, I found the result to be as follows:

Insects on the wheat in New York at the time it was in bloom in the year 1861.

Wheat midge	59 per cent.
Small gnats, (*Chironomus*, etc.)	12 "
Grain aphis	7 "
Thrips	4 "
Bugs, (Hemiptera and Homoptera,)	3 "
Chlorops and kindred flies	3 "
Mites and Poduræ	2 "
Mistaken parasite	9 "
Other parasites	1 "

Of these insects the gnats and Poduræ probably do no injury to the wheat; all the others are pernicious except the parasites, which are beneficial.

Let us now enquire what insects and other destroyers of the wheat midge we have here in America.

It is a subject on which I have often pondered: How does it happen that the midge in this country is so vastly more destructive than it is in its native haunts? There it has never been known to devastate the wheat crop to any extent approximating to its ravages here. Mr. Kirby after a patient gathering of the data, estimated that it destroyed about two kernels to each ear, or one twentieth of the crop. When it was so destructive in Scotland in 1828, Mr. Gorrie estimates it to have caused a loss of about a third in the late-sown wheats. Moreover when it chances to become so multiplied and injurious as to attract notice, it is but a transitory evil which subsides in a few years, after which it is scarcely known or heard of again till another generation has come upon the world's stage. Here, on the other hand, it persistently continues; seldom a year passes but that the wheat crop suffers greatly from it, and every few years a season comes when its ravages are enormous. We have now had thirty years experience with it, and know it continues to be as formidable and destructive at the present time as it has been at

any previous period. Why is it so severe and unremitting a pest in our country when it is so slight and transitory in its native land? There must be a cause for this remarkable difference. What can that cause be? I can impute it to only one thing. We here are destitute of nature's appointed means for repressing and subduing this insect. Those other insects which have been created for the purpose of quelling this species and keeping it restrained within its appropriate sphere have never yet reached our shores. We have received the evil without the remedy. And thus the midge is able to multiply and flourish, to revel and riot, year after year, without let or hindrance. This certainly would seem to be the principal if not the sole cause why the career of this insect here is so very different from what it is in the old world. If we have any insect in this country which lives upon and destroys the midge, with the abundance of food which has been furnished it, why has not that insect increased and produced some mitigation of this evil?

But it has repeatedly been reported that we have insects in this country which are parasitic destroyers of the wheat midge. I have myself heretofore supposed that we had such insects; and it was only when I perceived how utterly they failed to fulfil their mission that I began to distrust the correctness of this opinion.

In the early part of my researches I noticed an insect under such circumstances as led me to confidently regard it as a destroyer of the midge. I saw it was a member of the Chalcidian family, and supposing I should have no difficulty in always finding the same insect in the same situation, I neglected to preserve specimens of it, and thus am unable now to ascertain with certainty the species which I then observed. A few years afterwards, when the midge larvæ were crawling down upon the straw, I again noticed a parasitic insect examining these larvæ with its antennæ, and the larva with a skip throwing itself from the straw to escape from it. I captured and saved two specimens of this parasite, feeling confident I should meet with it multiplied and much more numerous the following year, whereby I could then investigate it to better advantage. But the next year I was unable to meet with it; and within the past few years I have strenuously endeavored to find this insect at the same operation again, but without success. And now, on hunting out

the old specimens of it in my collection, to see if I could from them draw up a suitable description of the species, I find on examining them they are the Hessian fly's parasite, which is represented on Plate III, fig. 1. And I suspect it was this same species which I saw the first year of my observations on the midge. The Hessian fly and this parasite were somewhat common in this vicinity for a few years at that period; and it is quite probable that the parasite, unable to find a sufficient supply of Hessian fly larvæ on which to bestow its eggs, was examining these larvæ of the wheat midge, to ascertain if it might not be able to rear its young in them also.

An insect which resembles the European parasites of the midge the most closely of anything which we meet with upon the wheat of this country is a species of *Platygaster*, so very like the *P. Tipulæ* of Mr. Kirby that no one but an experienced observer of these minute insects will be apt to recognize it as really differing from that species. In the volume of the State Natural History on Insects, page 180, a species is inserted under this name, *Platygaster Tipulæ*. I know of no species but the one to which I now refer that can be alluded to in the remarks there made. But if this is the species intended, it is evident the description there given has been compiled from Curtis or Kirby; it could not have been drawn from our insect. And I suppose it to be this same species which has in other instances originated the reports which have repeatedly run through the newspapers, that a parasitic destroyer of the midge had been discovered, whereby it was probable our wheat crops would soon be released from this enemy. The last of these reports came to us from Canada West, a year since. See Journal State Agric. Soc., vol. ix, p. 30.

As this insect is seen in company with the midge on the wheat ears, and is very numerous some years, I will here describe it, and present what observations I have thus far made with respect to its habits. A magnified view of it is given, Plate i, fig. 4, the cross lines below on the left side indicating its natural size, and on the right side at *a* is one of its antennæ greatly magnified, whilst *b* is the antenna of *Platygaster Tipulæ*, copied from Mr. Curtis's figures. It will be noticed that these antennæ differ very manifestly in their structure, *b* having the two middle joints very minute and globular, and the four last joints plainly thicker than the basal

ones. Moreover in *P. Tipulæ* the scutel is prolonged into a conical thorn-like point, whilst in our insect there is no projection of the scutel. The legs too, in our insect, are black instead of yellow. Having been such a fruitful source of error I name it accordingly.

The MISTAKEN PARASITE *Platygaster error*, new species. (Hymenoptera. Proctotrupidæ.) Plate i, fig. 4.

Black, shining. Head nearly globular, slightly broader than long. Antennæ inserted near the mouth, longer than the head and thorax, thread-like, clothed with a fine inclined beard, elbowed, ten-jointed; basal joint long and stout, nearly half as long as all the remaining joints, thicker towards its tip; second joint oval or somewhat obovate, twice as long as thick; third joint shortest, obconic, a little longer than thick, scarcely as thick as the fourth joint, to which it is compactly joined; fourth joint short cylindric, twice as long as the third joint and they together as long as the second; fifth to ninth joints short cylindric, about twice as long as thick, cut off transversely at their ends, their bases abruptly rounded, separated by very short pedicels; last joint twice as long as thick, cylindric, with its apex tapering to a rounded point. Thorax egg-shaped, smooth. Abdomen flattened, oval, twice as long as wide, as long as the thorax but scarcely as wide, its second segment forming more than half of the whole length. Legs pitchy black, thighs and shanks thicker towards their tips, feet five-jointed. Wings wholly destitute of veins, clear and glassy, irised red and green, the surface minutely bearded and the margin having coarse short inclined ciliæ. Length 0.05.

Although its hind legs are not thickened this insect often moves with a skip, particularly when it first starts to walk.

The observations which I have made upon the habits of this parasite will probably be best communicated to the reader by copying them directly from my memoranda.

"June 22. Meeting in a wheat ear with two young larvæ of the midge, I placed them in a vial and introduced a Mistaken parasite into the vial; but it walks hurriedly about, frequently passing them without noticing them in the least. As this may be owing to its alarm on finding it is in a strange situation, I find two other larvæ and breaking off the young kernel on which they are lying I introduce it into another vial in which a parasite has been imprisoned since yesterday. It comes to the soft kernel and appears to nibble or sip the juice of its broken end. It then walks around a few moments and comes back and nibbles the end of the kernel again, but pays not the slightest attention to the larvæ.

"June 29. Finding some eggs of the midge I introduced the chaffs to which they are adhering into a vial in which is one of these parasites; but it walks over the chaffs and the eggs without noticing them in the least. Thus it indicates no attachment to either the eggs or larvæ of the midge.

"July 3. I watched the motions of the Mistaken parasite in a

wheat field to-day, in which the midge flies are less numerous than they have been and the aphis is increasing. One, and sometimes two or three of these parasites were present, on many of the ears, particularly those ears on which colonies of the aphis had established themselves. They walked about upon the ears and down between the chaffs. They are very tame and familiar, not at all shy like the midge fly. On taking hold of a wheat ear the midge fly will walk away from the spot, whilst this fly will walk out upon the hand without any symptom of fear or alarm. In two instances I saw it pushing the tip of its body into the small orifice at the apex of the outermost scale of the chaffs. One of these I watched until she had crowded the end of her body into this orifice three times, holding it there a few moments each time as if feeling around or dropping an egg there. I then secured her in a vial, and carefully dissected this floret. With the single lens of my pocket magnifier I could not discover any eggs on either of the chaffs near this orifice, nor were there any eggs or larvæ of the midge there or elsewhere upon any of the chaffs or the kernel of this floret. After my return, in a vial into which I had emptied some sweepings of the net, I noticed one of these parasites clinging upon the back of a plump wingless aphis which is three times as large as the parasite. The aphis walks impatiently about, crawling under the rubbish in the vial to crowd the intruder off, and mounting up the sides of the vial, and tumbling down and rolling over, but still the parasite clings to it with an air of *non chalance*. It occasionally touches the tip of its body to the body of the aphis, here and there, but does not appear to insert any egg, and if it stings, the aphis is such a stolid and phlegmatic creature that it shows no manifestation of feeling the puncture. I watch this rider upon his horse more than ten minutes. He at length dismounts and walks away. Perhaps it was only to tease and annoy the aphis that he thus clung to it.

"July 9. Visited M's spring wheat. This field is surrounded by woods except on one side, and the midge does not appear to have found it, for I discover no flies upon nor larvæ in the ears. Both the aphis and the Mistaken parasite are more numerous here than I have seen them in any other field. This looks as though these insects belonged together. Chlorops flies are also plenty on this wheat."

From these observations it appears quite doubtful whether this

MIDGE. PARASITES. IT IS FOUND TO BE THE EGG PARASITE OF A BUG.

parasite pertains to the midge. There are more indications of its belonging to the aphis, though it may be the Chlorops or some other common insect of our wheat which attracts it into the fields of this grain. It is scarcely worth while to speculate upon this subject when the exact truth can be ascertained by careful investigation. Of one fact, however, we are sufficiently assured, if this insect is parasitic upon the midge it has not power to subdue it, or to make any sensible impression upon it, else the midge would not have been pursuing its career all along, so unchecked as it evidently has been.

[When on the point of dispatching these pages to the printer, I happen to notice some figures which were sent for my inspection in August, 1859, from J. M. Klippart, Secretary of the Ohio Board of Agriculture. Mr. Klippart found adhering upon a chaff of wheat several small black globules. On magnifying them they were seen to be flattened or sunk in at their summits, with a row of about fifteen little thread-like spines radiating from the edge of this flattened portion. On opening one of these globules he found it hollow and containing a little sac within, in which were wings and legs which in his view were "certainly portions of *Platygaster punctiger*," accompanid by "genuine antennæ of *Cecidomyia Tritici*." I assured Mr. Klippart the figure of the antennæ showed they were not what he supposed, but were unmistakably parts of the same insect to which the wings and legs belonged. And on noticing this antennæ figure now, I see it corresponds with my fig. 4 *a* of Plate i, in such particulars as assures me it pertains to the same insect. And this insect Mr. Klippart found in the little black globules. I now perceive what the facts are in this case. I think I informed Mr. Klippart that these globules looked to me like the eggs of a Hemipterous insect. Now that my mind is refreshed upon the different insects which occur on our wheat, I can state with a considerable degree of confidence that these globules, according to the figures given of them, are the eggs of the *Nabis fera* of Linnæus, a long narrow ash-gray bug slightly over a quarter of an inch in length, which is common on wheat and very common on grass, both in this country and in Europe. I hope to have the dissimilar habits of this and the other bugs which occur on our wheat sufficiently investigated, to present an account of them in my next Report. This Mistaken parasite, thus found in those eggs, sufficiently set-

tles the question which is now before us. It is the egg parasite of that bug. The parasite punctures and inserts an egg in each egg of the bug it can find. Its egg hatching, the minute larva therefrom feeds on the contents of the bug's egg till it gets its growth; it then changes to a pupa and finally to a perfect insect, when it gnaws an opening through the egg shell and makes its escape therefrom. Portions of one of these insects which had died before it made its way out of the shell, were found by Mr. Klippart. My acknowledgments are due him for enabling me to show so conclusively that this insect, which he is "certain" is the *Platygaster* (*Inostemma*) *punctiger*, has no connection whatever with the wheat midge.]

Several other parasitic insects may be met with upon the wheat. Some of these we know prey upon the aphis. These will be described in connection with that insect in a subsequent part of this report. The others occur in such very limited numbers that it is evident they pertain to species which are much less abundant in this grain than the midge is. For several years I have been searching to ascertain if we had any parasitic destroyers of the midge. The present year I have looked with particular care; and I now am more confident than I have ever before been that we have no insects of this kind in our country.

A few spiders and other predaceous insects may be noticed on the wheat, capturing and devouring all flies and other insects which they are able to master. But the only natural destroyer of the midge known to us here in America, which is worthy to be mentioned, is our common yellow-bird, the *Carduelis Americana*, as it was first named by Catesby (Nat. Hist. of Carolina, vol. i, p. 43.) Linnæus subsequently changed its specific name to *tristis*, the black portions of its plumage probably suggesting to him the idea of mourning weeds; but a more unfortunate name could scarcely be imposed upon this lovely bird, its bright colors, its sprightly motions and the lively song it sings rendering it impossible to associate with it any thoughts of sadness and melancholy.

This bird causes that rough and ragged appearance of the wheat heads which is the most conspicuous indication we have that the grain is infested by this insect. The bird alighting grasps the wheat stalk just below the ear, clinging fearlessly to

it even when it is swayed to and fro by the wind, and with its bill it parts the chaff from the kernel as represented, plate ii, fig. 9 at * and *†, picking off and devouring the larvæ to which it thus gains access. When the larvæ are yet small, before the end of June, it begins to feed upon them; and if the wheat is badly infested, in a short time afterwards a large flock of these birds, both male and female, become collected upon it and return to it day after day. And after feasting upon these larvæ till their wants are satisfied, if the farmer be so slovenly as to have allowed a patch of thistles to grow in the vicinity, the birds fly from the wheat to them and end their repast each day by picking those seeds therefrom which are ripened and ready to be scattered abroad by the winds. Thus industriously does this little creature appear to exert itself in different ways for man's benefit.

Formerly our farmers from seeing such numbers of these yellow-birds upon the wheat, picking the heads, supposed it was the grain which they were devouring; and I have known boys to be stationed as sentries around the wheat fields to stone and drive these birds away. I believe it was first announced to the public in my previous Essay that it was the larvæ of the midge and not the wheat that these birds were in pursuit of. In more than one instance I have since seen the same fact set forth in some of our agricultural periodicals as a new and important discovery; sometimes with the further statement that there were two different birds which feed thus on the midge larvæ. The female of the yellow-bird being of a greyish brown color, so very unlike the gay yellow and black plumage of the male, has, in such instances, been mistaken for a distinct species.

This bird never attempts to obtain all the larvæ from the wheat heads; it only opens those florets in which the larvæ are the most numerous, namely, the outer florets of the headlets, seldom, if ever, disturbing the inner florets. It parts the bearded chaff from the kernel of these outer florets and devours the larvæ which are thus exposed, leaving the kernel in its place, sometimes with one or two larvæ remaining hid between the kernel and the inner chaff. Its operations seem to be of a most purely benevolent character, doing for man the best service in its power. Its aim appears to be to thin out and diminish these larvæ from the wheat heads to such an extent that part of the kernels—those which it leaves wholly untouched—will be able to fill and become good wheat.

To obtain all the larvæ it would be obliged to part the chaffs from all the kernels, whereby no wheat whatever would be produced. Thus we are indebted to this bird that the grain which we do gather is not dwarfed and shrunken to a much greater degree than it is. And were the natural parasites of the midge introduced into this country, it is very evident that the additional aid which this bird would give to their work would subdue this insect here much more effectually and completely than it is subdued in Europe.

Before leaving this branch of our subject, the reader will be anxious to know why these parasites of the midge have not followed it to this country, and how much longer we must probably wait for them to arrive here. Let us look then, at the chances which exist for these insects to be brought across the Atlantic. In what manner do insects become transported to such great distances? We see how this may be done in the case of the Hessian fly. Its larvæ remaining dormant in the straw of the wheat for a number of weeks will be liable to be carried anywhere that the straw is taken. We see its parasites also cradled within these larvæ in the straw, and thus know that they too will be equally as liable as the Hessian fly itself to be conveyed wherever it is conveyed. How is it with respect to the midge and its parasites? We see the larvæ of the midge lying dormant in the dry wheat heads for months, whereby they may be carried wherever any unthreshed wheat happens to be carried. And how is it as to its parasites? The egg parasite, *I. inserens*, has never been investigated, and thus we are unable to judge of this matter with respect to it. But of the larva parasite, *P. Tipulæ*, which the British writers regard as the most important and useful one of these parasites, we are sufficiently informed. Mr. Kirby tells us that when several of the larvæ of the midge are scattered about upon a sheet of paper, and one of these parasites is set down among them, it immediately passes around from one to another, stinging and inserting an egg in each one of them. Thus we know it is when the midge larvæ are openly exposed, crawling about upon the wheat heads and going down the straw to the ground, that this parasite is on the alert to deposit its eggs in them. And Prof. Henslow's researches, several years ago, impressed him with the idea that it was only those larvæ which were stung or ichneumonized which descended into the ground,

and that those which were unstung all remained in the wheat ears. This view is undoubtedly in a measure correct. It is from those larvæ which descend to the ground before harvest, and not from those which are remaining in the wheat heads, that these parasites are liable to come. And we thus see how very slight the chances are for this parasite to reach this country. Centurics may elapse before any of the earth from old wheat fields will happen to be brought to our shores, in which larvæ of the midge which are infested with this parasite will be lurking.

It was after the disastrous results of the harvest of 1854, that, on giving this subject my most attentive consideration, and weighing all the facts bearing upon it, I became persuaded that we had not any parasites, or at least any genuine and efficient parasites of the midge in this country, and that our only effectual remedy for this insect was to import these, its natural destroyers, from Europe. I thereupon felt that the position I occupy, might be regarded as making it my duty to endeavor to obtain these insects. Accordingly, having previously had some correspondence with Mr. Curtis, I addressed a letter to him in May, 1855, chiefly on this subject, informing him of the immense amount of damage we were sustaining from the midge here in America, and that with us no parasites appeared to accompany this insect to give it any check in its destructive career. I suggested the manner in which I thought in any place where the midge was present, ichneumonized larvæ of it might be obtained, and the mode in which they could probably be transmitted alive to this country, and requested if he knew any person so situated that he could conveniently procure and foward to me such larvæ, he would do me the favor of communicating to him my wishes to obtain them. When this letter reached him, Mr. Curtis was occupied in arranging for a tour upon the continent, with the hope of hereby recovering those faculties which had become impaired by protracted over-exertion. Being President of the London Entomological Society, he laid this letter before the Society at its next meeting. I have not seen the published proceedings of that meeting, but was informed that the subject led to an interesting discussion, and the adoption of a resolution to the effect that if any member of the Society met with the parasite of the midge, under circumstances which would enable him to forward it to me, he would endeavor to do so. But I can readily conceive that this parasite

may not be obtainable except upon particular exertions. If specimens of the living larvæ of the Hessian fly, or of its parasite, were requested of me, though I could have procured them with ease some years since, at present I should be wholly unable to obtain them anywhere in my own vicinity. And the case is probably similar in Britain with the midge and its parasites. It is only in places where these insects happen to be present in considerable numbers that larvæ which are ichneumonized can probably be secured.

Remedies.

Those remedies for the midge which are of sufficient importance to entitle them to a particular notice are of two kinds; those which have it for their object to destroy the insect, and those which aim so to cultivate the crop as to ward off and elude its attacks.

It has been proposed to destroy the insect when it is in its fly and also when in its larva state.

1st. Destroying the flies. When the flies make their appearance upon the wheat in such abundance as we usually see them, there appears to be but one mode by which it is then possible to save the crop from their ravages, namely, by destroying the flies, or expelling them from the field, before they have had time to deposit any considerable number of eggs. Various methods have been proposed for accomplishing this; placing lighted lamps in the field by night into the flame of which the flies may be attracted, setting stumps on fire with the same intention and that their smoke also may smother the flies, placing such fetid odors in the field as will drive the enemy away, &c. But none of these measures appear to possess sufficient efficacy to accomplish the end for which they are designed.

In the early part of my researches, upon noticing what a throng of these yellow flies were gathered by the common entomological net on giving it a few sweeps among the wheat, it occurred to me that with a net of more capacity it would be easy to sweep a whole field, and by doing this in the evening or on a cloudy day when all the flies are hovering closely around and alighted upon the heads, nearly the whole of them could be collected in the net and destroyed. No suggestion of this kind had ever been made before. It struck the French reviewers of my Essay as being the

most practicable and efficacious mode by which it was possible to combat this enemy and save the crop, and they accordingly noticed it with particular favor. I see a recent writer of our country, of a rather pretentious character, introduces this measure to the notice of his readers as "a mode recommended in France." I have therefore been more explicit in stating the above facts, lest this writer should suspect me of petty charlatanry in not informing my readers of the true source to which this measure is to be credited.

I have repeatedly determined that I would submit the efficacy of this measure to a decisive test, by resorting to it upon the very first appearance of the flies upon the wheat and before they had deposited any important amount of eggs. But after the close observations made in several years, I become satisfied it is impossible to do this. This insect comes upon a wheatfield very much as the malignant cholera comes upon a city: at the first intimation of its presence it is found to be scattered everywhere. The flies appear to arrive in the wheat so suddenly and so overburthened with eggs when they come, that in a single night the whole field becomes stocked with the eggs to such an extent that it seems as though to destroy the flies then will be of little avail, the mischief being already so far under way. Thus I have been discouraged from resorting to this remedy, always thinking that by looking sharper another year I could discover the flies before they had deposited such numbers of eggs. And yet, on observing that their forces continue to augment for several days, and that they remain some weeks at their operations in the same field, we in the end become sensible that if they had been swept off when they were first discovered, the wheat would receive but a small fraction of the number of eggs with which it eventually becomes burthened. I therefore still think this measure may be highly efficacious. Every fly deposits a sufficient number of eggs, I suppose, to destroy three or four kernels. And as we know that millions of these flies can be captured by sweeping the wheat with a net, there is a strong inducement to resort to this measure, on the first appearance of the flies, and to repeat it in any parts of the field where they may afterwards be gathered in numbers. And if valuable parasites are at the same time upon the grain and are captured by the net, these insects as a general rule are so very much more active than the midge that by opening the

net a moment, they (as I think) will mostly escape before any of the midge flies will be ready to do so; whereby, with a little skill acquired by practice, we shall probably be able to let the useful insects go free and retain for destruction those only which are noxious.

2d. Destroying the larvæ. Prof. Henslow deeming it was only those larvæ which remained in the wheat ears and were carried into the barn from which the flies were hatched, ascertained that when the grain was threshed, with a suitable sieve, he was able to separate all the larvæ from the grain and chaff. He accordingly recommended that such a "midge sieve" should be attached to the winnowing machine or fanning mill, in order that these larvæ might be thus separated and committted to the flames. And Mr. Curtis, in letters, directs my attention particularly to this measure. I notice it in this manner, that our English friends may be aware we have not overlooked this important remedy. I notice it to say that this very thing which Prof. Henslow recommends to have attached to the winnowing machines of England—this midge sieve, placed in an inclined position, like the roof of a house—has formed a part of every winnowing machine in this country, ever since my recollection. By this sieve any dust or small seeds of weeds or grass which happen to be among the grain, become separated and fall into a box underneath, and constitute what we term "the screenings" of the machine. And when the midge came into our wheat, its larvæ were always separated from the grain, forming a principal part of these screenings. It was the common custom to empty these screenings out at the barn door, until in my Essay sixteen years ago I directed attention pointedly to this subject; whereby our farmers, on coming to know that these screenings thus thrown into the yard produced a swarm of flies to invade their wheat the following June, have quite generally, I believe, come into the practice of effectually destroying them, either by burning them or feeding them to the poultry or swine. This should never be omitted when the yellow larvæ of the midge are observed to form a portion of these screenings.

As the larvæ which are brought into the barn can thus readily be destroyed, it is evident if that portion of them which descends to the ground before harvest and remains in the wheat field can in any way be destroyed also, we have it in our power to cut off

the whole generation of these culprits, unless a part of them chance to be nurtured elsewhere than in the wheat. Impressed with this view of the subject, Hon. S. Cheever, A. B. Dickinson, and other intelligent practical agriculturists of our State, have given to it their best thoughts. On coming to learn from my previous Essay, that these larvæ laid slightly under the surface, they have thought that by deep plowing they would be buried to such a depth that they would be unable to make their way up to the surface again. They accordingly have practiced this measure, and are confident they have in this manner destroyed millions of these larvæ, and have hereby materially diminished the destructiveness of this insect on their lands. Now that we know these larvæ do not lie naked in the ground, as we have heretofore supposed them to, but wrap themselves in cocoons in which they remain closely bound up and fettered until they are on the point of changing to flies, it becomes still more probable that this measure will be effectual, and that the pupa, on breaking out from the cocoon, being so illy adapted for locomotion as the insect is in this stage of its existence, will become exhausted and perish in its efforts to push itself upward such an unexpected distance to the surface. I am, therefore, more confident of the efficacy of this measure now than I have been heretofore.

Of the other class of remedies, those which aim so to cultivate the crop as to resist or elude the attacks of this insect, it belongs to the practical agriculturist rather than to me to speak. This branch of the subject, moreover, has been so much canvassed among our farmers, and is so well understood by them, that no new information can scarcely be given them with respect to it. They all know how much their success in attempting to cultivate this grain, depends upon a selection of the hardiest varieties of seed, such as the Mediterranean and the Black Sea, and sowing spring wheat so late that the most active period of this insect's operations will be past before the crop comes into bloom.

Brief summary of the foregoing account.

The Wheat midge (*Cecidomyia Tritici*, Kirby,) has been known in Great Britain for more than a century, and has occasionally been quite injurious to the wheat crops of that country. Within a few years past it has also been detected in the north part of France from the damage it was occasioning in the wheat crops there.

MIDGE. SUMMARY VIEW OF IT.

In these its native haunts it is everywhere accompanied by vast numbers of minute black flies resembling small ants, which are its parasitic destroyers. One of these deposits its eggs in the larva, another in the eggs of the midge, causing them to perish, and hereby this insect is restrained from multiplying, and is speedily quelled whenever it chances to become numerous.

It was introduced upon this continent, probably in unthreshed wheat brought to the port of Quebec, and began to attract public notice from its destructiveness to the wheat crop in the northwestern part of Vermont in the year 1828. From thence it has spread itself over all the free States and Canada, as far west as into Michigan and Indiana, everywhere laying the wheat crop under contribution for its support, and rendering the cultivation of this grain so uncertain that in all the older parts of the country wheat has long since ceased to be a staple product.

This insect is a very small fly about a third the size of a musketo, which it resembles in its appearance. It is of a bright orange yellow color with clear glassy wings. These flies come abroad each year a little before the middle of June, and continue more than a month, laying their eggs between the chaffs of the wheat ears. They are most active in a moist atmosphere and cannot endure a dry one. Hence they are only seen on the wheat ears in the night time and on cloudy days. And if the last half of June be wet and showery this insect is most numerous and destructive; but if it be remarkably dry the wheat that year escapes from injury, the insect withdrawing from it, probably to the grass of lowland meadows and the margins of streams, in which to rear its young to return as they do into the wheat the next year.

The eggs hatch minute footless worms or maggots which soon acquire a bright orange yellow color. These place themselves upon the soft young kernels of the grain and abstract the milky juice therefrom, whereby the kernels become shrunken and dwarfish. The worms get their growth in three to four weeks, when they are slightly less than a tenth of an inch long. When the straws are wet with rain, whereby they are able to adhere to them, they crawl down them and enter the ground, where they enclose themselves in minute cocoons scarcely the size of mustard seeds, in which they remain through the autumn and winter, and till ready to give out the flies the following June.

UNFRIENDLY MIDGE, ANOTHER SPECIES IN WHEAT.

In America we have now had thirty years experience with this insect. We have become well acquainted with its history, its transformations and habits. The best remedies for it which we are able to devise and practise are but partially efficacious. It continues to be as numerous and destructive now as it has been at any previous period. By diminishing the yield of its wheat crops it is occasioning a loss to the State of New York of some millions of dollars annually. And this loss will continue until by accident, or by the hand of man, the parasitic destroyers of this insect become introduced into this country, when it will disappear, in the same manner that its predecessor and compeer in destructiveness, the Hessian fly, has disappeared, and has almost ceased to be felt as an evil.

2. UNFRIENDLY MIDGE, *Cecidomyia inimica*, new species. (Diptera Tipulidæ.)

In wheat heads, often in company with the yellow larvæ of the wheat midgo, a similar larva of a white color and having a dark reddish internal stripe; secreting itself between the chaffs or descending to the ground to pass its pupa state; at the close of summer changing to a dusky or black midge with a lurid yellowish abdomen and smoky iridescent wings, its body 0.08 long.

In the attentive inspection which I have been giving to the insects on grain the present year (1861), I have detected another insect on wheat, closely related to the wheat midge, but which, instead of remaining in its larva state through the winter, changes to a fly the latter part of August. As it thus completes its transformations in so short a time after the larva has finished feeding, it scarcely requires to travel down the straw to the ground to secrete itself during its dormant state; and we accordingly find that it sometimes remains in the ears of the wheat until it becomes a fly. Upon what it then deposits its eggs, and where it lurks through the winter and till the wheat heads again appear the following June, are interesting points in its history which are still remaining to be discovered.

It was on the eleventh of August that my attention was first directed to the larvæ of this species as being different from those of the wheat midge. Ten wheat heads which had been gathered some three weeks previously, were placed the day before in a glass jar and set out doors in a sprinkling rain, for the larvæ of the midge to descend from them. Of forty larvæ which were thus obtained, six were noticed to differ from the others in being white or reddish white without any tinge of yellow, and in these the dark internal streak was very much larger, reaching two-

thirds the length of the body. This streak is of a dark purplish red color, frequently black towards its anterior end, and in one instance it was noticed to be black its entire length. All the body of the worm outside of this central streak is sometimes hyaline, colorless and watery; but more commonly opake white clouds are blended with the hyaline, giving the worm a curdled or frosted appearance, similar to that of many of the Syrphus larvæ; or it is wholly of an opake white color. Moreover the white coloring sometimes takes on a tinge of red or even becomes pale rose colored instead of white. These colors are variable and evanescent, the same worm sometimes changing more or less from hyaline to white in a short time. One worm was noticed as being hyaline and colorless, with the dark purple streak along the centre of its body, and on its under side two rows of opake white granules, eleven in each row, the three anterior ones in the three thoracic segments being smaller. These granules had a similar appearance to legs and prolegs inside of the transparent skin, and they also strikingly imitated those members in their motions as the worm was crawling on wet glass. It merits to be noticed also, that the larva of this species moves in the same manner and has the same form as the larva of the wheat midge, represented in Plate 2, figure 12, its tip also being four-toothed, as shown in figure 14.

From these larvæ a fly was obtained, which I found to be of the same species with one which a short time before had come directly from a wheat head, in which the pupa had nestled between the chaffs of two of the florets, crowding itself upward to their summits to give out the fly. The pupa case from which this fly had come was 0.08 long, white, subhyaline and glossy except on the abdomen, with a pale brown discolored spot on the back of the thorax. The leg sheaths were parallel and soldered together side by side, the inner pair being but little shorter than the outer, whereby only a semicircular notch was formed at their tips. Two robust brown bristles projected horizontally outwards, one on each side of the back of the thorax, the same as in some other species of this genus.

In the FEMALE, the head is nearly globular, broader than long, and broadest back of the middle. The antennæ are black, about half the length of the body, composed of about twelve joints, which are oblong, contracted in their middles, and separated by short pedicels. The thorax is black above and polished, orange-yellow on the sides and beneath, with the neck also yellow, and the poisers whitish. The abdomen is dusky, with the sutures yellow, and is clothed on the sides with silvery white hairs. Two exsertile points protrude from its tip,

GRAIN MIDGE. ITS SPOTTED WINGS.

indicating its ovipositor to be similar to that of the wheat midge. The legs are blackish, paler yellowish brown on their insides and at base. The wings are smoky, iridescent-blue, with blackish veins, the inner vein abruptly bent, with the end straight and nearly transverse; no transverse veinlet.

3. GRAIN MIDGE, *Cecidomyia graminis*, olim *cerealis*, Fitch. (Diptera, Tipulidæ.) Plate ii, fig. 2.

Associated with the wheat midge and supposed to have the same habits with it; a fly of the same size and color, but having six smoky spots on each of its wings, and the joints of the male antennæ alternately longer.

The flies of this spotted winged midge I met with sixteen years ago quite common in our wheat fields, in company with the flies of the wheat midge. I continued to find them the following year, after which they wholly disappeared, and I have not seen an individual of this kind since.

An insect in Germany, the larva of which nestles in the straw of barley in the same situation which the Hessian fly larva occupies, and which was very injurious to the barley crop in the grand duchy of Baden in the years 1813 and 1816, was in 1817 described by Dr. J. N. Sauter, in an octavo pamphlet of 47 pages, as we learn from a brief notice of it and its contents in Germar's Magazine, vol. iii, page 366. Dr. Sauter names this barley midge the *Tipula cerealis*, but, as Mr. Curtis observes in his notice of it (Jour. Royal Agric. Soc. vi. 151), there is every reason to believe it is a species of Cecidomyia. In that case another name for this spotted winged wheat fly of ours will be required, and as the present appears to be the most suitable opportunity to effect a change, whereby future confusion may be avoided, I deem myself justified in withdrawing the name which I had heretofore proposed.

This grain midge was met with quite common from the middle of June till the end of August, in the wheat fields and also among the grass in yards and on the windows of dwellings. There also occurred on grass and on windows, in the last half of July and through August, what I regarded as another species, extremely like this, but having the body of a deeper red color, and the wings with seven spots, there being three spots instead of two along the inner side of the wing. The difference between the two species in this respect is very distinctly shown in the magnified wings, figs. 3 and 18 of plate ii, the wing of the grain midge, fig. 3, having no spot on the apex of the inner vein, where one is situated in this species. I named this species *Cecidomyia*

caliptera, or the Spotted-winged midge. I continued to meet with this species also, the following year, since which it too has wholly vanished from my vicinity.

4. GRAIN APHIS, *Aphis Avenæ*, Fabricius. (Homoptera, Aphidæ.)
Plate 1, fig. 5 and 6.

Clusters of reddish-yellow plant-lice on the heads of wheat, oats, barley and rye, sometimes in immense numbers, stationed around the butt ends of the florets, sucking the juices away from the kernels and causing them to be more or less shrunken and light of weight.

The excessive numbers in which the grain aphis, the plant-louse upon the heads of wheat and oats, has this year (1861) made its appearance in the Northern States, is truly remarkable. Although it is a common habit of plant lice, at times, to become extremely numerous on the vegetation they infest, we meet with no recorded instance in which one of these insects has been known to be thus suddenly and excessively multiplied over such a wide extent of territory. Hitherto this grain aphis has been so rare and scattered so sparsely in our grain fields that no one had noticed it or was aware that we had such an insect in our country. This year, over all the New England States, over all the State of New York, except its western section, through the northeast portion of Pennsylvania, and in several parts of Canada, every grain field has been invaded, and most of these fields have literally been thronged by it.

Having forced itself so prominently into notice and excited so much alarm, I have already communicated notices of this insect to several of our agricultural periodicals, whereby a portion of what I here present has already met the public eye, particularly in articles which appeared in the Country Gentleman of August 15th, and the New York Observer of October 17th. The insect will here be found more fully described than heretofore, and an account of the parasitic and other enemies by which it is destroyed, is also here presented. Thousands of persons have closely inspected these insects the past summer. What I shall state will recall to their minds several things which they observed, and will explain to many of them some of the phenomena which they noticed but did not understand at that time.

Previous to the present year, in searching for injurious insects upon wheat, I have repeatedly seen this aphis. But as only a few of them appeared to be scattered about, singly, here and there

upon the leaves and stalks of the grain, I regarded it as a thing of no importance, and therefore gave no attention to it. Last year a letter, which I regret I have mislaid, from a gentleman, I think, in Columbia county, informed me of a reddish fly in excessive numbers on the oats in his vicinity, but I could find no such insect then on the oats in my own neighborhood. W. Freeman, Jr., of South Adams, Mass., visiting me soon after, mentioned a field of oats in that State in which he had noticed a reddish aphis in surprising numbers. These facts show that this insect had begun to multiply excessively in some places last year.

Early in May last, my attention was particularly directed to this insect for the first time. Rye and wheat sowed last autumn were then but a few inches high, and were just beginning their onward growth with the genial warmth of spring, when I noticed this aphis to be more common than any other insect, in every part of every grain field in my vicinity. Towards the close of May individuals having wings began to occur; and on thus having the insect in its most developed form, I ascertained it was a species which has from time immemorial existed upon the oats, wheat, barley and rye in Europe, and which was first scientifically named *Aphis Avenæ*, by Fabricius, a name literally meaning the aphis or plant-louse of oats. Kirby and Curtis describe it under the name of *Aphis granaria*, both having overlooked the description which Fabricius has given of it in his Entomologia Systematica, vol. iv, p. 214. Some of the German naturalists name it *Aphis cerealis*, and one of them, probably from supposing the insect on barley different from that on oats, has entered it under the name *Aphis Hordei*. As it infests all other kinds of grain as well as oats, the "grain aphis," rather than "oat aphis," will be the most correct and definite name by which to designate it in English.

These insects, in growing to maturity, cast off their skins three or four times at least; and numbers of these empty skins, of a whitish color, were everywhere noticed among clusters of the lice. The insects themselves occurred in three very distinct forms upon the grain through the season: 1st, winged females; 2d, wingless females, (these being much more numerous than the winged ones;) and 3d, young lice or larvæ. Persons who looked at them very closely might have noticed a few individuals of a fourth form, namely, the pupæ, which were to become winged

females,—these having the wings in a rudimentary state, and appearing like small scales appressed to the sides of the body. I have never yet seen a male of this species. The males will be readily distinguished from the females. Both the winged and wingless females have a short, tail-like process at the end of the body, which is the ovipositor or tube through which the young are passed. The males will be destitute of this tail-like appendage.

This insect has a slender, sharp-pointed bill or trunk, which it holds under its breast when it is not in use. With this it punctures the leaves and stalks of the grain and sucks their juices. It therefore has no occasion to leave the particular plant on which it is born, as, till the grain is becoming ripe and juiceless, it always has an ample store of nourishment directly at its feet. Hence it has no use for wings to carry it, like other insects, from place to place in search of food. It needs wings only to enable it to emigrate to fields of grain which are unoccupied, in order to found its colonies in them. Only a small portion of these insects, therefore, acquire wings. These fly away from the winter grain to plant their race upon the spring-sowed wheat and oats. Those which have no wings and remain where they are born, are much more prolific than those which have wings and wander abroad. By enclosing them separately in vials, I found the winged females quite uniformly gave birth to two young lice in a single night, whilst the wingless ones produced four in the same time. We frequently see young lice produced in the day time, but fewer appear to be born then than during the night. The winged ones are also much slower in coming to maturity. I placed several young lice the morning after they were born upon some grain growing in a flower-pot, and on the third morning afterwards, I found four little ones around each of them, showing that the wingless ones come to maturity in three days. It will thus be seen with what prodigious rapidity these creatures multiply. A single one producing four young daily, and these becoming equally prolific when they are three days old, her descendants in twenty days will number upwards of two millions, and will be increasing at the rate of a million daily. This will serve to explain to us how these insects became so surprisingly numerous as they were in July and August.

The latter part of June, when the grain has advanced so that the heads or ears put forth, two most remarkable changes occur

APHIS. BECOMES GREGARIOUS AND YELLOW COLORED IN SUMMER.

in this insect, whereby it appears to be another creature, a different species in summer from that which is seen in the spring. Before the heads appear it lives singly, scattered about upon the leaves and stalks of the grain, and the young lice as fast as they are born leave their parents and wander away. But no sooner are the heads protruded from their sheaths, preparatory to blooming and growing the kernels of the grain, than this aphis wholly forsakes the other parts of the plant, and becomes congregated here upon the heads, evidently because the juices which the plant elaborates for the growth of its flowers and seeds are much more nutritious, dainty and palatable to these insects than those which circulate in the leaves and stalks. They here fix themselves on the base of the chaffs which envelope the kernels, standing with their heads downwards, and inserting their bills, they suck out the juices which should go at first to grow the flowers, and after that to fill and perfect the kernels. And now the young lice, instead of scattering themselves and traveling away, settle down closely around their parent, crowding as compactly together as they can stow themselves. Thus it came to pass that in most of our grain fields last summer, scarcely an ear could be found that had not a cluster of these lice around the base of almost every kernel, all with their tiny bills inserted therein, pumping out the juices which should go to swell and perfect the seed. Thus, from being a solitary insect, wandering about singly on the leaves and stalks, it became a gregarious insect, clustered together and stationary upon the lower or butt ends of the kernels.

At the same time an equally remarkable change took place in the color of these insects. So long as they nourished themselves on the coarse juices of the leaves and stalks, they were all of a grass green color. When they came to feed on the more delicate juices of the flowers, they began to change to an orange color. One of the grass-green insects having stationed herself at the base of a kernel, next day, in the group of little ones around her, a yellow one would occur, all the others being green like their parent. A day or two later, as the nourishment she had derived from the leaves became more dissipated from her body and replaced by that now obtained from the kernels, half the young she produced would be of this yellow color. And still later all the young would be yellow, no green ones being afterwards born.

APHIS. WINGED FEMALE DESCRIBED.

And the older ones after a time dieing and disappearing, before these insects began to attract public notice they had all been changed to this orange color, their hue inclining more to red in some and to yellow in others. It is truly curious that this green insect, thus, on coming to feed on the juices which grow the flowers, begins to produce young of a gay yellow color similar to that of the flowers.

We distinguish this plant-louse from other species by its occurring on grain, and having the body of a bright grass green color when it is found on the leaves, and reddish yellow or orange when on the heads, the outer ends of its thighs being black and also its feet, the ends of its shanks, its antennæ and honey-tubes. The young larvæ of some of our plant bugs belonging to the genus *Phytocoris*, are met with on grain and are of the same size and the same bright green color as this aphis, but they are distinguished from it most readily by their motions, the young bugs always walking about with a brisk animated pace, whilst the aphis is sluggish and lazy in its movements.

The WINGED FEMALE (Plate i, fig. 5) is 0.10 long, or to the tip of the closed wings 0.20. *Head* transverse, convex in front, rectilinear at base, dull pale yellow. Eyes jutting out from each side of the head, globular, usually of a rusty reddish color. Eyelets or ocelli three, appearing like minute glassy dots placed at the angles of an imaginary triangle, far apart, one near the upper edge of each eye and the third one forming a slight projection upon the middle of the forehead. Beak appressed to the breast, arising between the base of the fore-legs and reaching half-way to the middle legs, pale green, its tip black. Antennæ long and slender, about equalling the body in length, tapering, black, their bases obscure yellowish, seven-jointed; basal joint thrice as thick as the third joint, short cylindric, little longer than thick, abruptly narrowed at its end; second joint nearly globular and twice as thick as the third joint, which is very long; fourth and fifth joints long; sixth but a third the length of the fifth; seventh more slender, tapering, about as long as the third; articulations of the joints except the first two inconspicuous and indicated only by the end of each joint being slightly thickened and bluntly rounded; joints clothed with distant inclined hairs which are quite short and coarse. *Thorax* nearly globular; collar much narrower, narrowing forward, a little longer than the head, grass green; remainder of the thorax dull pale yellow and shining, above with a large egg-shaped black or brown spot on each side and between the forward ends of these spots a smaller oval one which reaches forward to the collar, these three spots being elevated, convex and polished; sides beneath the wing sockets with an oval brown spot, paler than those on the back and placed obliquely. Breast dull black between the four anterior legs and often dusted with a glaucous powder. Scutel dull pale yellow, appearing as an elevated smooth transverse ridge of a semicircular form above the base of the abdomen. *Abdomen* broad oval, rounded at tip, grass green, with a row of about three blackish dots on each side forward of the base of the honey tubes. Honey tubes black, as long as to the tip of the abdomen, slightly thicker towards their bases. Tail very pale greenish yellow, straight along its upper and convex on its under side. *Legs* long and slender, hind pair longest; thighs very pale greenish, towards their middle becoming yellowish and beyond this black; shanks bearded with fine short hairs, pale dull yellow, their tips black. Feet short and slender, but half as thick as the shanks, obscurely two-jointed and with two small claws at their end. *Wings* hold together in a steep roof over the body, transparent, with slender brown veins, the rib-vein thick and sulphur yellow, as is the stigma

APHIS. ITS GENERATION ANOMALOUS.

spot also, the veins bounding its two sides being brown; inner edge with the customary blackish streak extending forward for a short distance from the tip of the first vein. First and second veins more than twice as far apart at their tips as at their bases. Third vein as far from the second at its origin as this is from the first, nearly parallel with the second vein, very slightly farther from it at its tip than at its base, its fork given off forward of its middle, and this fork sending off the second one beyond its middle. Tip of the first fork twice as far from the tip of the third vein as from the tip of the second fork. Fourth vein strongly curved through two-thirds of its length and then straight and parallel with the second fork, its tip nearer the tip of the second fork than this is to that of the first fork, and almost twice as far from the tip of the rib vein as from the second fork.

The above description was drawn up from a comparison of different individuals taken upon the leaves. Numerous variations occur however in the colors, in the veins of the wings, &c. The wingless female, plate i, fig. 6, is so like the winged one that a separate description of it is unnecessary.

In the generation of these plant-lice, we are presented with one of the most remarkable anomalies which we anywhere meet with in the works of nature. All the insects we see on the grain during the spring and summer are females. These do not produce eggs, but living young, which mature in a few days, and are fertile without any intercourse of the sexes. It is only when cold weather is coming on, at the end of the season, that males are produced. The insects then pair, and the females thereupon lay eggs, placing them, no doubt, upon the fall-sowed wheat and rye, which is then up in our fields. These eggs remain through the winter, to be hatched by the warmth of the following spring. The young from them grow up, and commence bearing living young, no males and no eggs being produced, except as the closing act of their operations in autumn. Such, at least, is the case with other species of plant-lice, whence I infer it will be the same with this.

Rye grows so rapidly and ripens so early, that it outstrips this insect in its increase, and thus sustains no material injury from it. Winter wheat, ripening more slowly, suffers more from it. But the crops which ripen latest and when this aphis has become multiplied to its greatest extent, namely, spring wheat and oats, have been the most thronged and have sustained the greatest injury. At our recent State Fair, persons from different parts of the State informed me that the spring wheat in their respective localities had been severely injured by this insect, several instances being told me in which the yield has been diminished fully one-half by it.

We come next to notice the destroyers of this insect, which at

harvest time had become gathered in the grain fields in such swarms as appeared sufficient to overwhelm and totally suppress it. Seeing them in such multitudes impressed me with the opinion that this insect would be so reduced that perhaps it would not be noticed in the grain fields another year. Though since the fall sowed wheat and rye has come up, now in autumn, I find this aphis is quite as common upon the young grain as it was last spring, whilst scarcely any of these destroyers have yet found their way to it in these new situations. Hence it is to be feared it may become multiplied to be as numerous next year again as it has been the present year.

Among the most efficient and interesting of these destroyers of the aphis are its parasitic foes. We see on many of the infested wheat heads from one to a half dozen or more of these lice which are very large, plump and swollen, of the color of brown paper, standing in a posture so perfectly natural you suppose they are alive. Touch them with the point of a pin, you find they are dead. Pick off a part of their brittle skin; you see there is inside a white maggot doubled together like a ball. Put one or two of these wheat heads in a vial, closing its mouth with a wad of cotton. In a week's time or less you find running actively about in the vial some little black flies like small ants. These you see have come out from the dead lice through a circular opening which has been cut in their backs. Drive one or two of these flies into another vial, and introduce to them a wheat head having some fresh lice. You will soon see the fly running about among them, examining them with its antennæ. Having found one adapted to its wants, it dextrously curves its body forward under its breast, bringing the tip before its face, as if to take accurate aim with its sting. The aphis gives a shrug, indicating to us that the fly has pricked it with its sting and that by this operation an egg has been lodged under its skin, from which will grow a maggot like that first seen inside of the dead, swollen aphis. And thus the little fly runs busily around among the lice on the wheat heads, stinging one after another, till it exhausts its stock of eggs, a hundred probably or more, thus insuring the death of that number of these lice. And of its progeny, fifty we may suppose will be females, by which five thousand more will be destroyed. We thus see what effecient agents these parasites are in subduing the insects on which they prey.

APHIS. ITS APHIDIUS PARASITES DESCRIBED.

From the dead ichneumonized lice I have bred two different parasites, and have met with the same species also upon the grain. They pertain to the Aphidius group of the family *Braconidæ* and the order *Hymenoptera*, of which some account was given and a few species were described in my First Report. One of these parasites has the veins of its wings identical with those of the *Ephedrus Avenæ*, one of the three parasites which Mr. Curtis describes and figures as belonging to this grain aphis in England. But as its antennæ are longer and their joints more numerous, it will pertain to a different genus, named *Toxares* by Mr. Westwood, whilst the other species falls within Mr. Haliday's genus *Praon*. I now proceed to name and describe these insects.

WHEAT-LOUSE APHIDIUS, *Toxares Triticaphis*, new species. (Hymenoptera. Braconidæ.)

Black, shining, antennæ thread-like, longer than the body, twenty-five jointed. Length 0.08.

Head transverse, convex in front, concave at base; face clothed with fine short hairs; eyes lateral, rather small; eyelets (ocelli) three, placed in a triangle upon the crown; feelers dull white, bearded, five-jointed, the joints nearly cylindric, separated by intervening pedicels, the last one elliptic and shortest. Antennæ 0.10 long, filiform, bearded with short inclined bristles, composed of twenty-five cylindrical joints; basal joint thickest, top-shaped, a third longer than thick, receiving into its apex the second joint, with which it is compactly joined, and which is thicker than the following ones, a third longer than thick, and slightly narrowing towards its apex; third joint longest and rather more slender than the following joints, faintly thickened or swollen near its base and also at its apex, and showing when greatly magnified a minute transverse joint interposed between it and the second; fourth joint a third shorter, more than four times as long as thick; remaining joints successively diminishing in length, the last one more than twice as long as thick and of an oval form. *Thorax* egg-shaped and rather broader than the head. *Abdomen* flattened, a little longer than the thorax but scarcely as broad, long oval, more narrowed anteriorly and bluntly rounded at tip, highly polished, its hind part clothed with short hairs which are more dense at the tip. *Legs* black, brownish at base and on the knees. *Wings* transparent, slightly smoky, strongly iridescent red and purple, fringed on their hind edge, more conspicuously so on the hind pair; stigma dull pale brown; veins brownish black.

OAT-LOUSE APHIDIUS, *Praon Avenaphis*, new species. (Hymenoptera. Braconidæ.)

Black, legs honey-yellow and also the base of the abdomen and a sub-basal band; antennæ as long as the body, thread-like, twenty-jointed. Length 0.10.

Head black and shining, square when viewed from above and twice as broad as long; eyes oval, slightly projecting, occupying the fore part of each side; eyelets on the crown, appearing as three elevated shining dots forming the corners of a triangle; mouth and feelers very pale yellow, the latter appearing as very slender threads jutting from the mouth and as long as the head. Antennæ about as long as the body, filiform, rather thick and robust, black, the basal joint often pale on its under side, joints nineteen or twenty, clothed with a short inclined beard; two first joints shortest and compactly joined together, the basal one obovate and thickest; remaining joints cylindric, about thrice as long as thick, narrowed at their bases and cut off transversely at their tips, separated by short pedicels; last joint longer usually than its predecessor, egg-shaped. *Thorax* broader than the head, more deep than wide, egg-shaped, black and shining. *Abdomen* as long as the thorax but narrower, oval, viewed laterally broadest at the tip, highly polished, brownish black; first segment narrower and forming a cylindrical podicel, bright honey-yellow; a dull yellow or olive band or spot

on the suture between the second and third segments. *Legs* honey-yellow; feet black except at their bases, sometimes wholly black with the shanks dusky. *Wings* transparent, slightly smoky; veins of the anterior pair coarse, black or dark brown, becoming abruptly more slender, colorless and almost imperceptible on the hind part of the wing; stigma long-triangular, salt-white; a single large irregular cell occupying the middle portion of the wing and bordering the stigma on its inner side, a short coarse transverse veinlet bounding this cell at its hind end, the two longitudinal veins between which this veinlet is placed becoming slender and abortive a short distance back of it, the outer vein remaining coarse twice the length that the inner one does after passing the veinlet.

Variety *a, obscura*. Legs blackish, honey-yellow only at base and on the knees; subbasal band of the abdomen less distinct.

This was the most common of these parasites in July and was met with again on young grain late in autumn. The larger size of this parasite causes the body of the aphis containing it to be perceptibly more swollen than it is with the other species, being distended almost to a globular form. It was in one instance bred from an aphis which was adhering to one of the anthers hanging out of the chaffs, the under side of her abdomen being tied, as usual in such cases, to the surface on which she was standing. Her body was faded to drab gray, the antennæ, honey tubes, feet and ends of the thighs retaining their natural black color.

I have also met with two other species in the grain fields, which could only have been there for the purpose of depositing their eggs in these insects, it being the well ascertained habit of the genus to which they pertain to rear their young in the different species of plant-lice.

Wheat Allotria, *Allotria Tritici*, new species. (Hymenoptera, Cyniphidæ.)

Black; head and legs pale yellow; antennæ 13-jointed, basal joints more slender and pale yellow. Length 0.05.

Head transverse, twice as broad as long, convex in front, concave behind; face and mouth pale yellow, crown piceous-yellow; eyes protuberant, rather small, black; eyelets three, at the corners of a triangle, on the crown. Antennæ inserted on the middle of the front, clothed with a very short inclined beard, more slender towards their bases, nearly as long as the body, black, the four first joints pale yellow; basal joint thrice as long as thick, obovate, transversely cut off at its end; second joint rather more slender, twice as long as thick, oval; third and fourth joints each as long as both the preceding and but half their thickness, cylindric; fifth joint more thick, and the following ones gently increasing till they come to equal the basal in thickness, the last ones thrice as long as thick, cylindric, the terminal one oval. *Thorax* broad oval, broader than the head, black, shining. *Abdomen* smaller than the thorax, nearly globular, moderately compressed, its end blunt or vertically sub-truncated with a thick teat-like projection from its middle. *Legs* honey-yellow; feet, five-jointed, filiform; anterior pair with the basal joint more than twice the length of the following one, second to fourth joints successively shorter, last joint more than twice the length of the fourth, ending in an egg-shaped toe of the same thickness and appearing like a sixth joint; hind feet with the basal joint as long as the three following ones, which are successively shorter, the last joint twice the length of the fourth, and furnished with a pair of hooks at its tip. *Wings* hyaline, slightly smoky, with a row of short inclined bristles along their outer edge but no fringe on the inner margin or tips; fore wings with

coarse brown veins bounding a nearly triangular cell placed on the middle of the outer margin, from the inner angle of which a vein extends inward and backward which is gradually more slender and the last half of its length abortive and scarcely perceptible; a very coarse vein crossing the middle part of the wing obliquely, forward of the triangular cell.

OAT ALLOTRIA, *Allotria Avenæ*, new species.

Black, polished; feet brownish; antennæ longer than the body, 15-jointed. Length 0.06.

Head nearly globular when viewed from above, egg-shaped when viewed laterally, with the smaller end downward; small short bristles scattered sparsely on the face but dense on the throat. Antennæ longer than the body, equalling the tips of the wings, thinly bearded with short stiff inclined hairs and a row of longer ones surrounding the apex of each joint; basal joint no thicker than the others, long egg-shaped with the smaller end downwards and tapering into a slightly curved pedicel; second joint globular; third and following joints cylindrical, about thrice as long as thick, cut off transversely at their tips, and at their bases suddenly tapering into a short pedicel which is a third of the thickness of the joints and less long than thick; last joints scarcely diminished in thickness and not at all in length, the end joint long egg-shaped. *Wings* smoky-hyaline, with a row of short inclined bristles along the outer edge and fringed with longer ones at their ends and along the inner margin of the hind pair; their veins the same as in *A. Tritici*, and various other details which it is unnecessary to repeat.

NINE-MARKED COCCINELLA, *C. 9-notata*, Herbst. (Coleoptera, Coccinellidæ.)

In addition to the internal parasites above spoken of, we have several other insects which are efficient destroyers of the grain aphis, slaughtering it to feed upon it. One of these which will be most apt to attract notice, is a pretty beetle, a species of lady bug or lady bird, named the Nine-marked Coccinella (*C. 9-notata*, Herbst) and pertaining to the family *Coccinellidæ* in the order *Coleoptera*. It is one of the most common species of lady bug in our State, and feeds upon several kinds of plant lice, but appears to prefer this on grain to any other. Hence it is met with in our grain fields in greater plenty, according to my observations, than in any other situation. It is readily recognized, being about the form and size of a half pea, of a bright red, sometimes a yellow color, with nine small black spots on its wing covers.

Its larva is more voracious than the perfect insect in feeding upon these plant lice. It is often noticed, walking actively about upon the straw at the time the grain is harvested, and has such a scorpion-like look that it is on this account sometimes destroyed by persons who are ignorant of its friendly character. It is three-eighths of an inch long when fully grown, and resembles a very flexible worm with three pairs of long stout legs on its breast. It is blue-black, and appearing as though coated over with a glaucous bluish grey bloom, and on each side, near the middle, are two bright red or orange spots, occupying the outer

ends of the fifth and eighth segments. The neck or second segment, which is large, flattened and roundish, is black in the middle and has a broad border of the same red or yellow color, though sometimes of a paler shade, and usually in this border is an oval black spot on each side. Occasionally the whole neck is red or yellow, with four oval black spots placed side by side, the two middle ones being larger. The face and breast are dull pale yellow. Each ring of the body has elevated black dots, six on the upper and six smaller ones on the under side, all of which are crowned with short slender prickles. These black prickly dots form rows lengthwise of the body, of which the two upper ones upon the back are the most conspicuous, and the two rings next to the neck have an oval black spot on each side of the middle, in which spots are included the upper prickly dot and the one next to it.

It is wonderful how this larva succeeds in finding the particular stalks of grain whose heads are infested with plant lice. Early in July, passing along the edge of an oat field, I noticed one of the heads which was thronged with lice, other heads here and there showing only two or three of them on some one of the pedicels. Two days afterwards, wanting to ascertain some point respecting these grain lice, I recollected this infected stalk which I had seen in the oat field, and went to pluck it and bring it into my study. But on reaching it, to my surprise, it was perfectly cleansed of these vermin, and had nothing on it now except one of these lady bird larvæ, which was clinging to the stalk, in contented repose after the feast it had had. I was surprised that this little creature had the sagacity to discover and climb up this the only badly infested stalk along the edge of the field.

I should suspect the honey dew, which plant lice eject so copiously that where they are very numerous it is falling in a tiny shower to the earth underneath them, might indicate to this larva as it is running about on the ground, where a colony of them existed. But this grain aphis does not appear to give out any honey dew; nor do ants attend it to feed thereon as they customarily do with other species. And it is probable that the only manner whereby this larva is able to discover where these plant lice occur, is to climb up one stalk of the grain after another, until it chances to find one that is infested. This its movements indicate. The motions of the larva are the same with

those of the parent insect and with those of the species of this family generally. Many persons I doubt not have noticed the peculiar manner in which these lady bugs travel about upon plants, without being at all aware of the object of their journeyings. They move with more or less agility as they are more or less pressed with hunger, some species being always more active and sprightly in their motions than others.

Searching for plant lice, one of these insects will be seen to walk briskly up a plant to its very summit. You expect it will now take wing or will pause a moment to consider what to do next. But no; finding nothing, it abruptly turns about and walks back with the same pace that it ascended, till coming to a branch or a leaf it goes out upon this, travelling along its under side to its end and then immediately turning back without any pause and out upon another. Thus it industriously walks over the whole plant, scarcely any part of a leaf or a stem where plant lice will be liable to occur escaping its examination. Its foraging being unsuccessful here, it descends to the ground and coming to another plant mounts and examines it in the same manner.

These larvæ of all sizes were quite numerous in the stubble of the grain fields after harvest. They speedily consumed the few grain lice which had been scattered off upon the straws and weeds remaining in the fields, and then becoming pressed with hunger they were seen running wildly about, everywhere, in search of food. When reduced to such straits they became cannibals, devouring the helpless of their own species. If one of them chances to meet another which has suspended itself preparatory to changing to a pupa and is thus become incapable of resistance, it does not hesitate to devour its defenceless fellow. The suspended larva when thus attacked passively submits to its doom, without any struggling or writhing, to impede its murderer in his work, as if conscious it was wholly unable to avert its fate. Its assailant eats a hole in one side and then consumes all the soft inward parts, leaving nothing but the skin of the two ends slightly connected by what remains of the middle. But the fully formed pupæ are never attacked, their substance being so changed, no doubt, that it has ceased to be nourishing food for the larva.

But though these larvæ thus eat one another they will not eat the larvæ of other insects, nor any plant lice except those of particular plants. I introduced the larva of a wheat midge to a

hungry larva of the Coccinella, but it did not notice it in the least. I then introduced to it an aphis from the stem of a poplar leaf. It brought its mouth to this for an instant only, and then turned away from it, and the aphis happening to crawl upon its body annoyed it extremely, causing it to writhe and roll itself over to crowd the intruder off. I then let it walk out of its prison upon a poplar leaf having a colony of these lice upon its stem, over which it would be obliged to pass to go elsewhere. In approaching them it encountered a very small ant, the same species, I think, which I described in my First Report under the name *Myrmica Cerasi*, which was attending these lice, and thereupon it precipitately dropped itself from the leaf. I replaced it on the leaf and had the same result a second time. The ant did not appear to attack it, but its mere proximity seemed to be intolerably repulsive to this larva. And I doubt not it was the pungent odor which I have heretofore spoken of as being given out by this ant, and which odor it imparts to particular colonies of plant lice, thereby so marking them as its own property that other insects thenceforth avoid them, that made this ant and the lice it was attending, so annoying to this larva. I next introduced to it a cabbage louse. This it immediately clasped and commenced eating with evident satisfaction. And as these lice were becoming common on the cabbages in my garden, I now turned this larva out among them to forage for itself, bringing others from the fields also to accompany it, whereby I am assured my cabbages will soon be rid of the vermin upon them.

When this larva of the lady bird is fully grown and ready to change to a pupa, it seeks a situation where it will be least liable to be disturbed by the aphis or any other insect or worm crawling about or upon it while it remains reposing in this state. It sometimes selects the under side of a leaf of the grain, but more frequently it wanders off to some weed growing among the grain. Thus it often resorts to that vilest of all weeds, the toad-flax or "butter and eggs," (*Linaria vulgaris*), if this chances to be scattered among the grain; as though the intelligent little creature had observed the same fact which I have publicly stated, that in this country no insect or worm occurs upon this weed. Some of my neighbors being aware that I had thus stated, have brought this weed to me with this pupa attached to it, that I might see whether it were not an insect that belonged upon it.

APHIS. COCCINELLA LARVA CHANGING INTO A PUPA.

It chooses a spot towards the summit of the weed from whence it can hang freely downwards and be fully exposed to the air and light. It here affixes itself by the tip of its body, which emits a small quantity of a varnish-like fluid whereby it is securely glued to the surface. It thus hangs with its head downwards for several hours, slightly bending and writhing itself at times, whereby the pupa inside becomes more and more separated from the larva skin in which it is inclosed. It also becomes perceptibly thicker, thus distending the larva skin laterally, till at last with this distention and the bending of the pupa within it, the skin cracks open in a straight smooth fissure at the anterior end of the back. The continued motions of the pupa now rapidly open this rent longer and wider, and the pupa pressing firmly against it begins to protrude from it, of a bright yellow color. Its whole back soon emerges from the skin, and by a few more writhings this old skin is then gradually slipped off and crowded upward to the end of the body, around which it afterwards remains in a wrinkled black mass studded with prickly points and forming an intrenchment as it were around the tip of the body, which no enemy will care to climb over.

The pupa is at first egg-shaped, but contracting in its length as it dries, and thickening at its tip it soon becomes oval and very convex on its back, with its under side flattened and curved, whereby it has nearly the shape of a crescent when viewed laterally.

It is interesting to observe the manner in which the pupa acquires the different spots with which it is so prettily ornamented. When it first throws off the larva skin it is of a uniform bright citron yellow color throughout, perhaps with the breathing pores appearing as a row of dusky dots along each side. But a deeper yellow or orange colored spot immediately begins to be perceived on each side of the back forward of the middle and another back of the middle, these spots occupying the outer ends of the first and of the fourth segments of the abdomen, and others on the ends of the sixth segment are sometimes to be seen, though smaller and less bright. Next, along each side of the middle of the back a faint smoky streak or row of spots may be discerned, each spot first commencing as a short, dusky, transverse line on the elevated hind edge of each segment except the two first. The knees are next perceived to become dusky, in which

APHIS. COCCINELLA PUPA CHANGING TO THE PERFECT INSECT.

color the whole of the under side soon participates. Two dusky spots next begin to come out on the hind edge of the thorax, and two smaller ones appear on the second segment of the abdomen, followed by a few other spots elsewhere, which it is scarcely necessary to particularize. These smoky colors continue to deepen, becoming almost black where they were first perceived, when, last of all, in about two hours after the larva skin is thrown off, the sheaths of the wing covers are seen to acquire a dusky dot near their centre, which becomes more obvious as the same hue begins to be seen on the tips and along the margin of these members. On longer exposure to the air and light, all these spots change to pure black, the rich yellow ground color in the mean time fading to obscure pale yellow, somewhat brighter upon the wing covers.

I notice some larvæ are suspended which are not grown to their full size, and which do not cast off their skins to assume their pupa form. These, I suspect, are infested with internal parasites.

The insect remains suspended and at rest in its pupa state ten days, in the instances I have observed. Its dry outer skin, or shell, then again cracks asunder at the anterior end of its back, and the perfect insect withdraws itself therefrom. It is at first a soft, turgid, unwieldly mass, overloaded with fluids. For these fluids to evaporate, it remains stationary for several hours, clinging to the outside of its pupa skin, or to the leaf or stalk where this skin is fastened. It stands with its wings projected out from under the ends of its wing covers, resembling flattened tail-like appendages almost as long as the body, light yellow and opake, or but feebly translucent. The wing covers are at first of a rich citron-yellow color, and wholly destitute of any discoloration to indicate the black spots which belong to them, although the thorax has its black color and white margin well developed. The spots of the wing covers are gradually brought out as in the pupa, by exposure to the air and light, those of the hind part being first to appear by a slight discoloration or smokiness, and the common spot at the scutel being the last one that is completed, this remaining divided by pale lines upon the suture after its outer part has become dark colored and quite distinct. As soon as its several parts have acquired a sufficient degree of firmness and consistency by the evaporation of their superabundant juices,

the insect walks slowly away; though it continues to become still more hard and solid for two or three days.

It places its eggs among, or in the vicinity of the plant lice on which its young are to feed. These eggs may frequently be noticed on the chaff of the wheat ears, and adhering to the slender, hair-like pedicels of oats, in little irregular masses of a bright yellow color. From them hatch the larvæ, which have been described above.

The Nine-marked Coccinella measures from 0.20 to 0.25 in length and 0.15 to 0.20 in width, the smaller sized individuals being males. Its body is nearly hemispherical, with the surface smooth, shining and minutely punctured. The *head* is white, changing after death, as does all the other white parts on the upper side of this insect, to pale dull yellow. It is crossed by two black bands, one placed slightly above the anterior edge, the other occupying the base and being often thicker in its middle than at the ends, its anterior edge two-toothed in the males, smooth in the females. The lip is testaceous or obscure yellowish, its base frequently black or dusky. The mandibles are black, their outer side white. The palpi are black. The antennæ are testaceous with the basal joint black and the tips blackish. The *thorax* is black with a white band occupying its anterior margin, which band is about a third narrower than the white portion of the face, and in the males has an angular tooth on the middle of its hind edge, jutting back into the black portion. This band ends on each side in a large and somewhat square white spot which occupies the anterior angles and is more broad than long, and extends back on the outer margin more than two-thirds of its length, its hind side being concave and its inner hind angle acute. The scutel is small, triangular and black. The *wing covers* are bright orange red or frequently firey red, but change after death to yellow, less pale than that to which the white parts change. Their anterior edge adjacent to the scutel is white, this color being gradually shaded into the orange ground. On the suture is a slender black line running its whole length. At the anterior end of the suture is a black spot, common to both wing covers and embracing the scutel in its anterior end. This spot is quite variable in its form, being sometimes broadest across its middle and diamond-shaped or with its posterior half rounded, sometimes broadest posteriorly and then spear-shaped or broadly egg-shaped, sometimes yet more developed and broadest at its hind end, forming then a triangular spot as wide as it is long. On each wing cover are four other black roundish spots, an anterior, an outer, an inner and a posterior one, the two first smaller and the other two larger than the common spot. The anterior spot is placed at a distance equal to its width from the anterior edge and more than twice as far from the outer edge, and it is more round in its form than either of the other spots. The outer spot is usually of the same size with the anterior one and is more or less triangular in its form. It is placed at a third of the distance from the base to the tip of the wing covers, and less than its width from the outer edge. The inner spot is situated farther back than the outer one, but is forward of the middle, and less than its width from the suture. It is round, or short oval and transverse. The hind spot is similar in size to the one last mentioned, and is twice as far from the suture as from the outer edge. It is transverse and in form of a very short band. The wings are smoky hyaline, becoming clear towards their bases and having the veins here red. The back underneath the wing covers is black with red bands on the sutures, each side being also broadly red with a longitudinal row of black dots. The under side and legs are black, with a small white spot upon each of the corners of the hind breast.

This species is remarkably constant and uniform in the spots of its wing covers, and has hence had the rare fortune to escape being burthened with those synonyms with which carelessness and ignorance have so overloaded many of its kindred; the name

Coccinella novem-notata, given it by Herbst over sixty years since, being the only one it has received. The number of its spots is always the same, and only the following variations in their size and connections have occured to my observation, which appear sufficiently remarkable to be worthy of notice:

Variety *a*, *inæqualis*. The outer spot of the wing covers smaller than the anterior one, sometimes merely a round dot. Common.

b, *parvamaculata*. The three anterior spots on each wing cover small round dots of nearly equal size, with the hind spot also smaller than usual.

c, *conjuncta*. The two anterior spots connected by a slender black line running from the outer side of the forward one to the inner side of the outer one. Not rare.

d, *confluenta*. The inner and hind spots broadly united, the anterior spot nearly as large as the inner one and slenderly united to it and also to the outer spot.

e, *divisicollis*. A black streak extending backward from the eyes to the disk of the thorax and dividing the white band from the spots at each end of it.

This Coccinella is common in all parts of the United States, and extends south through Mexico and Central America.

THE FIVE-MARKED COCCINELLA, *C. 5-notata*, Kirby.

Associated with the Nine-marked coccinella in our grain fields another species makes its appearance in the month of August or earlier, so closely resembling it that it is only by looking particularly at them that they will be recognized as different. Viewed from behind their marks appear to the eye to be identical, four large black spots occuring in the same situation in both species. But on the fore part of the wing covers, instead of three black dots a black band is here seen. This species, moreover, is slightly larger than the preceding one, and it will be perceived to be more slow in its motions.

I have been unable to distinguish its larva if I have ever seen it, from that of the preceding species. And the only pupa from which I have bred this insect appears from the evacuated shell to have been similar to that already described, but more black, having only yellow colors as follows: a row of spots on the middle of the back, the abdomen with a spot on each side at its base and a smaller one near its middle, a broad cloud across the middle of the thorax and a cloud-like spot on the base of the wing-sheaths.

The insect which came from this pupa walked slowly about on the small leaf to which it was attached, returning to its pupa shell and applying its mouth to the inside of the fissure therein,

apparently to sip some of the moisture there. It did not become stationary and hang out its wings to dry till nearly a half hour after it came out of its pupa shell. Its wing covers were very glossy and of a rich citron or lemon color, and it was almost an hour after its birth before any smokiness to indicate the coming out of spots thereon could be perceived, although the head and thorax had their colors and spots perfect when it came from the pupa shell. The places of all the spots began to be dimly discolored at the same time. At nightfall, four hours after its birth, the spots were about half completed, the inner ends of the hind ones being still smoky and pale, and the anterior band being black only on the suture, with its outer ends yet faint and indefinite. The next morning it was standing in the same place its spots being now perfect.

This species was named the Five-marked Coccinella or *Coccinella 5-notata* by Mr. Kirby. It had previously been ticketed the Transverse-spotted Coccinella (*C. transverso-guttata*) by Mr. Say, and this name had been published by Dr. Harris in his Catalogue of the Insects of Massachusetts, but no description accompanied it to render it valid until the species was described by M. Falderman in the Memoirs of the St. Petersburg Academy.

The Five-marked Coccinella measures 0.20 to 0.28 in length by 0.16 to 0.20 in width, its body being nearly hemispheric, smooth and shining, with minute punctures. Its *head* is black with a narrow white band on the lower edge and on the front two white spots (becoming yellow in the dead specimen as does all the other white parts except those on the under side) each occupying a third of the space between the eyes, these spots being angulated on their inner sides. There is also a small white dot at the lower corner of the eyes. The lip is black and also the palpi and mandibles, the outer side of the latter being white. The antennæ are dark brown, their basal joint black and their tips blackish. The *thorax* is black with a squarcish white spot occupying each of its anterior angles, the inner side of this spot being shortest and its outer side reaching more than half the length of the thorax, the slender outer edge of which is black at least a part of the distance along the outer side of this spot. The scutel is triangular and black. The *wing covers* are orange red or orange yellow, with a white spot on their front edge on each side of the scutel, and near their base is a black band common to both wing covers and extending from the suture more than two-thirds of the distance to the outer margin, this band jutting forward in its middle and embracing the scutel, and sometimes having its hind side prolonged in a corresponding manner along the suture. Near the middle of each wing cover is a transverse black spot resembling a short band, its inner end being twice as near the suture as its outer end is to the outer margin. Half way from this to the tip is a second similar spot, but slightly larger and occupying half the width of the wing cover at this point, with its inner end twice as far from the suture as its outer end is from the outer margin, this spot being frequently thicker on its inner than its outer part. The wings are smoky with their basal part clear and having pale orange colored veins. The back underneath the wing covers is black with a pale red stripe on each side near the outer edge and two or three bands of the same color across the fore part. All the under side is black with a white spot on the fore angles of the hind breast and usually a less clear one on the hind angles. In the males is a milk white dot on the haunches of the fore legs.

APHIS. PARENTHESIS COCCINELLA.

There are but two varieties of this species which appear sufficiently remarkable to be worthy of notice.

Variety *a, interrupta.* The band on the wing covers with its ends nearly or quite broken off from the middle portion. I have never seen a specimen with the ends of the bands perfectly separated. Those in which they are partially broken off are not rare.

b, transverso-guttata, Falderman. A small black dot on the wing-covers near their outer margin, placed at a third of the distance from the base to the tip. Common. Mulsant regards this as the normal state of this species. Of twenty specimens at present under my eye only six have this dot, and a seventh one shows it on the left wing cover only.

This species occurs in New York and other Northern States, in Canada, Greenland, and Russian America, and has also been discovered in Irkutsk and other provinces of Siberia.

THE PARENTHESIS COCCINELLA. *Adonia parenthesis,* Say.

A smaller and more oblong species than the two foregoing ones, and running with much more briskness, began to appear in the grain fields as the crops were ripening, and rapidly increased, so that at harvest time it had become much more numerous than the Nine-marked Coccinella, at least in fields of oats. This is another of our common species, which begins to be seen abroad on the first warm days in April, having come out from its winter retreats under stones and sticks lying on the ground. It is met with through the whole summer, on rushes and grass in wet places, and in other situations, indicating it to have an appetite for a greater variety of plant-lice than the Nine-marked Coccinella has.

Its eggs are 0.035 long, oval, soft, shining, pale orange, and are placed irregularly together in little masses of three or more, slightly adhering to each other and to the heads and stems of the grain on which they are scattered.

Its larvæ are so similar to those of the Nine-spotted Coccinella that I have overlooked them, supposing them from their smaller size to be the same species in its younger state.

To change to a pupa it usually places itself upon some small weed where it will be nearer the ground than the situations which the Nine-marked Coccinella seems to prefer. The dead stalks of sorrel are much resorted to by it, on which it suspends itself to the slender thread-like branches, from among the dry brown seeds which are attached thereto. Its black larva-skin beset with

slender hair-like prickles forms a wrinkled mass around the tip of the pupa, similar to that of the Nine-marked Coccinella already described.

The pupa is colored and spotted very similarly to that of the Nine-marked Coccinella. It is dull citron yellow with an orange red spot on the outer end of the first and fourth segments of the back, and a row of black spots each side of the middle of the back, which are often confluent with each other forming two stripes. The flattened first segment of the thorax has four black spots on its anterior edge which are somewhat confluent with each other, and four others on its hind edge which are more distinctly separated, the outer ones being in contact with a similar black spot on the sheaths of the wing covers, which sheaths also have the margin and tips more or less black and a large black spot in their centre, which is often confluent with the black margin.

But this pupa is quite variable in its colors, sometimes having the whole of the first segment of the thorax black, except a cloud across its middle, and the abdomen black, with a pale stripe along the middle, and a more slender one on each side of it, and the outer ends of fourth and fifth segments pale, thus approaching in color the pupa from which a Five-marked Coccinella was obtained. Yet these dark colored pupæ yield as bright colored and perfect insects as the lighter ones. Pupæ very probably occur, from which it will be impossible to decide whether this species or one of the others will come, although they are so readily distinguished when they arrive to their perfect state.

The Parenthesis Coccinella is oval and more than a third longer than wide, measuring 0.16 to 0.20 by 0.11 to 0.13. Its surface is shining and is closely and minutely punctured. The *head* is black with three white spots on the front, the middle one diamond-shaped and usually prolonged upward in a short line, the lateral ones triangular and placed at the inner side of the eyes, their inner angles being sometimes confluent with the lateral angles of the middle spot, the three spots when thus united forming a figure resembling the head of a trident, from which circumstance Mr. Kirby named this species the Trident Coccinella. These spots on the other hand are sometimes much smaller, the middle one merely a short white line or even entirely wanting, and the lateral ones a small lunule or a mere dot on the margin of the eyes. The lower edge of the head and the lip are livid yellow or testaceous. The mandibles are white and the palpi testaceous with blackish tips. The antennæ are testaceous, their basal joint black on the upper side and their tips blackish. The *thorax* is black, margined with white on the front and sides, this margin being usually wide but sometimes narrow, widened on the hind angles, where its end is obliquely or concavely cut off, the inner side of its end being often prolonged into an acute angle which points towards a similar angle jutting backward from the front margin, thus tending to cut off a large round dot from each side of the black portion of the thorax. The front margin in the middle of its hind side is also always prolonged backwards into a short white stripe which narrows backwards and usually reaches halfway to a white spot which is placed on the hind margin, this white spot being

sometimes square but oftener more wide than long and narrowing forward, and frequently having a notch in the middle of its fore side. The scutel is triangular and black. The *wing covers* are red in the live insect, rarely yellow or red with the disk yellow; but in the dead insect they fade to a lurid yellow color. Their front edge is often white or whitish. They are ornamented with four black spots on each, namely, a common one on the forward end of the suture, an anterior, a middle and a posterior one, the two last being very often united at their outer ends. The common spot is oblong and extends upon the suture a fourth of its length. It is narrowest at its anterior end and gradually widens backward to its middle or beyond, where it becomes abruptly broader, this hind part being often in the form of a large round or diamond-shaped spot. The anterior spot is in the form of a large round dot placed upon the shoulder and nearer to the front than to the lateral edge. The middle spot is broad oval and equally as thick as the anterior one. It is placed obliquely, with its outer end more forward and occupying the centre of the wing cover, being thus much more distant from the outer margin than the inner end is from the suture. The posterior one is more oblique and longer, but of the same thickness with the middle one, and is placed halfway between it and the hind margin. It is slightly curved, whereby its outer side is nearly parallel with the margin, receding from it very slightly towards its hind end and frequently having a notch or a concavity in this outer side forward of the middle, its inner end being nearer to the suture than is the inner end of the middle spot. Its outer end is very frequently prolonged inward upon its inner side, thus uniting this spot more or less perfectly with the hind side of the outer end of the middle spot, the two spots when thus united forming a letter **C**, and these united spots facing each other on the two wing covers, come to have some resemblance to a parenthesis mark, ( ), which suggested to the older Mr. Melsheimer the name for this insect, which Mr. Say afterwards adopted when he came to describe it. These spots are frequently edged with yellowish white in the living insect, thus rendering them more distinct and conspicuous on the red ground. The wings are colorless and hyaline, but without a glassy transparency, and they have a smoky spot on their outer margin and smoky streaks on the veins. The back underneath the wings is black, with a bright red stripe upon each side. The *under side* is black, with a white spot on each of the corners of the hind breast and a row of small white spots along the outer edge of the abdomen. The shanks and feet of the fore legs and sometimes of the middle one also are testaceous or livid yellow.

In this species we meet with numerous VARIETIES, of which the following merit to be noticed:

Variety *a*, *tridentifrons*. The three white spots on the front confluent, forming a mark resembling the head of a trident. Common.

b, *permacrifrons*. The white spots on the front reduced in size to a short streak on the edge of each eye and a slight line in the middle. Not rare.

c, *triangularis*. The white spot on the base of the thorax triangular instead of square.

d, *tituricollis*. The thorax white, including the whole of its basal edge, with black marks on the disk resembling a full faced letter **H** widened backwards, and having a large black dot on each side confluent with it by a neck only half as thick as the dot. Of this I have seen two examples.

e, *atbomaculata*. A white triangular spot on each side of the scutel, margining the common spot to its dilated part, its outer edge indefinite.

f, *linearis*. The common spot on the wing covers linear and not dilated posteriorly.

g, *approximata*. The anterior spot large, its fore side reaching the anterior edge of the wing cover.

h, *disco-punctata*. The middle spot thick and round instead of oblong.

i, *tridens*, Kirby. The middle and hind spots not united with each other to form a parenthesis mark. This is probably to be regarded as the normal state of the species, a very small majority of the examples as they occur in nature having these spots separated.

k, *confluenta*. The middle and hind spots large and broadly confluent, with only a linear or narrow oval cleft dividing their inner ends little more than half their length.

Variety *l, connata.* The middle and hind spots united in one, resembling an imago of the human head and shoulders, with the neck nearly or quite as broad as the head.

m, insulata. Like *connata,* but with a small dot the color of the ground, in the neck of the spot, towards its inner side.

n, nimia. A very small oval spot or minute dot of black on the wing covers, near the outer hind side of the anterior spot. Of forty specimens now before me only three are of this variety.

In addition to these Mulsant mentions a variety which I have never met with, in which the hind spot of the wing covers is wanting.

This species inhabits California as well as the other United States and Canada.

In addition to the insects which have now been described various others to which I can at present make only a passing allusion were on the grain with them, aiding them in their useful work. The O-marked Golden-eye and other species of Chrysopa described in my First Report were frequently noticed in the grain fields, as were also their white eggs elevated on the summit of slender threads. The white and yellow larvæ of different Syrphus flies, small worms shaped like leeches, were also common on the wheat heads, reaching around like the elephant with his trunk, to find and seize hold of an aphis to devour it. Another efficient destroyer was a common species of bug, the *Nabis fera,* which has already been mentioned on a previous page, in the note appended to our account of the Mistaken parasite. This bug was frequently seen with its sharp needle-like beak inserted into the body of an aphis, the winged as well as the wingless ones, sucking out the contents, whereby the abdomen becomes collapsed and so wholly disappears that the honey tubes at its end often appear as appendages belonging upon the base of the thorax. This bug, therefore, by thus destroying these and other insects and their larvæ on grain and grass, renders us a valuable service; and the Mistaken parasite instead of being the important enemy of the wheat midge which it has with so much assurance been proclaimed to be, now turns out is the egg parasite of this useful bug, and is thus a pernicious instead of a beneficial species. I propose, as already stated, to fully describe this in connection with the other bugs which occur on grain, in my next Report.

I have supposed that dusting the grain with the dry powder of chloride of lime might smother and destroy these lice. Should they reappear another season I hope to ascertain whether this remedy is practicable and efficacious.

ARMY WORM. WHY THUS CALLED.

ARMY WORM, *Leucania unipuncta*, Haworth. (Lepidoptera, Noctuidæ.)

Stripping the leaves and severing the heads from wheat stalks, or wholly consuming the plants when young; worms growing to 1.50 in length, variously striped with black, yellow and greenish, which suddenly appear in immense numbers and keep together in a compact body, advancing in a particular direction and devastating the fields of grain and grass through which they pass, and then totally disappearing; producing drab colored moths 1.75 wide with a white dot on the middle of their fore wings and an oblique dusky streak at the tip.

As the army worm has appeared so extensively, and excited so much inquiry and alarm in our country the present year, I doubt not an account of it will be looked for in the present report. A popular history and description of this insect and its habits was given in an address which I delivered at the annual fair of the State Agricultural Society, the publication of which was requested by a vote of the audience. As this address contains all the important facts known to us in relation to this insect, I present it in this place with but little alteration.

This present year may be regarded as the most remarkable in the insects it has developed of any that has occurred in our day, probably the most remarkable that has ever occurred since the country was settled. That an insect should show itself, of such a threatning aspect as to arrest public notice, in the midst of the intense excitement of a civil war, is an event seldom if ever known before in history. Yet we have this year had two insects of this character very extensively in our land, the one but vaguely and the other not at all known in this country before. I allude to the army worm, of which the newspapers have recently given such frequent notices, and the aphis, which has been seen everywhere in our fields of grain. And I here propose to give a short account of the information we have now obtained respecting the first of these insects, the army worm. I shall aim to speak of it in such plain, familiar language as will serve to give every one a distinct and definite view of its history and habits.

This name, "army worm," is given to a kind of worm which makes its appearance at irregular intervals, now in one place, then in another, coming out suddenly in immense numbers, keeping themselves huddled closely together like an army of soldiers, traveling usually in a particular direction, and devastating the fields of grain and grass through which they pass, and after a time suddenly disappearing.

We have long been aware that this was a common insect in the Southern States, appearing there in one place or another almost every year. The public prints have repeatedly noticed the fact

of trains upon the railroads being stopped and detained by encountering a dense host of worms, covering the track sometimes for a distance of two or three miles, and causing the wheels of the locomotive to slip upon the rails as though they were oiled. I have always supposed it was this army worm to which these notices referred, there being no other worm known in our country or in the world, that comes abroad, covering the ground in this manner.

The Western States also have been visited by it, though more rarely. In the northern part of Illinois, it appeared at numerous points in 1842, again in 1845, and again three years ago.

Here at the north, in New York and New England, a worm having the same habits had been known to occur, though at very long intervals, and from the little that was stated respecting it, it seemed quite probable that the insect which we had here was a different species from the army worm of the Southern and Western States. So rarely has it made its appearance here that we have been able to find its occurrence recorded in but four instances since the country has been settled.

As the short accounts which we have of its appearance on these different occasions, will be as interesting and instructive as anything I can present on this subject, I may here repeat them.

The first instance in which we find its occurrence clearly indicated, is in the year 1743, when it is merely stated, that "in Massachusetts this year, there were millions of devouring worms in armies, threatening to eut off every green thing." (Flint's 2d Report, Agric. of Mass., p. 36).

Twenty-seven years afterwards, in 1770, was the most remarkable period of its occurrence which we have ever had, previous to the present year. In Noah Webster's work on Pestilential Diseases, (vol. i, p. 259), we find the following notice of it:

In 1770, a black worm about an inch and a half long, devoured the grass and corn. Never was a more singular phenomenon. These animals were generated suddenly in the Northern States of America, and almost covered two or three hundred miles of country. They all moved nearly in one direction, and when they were intercepted by furrows in ploughed land, they fell into them in such numbers as to form heaps. They sought shelter in the grass, a hot sun being fatal to them. They disappeared suddenly about the close of June and beginning of July.

ARMY WORM. ITS APPEARANCE IN 1770.

But the most full and interesting account which we have of its appearance at this time, is that of the Rev. Grant Powers, in his Historical Sketches of the Coös Country, the Northern part of New Hampshire. He says: In the summer of 1770 an army of worms extended from Lancaster, N. H., the shire town of Coös Co., to Northfield, Mass., almost the whole length of the Granite State. They began to appear the latter part of July, and continued their ravages until September. They were then called the "Northern Army," as they seemed to advance from the North or Northwest, to the South. It was not known that they passed the highlands between the rivers Connecticut and Merrimack. Dr. Burton, of Thetford, Vt., informed the author that he had seen the pastures so covered with them, that he could not put down his finger without touching a worm, remarking, that "he had seen more than ten bushels in a heap." They were unlike any thing that generation had ever seen. There was a stripe upon the back like black velvet, and on each side a stripe of yellow from end to end, and the rest of the body was brown. They were seen not larger than a pin, but in maturity were as long as a man's finger and of proportionate thickness. They appeared to be in great haste, except when they halted to feed. They entered the houses of the people and came up into the kneading-troughs, as did the frogs in Egypt. They went up the sides of houses and over them in such compact columns that nothing of the boards or shingles could be seen. Pumpkin-vines, peas, potatoes and flax escaped their ravages. But wheat and corn disappeared before them as by magic. Fields of corn in the Haverhill and Newbury meadows, so thick that a man could hardly be seen a rod distant, were in ten days entirely defoliated by the "Northern Army." Trenches were dug round fields a foot deep, as a defence, but they were soon filled and the millions in the rear passed on, and took possession of the interdicted feed. Another expedient was resorted to: Trenches were cut, and then sticks six inches in diameter were sharpened and used to make holes in the bottom of the trenches within two or three feet of one another to the depth of two or three feet in the bottom lands, and when these holes were filled with worms, the stick was plunged into the holes, thus destroying the vermin. In this way some corn was saved. About the first of September the worms suddenly disappeared. Where or how they terminated their career

ARMY WORM. ITS APPEARANCE IN 1790 AND 1817.

is unknown, for not the carcass of a worm was seen. Had it not been for pumpkins, which were exceedingly abundant, and potatoes, the people would have greatly suffered for food. As it was, great privation was felt, on account of the loss of grass and grain.

He adds, that in 1781, eleven years afterwards, the same kind of worm appeared again, and the fears of the people were greatly excited, but they were few in number.

Twenty years after this most noted time of its appearance, it occurred again through the southern part of New England, as we learn from Webster, who says: In 1790, millions of the black worm noticed in 1770, reappeared in Connecticut, appearing at Hartford and Norwich, and disappearing in these places at the same time. They were very destructive to the grass and corn, but their existence was short, all dying in a few weeks. (Webster on Pestilence, i, 272.)

Again after an interval of twenty-seven years, it re-appeared in 1817, as I find from an old file of the Albany Argus, which gives the following item from Massachusetts:

1817. Worcester, May 22d. We learn that the *black worm* is making great ravages on some farms in this town, and in many other places in this part of the country. Their march is "a displayed column," and their progress is as distinctly marked as the course of a fire which has overrun the herbage in a dry pasture. Not a blade of grass is left standing in their rear. From the appearance of the worm, it is supposed to be the same which usually infests gardens and is commonly called the cut worm. We are informed that about forty years ago the same kind of worm made great destruction in ploughed land, among spring grain, but particularly in fields of flax. (Albany Argus adds to the above as follows:) This black worm is also destroying the vegetation in the northern towns of Rensselaer and eastern section of Saratoga. Many meadows and pastures have been rendered by their depredations as barren as a heath. It appears to be the same species of worm that has created so much alarm in Worcester county, but we suspect it is different from the cut worm, whose ravages appear to be confined to corn.

Since 1817, we have had no return of those worms, here at the North, until this present year, an interval of forty-four years.

Its career this year, so far as it has been made public, is briefly

ARMY WORM. ITS APPEARANCE IN 1861.

as follows: In April last, as we were informed by the newspapers, this worm began to appear in alarming numbers in Tennessee and Kentucky, and towards the close of that month in the southern parts of Illinois. And from that time onward till autumn, it was occurring at one place and another in Illinois, Indiana, Ohio, Pennsylvania, and on the sea-coast and its vicinity, the whole length of New England. Specimens of this worm and the moths bred from it, have been sent me from Mr. S. L. Goodale, Secretary of the State Board of Agrienlture of Maine, which were taken away "down east," between the St. Croix and Penobscot rivers. A letter from President Dawson, of McGill College, Montreal, also informs me of its occurrence in the vicinity of that city. In the southeastern part of Massachusetts, the damage it has done, is reported to exceed a half million of dollars. Here in our own State, this worm has appeared in the vicinity of Buffalo, and at several other points towards the western and southern line of the State; and also on numerous places on Long Island. The State Agricultural Society has received through Col. E. C. Frost of the Highland Nurseries, specimens of the worms from the town of Dix near the head of Seneca Lake, where they were discovered August 12th, and of corn stalks and grass as ate by them.

The colonies or armies of these worms are usually discovered when the worms are a third grown and about half an inch long. A particular spot in a field of grass or grain is found to be thronged by them, almost every stalk having one or more of them on it, and those which are not feeding, are crawling rapidly about, with an impatient aspect, as though they were "in a great hurry to get somewhere."

They resemble the caterpillars which we see on our apple trees, except that they are destitute of hairs. When particularly noticed it is seen that they differ very much from each other in their colors and stripes; but those which are recognized as being most perfect are of a black color with a pale yellow stripe along each side. Others are greenish or olive, with more numerous stripes and lines. And the worms occur of all sizes, mixed together, as they have hatched from the eggs earlier or later, those which are full grown being an inch and a half in length.

They avoid the rays of the sun; hence during the day they crawl under stones and sticks, as closely as they can crowd themselves together, and under swaths of grass or grain, or even into

ARMY WORM. EATS GRASS AND GRAIN ONLY. ITS MARCH.

the ground, like the cut worm. They rest in such places during the heat of the day, and come out towards sunset, to feed and continue forward in their mighty march. If they come to a field of grass or grain that is young and tender they devour the whole of it, down to the very roots; but if it is grown up to stalks, they eat the leaves only, and then usually crawl to the top of the stalk and cut off the head and drop it to the ground. In corn, too, they eat off all the leaves except the coarse keel or mid vein. One writer noticed a worm to eat a square inch of corn leaf in thirty minutes. It is leaves which are green and juicy that they eat; the dry leaves of ripened grain they do not feed upon.

They appear to be excellent botanists, knowing perfectly well what plants belong to the natural orders *Graminiæ* and *Cyperaceæ*, including the different kinds of grain and grass; these they eat, passing by everything else. When they are pressed with hunger, however, and do not readily find any grass or grain, they sometimes eat other vegetation slightly, but evidently do not relish it. Thus, they do not attack the vines of pumpkins, potatoes, peas, beans, flax, clover, nor the leaves of apple trees or any other trees or shrubs.

They all keep together like an army of soldiers, and usually advance in a particular direction, in a straight line, not swerving from their course to avoid hills, hollows, buildings or any other obstacle. A stream of running water, even, does not cause them to deflect from the line of their march. We learn from Solon Robinson that, on coming to a brook they crowd into it, although very few of them chance to be carried by its current to the opposite side. Millions of them are drowned, their dead bodies clogging and damming up the stream in places below, producing by their decay a stench in the atmosphere of the whole vicinity which is most noisome and intolerable.

In their march they travel faster at some times than others, advancing at the rate of from two to six rods in an hour. Thus instances have occurred in which an army of these worms, two or three miles wide, have advanced six or seven miles, leaving the track behind them as desolate as though fire had swept over it.

These worms continue to feed and travel for about three weeks from the time they are first discovered, when they all disappear, their work being finished. It was a perfect mystery to our grandfathers what became of them, as none of their dead carcases

could be found anywhere about the spots where there had been millions of them only a few days before. But now that more knowledge with respect to insects and their habits has become diffused in our country, we have had numerous persons this year who have ferreted out their retreats, whereby it is at last well ascertained what becomes of them.

When they have got their growth and finished feeding, the worms crawl into the ground to the depth of about two inches, and in two or three days change to pupæ or chrysalides—that is, their skin breaks open and out of it there comes a much harder body, shaped somewhat like an egg, of a shining chestnut red color. This lies dormant in the ground nearly three weeks, when the outer shell-like covering cracks apart and a miller or moth crawls out of it and comes up out of the ground, which is the insect in its perfect state—the creature which lays the eggs to produce another crop of these worms.

It probably, like other moths which are related to it, places its eggs at the roots of grass.

Heretofore it had never been ascertained what insect this army worm was. It had merely been conjectured in Massachusetts in 1817 that it was the common cut-worm of our gardens, and from all the information we had respecting it, this seemed to be the most plausible opinion that could be formed respecting it. Specimens of the moth were sent to me, from distant parts of the country, first from different persons in Illinois, and soon after from Massachusetts, very much as though I was referred to by common consent to decide what this insect was. I ascertained it to be a species which had been scientifically described in England, fifty years ago, from a specimen which had been obtained in this country, its technical name being *Leucania unipuncta*. It therefore was not one of the cut-worm moths, as we had conjectured it to be, but a *grass moth*. Of the genus *Leucania* to which it belongs, we have over a dozen species in the State of New York, several of them being quite common. They are those tarnished white and cream colored millers which are so common in our meadows and pastures, and which we frequently may see flitting aside in great numbers when the scythe of the mower sweeps away from them the grass in which they hide themselves.

This army worm I also find, is one and the same insect all over our country. I have seen specimens of the moths bred from it

last year in Maryland, and this year in Illinois, in Pennsylvania, in Massachusetts, and the eastern part of Maine. Thus, from nearly one extremity of the free States to the other, we know this army worm to be everywhere the same insect.

Such is the substance of what has been actually observed and ascertained of this insect. And as it now stands before us, this army worm is one of the most remarkable insects known, in this, that it makes its appearance suddenly, in countless millions, where no worms like it have been seen before; and after eating all the grass and grain in its path for a few weeks, it totally disappears, no worms of its kind being seen in the same place afterwards. Thus it appears to come without any predecessors, or parents, and to depart without leaving any descendants. It is thus the compeer of that most dreaded of all insects, the migratory locust of eastern countries, a swarm of which alights upon a particular spot, eats up everything there, and then flies away and is seen no more. But the locust has wings; everybody sees how it is that that appears and disappears as it does. But these army worms can only walk. They all appear to be infantry, all foot soldiers. How can it come to us, therefore, and again vanish, in the way it does?

This insect, I have no doubt, is a constant resident with us here in the Northern States. Its natural abode, its ordinary lurking place, I am confident, is in the wild grass of wet spots, in swamps, and on the border of marshes, waste places which we seldom visit in summer, and when there we notice nothing but the swarms of musketos which assail and torment us, forcing us to retreat from thence as speedily as possible. Hence it is, I think, that this army worm is never seen and is not known to be in our land. And thus I am able to account for the fact that I have never met with this insect. There being no marshes of any extent in the vicinity where I reside, I do not suppose it exists anywhere about me.

It probably occurs only in limited patches, in one place and another, but will be very numerous in the spots where it exists. It must be that our sportsmen, our hunters (as we complaisantly term them—"bird-murderers" they might better be called,) and other persons whose pursuits lead them to the swamps and marshes, have sometimes noticed spots there where the grass had all been consumed by these army worms.

ARMY WORM. HOW MULTIPLIED AND SCATTERED ABROAD.

Now, what multiplies this insect, and occasionally sends it out over the country, away from its accustomed haunts?

I think the weather of last year and this, being in such striking contrast as the two seasons have been, gives us the clue by which to solve this mystery.

Last year, the spring and summer till the middle of July, was the *driest* in my own vicinity, that I ever knew. The famine caused in Kansas by the extreme and protracted drouth there, is fresh in the recollection of every one; and throughout the Southwestern States the crops were stated to be a third short of their usual average, from the same cause. I suppose over the country generally the season partook of this character. Hereby, the swamps being made dry and the marshes unusually low, this insect had an unlimited extent of feeding range, and thus became greatly multiplied.

The spring and early summer of this year was exactly the reverse of last year—unusually wet, and the water high in all our streams. Hereby the swamps have all been overflowed, and this insect has been drowned out of them. The moths or millers on coming out of their chrysalides, found it was impossible for them to get to the roots of the grass there, to deposit their eggs. They were obliged to forsake their usual haunts and scatter themselves out over the country, the incessant rains making it sufficiently wet everywhere to suit their semi-aquatic habits. Thus going forth in companies, they alighted in particular spots, and there dropped their eggs; and the result is sufficiently well known.

More briefly expressed my view is this—a dry season and dry swamps multiplies this insect. And when it is thus multiplied, a wet season and overflowed swamps drives it out from its lurking place, in flocks, alighting here and there over the country. But on being thus rusticated, it finds our arable lands too dry for it; and immediately on maturing and getting its wings again, it flies back to the swamps, whereby it happens that we see no more of it.

Such is the most plausible opinion I am able to form, after the little thought I have had time to give to this subject. Very probably, hereafter, when the facts become more fully observed, some modifications of what I have now stated, may be required; but that the view I have expressed will be found to be substantially correct, I am well persuaded.

This enables us to account for a remarkable fact, namely, the difference in the localities where this army worm has appeared this year, as compared with its appearance so extensively in 1770. Then it attracted more notice along the valley of the Connecticut river than anywhere else in New England. This year we have seen no notice of its occurrence anywhere along the Connecticut river, whilst in the vicinity of the sea coast it has made its appearance from one extremity of New England to the other. Why has it not come out along the Connecticut river this year the same that it did ninety years ago? I doubt not it is because the swamps which originally occupied so much of the low lands adjacent to this river have now been so thoroughly ditched and drained and converted into dry meadow lands, that the former lurking places of this insect there are now all broken up. And thus the chief places of resort now remaining to it in New England, are the extensive marshes along the sea-coast which it is nearly or quite impossible to reclaim.

I have now finished all I supposed I should have to say on this subject. But at the moment of leaving it another thought occurs to me, so strongly confirming the view I have taken, that I can not but present it.

Our last previous visit of this army worm was in 1817, the year following the remarkably cold and *dry summer* of 1816. Thus the swamps were dry *then*, just as they were last year, for this insect to multiply. Whether the fore part of 1817 was wet and rainy I know not, though very probably memoranda are in existence, stating the fact, if it was so.

On the theory I have stated, also, the summers of 1769 and 1789 should have been very dry, and the forepart of the following years wet, to occasion the previous visits we have had of this army worm. Were these years of this character? The only work in my library, which I think of, that will be apt to give any information on this subject is, that to which reference has already been made, Webster on Pestilential Diseases. On referring to it, I find it stated that the summer of 1769 was very hot. The heat and drouth of this year cut short the rice crops in India, causing a famine there. And then we are told, the two next years were distinguished by the most terrible storms, rains and inundations, accounts of which fill the newspapers of those years. Then again, of the next period when this worm appeared, we are informed

that in the spring of 1789, the Northern States experienced a dearth approaching to famine. Vegetation was tardy, beyond what could be recollected by the oldest persons living. Part of the succeeding summer was excessively hot. And finally, we are told that the spring and summer of 1790 were "mostly rainy." Really, when I opened the book from which I have been quoting, I little expected to find in it evidence so strongly sustaining my hastily formed views.

Now that I become more confident that I have correctly penetrated the circumstances which bring the army worm upon us, I feel that I may venture further and indicate the manner in which I think we are to subdue this insect, and avert the terrible calamity of a visit from it in our cultivated fields. It seems as though nature had ordained that this most destructive creature should keep huddled together in flocks, purposely to enable man to destroy it, as he could not do if it lived singly and more widely scattered about.

Whenever an unusually dry summer occurs, we should not allow an extensive swampy tract in our vicinity to go unexamined. If a colony of these army worms is found there, it may be the merest trifle to smother and destroy them by setting fire to the dry moss and turf under them. But if danger to fences, to trees, or aught else of value, renders this measure inexpedient, ascertain where the worms bury themselves after they have done feeding, and surround the spot with a temporary fence, and inclose swine therein. If the chrysalids lie as thickly in the ground as I suppose them to, an acre of them will be of more value to the lucky finder, as food for his swine, than an acre of potatoes. Thus nature would appear to have offered a bounty to us, to induce us to search out and break up the colonies of these insects in their accustomed haunts, and thus prevent them from becoming so multiplied as to take flight and alight upon our grain fields, if a wet season should happen to follow the dry one.

As I stated when first announcing the name of this insect in the *Country Gentleman* of July 25th (vol. xviii, p. 66,) a short sketch of the history of this species, as it appears in our works of science, will interest the reader. Long ago a preserved specimen of the moth of our army worm found its way into the then celebrated collection of Mr. Francillon in London. Upon the

breaking up and sale of that collection, this specimen passed into the possession of Mr. Haworth, who, not doubting but that it had been captured in England, described it very briefly, in the year 1810, in his *Lepidoptera Brittanica*, page 174, naming it *Noctua unipuncta* or the White Speck, by which name it has ever since been referred to by English authors and collectors, save that a new generic name, *Leucania*, replaces that of *Noctua*. It appears to have been through inadvertency that Mr. Stephens changed this name to *impuncta*, when he came to describe the species in 1829, in his British Entomology, Haustellata, vol. iii, p. 80. Later, in 1850, he refers to it under its original name, in the List of Lepidoptera in the British Museum, p. 289, it having now been ascertained that it was a North American and not a British insect.

Guenée appears to have overlooked this species of the English authors. In his valuable work on the Lepidoptera (vol. v, p. 77—Paris, 1852,) he regards it as a new species, naming it *Leucania extranea*. From him we learn that there are specimens of it in several of the Paris collections, whereby they know it to be a common insect in North America, Columbia and Brazil. He also states that a variety of it which is destitute of the white dot on the fore-wings, occurs in the East Indies, Java and Australia. I cannot but think, however, that this East India insect should be ranked as a distinct species from ours, as it differs in such a prominent character, and is so widely separated from it geographically.

An acknowledgment is due to the persons who furnished me with such materials as enabled me to ascertain the name of this species. Specimens of the moths bred from the army worm, were sent me last year from Dr. E. Jenkins, of Easton, Talbot Co., Maryland, and the present year first from Dr. J. Bartlett of Pesotum, Champaign Co., Illinois; but in both instances, they came to hand in such a broken and soiled state that I could not confide in them as showing the true colors and markings of this moth. From these imperfect examples, however, I was able to obtain such characters as served to identify them with other very perfect specimens which had been received a few years since from Prof. D. S. Sheldon of Iowa College, and which had been already named in my collection. From them the following description of the moth was also drawn.

ARMY WORM. THE MOTH DESCRIBED.

It is very plain and unadorned in its appearance. The eye, on first glancing at it, only recognizes it as an ordinary looking moth of a tarnished, yellowish drab color, inclining to russet, with a small white dot near the centre of its fore wings, and a dusky oblique streak at their tips. On coming to look at it more particularly, we find it to be rather less than an inch long to the end of its closed wings, or if these are extended, it is about an inch and three-quarters in width, different specimens varying somewhat in their size. Its fore wings are sprinkled with blackish atoms, and a short distance forward of their hind edge they are crossed by a row of black dots, one on each of the veins. Outside of the middle of the wing this row of dots suddenly curves forward, and from this curve a dusky streak runs to the tip of the wing, the ground color being more pale and clearer yellow along the outer side of this streak. Though the moths of some other genera usually have a similar streak, this is the only species of this genus in which this mark occurs, and hence M. Guenée names this species *extranea*, i. e., extraneous, foreign, different, as though it did not belong here. And Mr. Stephens doubts whether it correctly portains to this genus. But a character that will appear to common persons as more conspicuous and important, is that from which Mr. Haworth names this species. Nearly in the centre of the wing is a milk-white dot, placed upon the mid-vein. This dot is surrounded more or less by a dusky cloud, and this duskiness is frequently extended forward upon the mid-vein to its base, forming a faint darker streak along the middle of the wing. Contiguous to this dot on its outer side, may be discerned a roundish spot of a slightly paler yellow color than the ground, and a very short distance forward of this is a similar spot, but smaller, both these spots often showing a more tarnished centre. On the hind part of the wing the veins are marked by slender whitish lines, and between their tips on the hind edge of the wing is a row of minute black dots.

The hind wings are smoky brown, with a purplish gloss, and are nearly transparent, with the veins blackish. The fringe of both pairs of wings is pale yellowish, with a dusky band on the middle.

On the under side the wings are much more glossy and paler, opalescent whitish inwardly, and smoky gray towards their outer and hind sides, where they are also freckled with blackish atoms. The smoky color on the hind wings has, on its anterior edge, a row of short, blackish lines, one placed on each of the veins, and in line with them on the fore wings is a faint dusky band, becoming more distinct towards its outer end, or sometimes only represented by a dusky dot on the outer margin forward of the tip. The veins are whitish, and also the hind edge, on which is a row of black dots placed between the tips of the veins. The hind wings have also a blackish crescent-shaped spot a little forward of their centre.

The abdomen or hind body is smoky gray above, and on its under side ash grey, freckled with black scales, and usually showing a row of black dots along each side.

Though these moths are subject to some variety, whoever has one of them in his hands will find it to coincide so exactly with most of the particulars stated in the above description, that he will be fully assured it is this insect.

In concluding the present account of this insect I have only to add further, that one of the parasite destroyers of the army worm was obtained from chrysalids received from Sanford Howard, Esq., of the Boston *Cultivator*, in which periodical a notice of it was given, August 31st, (vol. xxiii, p. 276.) This parasite resembles a small wasp, nearly half an inch long, of a bright rust-red color, its wings smoky, its breast black, and also the middle of its back, where is a small bright sulphur-yellow spot, which is the scutel. The antennæ or horns have a milk-white band on their middle, below which band they are rust-red and

above it black. There are two narrow bands also on the back of the abdomen or hind body, placed on the sutures or joints, and the slender stalk or petiole of the abdomen is likewise black.

This insect may very probably be a mere varicty of a common and quite variable species, the *Ichneumon suturalis* or Black-jointed ichneumon-fly, described by Mr. Say in the Boston *Journal of Natural History*, vol. i. p. 226. It however has a bright sulphur-yellow dot on each of the hind corners of the first segment of the abdomen, which dots do not occur in any of the several specimens which I at present have of the *suturalis* and of a species allied to and perhaps not distinct from it, the *Ichneumon ferrugator* (or rust-colored ichneumon-fly) of Swederus. For the present, therefore, I am inclined to rank this as a distinct species, and accordingly ticket it in my collection, *Ichneumon Leucaniæ*, or the Army worm's parasite, distinguishing the three insects which I have now alluded to as follows:—

I. FERRUGATOR, rust-colored throughout, with only the ends of the antennæ black.

I. SUTURALIS, the body (thorax) rust-color, marked with black on its sutures.

I. LEUCANIÆ, the body black with only the base and apex on the upper side dark rust-color; and other characters as above stated.

[NOTE.—In consequence of the delay which has attended the procuring of the illustrations of the foregoing Report, and the consequent issue of the volume in which it appears, much important matter has been added to it from recent observations; to make room for which it has been found necessary to withdraw some of the topics originally prepared for it, including an account of the Virginia joint worm, the fly of which is represented, plate i, fig. 1, the Angoumois moth, figs. 2 and 3 of the same plate, and the Hessian fly, for illustrating which plate iii has been prepared. These insects being of less interest at the present moment than those which here replace them, will be embraced in the next Report in the succeeding volume.]

SEVENTH REPORT

ON THE

NOXIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK.

By ASA FITCH, M. D.,

ENTOMOLOGIST OF THE NEW YORK STATE AGRICULTURAL SOCIETY.

INSECTS INFESTING GRAIN CROPS.

(CONTINUED.)

6. ANGOUMOIS MOTH, *Butalis cerealella*, Olivier. (Lepidoptera. Tineidæ.)
Plate 1, fig. 2.

In the bins of granaries and storehouses, in particular kernels of the grain, a smooth white worm which consumes all the flour inside of the kernel without injuring the external shell; passing its pupa state in the kernel, and coming abroad in May and again in November; a tawny dull yellowish gray moth having its fore wings commonly sprinkled with a few black dots, its width half an inch across its spread wings.

This insect, one of the most destructive to wheat, barley, oats and Indian corn, in France, was long ago introduced into the southern United States, where it has become fully naturalized. From thence it is frequently brought into New York in cargoes of grain, but our climate appears to be too cold for it here to thrive and establish itself.

In the museum of the State Agricultural Society, this moth made its appearance ten years ago, in the specimens of wheat preserved in glass bottles, multiplying itself in every bottle in which it occurred, until the contents were ruined. As these bottles were usually well stopped with cork and some of them also sealed with wax, it was a mystery how this insect gained an entrance to one after another of them, as it appeared to.

The description of this moth in its different states which I here present, was drawn up from the examinations made at that time. The account which I give of its habits and economy and

ANGOUMOIS MOTH. INTRODUCED HERE FROM EUROPE. ITS HABITS.

the measures for destroying it, is compiled from Reaumur, Curtis, and other writers.

The female moth lays 20 or 30 eggs in a cluster upon a single kernel of grain, and this operation is performed in the field before the grain is fully ripened, as well as in the bins of the granary. The eggs are of a bright orange red color, and are placed in a line or in little oblong masses in the longitudinal channel upon one side of the kernel. The worms hatch in a week after the eggs are laid, or sometimes, if the weather be moist and warm, in four days. When they come from the eggs they are very minute, being scarcely as thick as a hair. The first worm which hatches penetrates into the kernel on which the cluster is placed, entering it in a little spot between the beard and the appendage of the sheath, this being the point where the kernel is most tender. The hole it bores is so minute as to be imperceptible to the eye. This first born worm having taken possession of this kernel, its younger brothers and sisters, as they come out of the shell, are obliged to wander off to seek other grains; and when they find them unoccupied, they pierce and enter them in the same way, so that each kernel of the grain contains but one occupant; and this kernel is sufficient to support the larva until it arrives at maturity, when it changes to a pupa within the grain, having entirely consumed the farina, although to the eye the grain appears sound and uninjured. If, however, it be taken between the fingers and gently pressed, it is found to be soft; and from the feeling, an experienced person can discover whether the kernel contains a young larva, in the early part of its operations, or a pupa, that has consumed the whole of the flour inside of the grain. By washing the grain, also, that which is injured is readily detected, by its floating on the surface of the water.

A grain of wheat or of barley contains the exact quantity of food that is necessary to nourish and support this worm from its birth until its transformation to a pupa. If a grain containing a worm be opened when the insect is near its change, one sees there is nothing more than the skin remaining, all the farinaceous substance within having been eaten. The cavity contains, in addition to the larva, some little brown or yellow grains, which are its excrement. And as these grains are found to be fewer in number and less in bulk with the old than with the young worms,

it is supposed they eat these castings once or twice, as there is no aperture by which they can be thrust out of the cavity.

Having consumed all the flour in the grain, and completed its growth, the larva spins a white silken cocoon, which lines one end of the cavity within the grain, the other end being occupied with the castings of the worm, a partition dividing the cavity into two apartments. The moth makes its escape through a little round hole in the side of the grain, which the worm cuts with its jaws before it spins its cocoon, without, however, displacing the stopper of this orifice.

There are two generations of this insect annually, the moth coming abroad in the spring and again in the autumn. Olivier says: "One thing worthy of remark is that the moths which hatch in the month of May from the grains shut up in the granaries, hasten to get out by the windows and to gain the fields, instead of which, those that come forth immediately after the harvest make no attempt to escape. It seems that their instinct informs them that they will then find no more provision in the fields for the support of their postority."

As doubts are entertained by some writers, on the identity of our American moth with that of Europe, I here present such a detailed and carefully drawn description of our insect in its larva and its perfect state, as will enable foreign observers, I trust, to definitely settle this point. This description, it will be understood, is taken from specimens which made their appearance in the Agricultural Rooms at Albany, as already stated, this being the only instance in which this insect has fallen under my observation.

The larva, to the naked eye, appears to be a little oblong maggot, with a wrinkled skin, and of a white color throughout, except its mouth, which is blackish. It makes no effort to move or to crawl away, but lies commonly upon its side with its body bent into the shape of a crescent. When examined with the aid of a magnifying glass, it is found to be a soft, fleshy grub, cylindrical or rather broader anteriorly, and composed of thirteen segments. These are opake and without lustre, except the first segment or head, which is smooth and slightly polished. A few fine hairs are scattered over the surface. Beneath, three pairs of legs are detected, occupying the three segments next succeed-

ing the head. They are minute projecting processes, shaped like the point of a pin. When highly magnified, they are found to be smooth, pellucid, composed of three joints, and terminated by a pair of exceedingly minute hooks. Following these are four pairs of prolegs, placed on the seventh and the three succeeding segments, and a fifth pair on the apical segment. These prolegs are so little developed that they can scarcely be detected. When viewed laterally, the segments bearing them are seen to be more gibbous, or swelled out, where these legs are situated, than are the other segments. Upon the back there is a more or less obvious darker colored line along the middle, at least on the posterior segments, caused by the dorsal vessel showing itself through the semitransparent skin. On each side of the second segment is a round impressed point. It is thrice as long as broad, and measures 0.15 in length.

The following observations on the manner in which the moth extricates itself from the grain, (see plate 1, fig. 3,) and its appearance and motions when it is abroad in its perfect state, are of sufficient interest to be here inserted.

Two bottles containing infested wheat gave out a number of the moths, the one on the 5th of March, the other a month later. In both instances it was observed that the hatching occurred the day before the access of stormy weather, indicating that, though inclosed in bottles in a stove-warmed room, these insects felt the change that was taking place in the atmosphere out doors.

The smooth round hole which the larva cuts through the shell of the grain, is barely of sufficient size to enable the moth to crowd itself out of it with much labor. The head and fore body is first protruded, followed by the fore legs. Then the hind body, being soft and flexible, is extricated by a series of writhing motions, the fore legs serving to assist very much in this part of the operation, by bracing and crowding the body over, first to one side and then to the other, and finally drawing it forward sufficiently to enable the tip to become extricated. The antennæ are next withdrawn, and the insect now remains attached by its wings and hind legs, which are still inclosed within the orifice. It is only after a protracted and laborious series of efforts and writhings that these members are extracted, little by little, the fore legs and the hind body serving as props by which to elevate

and put them on the stretch, repeatedly, till they at length are wholly free. Intervals of repose and periods of exertion alternately occur during the whole of this process. And by its struggles many of the scales with which it is clothed are rubbed off and remain adhering to the surrounding kernels of grain.

The moth is a good pedestrian, walking with vivacity over the surface of the grain. It, however, usually moves with a skip, and commonly spreading its wings as it makes a leap, it flies a short distance, a foot or a yard it may be, alighting in the most shaded nook or corner within its reach. But, if it so desires, it readily makes a continuous flight from one side to the other of a spacious room, alighting upon the middle of the wall. One of my specimens chanced to alight in a tea cup of fine dry sand, in which I was keeping the larva of a lion-ant. This larva having recently been well fed, had now demolished its funnel-shaped burrow, and, as is its custom at such times, had exercised itself in plowing the surface of the sand into little irregular furrows. The loose sand afforded the moth no foothold sufficiently firm to enable it to make a leap and take wing, nor could it cling to the smooth sides of the cup sufficiently well to crawl up them to make its escape—although when unembarrassed and moving slowly and deliberately it is able to ascend the sides of glass vessels. It therefore walked hurriedly about, on the surface of the sand, sometimes passing directly over the partially exposed head of the lion-ant. But though the latter, at such times, instinctively essayed to grasp it in its formidable forceps, the steps of the moth were so agile that it readily glided out of the jaws of its wily neighbor.

When at rest, the wings are closed over the back, forming a rounded roof, nearly horizontal above and descending upon each side. Towards the apex of the closed wings the fringe of the right fore wing is protruded and overlaps the inner edge of the left wing, the same as in others of these small moths. The opposite sides of the insect, when its wings are thus closed, are parallel, and abruptly narrowed at the shoulders, with the head jutting out like a narrow protuberance in front. The fore legs, in repose, are stretched forward from the outer part of each shoulder, parallel with each other and usually in a line with the sides of the body, reaching forward thrice the length of the head. The antennæ are turned backwards, above the fore legs,

and are laid upon the outer part of the base of the fore wings, reaching less than half the length of the insect.

The moth is about 0.30 long, to the tip of its abdomen, and 0.40 to the end of its wings. Its width across the spread wings is 0.60 to 0.70. The head is smooth, being covered with short appressed scales, those surrounding the eyes being longer and radiating. The palpi are long, curving upward and backward over the head like horns, their tips reaching back to a line with the neck. The basal joint is clothed on its under side with long bristle-like scales. The spiral tongue when uncoiled is about equal to the palpi in length. The antennæ are about two-thirds the length of the body and are slightly tapering towards their tips.

The general color of this moth is a uniform dull yellowish brown or brownish buff, the hue closely resembling that of coffee-and-milk; sometimes it is of a darker shade with only the head and body of this pale color. It has a satin-like gloss, which is stronger on the under side, where the color is paler than above. The palpi are black on their bases, forming a conspicuous spot of this color slightly below the eye; and near their tips is a black band, which is broader on the inner or under side. The apex of each joint of the antennæ is also black on the upper side, forming a slender transverse line half encircling these organs. The fore legs also are black, the exterior side of their thighs and hips being tawny white. The middle pair of feet are also blackish above. The upper wings are freckled with black scales at the tip and along the middle part of the plait which runs from the base of the wing obliquely to the inner margin, these latter scales often appearing like a short black stripe. Often there are also black scales sprinkled on the disk and on the inner margin towards its tip, and a small black streak on the angle of the inner margin near the base. The fringe of the upper wings is sometimes of a paler gray shade than the ground, ornamented towards the base with a pale brown band in which some black atoms frequently appear; at other times the whole fringe is of the same brown color with the lower wings. The under side of the upper wings and both surfaces of the lower ones are of a blackish gray or leaden color.

A parasitic fly is mentioned by Reaumur, which sometimes hatches from the grains containing the larva or pupa of the Angoumois moth. Twenty of these flies have been known to come from a single grain.

Of the various attempts that have been made to prevent or diminish the ravages of this moth, in Europe, it appears that the most effective method is to subject the infested grain to the heat of an oven or a very warm room. We do not know that it is ascertained exactly what degree of heat the grain can endure without losing its germinating powers. It has been proved that it may be heated to about 190° of Fahrenheit's scale without losing those powers. But it is not so much the intensity of the heat applied, as the length of its continuance, that kills the larvæ and pupæ in the grain. Thus, from 45° to 50° Reaumur's scale, continued 24 or 36 hours, has more effect than 76° to 96° for one hour.

The chief difficulty is, to maintain an equal temperature throughout the operation, and to meet this, in France, machines called Insect mills have been invented. One of the most simple of these, that of M. Marcellin Cadet de Vaux, is a large iron

cylinder, analogous to a common utensil there in use for roasting coffee. Into this the infested grain is put, and the instrument is placed over a fire and revolved, heating the grain to a temperature of 57° to 60° Reaumur. Experiments made by a committee of the Agricultural Society of Cher in France, showed that with this machine all the insects in the grain were killed and dried in 50 minutes time, and at an expense of less than a farthing per bushel; and the grain thus dried is never afterwards attacked by these insects, even though it be mixed with other infested grain.

Dr. Herpin, who has made this insect a special study, thinks that simple friction and agitation of the grain will suffice to kill the worms within it. He remarks, "I think I have made a discovery of a very easy and very economical process for destroying the Alucita (*Butalis cerealella*) in its different states. It is by means of an Agitator or shaking-machine, furnished with little wooden or iron wings, and propelled with very great velocity (making 600 revolutions a minute). The shakings and concussions which the grain receives in passing in this machine are so quick and so multiplied, that the eggs are broken or detached from the grain, and the insect is mauled and killed even in the interior of the grain where it is enclosed. I had previously observed that some grain containing living larvæ of the Alucita, shaken briskly by the hand in a glass bottle for an hour, has produced only a small number of moths, compared with those which came out of the same grain which had not been submitted to this agitation."

7. Hessian fly, *Cecidomyia destructor*, Say. (Diptera Tipulidæ.)
Plate 3, fig. 2, the male; fig. 3, the female.

Small white maggots lying at the crown of the roots of young wheat plants, causing them to turn yellow and die; and also at the lower joints of the straw causing it to break and lop down; these maggots hardening and turning brown and then resembling flax seeds, from which come black flies or midges 0.15 long with smoky wings.

This is a European insect and has been detected in Germany, France and Italy, where it has at times committed severe depredations upon the wheat crops. Written accounts which appear to refer to it date so far back as the year 1732. It was brought to this country, probably in some straw used in package, by the Hessian soldiers who landed on Staten and the west end of Long Island, August 1776, but did not become so multiplied as to

attract general notice in that neighborhood, until 1779. From thence as a central point, it gradually extended over the country in all directions, advancing at the rate of from ten to twenty miles a year. Most of the wheat fields were wholly destroyed by it within a year or two of its first arrival at a given place, and its depredations commonly continued for several years, when they would nearly or quite cease—its parasitic insect enemies probably increasing to such an extent as to almost exterminate it. It is occasionally reappearing in excessive numbers in one part and another of our country. We hear of it at the present time as very destructive in Illinois and some of the contiguous States, the crop in many wheat fields being totally ruined by it.

This insect, as a general rule, passes through two generations annually. The first of these occupies the autumn, winter and fore part of spring, and is reared at the roots of the young grain, slightly under the surface of the ground. The second occupies the remainder of the spring and the summer, and is nurtured in the lower joints of the straw. The time when its several changes occur, however, is not perfectly uniform, being varied by the climate, the state of the weather, and perhaps other contingencies; and it is not improbable that individual specimens, placed in circumstances unfavorable to their development, in some instances have their growth so much retarded as to require even a whole year to complete their metamorphoses.

In the ordinary course of nature, therefore, our crops of winter wheat are liable to two attacks of the Hessian fly, one generation reared at its roots producing another which occupies the lower joints of the stalks. Thus the larvæ and pupæ are present in it almost continually, from the time the tender young blades appear above the ground in autumn till the grain ripens and is harvested the next summer. Our spring wheat, on the other hand, can rear but one brood of these insects; they consequently resort to it but little if at all. Nor can the Hessian fly sustain itself, except in districts where winter wheat is cultivated, in which for it to nestle during the autumn and winter.

The eggs of the first generation, or that which is nurtured in the young wheat, are deposited for the most part early in September. Dr. Chapman says the deposit is made from the latter end of August till the twentieth of September, and most other writers coincide with this, though some of them extend the time

into October. On the 8th of October the fly was seen ovipositing in Eastern Pennsylvania, and it had wholly disappeared three days afterwards, (American Farmer, ii, 180.) The deposit is doubtless made later, to the south of us, than it is here in New York.

The description which Mr. Tilghman gives, (Cultivator viii, 82,) of his observations of the female when depositing her eggs, is so interesting that it merits to be presented in his own words. He says, "By the second week of October, the first sown wheat being well up and having generally put forth its second and third blades, I resorted to my field to endeavor to satisfy myself by ocular demonstration, if I could do so, whether the fly did deposit the egg on the blades of the growing plant. Selecting what I deemed to be a favorable spot to make my observation, I placed myself in position, by reclining in a furrow between two wheat lands. It was a fine, warm, calm forenoon; and I had been on the watch but a minute or two, before I discovered a number of small black flies alighting and settling on the wheat plants around me; and so strong seemed to be their predilection for the wheat, that I did not observe a single fly to settle on any grass, or anything within my view, but the wheat. I could distinctly see their bodies in motion when settled on the leaves or blades of the wheat, and presently one alighted and settled on the ridged surface of a blade completely within my reach and distinct observation. She immediately commenced disburthening her apparently well stored abdomen, by depositing her eggs in the longitudinal cavity between the little ridges of the blade. I could distinctly see the eggs ejected from a kind of tube or sting, or by the elongation of the body; the action of the insect in making the deposit being similar to that of the wasp in stinging. After she had deposited, as I supposed, some eight or ten eggs, I easily caught her, upon the blade, between my finger and thumb. * * * * After that, I continued my observations on the flies, caught several similarly occupied, and could see the eggs uniformly placed in the longitudinal cavities of the blades of the wheat; their appearance being that of minute reddish specks."

We obtain from Mr. Herrick's account some valuable additional information upon this same subject, with a very exact description of the eggs, as follows. "The eggs are laid in the

long creases or furrows of the upper surface of the leaves of the young wheat plant. While depositing her eggs, the insect stands with her head towards the point or extremity of the leaf, and at various distances between the point and where the leaf joins and surrounds the stalk. The number found on a single leaf, varies from a single egg up to thirty, or even more. The egg is about a fiftieth of an inch long, cylindrical, rounded at the ends, glossy and translucent, of a pale red color, becoming, in a few hours, irregularly spotted with deeper red. Between its exclusion and its hatching, these red spots are continually changing in number, size, and position; and sometimes nearly all disappear. A little while before hatching, two lateral rows of opake white spots, about ten in number, can be seen in each egg. In four days, more or less, according to the weather, the egg is hatched."

From the time this insect leaves the egg, till its growth is completed, no better account can be drawn up than that which is given by Mr. Herrick, which merits to be preserved in his own words, as follows. "The little wrinkled maggot, or larva, creeps out of the delicate membranous egg skin, crawls down the leaf, enters the sheath, and proceeds along the stalk, usually as far as the next joint below," or, in other words, to the base of the sheath, which in the young wheat in autumn is at the crown of the root. "Here it fastens, lengthwise, and head downwards, to the tender stalk, and lives upon the sap. It does not gnaw the stalk, nor does it enter the central cavity thereof; but, as the larva increases in size, it gradually becomes embedded in the substance of the stalk. After taking its station, the larva moves no more, gradually loses its reddish color and wrinkled appearance, becomes plump and torpid, is at first semi-translucent, and then more and more clouded with internal white spots; and when near maturity, the middle of the intestinal parts is of a greenish color. In five or six weeks (varying with the season,) the larva begins to turn brown, and soon becomes of a bright chestnut color, bearing some resemblance to a flax-seed," &c.

When freshly taken from the roots of the wheat the mature worm, (see plate 2, fig. 19,) measures about fifteen hundredths of an inch (0.15) in length, by about 0.06 in width. It shows no signs of life when placed upon paper and turned over with the point of a needle. It is soft, glabrous, shining, white, oval, and apparently composed of but nine segments, although when it is

younger twelve can usually be perceived. These segments are but slightly indicated, the sutures between them forming faint transverse lines of a greenish brown hue. Its under side is flattened and shows in the middle an oblong grass green cloud from internal visceral matter. No impressed lines or constrictions are perceptible at the sutures at first, but after the worm has laid exposed to the air an hour or more, the color of the transverse lines above mentioned, vanishes, and then, perhaps from becoming somewhat dried, faintly impressed and very slender lines may be perceived at the sutures; and faint longitudinal lines or striæ are also discernable, as though produced by the pressure of the parallel veins or ribs of the sheath and the central stalk between which the worm had laid.

The autumnal attack of the Hessian fly is in a double sense a *radical* one. Each particular shoot at whose root one or more of these larvæ nestles, is commonly destroyed, by the time the worm has attained its growth and leaves off feeding. The presence of these insects therefore, is readily detected by an examination of the young wheat in October or November. Individual shoots will be found here and there in the field, withered and changed to a light yellow color, as represented, plate 3, fig. B,† strongly contrasting with the rich green of the vigorous uninjured plants, as shown in the same figure at *. The frost or some other casualty may cause the ends of some of the other leaves to be of a pale yellow color, but here the whole plant is of that hue; and where a field is badly infested, this yellow, sickly aspect may be discerned at a distance. On examining the withered plants, the worm, or flax-seed if it has advanced to that stage, can be readily found. It is situated a short distance below the surface of the earth, at the crown of the root. One or two radical leaves start from this point, their bases forming a cylindrical envelope or sheath around the central or main shoot, which as yet is only in its infancy. It is within this sheath, at its base, that the worms repose, one, two, three or more, and by imbibing the nutritious juices of the tender young shoot, cause it to wither and die. The mechanical pressure of the larvæ, which writers have so frequently spoken of as impeding the circulation of the fluids of the plant and thereby causing it to perish, I think has had too much importance assigned to it. The young plants are so soft and pliant that they would readily accommodate themselves to

this pressure, and if they received no more important molestation than this, would not be apt to perish as they do.

After the worm or active larva has fully completed its growth, a slight diminution in the dimensions of the inner soft parts of its body commences, in which the tougher outer skin does not participate, but retains its full size. The result of this contraction is, that the worm gradually cleaves from its outer skin. Examined with a magnifying glass when this change has recently commenced, a slight translucent space is observable at the head end, and a larger and more obvious one at the pointed or tail end, plainly indicating that the enclosed worm does not entirely fill its outer skin. This contraction continues, until the worm becomes entirely separated from its outer skin, and lies within it like the finger within a glove. The outer skin at the same time changes in color. From its original whiteness and transparency, it now becomes opake, brown, and finally of a bay or chestnut color. Though much less flat than a flax seed, its resemblance in color, size and form, to that familiar object, is so striking as at once to be remarked by every one. The figures *h*, *i* and *j*, of plate 3 give dorsal, ventral and lateral views of this flax-seed state of the insect.

When the warm days of early spring arrive, and the weather becomes sufficiently mild for some of our earliest plants to put forth their blossoms, the larva of the Hessian fly is by the genial warmth rapidly stimulated to maturity. In the year 1846, most of these insects were found changed from their larva to their pupa state, so early as the 21st of April. But as the season then was more forward than usual at that date, this was probably earlier than the change commonly occurs in the middle and northern parts of New York. A more accurate criterion by which to indicate the time when this change occurs, no doubt, is the progress which vegetation has then made. I may therefore state that, in all parts of our country, the Hessian fly will be found in its fully formed pupa state, about a week after the liverwort (*Hepatica triloba*), the trailing arbutus (*Epigæa repens*), and the red or swamp maple (*Acer rubrum*) first begin to be seen in bloom in our woods. The insect remains in this stage of its life about ten or twelve days, and then gives out the winged fly.

When the insect has reached its pupa state, the flax seed shell in which it lies inclosed has become quite brittle, breaking

asunder transversely if rudely handled, and one of its ends slipping off from the insect within, like a thimble from the end of the finger. On removing the pupa from its case, (see plate 3, fig. *l*,) it is found to be 0.13 long by 0.05 broad, of an oval form with rounded ends, the anterior or thoracic portion being slightly narrower than the abdominal. The essential difference between its form now, and what it previously was, is, that the wings, legs and antennæ of the future fly are now perceptible in their rudimentary state, appressed to the surface of the body. The sheaths in which the wings are enveloped do not quite attain the middle of the length of the body. The outer pair of feet come out from under the tips of the wings, and reach to the anterior margin of the penultimate abdominal segment, their tips curving gently inward towards each other. The next pair of feet are somewhat shorter, and the inner pair are shorter still. They all lie in contact with each other, and extend lengthwise upon the front side of the body, but are not soldered to it. The abdominal segments are distinctly marked by strongly impressed transverse lines, and are of a milk-white color, the head and thorax being of a delicate pale pink red, and the feet translucent whitish.

The time for its last transformation having arrived, the pupa by writhing and bending its body breaks open its puparium or flax seed case, crawls from it, and works its way upward within the sheath of the leaf, until it comes to some cleft in the now dead, brittle and elastic straw. Through this cleft it crowds its body, until all except the tip of the abdomen is protruded into the air, the elasticity of the straw causing it to close together upon the tip of the abdomen, sufficiently to hold the pupa in this situation, secure from falling to the ground. And as if to preserve the body in a horizontal position, the feet are slightly separated from the abdomen, and directed obliquely downwards, with their tips pressed against the side of the straw, thus curiously serving, like the brace to a beam or to the arm of a sign post, to support the body from inclining downwards. Thus securely fixed, and now freely exposed to the drying influence of the atmosphere, the outer membrane of the pupa exhales its moisture, and as it becomes dried, cracks apart upon the back or upper side of the thorax. Out of this opening the inclosed fly protrudes its head and thorax, more and more, as it gradually withdraws its several members, the antennæ, wings and legs,

from the sheaths in which they are respectively enveloped—a process analogous to that of withdrawing the hand and its several fingers from a tight glove—until at length entirely freed from its pupa skin, the fly, now perfect in all its parts, usually walks a few steps further up the straw, where it pauses for its body and members to acquire more firmness and strength by the further evaporation of their moisture, after which it is ready to spread its wings and mount into the air.

In the FEMALE fly the head is black and of a flattened spherical form. The antennæ are about half as long as the body, and composed of sixteen joints, which are separated from each other by very short translucent pedicels, which are about a third of the diameter of the joints. The joints are of a cylindric-oval form, their length being about double their thickness. Each joint is clothed with a number of hairs, of which those towards its base are perceptibly longer and coarser, about equalling the joint in their length, and placed in a row or whirl around it. The terminal joint is a third longer than these which precede it; whilst the two basal joints are thicker than the others, globular, and compact or not separated by an intervening pedicel. The palpi are clothed with fine short hairs and are composed of three joints, of which the two last are nearly equal in size, cylindrical, and about twice as long as broad, the basal one being more short and thicker. The thorax is black, oval, and broadest immediately back of the wing sockets. The abdomen is elongate-ovate, its broadest part scarcely equalling the thorax in diameter. It is black on the back, with a tawny yellow or red band at each of the sutures, these bands varying in their width as the abdomen is more or less distended. The under side is obscure brownish; but when the fly is newly hatched, it is bright red or yellow, with a blackish stripe along the middle, in which stripe a small red or yellow spot is sometimes present upon the middle of each segment. The abdomen is clothed in places with fine black hairs, and is composed of seven segments. When the sting or ovipositor is protruded, it forms two additional segments, of a pale red or yellow color; the apical one is a little tapering, thrice as long as broad, and is slightly dusky at its tip, the end being blunt. The other is of the same length with the apical but is twice as thick. The wings are slightly dusky and at their bases are tinged with tawny yellow. They have the three longitudinal veins whereby the genus Cecidomyia is characterized, the middle vein towards its apex and the forks of the inner vein being very slender for a species so large as this; and the cross vein between the middle and outer longitudinal veins, which is seen in many of the insects of this genus, is wanting in this species. The poisers are dusky. The legs are pale brown, the thighs paler at their bases, and the feet are black. The different pairs of legs equal each other in length, and are about 0.24 long when extended, of which length the feet form one-half. The short basal joint of the feet is so indistinct that often it is only after an examination of several specimens that one becomes assured such a joint really exists in this species.

In the MALE the antennæ are three-fourths the length of the body, with the joints short oval and almost globular. Each joint is surrounded with a whirl of longish hairs. The terminal joint does not differ from those which precede it. The two basal joints are compacted together as in the female. The antennæ diminish very slightly in thickness towards their tips. The pedicels separating the joints are smoky, translucent, nearly as long as the joints and about a third as thick. The abdomen is cylindric or slightly tapering towards its tip, and is formed of seven joints in addition to the terminal one, which is transversely oval and gives off two robust processes which are armed each with an inourved hook at its tip. The abdomen in the living specimen is black or brownish black, with bands at the sutures both above and beneath, of a brick red, tawny yellow, or grayish color, varying in their width as this part of the body is more or less distended. In all other respects the male fly corresponds with the female.

HESSIAN FLY. PARASITES.

The Hessian fly is everywhere followed up and destroyed by parasitic insects. The most common and important one of these was described by Mr. Say in connection with the Hessian fly, (Journal Academy of Natural Sciences, vol. i, p. 47,) under the name *Ceraphron destructor*. We present a carefully drawn figure of this insect, Plate 3, fig. 1. Entomologists have been much perplexed to determine the true generic place of this species, it being evidently not a member of the genus to which Mr. Say assigned it, or even of the family to which that genus pertains. It clearly belongs to the family *Chalcididæ*. Mr. Westwood, from the imperfect figures accompanying Mr. Say's description, at first supposed it was a member of the group Eulophides (Introduction, vol. ii, p. 160) but the number of joints both to its feet and antennæ exclude it from that group, and he subsequently, as we are told by Mr. Curtis, (Jour. Royal Agricultural Society, vol. vi, p. 139) thinks it is perhaps a *Pteromalus*. Dr. Harris at first regarded it as an *Eurytoma*, but becoming aware this location was erroneous he finally concluded the genus *Rhaphitelus* to be its true place. But independent of other discordances, its antennæ indicate it to be a member of the group Pteromalides rather than that of Ormocerides where Dr. Harris's conclusion would place it. The number of joints to its antennæ exclude it from the extensive genus *Pteromalus*, and of the several kindred genera in which these organs are twelve-jointed, that of *Semiotus*, Walker (which name being pre-occupied, Mr. Westwood proposes to modify to *Semiotellus*) seems to be the only one from which it is not decidedly excluded by some one or more characters. With this genus it appears to fully coincide, having the antennæ in the male thread-like, in the female perceptibly though but slightly thicker towards their tips, the apical joints being compacted into a linear mass in the one sex, an oval one in the other, the thorax punctured, and other characters which will appear from the full description presented herewith. So far, therefore, as I am able to judge from the characters assigned to this genus without any of the foreign species in my hands for a comparison, I am induced to regard this as its true location. And I may further observe, that a parasitic destroyer of the Apple-tree caterpillar which I described in my second Report under the name *Cleonymus Clisiocampæ*, I now see is co-generic with this destroyer of the Hessian fly. I stated its antennæ to

be eleven-jointed, the third joint small and scarcely perceptible. I now perceive this small third joint to be in reality two joints.

This Hessian-fly larva-parasite, *Semiotellus destructor*, (the female of which is represented, plate 3, fig. 1, and the antennæ of the male at the bottom of the same plate at *p.*,) is one-tenth of an inch long and of a black color, its head and thorax having a brassy green reflection. Its legs and the base of its antennæ are dull pale yellow, the middle of the thighs being often stained with brown or blackish. Its abdomen is smooth and polished and is usually tinged with yellow at its base, which tinge, sometimes at least, becomes a bright lemon yellow spot in the males.

The HEAD is as broad as the thorax and thrice as broad as long when viewed from above, concave on its hind side and convex in front. Viewed in front it appears nearly globular with a depression rather below the centre, in which the antennæ are inserted. The *eyes* are of a dull red color and but slightly protuberant, occupying the sides of the head. As seen from above they appear egg-shaped, forming an angular point at their hind part. The ocelli or eyelets appear like three red glassy dots on the crown, placed at the angles of a triangle, of which the hind side is longest. The *antennæ* when turned back reach to about the middle of the thorax. They are elbowed, the basal joint occupying a third of their total length. This joint is dull pale yellow the other joints being black and covered with an inclined beard. In the female they are very slightly thicker towards their tips, whilst in the male, (see plate 3, *p.*,) they are of uniform thickness through their entire length. Viewed with a common magnifier they appear ten-jointed, though the last joints are usually so compacted that in the dried specimen the full number cannot be distinctly discerned. When highly magnified two small additional transverse joints may usually be discerned more or less distinctly, between the second and the third joints, of which the first is rather smaller than the second. The joints are slightly longer than thick, and rather narrower towards their bases. The second joint is longer than the others, its length being about double its thickness. The last joint is egg-shaped, twice as long as thick in the female and a third longer than this in the male, its apex appearing to be cut off transversely, with a minute teat-like process protruded therefrom.

The THORAX is twice as long as broad, broadest forward of the middle and more narrowed behind than before. Its surface, as well as that of the head, has a rough and shagreened appearance from numerous close punctures. Near its anterior end it is crossed by an impressed line, marking the collar, which is short and broad, of a slender crescent form. The mesothorax or part next back of the collar shows on each side a shallow groove running obliquely upward and backward, above the wing sockets, and dividing what are termed the parapsides from the upper or main part of the mesothorax A deep furrow across the middle of the thorax and forking upon each side, more conspicuously separates these last named parts from the tegulæ—the small oval pieces between the forks and above the wing sockets—and from the scutel, which last is large and rounded.

The ABDOMEN is black, smooth and polished, flattened egg-shape, broader and shorter than the thorax, pointed at the tip, its sutures marked by fine transverse lines, and its basal segment large. In the male it is smaller and more oval, its tip forming an angular point. Towards its base is usually seen a bright lemon yellow spot both above and beneath, which in the female is replaced by a dull pale yellowish cloud.

The WINGS are clear and glassy, fringed with fine hairs along their inner margins and tips and also along the middle part of their outer margins. The rib-vein of the fore wings recedes from the outer edge at first and then curving joins the edge at a third of the distance from the base of the wing to its apex, and continues united with the edge more than two-thirds of the distance to the apex, where it terminates. Beyond the middle of the outer margin it gives off the stigmal branch, which is curved and thickened at its end, with its apex

notched. Three exceedingly slender abortive veins may be perceived in these wings, as follows: One extending from the inner tooth of the apex of the stigmal branch to the hind end; another arising in the base of the wing near the rib-vein, meeting the end of the transverse veinlet and continuing from thence nearly parallel with the inner margin its whole length till it reaches the edge; a third forking from this latter one near the middle of the wing and joining the hind edge equidistant between the ends of the other two.

Legs dull pale yellow, or in the males whitish, with a brown streak on the thighs. Feet black at the tips, five-jointed, the basal joint longest and the following ones successively shorter.

It is when the Hessian-fly has completed its growth and assumed its flax-seed form that this parasite attacks it. With its sting it pierces the straw to where its victim lies, and punctures its body and inserts an egg therein. The little maggot which comes from this egg consumes the larva and then occupies the flax-seed shell in its stead, till it has passed through its pupa state and become a fly, when it gnaws a small hole through the shell and straw and makes its escape. Two of the holes thus made in the straw are seen in fig. B, plate 3, at the mark §§.

In addition to this species, Mr. Herrick discovered two others which destroy the Hessian fly in its flax seed state, and a fourth which attacks the eggs. This last is a species of *Platygaster*, and is probably closely like that which we have represented in fig. 4 of plate 1. He states that this egg-parasite is abundant in autumn, and when the Hessian fly deposits its eggs upon the leaves of the young wheat, this insect searches them out, and piercing them with its sting, lays four or five of its own eggs in a single egg of the fly. These eggs it is probable do not hatch immediately, as the contents of the fly's egg are obviously insufficient to feed even one of them to maturity. It is therefore necessary that more nutriment should be elaborated for their sustenance. And accordingly the larva of the fly comes from the egg with these seeds of destruction within it; it grows to maturity and passes into its flax-seed state, by which time its "intestine foes" having also become fully grown, spin their cocoons in a cluster within the flax seed and in due time eat their way out, the worm of the Hessian fly having now perished.

By these different parasites, according to the observations of Mr. Herrick, it is probable that nine tenths of every generation of the Hessian fly is destroyed.

With regard to remedies, it may be observed that, in districts where the Hessian fly is numerous, it is scarcely possible to obtain a crop of winter wheat except upon a fertile soil. Such a soil enables the plants to elaborate a sufficiency of fluids for

their own sustenance in addition to what is abstracted for their nourishment by the insects which invade them. To elude this fly, late sowing is one of the most easy and successful expedients that can be resorted to, and the one most fully sanctioned by universal experience. About the last of September is probably as late as it will be judicious in our climate to defer sowing wheat, and this will usually insure it against injury from this insect; for though when it appears above ground the season for the fly to deposit its eggs may not in some years be entirely past, it will be rare for a number of these sufficiently large to be perceptibly injurious, to be then laid. Where the soil is of but medium fertility, a resort to some of the hardier varieties of wheat, which are known to be in a measure fly-proof, will be advisable.

In my essay upon this insect, published in the Transactions of the State Agricultural Society for the year 1846, pp. 316–376 is given a full account of its history, habits and remedies, to which the reader is referred for numerous details, which I have not thought it necessary to repeat in this place. At the time that Essay was written, in the autumn of 1845 and the spring of 1846, this insect had suddenly become quite numerous through all the district where I reside. But after harvest, in the stubble of the wheat fields, almost every infested and swollen straw was noticed as being perforated by parasites which had escaped from it, and the depredations of the insect abruptly ceased. But, in sweeping with a net in fields of winter wheat at any time in May or June, I continued to find some of the flies, till within a few years past it appears to have wholly vanished from my vicinity. I therefore have had no opportunity to make any recent observations upon this insect, and in the foregoing account, what is stated of parasites is about the only important matter which I have been able to add to what had previously been communicated to the Society.

8. JOINT-WORM FLY, *Eurytoma Tritici*, Fitch. (Hymenoptera. Chalcididæ.)
Plate 1, fig 1.

Hard and wood-like swellings on the wheat stalks, mostly at the lower joints, retarding their growth and causing many of them to become angularly bent or elbowed; these swellings having a number of small cavities in the substance of the sheath and sometimes in that of the central stalk, each cavity containing a small yellowish-white maggot which remains in the straw through the winter and becomes changed to a four-winged fly which the fore part of May perforates a small hole through the straw and escapes therefrom; this fly 0.12 long, and jet black with pale dull yellow knees, feet and anterior shanks.

JOINT-WORM FLY. ITS DEVASTATIONS IN VIRGINIA.

The diseased appearance which this insect occasions in the growing wheat is so similar to that produced by the Hessian fly that many persons at first supposed it to be the same insect, it residing in the straw usually immediately above the lower joints, producing an enlargement or tumor in the straw at that point and causing it to become angularly bent and lopping down more or less. But the worm instead of residing in the natural crevice between the sheath and central stalk where the larva of the Hessian fly reposes, occupies a small cell in the substance of the sheath or of the central stalk, and the swelling or gall which it occasions, is of a hard, knotty and wood-like texture instead of being soft and of a substance similar to that of the straw.

It is in the central parts of Virginia, in the district around Charlottesville and Gordonsville that this insect has been most destructive. It began to attract public notice about the year 1848. The first account of its depredations appeared in the Southern Planter, July 1851, from the pen of the editor, Frank G. Ruffin. He states that "a new and most destructive enemy to wheat has appeared under the name of the Joint-worm. Many crops in Albemarle are hardly worth cutting in consequence of its attacks, and all that we have seen or heard of, except one, are badly hurt by it. In the area it has traversed, and the completeness of its devastation within it, it has no rival amongst insects in this country. The dreaded Hessian fly is nothing to it; and no atmospheric calamity can pretend to a comparison. It sweeps whole districts, and everywhere, we hear, has done great damage, and it is feared will do much more before it is checked or destroyed." This is followed by a communication from a friend to the editor, giving an account of the habits of the Joint-worm, so far as he had been able to discover them, and an extract from the proceedings of the "Hole and Corner Club, No. 1, of Albemarle," embodying the experience its members had had with this insect, the situations where it is most destructive, the varieties of wheat which were the least injured, and the effect of guano and other fertilizers in withstanding it.

The second article which was published on this insect, appeared in the Albany Cultivator, October 1851 (vol. viii, pp. 321–324). Mr. Alex. Rives of Albemarle, transmitted to that widely circulated periodical an account of the habits of the insect, accompanied with samples of the diseased green wheat containing the

worm, and requested they should be handed to some naturalist for a more exact description and any additional information respecting it which could be given. These specimens were forwarded to me, and the result of my examination accompanies Mr. Rives' communication. He states that some of his acquaintances had in glass jars hatched the perfect insects from these worms, and represent it to be "a dark-colored gnat, with small wings, some want of activity, and little power of flight." I described the diseased wheat and the worm therein, as follows:

The wheat stalk immediately above the lower joint, is obviously diseased for a distance exceeding a half inch. It is swollen to a size a third larger than it is above or below; it is changed to a harder and more wood-like texture; the veins are distorted and crowded out of their natural straight and parallel direction; and several long spots of a paler color and slightly elevated, like blisters, appear. On carefully cutting into these blister-like elevations, a hollow cavity is found, which is nearly a quarter of an inch long, and tapering to a point at each end. In each of these cavities lies a footless worm or maggot, which is about ten-hundredths of an inch long (0.10) by four-hundredths broad (0.04); of an oval form, rather more tapering towards one end, and divided by slight constrictions into thirteen segments. The worm is soft, shining, of a uniform milk-white color, and on its anterior end is a small V-shaped brown line, marking the situation of its mouth. So exactly does this worm in its form and appearance resemble the larva of the Hessian fly and other species of Cecidomyia which have fallen under my notice, that I entertain no doubt it pertains to the same genus of insects. And when we see it infesting the same part of the wheat stalk with the Hessian fly, and producing much the same swollen appearance of the stalk, no person but one well acquainted with the habits of that insect would suspect that this was anything different. But the Hessian fly worm occupies a natural cleft or partition in the wheat plant, to wit, between the sheath which is formed by the base of the leaf, and the main or central stalk or culm. Therefore, on drawing the leaf aside so as to part this sheath and separate it from the stalk, when it is stripped off downwards almost to its base, the Hessian fly worm is exposed to view. This may be done without any cutting or tearing of the plant. The Joint-worm, on the other hand, lives in the parenchyma or

substance of the sheath, near its base. On separating the sheath from the culm and drawing it aside, the worm is not exposed to view: it lies in the texture that is thus separated, and can only be seen by cutting into the elevated or blistered spot already spoken of, which spots are equally manifest on the inner as they are upon the outer surface of the sheath.

Dr. Harris on reading the above description observed that this joint-worm occupied the identical situation in the straw with an insect which some years before had infested the barley in Massachusetts, from which he had obtained what was supposed to be the parasitic destroyer of the real culprit, and which he had described under the name *Eurytoma Hordei*. A correspondence upon this subject took place between us, and we mutually concluded the parent of this joint-worm would prove to be a Cecidomyia of the same species, probably, with that which had infested the barley.

In March of the following year Mr. Ruffin forwarded to Dr. Harris a quantity of the diseased straw, which he, to be more secure in having specimens of the perfect insect obtained therefrom, divided into two unequal parcels, the larger one of which he transmitted to me. An examination of these samples showed that this insect was not constantly confined to the substance of the sheath above the joints, where I had previously found it, but was sometime lodged in the joints themselves, whereby their texture becomes swollen and distorted; and in a few instances the cells containing the worms are found to be in the walls of the central stalk or culm, wholly inside of the sheath.

These straws placed upon moist earth in a glass jar, the most natural situation I could give them, and kept in a stove warmed room, began to give out the flies profusely on the 28th of April, between which date and the 6th of May when the hatch terminated, upwards of a hundred specimens were obtained. To my great surprise no Cecidomyia flies were disclosed. They were all alike and on careful inspection all were found to be females, very similar to if not identical with the *Eurytoma Hordei* from the Massachusetts barley. The parcel which Dr. Harris retained, was placed in a dry jar, and yielded him a few days later, fifteen of the same flies, all females save one. These results, in connection with the fact that no other insect but this had been obtained from the Massachusetts barley, could not but excite our strong

suspicions that this fly was itself the real depredator upon the wheat and not a parasite which had in such a multitude of instances killed the destroyer to come out thus in its stead. But as all the family of insects to which this species pertains were currently regarded by authors as parasitic, and we were acquainted with American species of this same genus *Eurytoma* which we had conclusive evidence were parasites, we could not but hesitate in adoptiug this view.

Prof. J. L. Cabell, of the University of Virginia, residing in the midst of the region where it was so destructive, was simultaneously directing his attention to this insect. In the spring of this same year, 1852, from different parcels of wheat he bred flies to more than a hundred in number, obtainiug the same insect in every instance. In examining the worms in the diseased straw he met with two kinds, one being yellowish, smooth and sluggish; the other white, hairy and very active in its movements. This last was evidently a parasite. In several instances it was found in the same cell with an individual of the first kind, and feeding upon it, but at all times it was found in an exceedingly small proportion of cases, not more than one in twenty or thirty. Prof. Cabell embodied the results of his investigations in an article which was published in September, 1852, in the Southern Planter, vol. xii, pp. 271, 272, in which the fly obtained from the joint-worm was announced to be the *Eurytoma Hordei*, Harris, to which he adds that everything concurred in confirming his first impression that the mischief to the wheat was occasioned exclusively by this insect, and that he was obliged to hold to the opinion, at least until another fly was produced, that entomologists have made a premature generalization in ascribing exclusively carnivorous habits to the group of insects to which the *Eurytoma* belongs.

It will readily be seen that the question whether this *Eurytoma* was a phytophagous or a carnivorous insect, a vegetable feeder or a flesh eater, whether it was the real parent of the joint-worm or its most inveterate foe, and consequently whether it should be combatted and destroyed or cherished and protected, was no less interesting in a scientific than it was important in a practical point of view. How could the real fact be ascertained? I felt confident that if I was personally present where this joint-worm abounded, I could assuredly observe it so closely and obtain

such perfect knowledge of it as would settle the point definitely and conclusively; and for a time I had it in serious contemplation to visit Virginia on this business. But other avocations came to me, which diverted me from this purpose.

Was any further light upon this topic attainable? How was it possible for this *Eurytoma* to thus come from these joint-worms and the worms in barley in every observed instance, to the amount of some hundreds, if it were not the legitimate descendant of those worms. It occurred to Dr. Harris that a portion of the joint-worms might perhaps complete their transformations and come from the straw the first summer, leaving only those containing parasites to pass over till the following spring, and he addressed Mr. Ruffin on this subject, desiring him to have this point examined. Prof. Cabell, the only respondent to this inquiry, states that he has known a few flies to leave the straw the first year, but in each instance the fly which came forth thus was the same *Eurytoma*. It, moreover, is quite evident that no considerable number of flies do leave the straw anterior to the hatching of the *Eurytoma* in May, or we should meet with their evacuated cells, with the openings therein through which the inmate had made its exit.

Another important inquiry suggested itself to Prof. Cabell. Although the larvæ of the gall-flies (*Cecidomyia*) of the order Diptera, and of the gall-bees (*Cynips*) of the order Hymenoptera, may be closely similar to each other, is there not some character by which they can be distinguished, whereby it can be ascertained whether this joint-worm itself is really a Dipterous larva, as I had confidently pronounced it to be, or a Hymenopterous larva as it must be to produce this Eurytoma? Upon comparing the Dipterous larvæ of the Hessian fly with the Hymenopterous larvæ found in oak-galls, Prof. Cabell noticed that the blackish jaws of the latter were placed upon a straight transverse line, whilst in the former they have an oblique direction, their ends meeting at an acute angle. Thereupon inspecting the joint-worm he found its jaws plainly indicated it to be a Hymenopterous larva. Specimens were forwarded to Dr. Harris, which were carefully examined by him, and also by Prof. Jeffries Wyman, a skilful anatomist and experienced microscopical observer. They fully confirmed the correctness of Prof. Cabell.

JOINT-WORM FLY. A MIDGE LARVA ALSO IN THE WHEAT.

Upon this subject I would observe that I have in instances without number, with the aid only of the common pocket magnifier, noticed the jaws in the larvæ of various species of Cecidomyia appearing as two minute black lines meeting at an acute angle, in the form of a letter V or sometimes like a Y, and have mentioned this in my published descriptions of some of these larvæ. More recently the larvæ of numbers of the gall bees have come under my examination, in the larger ones of which, the jaws are equally distinct, forming a straight transverse line slightly interrupted in its middle. Prof. Cabell is undoubtedly correct in regarding this as a decisive character whereby we may know whether the larvæ we meet with in galls pertain to the order Hymenoptera or Diptera.

But this instead of diminishing our doubts upon the question at issue—whether the Eurytoma is or is not a parasite—greatly increases those doubts. It sufficiently proves that the worm which Prof. Cabell found in the wheat is the real larva of the Eurytoma; and Prof. Cabell and Dr. Harris hence inferred that I was in error in pronouncing the worm which I found in the Virginia wheat from Mr. Rives to be a Cecidomyia. But that by no means follows. On the contrary, the very character stated renders it quite evident that I was correct. I was at that time perfectly familiar with the appearance of the mouth in the larvæ of the Cecidomyiæ, and of the Hessian fly in particular. Had there been any perceptible variation therefrom in the larva examined, I think I could not have failed to observe it and to have noticed it in the careful description which I drew up. In that description I say, "The worm is soft, shining, of a uniform milk-white color," not at all yellowish therefore, like the Eurytoma larva, and no green central cloud as in the Hessian fly larva; and observe what follows, "and on its anterior end is a a small V-shaped brown line, marking the situation of its mouth." Now this V-shaped brown line is the jaws, their ends coming together at an acute angle. It is clear, therefore, that the worm sent us from Mr. Rives as being the joint-worm was a different species from that which Prof. Cabell found in the wheat the following year, and was undoubtedly a Cecidomyia, as I supposed it to be. It was not till some considerable time afterwards that I became aware of this. When I was first informed of the distinctive mark which Prof. Cabell had ascertained to exist

between the Hymenopterous and Dipterous larvæ, I supposed this character to be so minute and inconspicuous that it could only be observed upon making a nice dissection of the mouth. A few years later, however, on coming to see the larva of a Eurytoma, a glance at its head and mouth assured me I could never have confounded a larva of that kind with a Cecidomyia larva. I have since examined several Eurytoma larvæ of different species. I observe in all of them that the head is broad and bluntly rounded, not tapering to a point, and the discolored transverse line formed by the jaws is placed at the very end of the head. In the Cecidomyia larvæ on the other hand, the V mark is invariably seen a short distance back from the anterior end, the head being retracted and thus appearing much as though the insect, if it had not, as the common expression is, bit off its own nose, had accomplished an equally marvellous feat, to wit, had swallowed its mouth, whereby the jaws come to be seen partly down its throat. It is only when they are in use that, in the larvæ of the Cecidomyiæ, these jaws, these minute black lines, are moved forward to the orifice at the anterior end of the head; at all other times they are retracted and are situated a short distance back from the end, being quite visible through the transparent skin which overlies them.

Thus the highly important fact is, I think, well authenticated—a Cecidomyia larva occurred in this diseased Virginia wheat, as well as a Eurytoma larva—the one being found in the same kind of cavities or cells in which the other occurred. The wheat which I examined was green and succulent. The worm in it was at that time one tenth of an inch long. This is the average length of the mature larvæ in the genus Cecidomyia, although there are some species which grow to twice this size. On the other hand, it is from the dry straw that the Eurytoma larva has been taken, so far as appears. It certainly looks, therefore, as though this Cecidomyia larva might leave the wheat and go into the ground before the crop fully ripens and is harvested, whereby it has wholly eluded observation, its evacuated cells perhaps becoming so much altered and effaced that they are not liable to be noticed in the dry straw; whilst the Eurytoma larva by feeding upon and consuming the former, in numerous instances comes to occupy the cells in its stead, remaining in them till the following year, whereby it is this insect only which we obtain

from the dry straw. Several incidental circumstances occur to my mind, some favoring and others militating against this view. It is scarcely worth while to consider these in detail or speculate further upon this subject, since it is only by actual observation that the real facts in the case can be ascertained. I must confess, however, that now, when I come to cast over all the evidence which we have in relation to this subject, I feel less confident than I have been for a few years past, that this Eurytoma is the real parent of the joint-worm.

It was in the year 1853 that the concluding portion of the second edition of Dr. Harris's Treatise on Injurious Insects passed through the press, giving the most full and exact account of the joint-worm that has hitherto appeared. He regards the fly which we obtained from the diseased straw as being a mere variety of the barley fly which he had previously described, this wheat fly differing in no respect from that except in the color of the shanks of the fore legs, these being pale yellow instead of black. And he regards this fly as being in all probability the real cause of the disease in the wheat and barley, and not a parasite as he had supposed it to be in the first edition of his treatise.

In connection with the *Eurytoma Hordei*, Dr. Harris gives an account of the insect which appears to be its most common parasitic destroyer, specimens of which we had obtained from the same parcels of wheat from which the Eurytoma came. There is every reason to believe that this parasite descends from the active white worm clothed with a few scattering hairs, which Prof. Cabell occasionally found as already stated, sometimes in the same cell with a dead and partly consumed Eurytoma larva, and sometimes alone in the cell, it being perceptibly larger in the latter case than in the former. Two individuals of this fly which I obtained did not come from the straw until some days after the hatch of the Eurytoma flies had ended. They are 0.10 long, black, with pale yellow legs having the thighs black and the anterior and hind shanks more or less smoky, the claws at the end of the feet being black. The fore wings usually have a smoky cloud or spot in their middle. The basal joint of the antennæ is black in the male and pale or whitish in the female. It pertains to the same family CHALCIDIDÆ to which the Eurytoma belongs, and Dr. Harris refers it to the genus *Torymus*, but no specific name for it accompanies his description. I therefore

propose for it the name by which it has been ticketed many years in my cabinet, *Torymus Harrisii.*

The joint-worm continued its depredations upon the wheat to such an alarming extent, that in the year 1854, a "Joint-worm Convention" composed of persons who were sufferers from it, was held at Warrenton, Va., for the purpose of comparing their views and experience and deciding upon the best modes of opposing this enemy. The idea of putting down an obnoxius insect by the same machinery and denunciatory resolutions which they were accustomed to bring into operation against a political adversary, caused at the time some merriment among our newspaper editors here at the north. I have been unable to find any report of the proceedings of this convention, but I see it stated that it resulted in recommendations of a better cultivation of the wheat crop, a use of guano or other fertilizers, and all other measures which tend to promote a rapid growth and early ripening of the grain, and also after harvest burning the stubble and any other masses of vegetation which may be growing contiguous to the wheat field.

From the occasional notices of this joint-worm which we meet with in the Southern Planter for a few years subsequent to this, it would appear that it still remained so common as to be a subject of public concern. The fact of its thus continuing to be destructive year after year strongly indicates that the Eurytoma was itself the real enemy and not a parasitic destroyer of that enemy, since were it the latter, so numerous as it was in 1852, we should expect this malady in the wheat would speedily have ceased.

A similar disease began to appear about this time in the barley crop in the central counties of the State of New York. The first samples of the affected straw were received at the Agricultural Rooms in Albany from L. Lincklaen of Cazenovia. The disease in this straw was identical with that of the Virginia wheat and the Massachusetts barley, and as the worm was found to be the larva of a Eurytoma, I made no doubt it would produce an insect of the same variety that Dr. Harris first observed. But on coming to examine the flies which came from this New York barley, of which upwards of fifty were obtained, I was surprised to find the color of their legs so dissimilar as to forbid their being regarded as the same species. Thereupon, on notic-

ing in such a number of these barley flies and a still larger number of the flies from the joint-worm, how perfectly constant and uniform the insects from these two sources were in the colors of their bodies and limbs, the fact became patent that the fly obtained from the Virginia joint-worm was a distinct species from the Massachusetts barley-fly, and not a mere variety of it as I had all along supposed it to be. An article upon this subject was thereupon inserted in the Journal of the Society, for April 1859, (vol. ix, p. 115,) in which I named and gave the distinctive marks of these three species, about as follows:

The BLACK-LEGGED or Massachusetts BARLEY-FLY, *Eurytoma Hordei*, Harris, is black, its feet and knees pale dull yellow, its *anterior shanks* of the same *dusky* or blackish color with the middle and hind ones, its neck with a dull whitish transverse spot on each side.

The JOINT-WORM FLY, which I name *Eurytoma Tritici*, is black, its feet and knees and its *anterior shanks dull pale yellow*, its neck with a dull white spot on each side.

The YELLOW-LEGGED or New York BARLEY-FLY, *Eurytoma fulvipes*, is black, its *legs bright tawny yellow*, its feet whitish, its neck with a small dull white dot on each side.

In this connection it should be added that a fourth fly of this kind has recently commenced infesting the rye in the eastern part of Pennsylvania. I described this species in the American Agriculturist, August 1861, (vol. xx, p. 236) giving it the name of the RYE-FLY, *Eurytoma Secalis*. It is intermediate between the Joint-worm fly and the New York barley fly, its *anterior and posterior shanks* being *dull pale yellow*, the middle ones only being black.

These four insects are closely alike in their size, form and sculpture, the differences in the color of their legs being the most conspicuous and almost the only character whereby they are distinguished from each other. The males are much less numerous than the females and are usually smaller in size, with the abdomen of a different form. It is oval and somewhat depressed or flattened in the females, and when I had before me specimens of this sex only, I much doubted whether they rightfully pertained to the genus *Eurytoma*. It is the males only which present the characters assigned to this genus by authors. In these the abdomen is compressed, more strongly so in some

species than in others, the *Eurytoma Hordei* presenting the generic characters more perfectly than either of the three other species.

The joint worm remains in its cell in its larva state through the winter, and changes to a pupa with the first warm days of spring. Its final transformation takes place and the flies come out from the straw during the first half of May. With their stings they pierce the green stalks of the grain and insert their eggs therein, one in a place, usually just above the lower joints, and from these eggs come the worms which are afterwards found there upon dissecting the straw. But if this fly is really a parasite, it will be found that a worm is lying in the straw at each point where it inserts its sting, into which worm the egg is thrust. By watching one of these flies therefore, when it is thus occupied, its true character may readily be ascertained.

As the joint-worm lies in the straw through the autumn and winter, it will be obvious to every person that the most feasible mode of combatting and destroying it is to burn the straw containing it.

9. BLACK-LEGGED BARLEY-FLY, *Eurytoma Hordei*, Harris. (Hymenoptera, Chalcididæ.)

In barley, particular stalks stunted and backward in their growth and of a yellow, sickly appearance, these stalks having a hard woody swelling at one of the lower joints, the surface of which shows little oval glossy elevations like blisters, within which is a cavity in which a soft straw-colored maggot lies, which remains in the ripened straw till the latter part of the following May, when it gnaws a hole in the straw and comes out, a shining black fly resembling a small ant 0.12 long and having obscure yellowish knees and feet.

In connection with the joint-worm fly which has been considered in the preceding pages, may most appropriately be given an account of the three other insects which have been mentioned as being most intimately related to it both in their appearance and habits, although they attack other kinds of grain. And the same figure 1 of plate 1 which represents the female of one of these species serves equally well to illustrate the others, they are so much alike in every respect except the colors of their legs. We will proceed first to consider the species which has been known the longest time, the Black-legged or Massachusetts barley-fly.

It is upwards of thirty years ago that an insect malady prevailed in the growing barley in the north-eastern section of Massachusetts, whereby only a small crop of this grain could be

obtained, some farms producing little more than the seed which was sowed. It formed the subject of several communications in the New England Farmer, in 1829 and the following years, of which the more important portions are extracted in the account contained in Dr. Harris's Treatise. This disease of the barley had been prevailing for some years previous to these published notices of it, rendering the crop so precarious that in some places the cultivation of this grain had been abandoned. It was conjectured that the insect which occasioned this disease had been imported from Bremen or some other German port, in some seed barley which was sown in the vicinity of Newbury, three or four years before 1829. John M. Gourgas, Esq., of Weston, Mass., ascertained that the worms in the straw were transformed to small flies, "about the make and size of a small black ant, with wings," which some persons supposed to be the same as the Hessian fly. Myriads of these flies were found alive in beds which had been filled with the diseased straw; and an opinion prevailed, that the troublesome humors with which many persons were at that time afflicted in some of the places where this straw was thus employed, were occasioned by the bites or stings of these flies, in consequence of which the straw beds which were found to be infested with these insects, were generally burnt.

Mr. Gourgas (New England Farmer, viii, 299) gives the following description of the manner in which the growing grain was affected. When the barley is about eight or ten inches high the effects of the disease in it begin to be visible by a sudden check in the growth of the plants, and the yellow color of their lower leaves. If the butts of the straw are now examined, they will be found to be irregularly swollen and discolored between the second and third joints, and, instead of being hollow, are rendered solid, hard and brittle, so that the stem above the diseased part is impoverished, and seldom produces any grain. Suckers, however, shoot out below, and afterwards yield a partial crop, seldom exceeding one half the usual quantity of grain. Mr. Gourgas further remarks, that the quality or soundness of the grain which is produced is not at all affected, the disease being seated wholly in the straw, in which, and not in the kernels of the grain, the eggs or seeds which perpetuate this malady from year to year are lodged.

Dr. Andrew Nichols, of Danvers, states (New England Farmer,

viii, 138) that the worms lying in the swollen part of the barley stalks, are about one-tenth of an inch in length, and of a yellow or straw color; and that, in the month of November, they appeared to have passed from the larva to the chrysalis state. They live through the winter unchanged in the straw, many of them in the stubble of the field, while others are carried away when the grain is harvested. When the barley is threshed, numerous small pieces of the diseased straw, too hard to be broken by the flail, will be found among the grain. Some of these may be separated by the winnowing machine, but many others are too large and heavy to be winnowed out, and remain with the grain, from which they can only be removed by the slow process of picking them out by hand.

A few pieces of the diseased barley straw were furnished to Dr. Harris, who found in each of them several small whitish maggots, each of these being imbedded in the thickened and solid substance of the stem, in a little longitudinal hollow, of the shape of its own body, its presence being known by an oblong swelling upon the surface. In some pieces of straw the swellings were so numerous as greatly to disfigure the stem, the circulation in which must have been very much checked if not destroyed. Early in the following spring these maggots entered the pupa or chrysalis state, and on the fifteenth of June the perfected insects began to make their escape through minute perforations in the straw, which they gnawed for this purpose. The insects continued to release themselves from their confinement till the fifth of July, after which no more were seen. Instead of a midge or two-winged fly similar to the Hessian fly which he confidently looked for these maggots to produce, Dr. Harris says it was "much to my surprise, they proved to be minute four-winged Ichneumon-flies, which are parasitical, preying in the larva state on the bodies of other insects." These were described in the New England Farmer for July 23d, 1830 (vol. ix., p. 2) under the name of *Eurytoma Hordei*. At that time Dr. H. supposed the *Semiotellus destructor*, (of which we have spoken on a preceding page,) the parasite which destroys the larva of the Hessian fly, to be a species pertaining to this same genus *Eurytoma*. This error contributed still further to impress him with the view that this barley fly, like that, was a parasite which had destroyed a midge similar to the Hessian fly, and had thus come out in its

place. And ten years later, in the first edition of his Treatise (p. 436) he says, "Although the barley-fly has not yet been seen by me, there does not exist the smallest doubt in my mind that it is a two-winged gnat, like the Hessian fly." Indeed, this was evidently the most intelligent and correct conclusion which he could form from all the evidence which he at that time had before him.

Dr. Harris represents this insect to be "very much like the parasite of the Hessian fly." The reader may judge of the similarity of these two insects by comparing the magnified figure, plate 1, fig. 1, with that of the Hessian fly parasite, plate 3, fig. 1. Although there are many points of resemblance, there are also obvious differences, which, however, become less observable in nature, in consequence of the minute size of these objects. In particular, the abdomen of the female barley fly has the elliptic form represented in the figure, but when viewed laterally, it has the egg-shaped form of the Hessian fly parasite's abdomen, being, however, much more long and slender than in that insect. In the second edition of his Treatise Dr. Harris gives the following description of this barley fly.

"The body is jet black and slightly hairy. The head and thorax are opake and rough with dilated punctures. The hind body is smooth and polished. The thighs, shanks, and claw-joints are blackish; the knees, and the other joints of the feet are pale honey-yellow. The females are twelve or thirteen-hundredths of an inch long. The males are rather smaller, and are distinguished from the females by the following characters. They have no pioneer. The joints of their antennæ are longer, and are surrounded by whorls of little hairs. The hind body is shorter, less pointed behind, and is connected with the thorax by a longer stem or pedunele. These insects are very active, and move by little leaps; but the hindmost thighs are not thickened."

To this description it should be added that on each side of the neck is a dull whitish transverse spot.

Although this insect was so numerous in Massachusetts at the period to which reference has been made, Dr. Harris, writing upwards of twenty years afterwards, informs us that since that time he had heard nothing more either of it or of the disease of the barley which it occasions. And in no other part of the country, down to this present time, has it shown itself in sufficient numbers to attract public notice. The following additional facts with respect to it are therefore important, indicating as they do that this depredator is still lurking in our country, and will no doubt at some future time become again so multiplied in some locality, as to seriously injure the barley crop.

YELLOW-LEGGED BARLEY-FLY. IN CENTRAL NEW YORK.

On examining the several insects which I had collected May 23d, 1861, in a rye field at Salem, N. Y., by sweeping over the young grain with a net, one was discovered which I identified as being a female of this Massachusetts barley fly. Thereupon repairing again to the same field four days afterwards, on a careful search several more of the same insects were found; and returning to the same hunt again, June 5th, three males of this species were obtained. We hereby learn the date when these flies are naturally abroad to deposit their eggs. Those obtained by Dr. Harris, it hence appears, were delayed in coming out, in consequence of the artificial conditions under which they were placed.

This rye field was inspected a few weeks after and again at harvest time, but none of the stalks were discovered bent or swollen at their lower joints. It would hence seem that this insect was present in this grain merely for the purpose of examining it, and finding it was unsuited to its wants it forsook it and went elsewhere to deposit its eggs.

10. YELLOW-LEGGED BARLEY-FLY, *Eurytoma flavipes*, Fitch. (Hymenoptera. Chalcididæ.)

In barley, the stalks diseased in the same manner as by the preceding insect, and the maggots therein producing similar flies, but having the legs and also the tip of the body bright tawny yellow.

Central New York, it is generally known, is the great barley-growing district of this country. And in this crop the county of Onondaga takes precedence of all others, it producing, according to the census of 1850, nearly a third more than any other county in the State, and surpassing the total amount yielded by Ohio, the state which ranks next to New York in this crop. But all through Central New York there has been a great change, a great diminution of the barley crop within the last ten years. Hon. George Geddes, President of the State Agricultural Society, in his survey of Onondaga, informs us (Transactions, 1859, p. 332) "Formerly we expected forty bushels to the acre; now we cannot rely on more than twenty." And he goes on to state that "This falling off is principally due to the depredations of an insect, described by Dr. Fitch in the Journal of our Society of April 1859, and named the Yellow-legged or New York barley-fly. Unless some relief from it is found, we must entirely discontinue raising this crop, and henceforth barley will hardly appear in our census reports."

YELLOW-LEGGED BARLEY-FLY. MR. GEDDES' ACCOUNT OF IT.

Mr. Geddes states that "this insect attacks the crop just before the heads appear, laying its eggs in the straw; the stalk is either entirely destroyed, or if any grain is matured the kernels are small and imperfect. When the crop is thrashed, small pieces of straw are seen, having enlarged places in which the cells and larvæ of the insect are found."

The first specimens of this diseased barley straw were sent to the Agricultural Rooms, Albany, October 1856, by Ledyard Lincklaen, Esq., of Cazenovia. An examination of this straw showed the malady to be identical in every respect with that in the Massachusetts barley as described by Dr. Harris, and the worms therein corresponded fully with Prof. Cabell's account of the Eurytoma larvæ or joint-worms in the Virginia wheat. I therefore was fully confident it was the *Eurytoma Hordei*, which occasioned this disease and would be produced from this straw. Hoping some parasites might be obtained in company with this insect, the straw was inclosed in a glass jar and set aside. Upon the 23d of the following July a number of flies were noticed running about in this jar, and a much increased number on the 25th, their transformations having been retarded, no doubt, by the dryness of the straw. As there appeared to be no parasites accompanying them and other engagements were pressing upon me at that time, the jar was placed aside and forgotten. On coming to examine it afterwards, some sixty flies were found in it, dead, but otherwise in good condition for study, about a quarter of the number being males. As has already been stated, they led me to much more important results than I had anticipated. The uniformity and constancy of the colors in their bodies and limbs, as seen in such a number of examples, showed that the insects of this genus are not liable to vary in this respect, and that this fly in the New York barley was a species distinct from that of Massachusetts and also from the joint-worm of the Virginia wheat. It was named and described accordingly, in the Journal of the Society, as has been related on a preceding page.

In addition to this diseased straw from Madison county, samples of the same kind have since been received from Hon. George Geddes of Onondaga, G. C. Bradley of Jefferson, Wm. H. Davis of St. Lawrence and Wm. D. Cook of Wayne counties, thus show-

ing that this insect has extended itself over all that portion of the State where barley is most extensively cultivated.

On particularly inspecting the diseased barley straw it will be observed that when there are only two or three worms in it, lying slightly distant from each other, the stalk does not become bent or swollen into a knotty enlargement. On stripping off the outer sheath the point where each worm is lodged in the central or main stalk is indicated by a slightly elevated, smooth, glossy, oval spot, resembling a blister, placed lengthwise of the stalk. On the surface of this spot the fine elevated lines which form the longitudinal fibres or veins of the straw are almost wholly obliterated, whilst around the margin of the spot these lines are crowded together and more or less wavy and distorted from their natural straight and parallel position. But where a number of the worms are nestled in the same part of the stalk, as they usually are, just above one of the lower joints, the whole stalk becomes thickened and swollen, hard, knotty and of a wood-like texture, and so bent, so distorted and grown out of shape, that its natural structure is almost wholly obliterated. Upon the outer surface of this swelling several of the same elevated, glossy, blister-like spots occur which are noticed above. In cutting into one of these spots an oval cavity or cell is there found, about 0.18 long and 0.05 wide, in which a worm resides. These cells are usually situated in the walls of the central stalk, though they sometimes occur also in the sheath which surrounds the stalk; but the straw is so much distorted and its structure is so changed and confused that it is frequently impossible to determine whether it is in the outer sheath or the central stalk that these cells are formed; the hollow in the centre of the straw being nearly or quite obliterated, in consequence of being encroached upon by these cells. The walls of the cells are quite thin, both above or over the worm, and beneath or between it and the central cavity—so thin that they are slightly translucent. The surface on the inner side of the cells is smooth, and shows near its lower end a few small, black, shining grains, like scales, adhering to it; which are probably the feces of the worm.

The worm or larva which lies in this cavity is about 0.14 long and 0.04 or slightly less in thickness. It is shining and of a very pale yellow color, almost white. It is straight, motionless, destitute of feet and of a distinct head, of an oval form, slightly

more rounded at its anterior than at its hind end, and its mouth is indicated by a transverse dark brown line formed by its jaws. It is divided by fine impressed transverse lines into segments or rings, of nearly equal length, the number of which is usually twelve, though sometimes thirteen are visible.

I present, in conclusion, a full description of this species, as drawn up on a careful comparison of numerous specimens, in their dried state; and this description will also apply in most of its particulars to the two preceding and also to the following species.

The FEMALE of the yellow-legged barley-fly (see plate 1, fig. 1,) is 0.12 or 0.13 in length to the end of the body.

The HEAD, viewed from above, is nearly twice as wide as long, convex in front, concave at base, and is closely and irregularly punctured and bearded with short gray hairs. It is black, with the mouth chestnut red. The antennæ are black with their basal joint pale tawny yellow. When turned backward they reach a third of the length of the thorax. They are bearded with small black bristles which incline forwards. They are perceptibly thicker towards their tips and are composed apparently of ten joints, whereof the two or three last ones are usually so compacted together as to appear as a single joint much longer than those which precede it. The first joint is long, somewhat tapering and less thick than the following joints, with which it forms an elbow. The second joint is shortest and the third is longer than those which follow it. The fourth and following joints are little longer than wide, shaped like a tea-cup, their bases being rounded and their tips cut off transversely. The last joint is longer than that which precedes it, and is a little narrowed towards its tip, the end being bluntly rounded.

The THORAX is oval and about three times as long as broad, broader across its middle than the head, its anterior end blunt and abruptly rounded, conforming to the concavity of the base of the head. Its collar is half as long as wide and is distinctly separated by a smooth, shining, elevated, transverse line, which bounds it posteriorly, this line being bowed and parallel with the rounded anterior end of the thorax. Viewed laterally the thorax approaches to a crescent in its shape, the back being very convex or arched, with its anterior end obliquely cut off by the head. Its surface is rough punctured and finely bearded, like the head, and of a black color. On each side of its anterior end a pale dull yellow dot, elevated and smooth, is usually perfectly distinct.

The ABDOMEN is of the same length with the thorax, but scarcely as broad. Viewed from above it is long oval, with the sting protruded and forming a sharp, attenuated point at its tip. The back is excavated or occupied by a long oval hollow, extending from near the base to the tip. It is divided by fine transverse lines into five segments of nearly equal length. Viewed laterally it has the form of a long cone with its base hemispherically rounded. Its surface is highly polished, smooth and shining, of a black color with the attenuated point at its tip dull pale yellow.

The LEGS are shining, pale tawny yellow, nearly the hue of bees-wax, with the feet whitish and their tips black. They are of equal thickness, the anterior pair being shortest. The hind shanks are slightly curved. The shanks are armed similarly to kindred species of this group; that is to say, near the tip of the fore shanks on their inner side is a large cylindrical spur which reaches half the length of the basal joint of the feet and is forked at its tip, the outer fork being twice the length of the inner one, sharp-pointed and incurved; the middle shanks have a single spine at their tips, and the hind ones have a pair. The feet are five-jointed, the basal and apical joints being about equal in length and the middle ones shorter, the fourth one shortest. The four forward feet have at their ends a single toe, which is scarcely as thick as the joint to which it is appended, is longer than thick, and is inclined obliquely inward; and from its apex projects a hoof or nail of a conical form, the

width of its base equalling its length. The hind feet instead of this toe and nail have at their ends a pair of books.

The WINGS are transparent, glassy and colorless, except on the disk of the forward pair adjacent to the inner side of the rib-vein, where a large smoky yellowish cloud is faintly perceptible. The rib-vein is fringed with long hairs, like eye-lashes, along its outer side; it unites with the outer margin in its middle, and continues thus united for a short distance only, before it gives off the stigmal branch, which branch is short, thickened at its end, and notched, the outer tooth being small and slender.

The MALES are smaller than the females, measuring 0.10 to the end of their wings, which reach a little beyond the end of the body. Their antennæ are also longer, reaching half the length of the body, and are thread-like or of equal thickness through their whole length, and thinly bearded with short robust bristles. They are composed apparently of nine joints, which are of a cylindrical form, three times as long as thick, the second joint being shortest, but little longer than thick, and the third joint longer than those which follow it. The joints are separated by a wide notch on their upper side at each articulation. The last joint is rather longer than those which precede it and tapers to an acute point at its tip. The abdomen is shorter than the thorax and of a flattened oval form. The thighs are black at their bases and the hind pair is wholly black, except at their tips. The hind shanks also are dusky at their tips.

The joints of the antennæ in the males of this species are not surrounded with whorls of hairs as they are in *Eurytoma Hordei*. It perhaps does not rightfully pertain to this genus, therefore, though I see no other one in which it can be included.

11. RYE-FLY, *Eurytoma Secalis*, Fitch. (Hymenoptera. Chalcididæ.)

In rye, particular stalks stunted and bent at one of their lower joints, where is a hard woody swelling, the surface of which shows little smooth blister-like elevations within which is a cavity in which lies a soft white or straw-colored maggot, which remains in the ripened straw till the latter part of the following May, when it gnaws a hole in the straw and comes out, a shining black fly resembling a small ant 0.10 long, its knees and feet and its fore and hind shanks pale dull yellow, the middle shanks black.

In August, 1860, Daniel Steck, Esq., of Lycoming county, Pennsylvania, transmitted to the office of the American Agriculturist, several pieces of rye straw, containing the larvæ of an insect which had made its appearance in his vicinity and was attracting notice by the injury it was threatening to do to this grain crop. In May 1861, additional slips of this diseased straw were sent by him, two of which were forwarded to me for information as to what insect this was, Mr. Steck himself supposing it to be a Cecidomyia analogous to the Hessian fly. The straws received were of the previous year's growth, which had been kept in a cool place, whereby the insect had probably been somewhat retarded in completing its transformations. They reached me on the first of June, and the flies were then coming out from the straw. In a few days fifteen specimens were obtained, all save one being females.

The disease in the straw was plainly the same as that in bar-

ley, produced by the two insects which have last been considered, and with that in wheat caused by the joint-worm. In these samples of the straw the cells in which the larvæ were contained were situated in the walls of the central stalk, not in the sheath surrounding it. And the flies though closely akin to those of the barley and wheat were not identical with either of those species. They were most nearly like those of the joint-worm fly, from which they were observed to differ in every instance, in having the hind pair of shanks dull pale yellow, as well as the forward ones. An article was hereupon communicated and published in the American Agriculturist, August 1861, (vol. xx., p. 235,) in which I described this species under the name of *Eurytoma Secalis* or the Rye-fly.

As the disease which this insect causes in the rye is in every particular like that in barley and wheat which has been so fully described in the preceding pages, and the insect itself differs so little from the foregoing ones, any extended account of it and its operations is unnecessary. I therefore have only to add that this rye fly is very slightly smaller than the other species, the female in different examples measuring 0.10 and 0.11 in length, and the male is scarcely if at all inferior in size to the other sex. The hind shanks are slightly dusky and less bright than the forward ones, but are manifestly paler than the middle ones. An obscure brown dot or lunule is faintly perceptible on each side of the neck. The male, in the structure of his antennæ, the form of his abdomen, &c., corresponds with the description already given of the yellow-legged barley-fly.

After giving these four Chalcidian insects, which come from larvæ lying in closed cells in different kinds of grain, such a particular review as I have done in preparing this account of them, I ought not to dismiss the subject without remarking that I do not in the least doubt that they are the real cause of the disease which we see in the grain. Were they parasites, so very numerous as they have been in the straw in particular instances, I cannot but think this disease in the straw would have ceased, instead of continuing on as it has done, year after year, with no material abatement. And further, were they parasites, I cannot but think that in some of the many instances in which I have bred these insects, I should have obtained their foster parent, or should at least have noticed some remaining vestiges of it, or

some other circumstance to indicate its existence. But the only evidence we have that an insect of another kind occurs in the diseased grain for these Chalcidians to prey upon, is the larva which I saw in the Virginia wheat from Mr. Rives. I cannot doubt but that was a Cecidomyia larva. I therefore have carefully cast over in my thoughts the circumstances under which this larva was found, and I am led to suspect that there might have been an error attending it. According to the recollection which I have, the description I gave was drawn up from a single specimen, this being the only perfect specimen which I met with in the stalks. All the others were smaller, discolored, and so soft I judged them to be in an incipient state of decay and putridity. I now suspect these smaller, tarnished individuals, were the real joint-worms, and that the worm from which my description was taken was a larva of the Hessian fly, which happened to be present in the same stalk; and that the structure of the stalk was so much confused and obliterated that I did not and perhaps could not ascertain with certainty whether this particular worm was lying in a cell which was perfectly closed, like those in which the other worms were lying, as I took it for granted that the worms were all of one kind and that their cells would consequently be alike. I hasten to state these circumstances, lest an importance be attached to the occurrence of this Cecidomyian larva in the Virginia wheat, which it may not, after all, be entitled to.

12. Yellow-bellied Janus, *Janus flaviventris*, new species. (Hymenoptera. Tenthredinidæ.)

13. Three-spotted Cephus, *Phyllœcus trimaculatus*, Say. (Hymenoptera. Tenthredinidæ.)

In rye fields towards harvest time, scattering heads of the grain remaining erect and having a prematurely ripe appearance, the straw bored its whole length by a footless worm a half inch long.

In Europe one of the insects most noticed by writers as injurious to the rye crop is a saw-fly three tenths of an inch long, of a shining black color, with a bright yellow mouth, legs, and spots on its hind body. It is named *Cephus pygmœus*, and forms the type of a small group, named *Cephides*, in the family *Tenthredinidæ*. It resembles a small wasp, except that its fore and hind body are closely united together, and not separated by the strong contraction which is observed in the wasp. This fly becomes common in the rye fields towards the end of May, the female

inserting an egg in the stalk or straw, just below the ear. From this egg hatches a tapering, white footless worm, which feeds upon the soft pithy substance that lines the cavity in the centre of the straw, perforating the partitions at the joints as it works its way downward to the root, which it reaches about harvest time, and there incloses itself in a thin transparent case, in which it remains through the winter. Burning the rye stubble after harvest is regarded as the best measure for destroying this insect. Other saw-flies of the genus *Cephus* are found in Europe, in company with this, and are supposed to have the same habits.

In our American rye fields we some years see particular heads of the grain affected in the same way as above stated. But during the two past summers I have been unable to find any such in my own vicinity, and hence have not had an opportunity to ascertain the kind of worm that in our country occasions this disease. It may be some of those species of *Chlorops* which were noticed in my second report as producing a similarly prematurely ripened appearance in wheat; or it may prove, in some instances at least, to be some saw-fly of this country nearly related to the *Cephus pygmæus*. A New York insect of this kind, the same in size with the European species, and coming abroad like it the last of May, has the hind body cylindrical instead of being compressed, and consequently pertains to the genus *Janus*. It is a pretty little fly of a shining black color, with the hind body lemon yellow except at its base, its mouth being straw-colored, and also the hind margin of its collar, the base of its wings, a small spot above their sockets, and the fore and hind margins of the metathorax. The hind body is narrower than the fore body and more narrow and long than in the typical species of this genus, forming almost two-thirds of the total length of the insect. Its basal segment is black, edged anteriorly with straw yellow, and with a slender line of this color along its middle, ending in a large triangular spot. The second segment is also black except at its hind end; and on the sides is a blackish cloud on the sutures of each of the remaining segments. The wings are hyaline and glassy, their stigma sooty brown, which color extends inward, occupying most of the anterior marginal cell. A faint smoky cloud may also be perceived near the middle of the posterior apical cell, and another along the margin of the anterior one. The hind feet are dusky.

THREE-SPOTTED CEPHUS. DESCRIPTION OF THE FLY.

No American representative of the genus *Janus* has hitherto been described, that I am aware, and the few European species pertaining to it are rarely met with by collectors. As the color of its hind body distinguishes our insect from the other known species of this genus, it may most appropriately be named the Yellow-bellied Janus, *J. flaviventris*.

A kindred but larger insect, of which a pair found in Pennsylvania, were described by Mr. Say under the name *Cephus trimaculatus*, occurs in New York also, making its appearance the fore part of June. This insect has the aspect of a very slender *Tremex* with the abdomen compressed as in *Ophion*. Its antennæ are 27-jointed; hence it pertains to the genus *Phyllœcus* of Mr. Newman. These organs are thickest in their middle and taper insensibly towards each end, the sub-basal joints being less than half the diameter of the middle ones, and cylindric. The third joint is four times as long as thick and is slightly curved, and the fourth joint is a third shorter.

This insect is black with a small white spot on each side of the middle of the hind body and a larger egg-shaped one on its base, from which spots it has received its name. The orbits or edges of its eye sockets have a white dot above and a white streak below the antennæ sockets, and the mandibles are dull white, except at their tips. Its wings are smoky-violaceous and transparent. In the second cubital cell is a black dot, placed near the anterior end of its inner margin; and the vein, from this dot to the anterior end of this cell, is margined on each side with a short white line. The anterior inner discoidal cell has a smoky spot on the middle of its hind side. Most of the middle and posterior veinlets have a white band on their inner or on both their ends. The male varies in length from 0.48 to 0.55, and the female is a third larger.

SUPPLEMENTARY NOTICE OF THE WHEAT MIDGE.

THE FLIES OBSERVED, HATCHING IN OLD WHEAT FIELDS.

Although it has heretofore been sufficiently certain that most of the flies of the wheat midge are hatched each year in the fields in which wheat was grown the year before, we have no record that any examination of these old wheat fields has ever been made, to discover whether these flies were really present in them. And in the history of this insect which I gave in my last report, in remarking upon the male flies, which have never been found except in a very few instances, I advanced the opinion that this sex was probably as numerous as the females; that the sexes pair immediately after they come forth, and the males remain where they are born and do not accompany the females when the latter fly away in search of the new wheat fields; and that I was confident collectors of insects would readily supply themselves with specimens of the male flies by searching for them in the old instead of the new wheat fields. After having thus expressed this opinion, I of course became anxious to ascertain by actual observation whether what I had stated was correct. I accordingly have now made a special investigation of this subject. This investigation was so accurately conducted, and is of such an interesting nature, that it merits to be fully reported as an important addition to the history which I have given of the wheat midge. I therefore present it in the words in which it is written in my diary.

June 12, 1862. This is the day on which the flies of the wheat midge usually begin to appear. But the season, this year, is remarkably backward, cold and dry. Not a single hot sultry day have we yet had. And different plants, I have noticed, are a week or ten days later than their usual time, in flowering; and every kind of insect is equally tardy in making its first appearance. I therefore do not expect the midge flies yet, for some days. But, to see how many of these flies will come out from a small space of ground, and how long new flies will continue to come forth, I to-day get ready for them. I go to Deacon L.'s field, in which the midge larvæ were so plenty in the wheat heads last year, although he had a tolerably satisfactory crop. The field is now overgrown

with clover and grass. I select a spot a few paces inside of the south-east corner of the field. With shears I cut off the herbage smooth to the surface of the ground. I fasten down to the ground the mouth of a gauze net twelve inches in diameter, confining it by little slanting pegs driven into the ground. I heap a little ridge of dry sand around it, whereby no fly can crawl in or out under the edge of the net. I barricade it around with old fragments of rails, that no cattle may walk over and trample upon it. I go and inform the proprietor of what I have done, and why I have done it. He promises not to disturb the net, and hopes no mischievous boy will meddle with it. I think some flies will hatch under this net; still, it may be that no larvæ descended last summer in the exact spot which it covers.

June 14. Going to the net, I see through the thin gauze that no flies have yet come out under it.

June 16. The idea has been extensively entertained that a frost occurring just as the midge is about to appear, will kill it. Now I shall know if there is any truth in this conjecture. There was a pretty hard frost last night, cutting off beans and all other young tender vegetation. And to-day is so cold, after freezing out of my study this morning, I kindle a fire to make it comfortable sitting there through the day. As nothing will hatch under the net in such weather, I do not visit it.

June 18. Still cool. Nothing yet appears inside of the net.

June 20. Last night was rather warm; so I was pretty confident the midge would begin to hatch. And going to the net, after tea, I see two yellow flies resting on the gauze inside, which are unmistakably the midge. To-night is cloudy, with slight rain, and I see a single fire-fly sparkling in the dark air, the first I have seen this year. This is the best mark we have, to inform us when the midge flies are first beginning to appear.

June 21. Cool and rainy. At sunset I find three more yellow flies in the net. I raise the edge of the net sufficiently to get one of them into a vial, and I destroy the others. The captured one I examine carefully, and am thus certain it is the midge which is appearing in the net. I sweep the wet clover with another net, and find it collects numbers of these flies, and the pocket magnifier shows a large portion of them to be males.

June 23. Mild, pleasant weather, and to-day warm, favorable to the hatching of insects. On going to the net, after tea, I find

eight flies in it, which I destroy. Then, upon walking around in the field I find the midge flies are quite numerous everywhere in it, flying about, low down in the vacancies between the herbage, and others alighted and resting upon it. And when the open mouth of a vial is approached towards one of them, to inclose it therein, when it gets within an inch or two of the fly, the latter suddenly opens its wings and "skedaddles"—to use a slang term which has recently become current in our country. With three or four sweeps of the net I capture a multitude of them. I inclose ten of them in vials, and on examining these the following morning, I find five of them are males, and these are all dead, whilst the females are all alive; showing that the latter possess much more vitality and are longer-lived than the former. Both sexes are alike in their colors, their bodies being lemon yellow with the thorax orange yellow above, and usually slightly smoky on its fore part. The males are 0.06 long. A wing of a female, laid upon a scale, measures 0.09 by 0.045; a wing of a male is scant 0.07 by plump 0.03.

June 24. A cool rainy night and day, thermometer at 58°. Find two midges in the net, a male and female, which I destroy.

June 26. Yesterday rainy, the thermometer at 58°. To-day pleasant, but cool. Find three midges in the net, all males, and also a black midge of the same size with the yellow ones.

June 28. Warm and pleasant, thermometer at 75°. Find but one midge in the net. I suppose the hatch has now probably closed.

July 1. The weather continues warm and pleasant. On going to the net I find nine midges in it, four of them males; also two small flies, probably of the Chlorops genus. And among the clover in all parts of the field the midge flies continue to be plenty.

July 3. Warm and pleasant. I find four more midges in the net.

July 5. Yesterday pleasant, and to-day a hot sun will roast out of the ground any midges which may yet be remaining therein. On going to the net at sunset, I find there is nothing in it; and being satisfied these insects have finished hatching, I take up the net. I have, therefore, as the result of these observations, that thirty-two of these midge-flies came out of the ground within a circle a foot in diameter, the hatch commencing on the nineteenth of June and ending on the third of July, thus continuing for a fortnight.

EXPLANATION OF THE PLATES WHICH ACCOMPANY THE SIXTH AND SEVENTH REPORTS ON INSECTS.

Plate 1.

Fig. 1. Joint-worm fly, magnified, the cross lines on its left indicating its natural size, as in other instances.

2. Angoumois moth.

3. The same, newly hatched and extricating itself from a kernel of wheat.

4. Mistaken parasite.

a. Its antenna, more highly magnified.

b. Antenna of the midge larva parasite, (from Curtis.)

5. Grain aphis, the winged female.

6. The same, the wingless female.

Plate 2.

Fig. 1. Wheat midge, female.

a. Its natural size.

2. Spotted-winged midge, (*Cecidomyia caliptera.*)

3. Dusky-backed midge, *C. tergata.*

4. Wheat midge, male.

5. Wing of the spotted-winged midge.

6. Antenna of the male wheat midge, greatly magnified.

7. The same of the female.

8. Eggs of the wheat midge, greatly magnified.

9. A head of wheat, the chaffs at ** opened by the yellow bird to pick the worms from the kernels of the grain, the kernels remaining at ††.

10. A flower of wheat, opened to show the worms lying upon the kernel.

a. The *glume* or outermost scale of the chaff.

b. The *outer palea* or the bearded chaff.

c. The *inner palea* or inner chaff.

d. The *germ* or young kernel.

11. Larva of the wheat midge, as commonly seen, in repose.

a. Its natural size.

12. The same, when crawling on a wet surface, with its horns fully extended.

a. Its natural size.

EXPLANATION OF PLATE THREE.

Fig. 13. Anterior end of the same, when attempting to crawl upon a dry surface, its head being drawn in and only the ends of its horns visible.

14. Hind end of the same, with sharp teeth protruded to aid it in moving.

15. Ovipositor as figured by Mr. Curtis.

16. Ovipositor correctly represented, composed of telescopic-like tubes.

a. Two finger-like appendages, to guide the egg to its place.

b. A slender tube, bearded to hold the implement securely.

c. A larger tube into which the preceding one shuts.

d. The last joints of the body, into which the ovipositor is withdrawn.

Fig. 17. Wheat midge with wings closed, as when standing or walking.

18. Wing of the spotted-winged wheat midge, *Cecidomyia graminis.*

19. Larva of the Hessian fly.

d. Its natural size.

Plate 3.

Fig. 1. Hessian fly parasite, *Semiotellus destructor.*

a. Its natural size.

2. Hessian fly, male.

3. The same, female.

b. Its natural size.

c. Female antenna.

d. Male antenna.

e. Tip of the male abdomen, and its hooks.

f. Profile view of the head.

g. Larva.

h. Flax-seed or larva case, its upper side.

i. The same, under side.

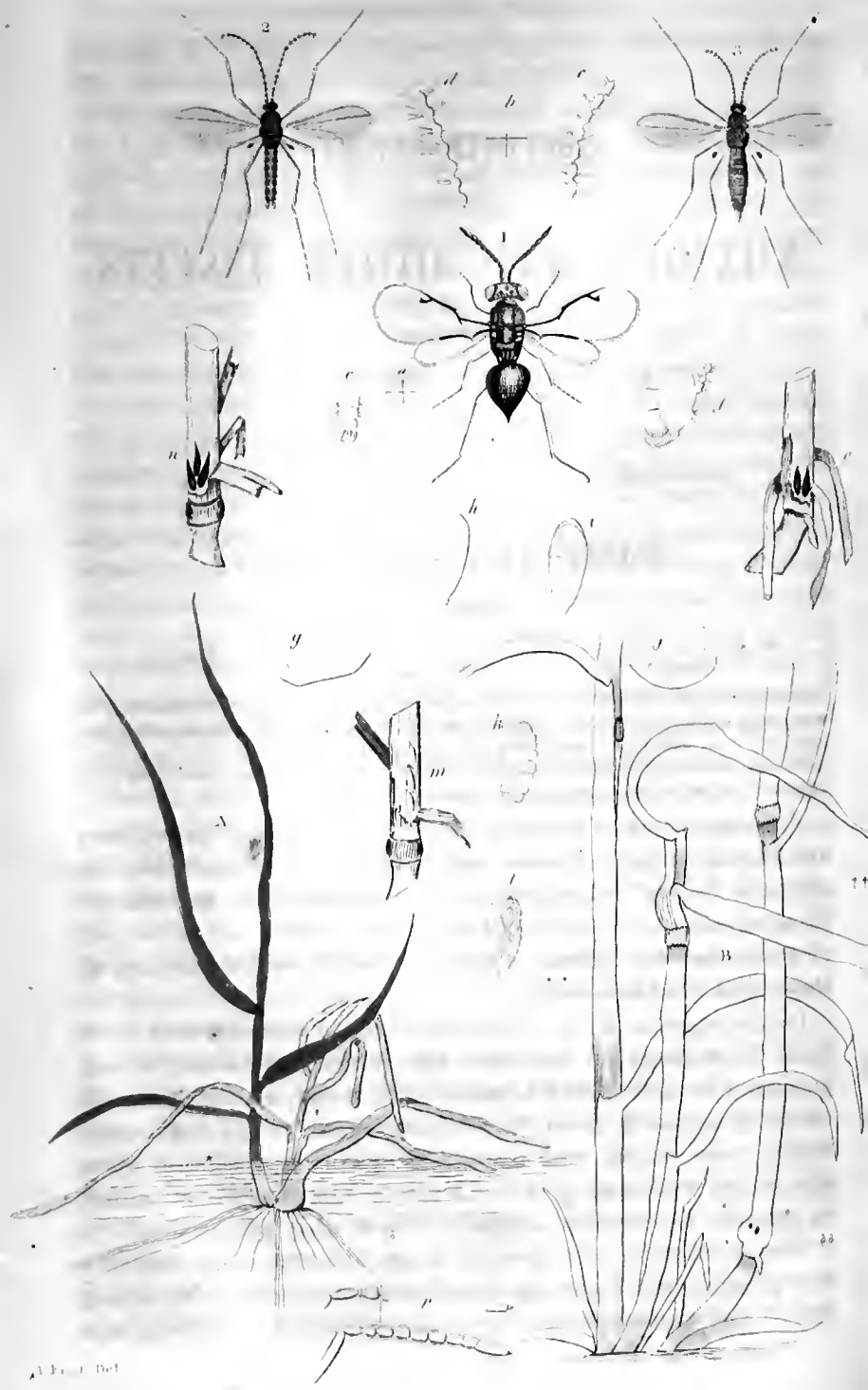
j. The same, viewed laterally.

k. Dormant larva, taken out of the flax-seed.

l. Pupa, taken out of the flax-seed.

m. Wheat stalk, its sheath broken away, showing the young worms on their way downwards to the joint.

Hessian Fly



EXPLANATION OF PLATE THREE.

n. and *o.* Wheat stalks, the sheath broken away, showing the flax seeds in their ordinary situation.

p. Antenna of the male parasite.

A. Appearance of a healthy (*) and of a diseased (†) shoot of wheat in autumn, the worms lying at §.

B. Appearance of a healthy (**) and two diseased stalks of wheat; (††) the stalk broken from being weakened by worms; (§§) the lower end of the sheath swollen from worms within, and perforated by parasites coming from two of those worms.

EIGHTH REPORT

ON THE

NOXIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK.

By ASA FITCH, M. D.,

ENTOMOLOGIST OF THE NEW YORK STATE AGRICULTURAL SOCIETY.

Executive Committee N. Y. State Agricultural Society:—

In presenting this my Eighth Report upon the Noxious and other Insects of the State, I have it to observe, that, as the preceding year, 1861, furnished a profuse amount of material for my examinations—not only bringing out our customary insects in unusual abundance, but superadding to them such important subjects as the Grain Aphis and the Army Worm—so the present year, 1862, has been a most barren one. On no previous occasion since I have been occupied in these researches, have I been at any loss for suitable subjects for study. It was my design to this year continue and complete my examination of the remaining insects which are detrimental to our grain crops. But, with the exception of the Aphis and the Midge in very limited numbers, our fields of grain were singularly clean and free from insect vermin. That profusion of flies, bugs and leaf-hoppers which we are accustomed to meet with in them, particularly in fields of green wheat, failed this year to make their appearance. Our fruit trees had a similar exemption, even the curculio having vanished from them; and as a consequence, such a crop of fruit was harvested as has seldom before been gathered by the present generation. These remarks apply not only to my own vicinity but to the State generally, although I have become informed of particular localities which were exceptions.

Thus, when the season for being actively engaged in my investigations arrived, I was not a little disconcerted to discover a total want of any interesting material in the fields, the orchards and the forests around me, on which to bestow my attention. The only subjects for study which I was able to meet with in sufficient plenty to favor their investigation were the excrescences or galls upon the oaks and other trees and shrubs. These I had examined and partially reported upon four years ago. And it was now remarkable to observe what a change had taken place in these galls

Some of the kinds, of which four and five years ago I could find scarcely any examples, and was therefore able to give but a meager and imperfect account of them, were now growing upon the trees in abundance, and with them others which were wholly new to me; whilst some kinds which were then most common and which I had studied most fully had now become exceedingly rare or had totally disappeared. I accordingly returned to an examination of these excrescences, and devoted the fore part of the season to them, anticipating that they would perhaps be the only subjects which the year would bring to me, from which to prepare this present Report.

The appearance, however, of the Asparagus Beetle upon Long Island unexpectedly brought to me another subject for investigation, which was of much greater moment and of more immediate consequence than these gall insects of our forest trees; and it seemed to be of paramount importance that this new and surpassingly destructive insect should have its habits and transformations ascertained and that full information respecting it should be promptly communicated to the public. To this subject, therefore, my attention became directed during the latter part of the season. And on coming to make up this Report, as none of our Garden Insects have yet been treated upon in this series of papers, I have thought that some of these which I was prepared to elucidate and on which I had interesting matter to communicate, might most appropriately accompany the Asparagus Beetle—thus making these Garden Insects my leading theme upon this occasion, and deferring the new matter which has been acquired upon Fruit Insects until additional observations will enable me to work it up in a more finished shape than I shall at present be able to give it; although the omission of so considerable a portion of the year's researches will render this Report more curtailed than its predecessors have usually been.

Respectfully submitted.

ASA FITCH.

ASPARAGUS BEETLE. A EUROPEAN INSECT, NEWLY INTRODUCED HERE

INSECTS INFESTING GARDENS.

1. ASPARAGUS BEETLE, *Crioceris Asparagi*, Linn. (Coleoptera. Crioceridæ.)

Upon asparagus stalks, throughout the summer, eating irregular roundish spots in the bark; oblong shining blue-black beetles about a quarter of an inch long, with a tawny red fore body and three bright lemon yellow spots on each wing-cover; and with them on the stalks their larvæ, which are soft bodied, thrice as long as thick, thicker posteriorly, of a dull ash gray or obscure olive color, with black heads and legs, of which there are three pairs all placed upon the breast.

Much the most important entomological event in our State the present year (1862) has been the appearance upon the asparagus on Long Island of an insect new to us in this country, and doing great injury to this important crop, threatening even its total destruction. This insect has accordingly been the most prominent subject for investigation which has occurred to me since my last Report was prepared. And I accordingly here present the researches which have been made and the facts obtained respecting it and the vegetation on which it preys—for, as every one will be aware upon a moment's reflection, to enable us to discover the most effectual modes of combating an insect enemy, it is necessary that we know not only the history, habits and lurking places of the insect itself during each of the several states or stages of its life, but that we be also well acquainted with the vegetation which it attacks, its nature, mode of cultivation and all the circumstances attending its germination and growth.

Our garden asparagus, it merits to be observed, is a native of the southern and central countries of Europe, growing wild there, in sandy soils, mostly adjacent to the salt water. The succulent young heads which shoot up from its roots are so tender and palatable as to have rendered it one of the choicest of culinary vegetables and to have brought it into cultivation in gardens from time immemorial. By the writers of ancient Rome, Pliny, Cato and others, it is spoken of and extolled, the same as by writers of the present day.

In its native countries we see three and perhaps more insects are recorded as feeding upon and injuring the asparagus. One of these being quite common is a great pest to the European gardeners. It is called the Asparagus Beetle and in works of science is named *Crioceris Asparagi*. It appears to abound everywhere that the asparagus is cultivated upon the eastern continent, and at times becomes so multiplied in particular districts as to greatly injure or even ruin the plants. Kollar, in his Treatise on Insects injurious to Gardeners and Farmers, places this as the second insect under the head of those which injure gardens.

Plants of the Asparagus kind and forming the group or genus to which the name *Asparagus* is given by botanists, are easily distinguished from other herbaceous plants by their leaves, which are very narrow and thread-like, similar to those of the larch or tamarack tree. Some of these plants are creeping vines, twining around and running over other shrubbery, or sometimes having stiff thorn-like branches whereby they hook to their supports.

ASPARAGUS BEETLE. NO INSECTS ON OUR ASPARAGUS BEFORE.

About twenty-five species of these plants are known to botanists. They are found growing wild in the temperate and tropical regions of the eastern continent, a moiety of them occurring in the neighborhood of the Cape of Good Hope, and the remainder along the shores of the Mediterranean and in the East Indies and Japan.

Being thus numerous and widely distributed in the old world, it is rather remarkable that we have not any plant of this kind, found wild, upon the American continent. And consequently we have no insects here which feed upon vegetation of this nature. Therefore, when the garden asparagus was introduced here from Europe, it was able to grow without molestation from any insect depredator.

There is no doubt that this vegetable was brought to this side of the Atlantic about the time of the first settlement of the country by Europeans. Although we are unable to refer to any record definitely informing us of the time when it was introduced, the fact is fully attested in the documents which have come down to us from that period, that the companies of early emigrants to our shores were unremitting in their efforts to introduce here all the more valuable plants with which they had been acquainted in their native countries—bringing the seeds and roots with them on their emigration hither, or afterwards receiving them from their European friends as opportunities for their transmission presented. We are hereby sufficiently assured that a vegetable so esteemed and so easy of cultivation as is the asparagus, would find its way here immediately upon the first arrival of the settlers. And thus this plant has been growing upon this continent for upwards of two hundred years, wholly free from those insect enemies from which it has all along been suffering in its native regions. It is now in universal cultivation with us. Everywhere through the United States, north and south, there is not a garden of any pretensions, which has not its bed of asparagus, whilst in the vicinity of our largest cities, to supply the demands of their population, whole fields are occupied with it. And yet, although it is growing thus extensively, neither one of those insects which depredate upon it in Europe has ever been found in this country, nor do any of our American insects attack it. Thus it has been our happy lot to grow this one valuable plant, wholly free from the annoyance of seeing it marred and mutilated by those insect foes which give us so much vexation and trouble with almost every other kind of vegetation which we attempt to cultivate.

Alas that our condition, which has been so felicitous in this particular, is now about to terminate—that the worst enemy to this culinary herb has at length found its way to our shores, with every probability that it will multiply and extend itself over our country, to remain as another evil entailed upon our land through all coming time!

It was in June last that a box came to my hands from the President of the Queens County Agricultural Society, Daniel K. Young, Esq., of Matinnecock, containing an insect and its larva, which in an accompanying letter was stated to have newly appeared there upon the asparagus, greatly injuring and threatening to totally ruin this valuable Long Island crop. This insect I at once saw was the noted Asparagus Beetle, so long known and so often complained

of in Europe. An article was thereupon furnished to the Country Gentleman, which appeared in that periodical the following month (vol. xx, p. 32) announcing the presence of this insect in our country, and giving a description of it in the different stages of its life. From the imperfect information which I then possessed, I supposed that, having newly arrived upon our shores, it was probably limited to a small district as yet, and if so, that it might be possible to crush and exterminate it, whereby our country would be released from it, perhaps for a century to come, as it has been for two centuries past.

It was only by inspecting the insect in the field of its operations that such a full acquaintance with it and the conditions favoring its existence could well be obtained as would enable me to judge of the practicability of subduing it, now, before it becomes more widely spread and more securely established. As one of the most important points remaining to be discovered respecting it was the state and situation in which it secretes itself during the winter season, it was in the month of October, when it had mostly retired into its winter quarters, that I visited Long Island on this business.

In reporting the information which I there obtained I may first allude to the value of this crop upon Long Island, and the amount of loss which this insect is threatening to occasion.

Some of the largest asparagus plantations are at the western extremity of the island. The name of Mr. Backus was mentioned to me as having one hundred acres occupied by this plant. But attention in that vicinity is more directed to other market vegetables, whereby this receives less care and is not grown to so great perfection as at some other localities. The best asparagus is brought to the New York market from different places along the Sound in Queens county. Oyster Bay and Glen Cove in particular are noted for the quality and amount of this vegetable which they export. There are steamboat landings, one near the north-east the other near the north-west corners of the town of Oyster Bay, some thirty miles distant from New York. Between and five miles equi-distant from these two places is the hamlet and post office of Matinnecock, where this plant appears to be cultivated in the greatest perfection—where the premiums on asparagus of late years awarded by the Queens County Agricultural Society have all been taken—and where this insect has the past summer been most destructive. The locality appears to be peculiarly well adapted by nature for the growth of this plant, it being a nearly level tract at the head of one of the arms of Oyster Bay and but moderately elevated above the ocean level, its soil for the most part a deep sand, the cultivated portions of which are kept in a high state of fertility by stable manure brought by water from the city, of which one hundred carman's loads (of fourteen bushels) per acre are customarily applied—this being the dressing given each year to the asparagus beds. The largest and best crops in this place have been grown by Peter Cock, who is now deceased. Full particulars of the crops he has produced may be found in the Transactions of our Society for 1860 and 1861. He has seven acres planted to asparagus, his sales from which amount to two thousand dollars annually, one-half of which is clear profit. And it is in his plantation that the Asparagus

ASPARAGUS BEETLE. FIRST APPEARANCE OF THIS BEETLE. ITS DESTRUCTIVENESS.

Beetle bas been the most destructive. About three acres of his plants were almost ruined, and the loss which he sustained the past summer from this insect was full four hundred dollars. Adjoining Mr. Cock is Daniel Smith, whose crop is also given in our Transactions. He has five acres, and contiguous to him George R. Underhill has a similar amount. Though their crops were badly injured they suffered less than Mr. Cock.

About seventy-five acres in and around Matinnecock are occupied with asparagus; and should this insect continue to multiply and increase the coming year as it did the past it will ruin every plantation in the place.

As is shown by the freight bills of the steamboats, this crop brings to the town of Oyster Bay the sum of $20,000; one-half of which being clear profit, this insect threatens to occasion a loss to this town of ten thousand dollars annually.

At a conversational meeting of the Queens County Agricultural Society, held in connection with its annual meeting, November 4, 1862, and reported in the pamphlet edition of the Society's Transactions, pages 6 and 7, this insect was the principal topic of remark. Though the amount of asparagus grown in other towns than Oyster Bay was not definitely reported, it was there supposed that Flushing, Newtown and Jamaica each equaled Oyster Bay, and that the two remaining towns of the county, North Hempstead and Hempstead, together produced perhaps a similar amount. The annual dead loss which it was thus estimated this insect was threatening to occasion the county was fifty thousand dollars.

At Matinnecock I had the pleasure of forming the acquaintanee of Mr. Young, President of the County Society, and was gratified to find he had bestowed such particular attention upon this insect and its habits that he was able to give me exact information upon a number of points respecting which I wished to inquire, and to guide me to the most favorable places for making such personal examinations as I desired. The insect was first noticed at that locality the year before, in July, and it was then seen that it fed upon the asparagus; but there were so very few of them that they excited no apprehensions. This season more were to be seen upon single stalks of the asparagus than were noticed in all the grounds around there the year before.

At the conversational meeting of the County Society above referred to, Mr. John Quin presented a written statement rendering it tolerably certain that at Astoria this insect was first noticed in the year 1859. And I recently learn that specimens of the beetle were found by the entomologist Henry Ulke, somewhere in or around the city of New York, at least as early as the year 1858 or '59. Mr. Young has seen this insect at different points along the north side of Long Island, whereby he knows it is at present spread a distance of at least forty miles, from Williamsburgh to Huntington.

The following facts stated at the conversational meeting above alluded to, will serve to show the ravages of this insect at different localities in Queens County.

At Astoria, Mr. F. Briell first noticed this insect on his beds in 1860. Their depredations were but slight that year, were greatly increased in '61, and this past summer one of his beds was entirely destroyed, the roots being

so much reduced for want of tops to support them that he had it plowed up. Capt. Monson had his beds attacked in 1860, and in 1861 the tops were badly eaten, but for some unknown cause the beetles all left his grounds about the last of August, whereby towards the close of the season a few new shoots sprang up and grew unmolested. The last summor the bark was completely eaten from all his plants and the roots showed such rapid decay that he had them broken up. Mr. Rebono stated that his asparagus beds had been entirely destroyed the past summer.

At Flushing, Mr. King has had them two years in his beds; has tried lime, salt, and a strong solution of potash, to no purpose, and thinks if this beetle is not soon destroyed the asparagus will be. Thomas Duncan, gardener for E. J. Wooley, Esq., thinks he had less of the insect this year than last and attributes this to his having mulched the beds with sea-weed last winter. Edwin Hoyt has had his beds almost destroyed. A new bed planted a year ago was weaker now than it was the first season.

From Newtown a gentleman stated his beds had escaped with the exception of his young seedling plants which were all destroyed.

From these data it appears that this insect was first noticed in Queens county at Astoria, one of the points nearest to the city of New York, where it began to be slightly destructive in the year 1860 and has rapidly increased each year since and has spread itself over nearly all of the county. It would seem to have advanced at the rate of some twenty miles a year, although our information upon this point is by no means precise.

Over the State of New York generally, at least over all its northern section, we are accustomed to see the asparagus only in gardens, where the roots have been planted by the hand of man. In only a solitary instance many years ago I met with a small stalk of this plant in my own vicinity, abroad in the fields, growing spontaneously from the seed. Where it is thus restricted exclusively to the gardens it would be no formidable task to keep all the shoots from the roots cut down a sufficient length of time to cause any insect which subsisted upon them, to perish for lack of food. But upon Long Island the circumstances I find are wholly different. There the asparagus plant is perfectly naturalized, growing readily from the seeds, which are everywhere scattered, chiefly by the crows which feed upon the berries the latter part of winter when their other supplies of food have become exhausted. Hereby slender, spindling stalks of this plant may be seen growing in all situations—by the roadsides, in the fields, and in the woods. Thus the Asparagus Beetle has such an abundance of food everywhere presented to it, and the insect is already occupying such an extent of territory that there seems to be no mode by which it is now possible for us to effect its extermination.

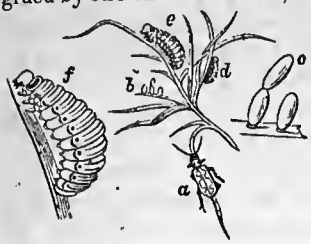
One of the points of most importance to complete the history of this insect—a point upon which I was able to find no information in any foreign author in my hands—was to ascertain its hybernation or the situation in which it secretes itself to pass the winter season. Three of the larvæ which had been sent alive to me in June, forsook the asparagus when they had completed their growth. I hence supposed it was most probable that they entered the earth to repose during their pupa state; and that the last larvæ which descend

ASPARAGUS BEETLE. WINTER QUARTERS OF THE INSECT. IT COMES OUT IN MAY.

from the asparagus at the close of the season, remain in the earth during the winter and produce the beetles which come abroad in May. To ferret out the winter quarters of the insect, therefore, my first step was to examine the earth in a place where these insects had been most numerous and destructive. But neither in contact with the underground portion of the stalks nor in the soil surrounding those stalks were any pupæ to be found or any traces indicating that the soil had been mined and penetrated by these insects. Though disappointed and scarcely knowing where to look next, it was certain that the insect either in its larva, its pupa or its perfect state, was concealed somewhere about these asparagus-beds in such numbers that its lurking place could surely be discovered. Upon inquiring the circumstances under which the insects had vanished, I was informed that the beetles had remained upon the asparagus without any apparent diminution of their numbers, until the first frosty night of autumn, when they suddenly and almost totally disappeared. A very few stragglers only were the latter part of October still remaining out upon the stalks on warm pleasant days; and observing them in this situation, it occurred to me that if a cold wind were to arise it would so chill and benumb them that they would drop to the ground, where they would crawl under any rubbish, such as fallen leaves and fragments of straw and dead weeds, which they could there meet with, and thus concealed, they would remain torpid through the winter and revive and come abroad again with the warmth of the following spring. Search was thereupon made under the small masses of haulm which were lying on the surface of the asparagus beds, but only occasionally could one of the beetles be met with in this situation, rendering it evident that this was not the retreat to which their legions had withdrawn for the winter. Turning next to examine a contiguous fence to see if this could furnish any lurking place for them, upon raising a splinter from one of the rails a view was obtained which it was wonderful to behold. The crevice under this sliver, a foot or more in length, was occupied by a throng of these beetles, crowded and compacted as closely together as it was possible for them to stow themselves. And on looking further, it was found that under the coarse lichens and moss growing upon some of the rails, under the dry bark adhering to others, under the loose scales of bark upon the trunks of trees, under the clapboards of buildings, in short, wherever a crack or crevice, so situated as to shed the rain, occurred around these asparagus plantations, it was filled and thronged with these beetles. They were lying torpid and motionless in these retreats, sunk in their winter's slumbers, although the weather was still mild and warm, nor did they awaken to activity even when uncovered and exposed to the rays of the sun.

Early in May, soon after the season for cutting the asparagus for market has begun, these beetles come forth from their winter quarters and commence feeding upon it, gnawing and marring it, and scattering their eggs upon it. The eggs, represented in the annexed cut at *b* and magnified at *c*, are of a blackish brown color and of an oval-oblong shape, like a grain of wheat, though not an eighth as large. They are attached to any part of the young plants, but after these have grown up to stalks the eggs are for the most part placed upon the leaves and near the end of the slender branches

which are no thicker than a coarse bristle—situations where they will be least liable to be disturbed by the beetles or larvæ in feeding. They are glued by one end to the leaf, and so firmly that the end appears as though it were embedded in the leaf. They thus stand erect, in a row, about as far distant from each other as their lengths, each row containing about five eggs, but the number varying in different instances from two to six or seven. Mr. Westwood, whose figures of this insect we have copied in the above cut (Modern Classification of Insects, vol. i, p. 372, fig. 16 and 18) represents two of these eggs, placed, one elevated upon the top of the other. His figuring them thus, is an ample assurance of the fact that they do sometimes occur, placed in this manner. But it must be exceedingly rare. Mr. Youngs informs me, that since seeing this figure, he has looked particularly to find an instance of this kind, but without success.



ASPARAGUS BEETLE, ITS EGGS AND LARVA.

The eggs hatch in eight days, and the larva (represented in the cut, when young at *d*, when full grown at *e* and magnified at *f*) is from ten to twelve days in getting its growth. It attains a length of about a quarter of an inch. It is of an obscure olive or dull ash gray color, often with a blackish stripe along the middle of the back. It is soft and of a flesh-like consistency, about three times as long as thick, thickest back of the middle, with the body much wrinkled transversely. The head is black and shining, and the neck, which is thicker than the head, has two shining black spots above. Three pairs of legs are placed anteriorly, upon the breast, and are of the same shining black color with the head. As will be seen when it is crawling, the larva clings also with the tip end of its body; and all along its under side may then be seen two rows of small tubercles, slightly projecting from the surface, which serve as pro-legs in addition to the tip of its body. Above these tubercles on each side is a row of elevated shining dots like warts, above which the breathing pores appear like a row of minute black dots.

Like the perfect insect, the larva feeds upon the asparagus only, eating holes through the outer bark of the plant, and preferring the tender bark on the ends of the stalks and on the branches, to the more tough and stringy bark towards the base of the stem. It moves very slowly, and is shy and timorous. As you approach it, it stops eating and holding its head stiffly back it emits a drop of black fluid from its mouth. This appears to be its only defence against being devoured by birds and other predaceous animals, the acrid taste of this fluid probably rendering the larva unpalatable to them. It also clings tenaciously to the asparagus. Before tying the cuttings up in bunches for the market, they are thoroughly washed, by being held usually under a pump; but these worms cling so tightly that only a part of them are washed off, and this black fluid from their mouths stains and nasties the hands of the men, in bunching the cuttings, it being as sticky as molasses.

When they were done feeding, the three larvæ which came under my observation in June, left the plants. I therefore inferred that they entered the

earth to repose during their pupa state. But it may be that they merely crawl under any mass of dead leaves and bits of straws which they find lying on the surface of the ground. This is rendered probable by Mr. Young's observations. He put several of the larvæ into a tumbler, with netting tied over it to prevent their escape, supplying them with fresh asparagus from time to time. They finally went down to the bottom of the tumbler and disappeared under the mass of dry withered leaves and branches which had accumulated there. Upon raising this mass from the tumbler, the insects were found to be inclosed in slight cocoons which they had spun, and which adhered to the under side of the rubbish when it was elevated. As some of these completed their transformations, it shows that it is not essential for them to enter the ground to pass their pupa state.

In about thirty days from the time the egg is laid the insect grows to maturity and comes out in its perfect form, when it appears as represented in the foregoing cut at *a*. The time will be shorter, no doubt, in the hottest part of the season in July and August, than in the cooler days of May and June. How long it lives, to be eating the asparagus, after it attains its perfect form, is not known. One of the beetles, fed in confinement, lived a fortnight, but how long it had been hatched from its pupa before it was imprisoned was not known. The females probably live much longer than the males, this being the case with insects generally. As it occurs to notice upon the asparagus, the two sexes are usually seen paired. They feed upon the bark, eating irregular oval or oblong holes through it, lengthwise of the stalks, and varying in size from about an eighth to a quarter of an inch in length. These holes are most numerous towards the top of the stalks and on the branches, where, frequently, nearly the whole of the bark is consumed. The beetles are very shy and timorous, whereby we are never able to see them in the act of eating. As you approach, the guilty culprit always slips around to the opposite side of the stalk, to hide himself from being noticed. And if the stalk is taken hold of to turn him around into view he drops to the ground and pretends to be dead, lying perfectly still. You think he is now playing off his last dodge upon you, and that you have finally got him where you can turn him over and deliberately inspect him before you crush him. But these thoughts only have time to flash across your mind before the creature takes wing and flies away so suddenly that ere you are aware of it he is gone out of your reach.

In its perfect state the Asparagus Beetle is a beautiful insect, of an oblong form, its length very slightly exceeding twice its width. It measures a little less than a quarter of an inch, its average length being 0.22, but different individuals vary somewhat in their size. It is highly polished and shining, of a blue-black color, frequently with a tinge of green. The head and thorax are narrower than the hind body, and have numerous punctures. The head shows a furrow on its middle, above the insertion of the antennæ. The antennæ reach the base of the wing-covers, and are coarse, thread-like, with the three joints following the basal one somewhat smaller and shining, the remaining joints being opake and brownish black. The thorax is slightly convex and bright tawny red. Frequently a discolored cloud appears in its center, which in many individuals becomes darker, forming two black spots, and these spots are sometimes more or less united. The wing-covers are coarsely punctured in rows. They are broadly bordered on their outer sides with orange yellow, which color is widened at the tips, where, on the edge of the suture, is a slender blue-black line. Along the middle of each wing-cover is a row of three lemon

yellow spots. The anterior one of these spots is placed upon the base of the wing-cover, and is usually egg-shaped with its pointed end directed backward. In perhaps a majority of instances this spot is prolonged and is confluent with the inner anterior angle of the middle spot. The middle spot is placed at a third of the distance from the base to the tip of the wing-cover. It is transverse, being a third more broad than long, and is thicker towards its inner end, which terminates at the third row of punctures from the suture, its opposite or outer end being confluent with the orange border. The hind spot is placed nearer to the middle spot than to the widened orange tip of the wing-cover. It is similar in most respects to the middle spot, but is frequently smaller and placed somewhat obliquely, its inner end inclining backward, and its outer end uniting with the orange border by a narrow neck. But these three spots are much varied in their size and form in different individuals, and are sometimes white instead of yellow. The under side and legs are shining blue-black, and there is frequently a dull yellowish band below the knees and a spot of the same color on the base of the hind thighs.

We finally come to remark upon the remedies for this insect.

Being aware that the Asparagus Beetle has been known in Europe for centuries, we naturally look to the long experience they have there had with it, to furnish us with some convenient and efficacious mode of combating and subduing it. But we look in vain. As the result of the efforts and observations of the gardeners there, we are told there is one remedy which is effectual, and one only. It is given to us in a single line of Kollar's Treatise, as in other publications, that "the only means of destroying these insects, is, picking off and killing the beetles and larvæ."

Now this remedy of picking off the insects by hand and killing them, will suffice very well, we doubt not, for ordinary cases, where it is only a common sized bed in a family garden which requires attention. But where whole acres are overrun, and every plant thereon thronged with these insects, we see how vain it is to mention such a remedy as hand-picking, as being a suitable resort against such myriads. We should almost require to recall the million of men we have sent out to the war, and marshal them in these Long Island asparagus plantations, in order to succeed in cleansing them of these vermin by this process. The crops there must be hopelessly abandoned to their fate unless some more practicable remedy than this can be discovered.

In the middle of one of the asparagus fields we noticed the dry dung of some animal as being wholly composed of the prettily spotted wing-covers and shining fragments of the legs and other hard parts of these insects, showing that the animal had been feeding upon and had consumed an immense number of them. The animal which had been glutting itself in this manner was undoubtedly the skunk (*Mephitis Americana*) whose relish for insects, when it can obtain them in sufficient quantity to supply its wants, is well known. And it might hence be made a most valuable auxiliary in destroying this Asparagus Beetle—but unfortunately we cannot recommend the protection, even for this important purpose, of a creature which is everywhere in such *bad odor*.

But the query then occurred to us, if this tabooed animal has such an appetite for these insects, have we not in our country some other animal which will have a similar relish for them? This suggested an experiment to us, the result of which we hastened to ascertain. A large sliver upon which a multitude of these beetles were crowded together in their winter's sleep, was broken from a rail and taken to the poultry yard and a few handfuls of corn were

GARDEN FLEA. MOST ABUNDANT, BUT HITHERTO NEVER NOTICED.

scattered around, to attract the fowls to it. It was interesting to observe their gradual approach in eating the corn, until one of their number happened to perceive these insects. Instantly thereupon she hurried to picking them up, and in a moment, the whole flock, abandoning the corn, was crowded to this spot, each on the alert to obtain a portion of the dainty fare. It amply demonstrated how highly they relished these insects.

Although fowls are prone to pick and injure cabbages, cucumbers, and several other garden vegetables, experienced cultivators of the asparagus assure me they never molest this plant. We are therefore to look to them, I think, as being our best protectors against these insects. At the conversational meeting of the Queens County Agricultural Society above alluded to, two instances were related, in which a portion of a bed to which chickens had had free access, had not been injured. If a flock of fowls is placed in an asparagus plantation, they will probably range over the grounds, continuing to forage upon these insects so long as one of them can be found. There is the fairest prospect, therefore, that they will prove to be a most efficacious protection, and that by them our Long Island market gardeners will be able to rescue their valuable asparagus crops from the ruin with which they are at present threatened.

2. GARDEN FLEA, *Symnthurus hortensis*, new species. (Aptera. Poduridæ)

Superabundant in gardens in May and June, upon the leaves of young cabbage, turnip, cucumber, and various other plants, and also on the ground, soft black wingless insects smaller than grains of gunpowder, and skipping with agility.

It is fifteen years since, that in an article on "Winter Insects" in Dr. Emmons's Quarterly Journal of Agriculture and Science, I named and described the Snow Flea, *Podura nivicola*, a minute insect which appears like grains of gunpowder sprinkled over the surface of the snow upon warm days in the winter and the opening of spring. An insect closely related to this appears every year in our gardens during the fore part of the season, so numerous that it attracts the observation of every one at work therein, and is universally regarded as injurious. No account of it, however, is to be met with in any of our popular treatises upon gardening. I have always supposed it to be this insect, of which Dr. Harris speaks from memory, in the following paragraph in the First Edition of his Treatise, page 125, but which is omitted in the subsequent edition—and if so, this is the only published allusion to this insect, which, to my knowledge, has ever yet appeared in our country.

"Several years ago I observed that cucumber vines were much infested by some minute jumping insects, rather less than one-tenth of an inch long, of a broad oval shape, and black color, without wing-covers, but furnished with short thick hinder thighs. They injured the vines very much by eating holes into or puncturing the leaves, and were expelled by dusting the plants with flour of sulphur. These cucumber-skippers were so soft and tender, and withal so agile, that it was difficult to catch without crushing them. Consequently I was unable to examine them thoroughly, and failed to preserve specimens of them. It is possible that they may

come near the genus *Myrmecophila* (Order Orthoptera, Family Achetidæ) which was unknown to me at this time; and since then these minute insects have escaped my observation. They were very different from the little flea-beetles, *Haltica pubescens*, also found on cucumber vines."

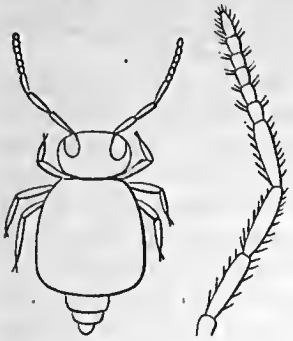
This is a wingless insect, most nearly related to the Lepisma or Spring-tail, and like it skipping by means of a forked tail which is held against the under side of the body. It thus pertains to the Apterous order of insects, and to the family Poduridæ, which, with the Lepisma constitutes the group or sub-order named Thysanoura. This group is arranged in scientific works next to that which embraces the flea (*Pulex*); and this name, flea, is frequently given to the species of the family Poduridæ also, and appears to be the most appropriate term which our language furnishes by which to designate these insects. By some of the gardeners around Albany I have heard the species now under consideration called the "Little sand flea," its size being so similar to that of a particle of sand. But as this name will be apt to give the erroneous idea that the insect abounds in sandy soils more than elsewhere, I regard the name Garden Flea as its most suitable designation; and it has for a long time been entered in my manuscripts under the corresponding technical name *Symnthurus hortensis*.

This insect is abundant in our gardens when we first commence work in them in the spring, though it is not till the young plants have come up from their seeds and the first weeding among them takes place that it usually attracts our observation. Numbers of them are then noticed to be standing in the warm sunshine, upon every leaf, every pebble and fragment of a dry weed which projects above the surface of the ground. Some of them are seen to be moving about, but with feet so minute that they are invisible. And if the finger is approached towards those which are standing upon a particular leaf, one after another deliberately throws itself with a sudden skip to the ground, till all have disappeared. They, however, are not shy and timorous, but gentle and disposed to be familiar; for, as they are everywhere skipping about in the dirt, if the hand happens to rest upon the ground a few moments, one or more of them is observed to have alighted upon it, and continues to stand thereon as if without any alarm or consciousness of danger. And thus they continue in the garden till in the latter part of June they become much less numerous and gradually cease to be noticed. As we look at them when they are standing in the strong sunlight, all that the eye is able to discern of them, is, that they are extremely small dull black objects, scarcely half the size of a mustard seed, that "smallest of all seeds," and that they have an egg-shaped form, moving with their smaller end in advance. Some of them it is noticed are smaller than the others, and the smallest ones are perceived to be of a paler or dull brown color.

When looked at through a magnifying glass, we first notice a remarkable difference in the structure of this Garden Flea from that of insects generally, it being composed of only two principal parts, a head and a body, this latter being formed of the thorax and abdomen consolidated together into a single piece the same as in the higher classes of animals,

GARDEN FLEA. THE FORKED TAIL AND SKIPPING APPARATUS.

the three pairs of legs being inserted upon the fore part of its under side.



As it is viewed from above the body has a somewhat square outline, but is broadest posteriorly. The four sides of the square are convex, with rounded angles, the rotundity increasing as it is more distended with food, and becoming globular when surfeited. It is plump and smooth, without any visible indications of transverse impressed lines or sutures dividing it into rings; but, jutting abruptly out from the middle of its hind side is a large teat-like protuberance forming the end of the body, and this is perceptibly composed of three segments, as is represented in the annexed figure. On its under side, however, the body is uneven and transversely wrinkled, here showing four segments more or less distinctly. And on its under side is also noticed the curious apparatus, the forked tail, wherewith these Garden Fleas possess the faculty of skipping. Two soft flesh-like threads are plainly perceptible, of a dull white color, and slightly diverging from each other, held against the breast with their ends reaching forward nearly or quite to the mouth. They seem to arise from the center of the under side of the body, but in reality are inserted into the end of a single stalk which it is more difficult to distinguish and which originates farther back toward the hind end. Thus this tail-like appendage is similar in its structure to a common table fork, of which the handle corresponds with the stalk or basal portion, and the tines with the two threads. These threads gradually taper towards their ends and are bearded with minute hairs, their tip being formed of a small oblong joint which is destitute of hairiness. On the fore part of the breast, bulging out between the two threads may be observed a slight protuberance or button-like elevation, looking much as though the insect had a tumor upon its neck analogous to the disease termed *goitre* by physicians. And it appears to be in a groove upon each side of this protuberance that the inner sides of the threads are pressed when the insect is about to make a skip. Then, in an effort to extend the tail out from the body, the threads slipping suddenly from the grooves strike against the surface on which the insect is standing, so forcibly as to throw it a distance of several inches.

The head is separated from the body by a deep constriction, leaving only a small neck connecting these two parts. It is about a third narrower than the broadest part of the body, more broad than long and of a flattened globular form The antennæ are inserted upon the front, wide apart from each other at their origin, and are held obliquely forward and outward, each moment touching the surface over which the flea is walking, as if they were examining the nature of the pathway before it. These organs, represented greatly magnified on the right of the above cut, are thread-like, four-jointed, and elbowed in their middle between the second and third joints. The three first joints are cylindrical and of equal length. The fourth joint is longer and compound, being formed of six small joints,

and cabbages are principally destroyed, whilst in the seed-leaf, by some *Symnthurus*, the size of a pin's head, and nearly globular. It hops with great facility by means of its forked tail, and may be found on every square inch of all old cultivated ground, but it is not plentiful on new land."

These Garden Fleas are so minute that the human eye without the aid of glasses is wholly unable to inspect their movements. The following observations will therefore be the more interesting to the reader. It is some years since, that I noticed several of these insects on a piece of new pine board lying in the garden. Wondering what they could find to attract them to that situation, where I thought the odor of any turpentine in the wood would rather make it repulsive to them, I was able to observe their operations by approaching a magnifying glass to them gently, so as not to alarm them and cause them to skip away—the light colored surface of the new wood enabling me to inspect their movements much more accurately than could be done were they standing upon a darker colored ground. Several of them were noticed, here and there, to have, grasped in their mouths, what appeared to be an exceedingly minute flexible fiber of the wood, fine as a fragment of a spider's web; and they were pulling backward, at the same time shaking their heads slightly, evidently to tear off these fibers. One of the fore legs was frequently used to crowd this fiber more and more into the mouth, whenever it became peeled up and too long to pull upon to advantage. Everything indicated that it was for the purpose of food that they were thus tearing off this fine fuzz from the surface of the new board. At one place was a small black spot in the board, caused apparently by some old disease in the wood at this point, which rendered it more soft and palatable to the insects, for two of them were here busily occupied in gnawing the particles of matter from the surface, as it seemed. And this brought them so close together that one of them happened to jostle against the other. This indignity was promptly resented by the flea which was thus intruded upon, who resolutely put his forehead against that of his comrade and pushed him back, in a similar manner to two cows fighting. A combat hereupon took place between them, each endeavoring to bite the head or legs of the other. This fighting lasted only a moment or two, however, and then both quietly returned to the discolored spot and again commenced gnawing the friable matter there. Ere long the same mishap again occurred and the same combat was again repeated and their differences adjusted as speedily as before.

Our gardeners universally regard these fleas as being injurious, but not so everely injurious as the larger sized flea-beetles (*Haltica*) with which they are almost always associated. And this appears to be a correct estimate of their character. I have sought to ascertain the exact nature of the injury which they do, and from the best observations which I have yet been able to make I think these fleas never perforate holes in the leaves or gnaw their texture where it is green and in a healthy, growing state. Their small jaws are probably too soft and weak to enable them to break down and masticate the substance of the leaf. But when a flea-beetle perforates a hole in a leaf, these garden fleas afterwards gather around the perforation to feed upon the soft matter which is there formed by the evaporation of the exuding juice.

GARDEN FLEA. COLORS. VARIETIES. IN GRAIN FIELDS AND ON CLOVER.

which are a third longer than thick, each one increasing slightly in thickness towards its tip, except the apical one which has the form of an elongated egg and is longer than those which precede it. The antennæ are bearded with fine, short hairs, as is also the front, the hind part of the body and the legs.

Its color, in the largest individuals, is dull black, without any glossiness, the head being dull yellowish brown or rust-colored, with the eyes black and the edges of their orbits whitish. The antennæ are also dull black with their bases rusty, and the legs are of this last color. This rusty color varies in its tone, being sometimes bright and clear, and at other times or in individuals from other situations, dull and obscure.

From differences in their color and size we might readily name and define four or five species from what I do not doubt are merely the different stages of one species in its progress from youth to maturity and old age. The following varieties are the most important, and are so marked and of such frequent occurrence that they merit to be noticed.

1, *juvenilis*, or the Young Garden Flea. Yellowish brown or rust-colored throughout, the body being of the same hue with the head; and but half the size of the largest individuals. These are most common at the opening of the season.

2, *basalis*. Body dull black, its anterior part and tip rust-color.

3, *dorsalis*. Body dull black, its tip and a stripe along the middle of its fore part rust-color.

4, *apicalis*. Body dull black with only the contracted apical protuberance or tip rust color. Common.

5, *maturus*. Body dull black throughout, the head, legs and bases of the antennæ rust-color. This appears to be the normal state of the mature insect.

This insect is not limited to the garden, but occurs more or less common everywhere in arable land. In fields of young wheat and rye, in May and June, I have often noticed it as being more numerous than any other insect there. And in fields of clover I have sometimes found it in great numbers, in company with the yellow Field Flea next to be noticed.

It is so very abundant in this country that we should expect it would be common in Europe also. But none of the species of *Symnthurus* described in Nicolet's article (Noveaux Memoires de la Societe Helvetique, vol. vi, p. 81) in Gervais (Apteres—Suites a Buffon) or any other author which I have at hand, appear to coincide with our insect. If it occurred in England as it does here, we think it could not have been overlooked by Mr. Curtis, in his late researches. But in his invaluable volume on Farm Insects, recently published, we only meet with one species of this genus, described (p. 432) as occurring on the under side of potato leaves in July and August, which is evidently unlike this insect of our country; though in the same connection he makes the following remark, which very probably refers to the species of which I am here speaking. He says: "In Nova Scotia the crops of turnips

This matter makes a kind of scab upon the raw surface of the wound, covering it and enabling it to heal. These garden fleas feed upon this scab, thus tearing open the healing wound and causing it to bleed afresh. Hereby the holes in the leaf become much larger than when they are first made by the flea-beetle, and nature is interfered with and embarrassed in her efforts to recover from the injuries done by the flea-beetles and other insects which wound the leaves. It is chiefly in this manner, I think, that these little garden fleas are detrimental to the plants on which they occur.

Dusting the infested plants with ashes, sulphur, etc., and most of the other remedies which we resort to for expelling the flea-beetles from them, are still more efficacious in driving off these garden fleas also. These remedies will be more fully treated upon when we come to speak of the flea-beetles, as they are insects which it is more important to combat.

3. FIELD FLEA, *Symnthurus arvalis*, new species. (Aptera. Poduridæ.)

In May and June, scattered upon the leaves of the pie rhubarb and other garden plants, on fruit trees in the orchard, and abundant in fields of clover; a minute soft yellow wingless insect, skipping feebly.

This species is scarcely half the size of the foregoing one, usually measuring only 0.02 in length. It is of a pale yellow color, commonly tarnished or dull yellow, sometimes with a tinge of green, and its head, underside and legs whitish. A dusky cloud is frequently seen in the middle of the body. It is of an egg-shaped form, almost globular, with the extremity of its body protruded as in the Garden Flea, its outline thus having a projecting angle on each side forward of the tip. The antennæ are thread-like, elbowed, and as long as the body. They are composed of three joints only, the last one being compound or made up of ten small joints similar to those of the last joint in the Garden Flea, and forming all that portion of the antenna which is beyond the elbow.

In a field of clover, on sweeping over the leaves, the net gathered myriads of these insects, so late as the last of June, at which time small young ones were greatly in excess of those which were full sized, indicating that they continue much later in the season than I have ever noticed them. Upon beating the leaves of apple trees in May and June, several of these insects will frequently be found in the net. And it is common to see them in the garden, upon the leaves, particularly of the pie rhubarb, *Rheum Rhaponticum*, where these leaves are perforated with holes by the flea-beetles.

On one occasion, when I was endeavoring to inspect the motions and operations of these insects with a magnifying glass, I saw two of them approaching each other as though they intended to bunt their heads together. Though I could not observe their motions so accurately as to be certain of the fact, it appeared as though, just as their heads were coming together, the smaller one with his antennæ grasped the sides of the head of the larger one, to break the force of the blow and prevent himself from being knocked over by his more powerful antagonist. Instantly therenpon, as though to break off the smaller one from his grasp, the larger

one commenced whirling, swinging the smaller one around and around as we sometimes see a man in play grasp a child under its armpits and whirl around with it. As if to prevent himself from becoming dizzy, the larger one after a few revolutions reversed his motion, whirling now in the opposite direction, and after a short time returned again to the direction he first had. The two then became separated, and stood facing each other for a time, the larger one ever and anon advancing slightly, as if about to hunt against the small one, which receded at the same moment, and then advanced again as the larger one drew back. At length the larger one seemed to get hold of the palpi or mouth of the smaller one, pinching it for a moment, and then walked away, the smaller one appearing for the instant to be semi-paralyzed with pain, recovering from which, it also walked off as though nothing had happened.

After the full account which has been given of the Garden Flea, it will not be necessary for me to speak further of this species which so frequently occurs in company with it and has the same general habits.

Several other species of this genus are known to me, but I am not at present prepared to describe them so fully and point out their distinctive characters so plainly, I fear, as will enable other persons to clearly identify them. The three following, however, are so strongly marked that a brief description will probably enable them to be readily recognized.

4. The New York Ground-flea, *Symnthurus Novæboracensis*, is 0.08 long, and of a dull brownish yellow color throughout, its head and legs slightly paler than the body, its eyes only being black. The body is but little broader than the head, oval, slightly attenuated at its tip, with an impressed transverse line conspicuously separating the apex from the body. The antennæ are nearly the length of the body, long and slender, thread-like, elbowed in the middle, with but a single joint preceding the elbow, the remaining length being obscurely divided into (three?) joints.

Several specimens, small and large, occurred under a board lying in a pasture field, in the month of November.

5. The Pretty Ground-flea, *Symnthurus elegans*, is 0.02 long, of a very pale yellow color, almost white, with a pale brown stripe along the middle of its back, and a wider black one upon each side of it, these stripes being common to the head and body. A still wider black stripe along each side of the body. Antennæ dusky, their basal portion pale. The body is globular, without any projection at its tip, and is a third broader than the head, which is also globular. The black stripes upon the back are often somewhat interrupted, or have a curdled appearance as if composed of a number of confluent black spots and clouds of different sizes.

Variety *a*. The middle stripe upon the head black instead of pale brown.

Variety *b*. The middle stripe wholly obliterated and wanting.

The history of the specimens from which the above description was drawn is briefly as follows: Some diseased wheat straws sent to me from Virginia

several years since were placed in a glass jar with moist earth in its bottom. Early in May a number of these ground-fleas made their appearance in the jar. And as I have never met with this species except in that instance, I infer that it was bred from eggs in the Virginia straw and not from the New York earth in the jar, and that it is therefore a Southern insect. Can it be the juvenile state of the following?

6. The MARKED GROUND-FLEA, *Symnthurus signifer*, is about 0.03 in length, black, with two short pale yellow stripes upon the head, the underside and legs dull white. Antennæ three-fourths the length of the body, black, their bases pale yellowish. The body is longer than broad, almost globular, without any projection at its tip, and about twice as broad as the head.

Several specimens of this occurred in company with the preceding.

7. MODERN VAPORER MOTH, *Orgyia nova*, new species. (Lepidoptera. Arctiidæ.)

Eating large notches in the leaves of roses, of plum, apple and other trees, in June; a small pretty caterpillar of a whitish color with a black head and back, and five pencils of long black hair, orange spots on its sides, and along its back four straw-colored tufts and two small bright red protuberances; spinning a cocoon which in July gives out a rusty yellow moth about 1.20 in width, its fore wings largely clouded with dark brown and having a snow-white crescent near their inner hind angle; the female pale gray and without wings.

In my Second Report I gave an account of our Common American Vaporer Moth, *Orgyia leucostigma*. I have since traced out the history of another species, which is closely like the European *Orgyia antiqua*, and is entered under this name by Dr. Harris in his Treatise on Injurious Insects. Our moth, however, differs from that of Europe, as I find on comparing it with very nice specimens of the *antiqua*, which I owe to the kindness of my friend, Dr. Sichel, of Paris, and the colored figures and descriptions of that species given by different authors, in having its fore wings much more extensively clouded with brown. And in its larva state it differs still more decidedly, in having towards the hind part of its back two small projecting vesicles of a bright red color, smooth and shining like sealing-wax. On referring to figures of the caterpillar of the *antiqua* which I meet with in Westwood's Introduction, in Westwood and Humphrey's British Moths, and the still more exact and beautiful illustrations in the "Iconographie et Hist. Nat. des Chenilles" of Duponchel and Guénée, (vol. ii, pl. vi, fig. *a* and *c*) I find these vesicles are not represented as pertaining to that species, nor do the descriptions of these and other authors make any allusion to them; whilst the work last cited distinctly figures similar vesicles as occurring in *Orgyia fascelina* (pl. xi, fig. *a*, *b*,) and particularly notices them in the accompanying text. We thus feel fully assured that these vesicles do not occur in the caterpillar of the *antiqua*, whilst in our American caterpillars they are constantly present, and are one of the characters which first strike the eye of the observer. The chrysalis also differs from the European species in its colors and pubescence, in both sexes, as we shall subsequently have occasion to notice.

Linnæus named the European species *antiqua* or the Ancient, it having been observed and known a long time before. Now that we find our insect to

be different from that, it may, in contradistinction thereto, appropriately be termed the New or Modern Vaporer Moth.

The caterpillars of this moth begin to be seen on rose bushes and plum trees the fore part of June, when they are quite small. They eat large irregular notches in the sides of the leaves, sometimes consuming them so that little more than the midvein is left. A medium sized leaf of the plum tree suffices to feed one of these caterpillars but twenty-four hours. They prefer leaves of the Natural Order ROSACEÆ, but feed readily upon various other leaves also. They are very similar to the caterpillars of our Common Vaporer Moth, but differ in having the head black instead of red, and they also have an additional pair of pencils of black hairs, which are placed on each side of the body forward of the middle.

When young these caterpillars are black with two orange yellow spots, placed, one back of the neck, the other beyond the middle of the body. They lose these spots and become brighter colored as they increase in size, their marks changing more or less with each change of their skins. The following is a description of their larvæ at different stages of their growth:

The YOUNG CATERPILLARS, less than half an inch long, are black and thinly clothed with long black hairs which radiate from warts symmetrically placed, those low down on each side giving out white hairs. The head is black, smooth and shining. The neck is white on its anterior edge, and on each side is a large wart-like spot of an orange color, giving out a cluster of black hairs with little feathery knobs on their ends, which hairs are held together in a pencil. The third and fourth segments have a large orange spot upon their back with a black line along its middle. The four following segments have each a dense tuft or brush of short hairs, on the back, the two first brushes being black and the other two gray. The top of the ninth segment is occupied by a large orange spot, shaded into white along its middle. Following this are two small shining vesicles of a bright vermilion red color, protruding from the middle of the back of the tenth and eleventh segments. On the twelfth segment is a tuft of black hairs similar to those on the fore part of the back. On each side of the body are two white stripes, the upper one slender and much interrupted, and between these stripes is a row of large oval dull orange spots. The underside is dull greenish white, and the legs pale yellow.

Upon changing its skin it becomes half an inch long and wholly loses the two bright orange spots upon its back. Its skin is now black upon the fore part of the body and of a dusky gray color posteriorly. Five pencils of black hairs having their ends enlarged into little heads now appear, placed, one upon each side of the neck, one on each side of the body a little forward of the middle, and one at the hind end of the back, the three last of these pencils being shorter than the forward ones. Of the four brush-like tufts on the fore part of the back the two first are black, the third one smoky yellowish, and the last one pale yellow or white. Another change of its skin now brings it to its full size.

The MATURE CATERPILLAR is a little over three-fourths of an inch long and of a lurid white color, having a smoky or bluish tinge. It is thinly covered with light yellow hairs radiating from wart-like spots of different colors. On the back is a broad coal black stripe with its hind portion margined on each side with white. On each side of the back are orange red or yellow warts margined with pale yellow, placed on the third, fourth, ninth, tenth and eleventh segments, these warts giving out diverging yellow hairs with an occasional longer black one; and lower down, along the middle of each side is a continuous row of similar warts. Below these is a faint, interrupted blackish stripe, in which the breathing pores are placed; and farther down are two rows of smaller dusky oval warts with pale yellow margins and diverging hairs. The back is surmounted with four brushes or dense tufts of short hairs, placed on the fifth, sixth, seventh and eighth segments, these brushes being usually of a sulphur yellow color, but sometimes white. A pencil of long black hairs with little heads or knobs on their ends projects obliquely forward and outward from each side of the neck. A similar pencil, but shorter, projects horizontally outward on each side of the sixth segment low down. And a fifth pencil, which is thicker than either of the others, projects upward and backward from the hind end of the back, being inserted upon the twelfth

segment. Forward of this last pencil are two vesicles of a bright vermilion red or sometimes of a bright orange color, smooth and shining liko sealing-wax, or as though they were wot with varnish. They protrude upward from the middlo of the tenth and eleventh segments, and are of a teat-liko form, more long than thick, and rounded at their summits when fully distended. Somotimes one of them may be seen wrinkled and retracted to half the sizo of tho other, and in a few moments after, inflated again to its full size. Forward of the anterior vesiclo are two small yellow oval dots, and on the noxt or ninth segment are two similar dots, but larger. The head is black, polished and shining. The underside is yellowish white, and all the legs aro light yellow.

When the caterpillar has finished feeding it wanders about until it finds a suitable situation in which to placo its cocoon. The corner formed at the lower edges of the claphoards of buildings furnishes such a retreat as it desires, and the cocoons of this moth may frequently be seen here, two or more of them being sometimes placed together, with the fore end of one overlapping the hind end of the other.

The cocoons are an inch and a quarter long and half an inch thick, and are formed of white silken threads, woven in with which arc the hairs of the hody of the caterpillar. They consist of a dense inner pod or sack inclosed within a looser texture of threads crossing each other in every direction. The whole of the cocoon, however, is so thin and slight that the inclosed inhabitant may frequently be seen through its walls. When the caterpillar first commences forming its cocoon and has inclosed itself inside of a few of the outermost threads of this structure, it finds its peneils of long hairs impede it in turning around within such a narrow space and embarrass all its operations. It therefore plucks out these long hairs, one after another, and to get rid of them, weaves them into the walls of the cocoon with the threads it is spinning. And as the space around it hecomes more and more circumscribed as the work progresses, the shorter hairs in their turn are plucked out and similarly disposed of, the skin of the caterpillar thus hecoming denuded of all its rigid hairs, including the short ones of the hrushes, when the work is finished. Thus it will be seen that it is chiefly the long hlack hairs with knobs on their ends which are interwoven in the loose outer walls of the cocoon, and only the short yellow hairs of the brushes which enter into the tissue of the more densely woven pod inside.

In a short time after its cocoon is finished the inclosed insect casts off its larva skin. The dry and shrunken relics of this skiu, of which the black shining head is the only portion which retains its natural appearance, are crowded hackward into the hind part of the cocoon, and the insect now appears in its pupa or chrysalis form.

Guénée says the chrysalis of the female *antiqua* is glabuous and of a yellowish color. Our speeies is clothed with long white hairs, and its color is greenish white with the back partly or wholly black. It is soft and shining, 0.70 long and 0.30 thick, egg-shaped, euding in a black thorn-like point, the tip of which is furnished with minute hooks which are fastened into the threads of the cocoon, whereby it is securely held therein.

The FEMALE CHRYSALIS has the head and thorax remarkably small and short, moasuring only 0.10 in length. The thorax is black and tho head is usually of a pale smoky yellowish color with the mouth hlack, and the eyes sometimes red, sometimes hlack. Tho sheaths of tho legs, firmly soldered upon tho breast, are scarcely a third of the length of tho body, the longest pair reaching

slightly upon the base of the third abdominal segment, whilst the wing-sheaths terminate at the suture at the anterior edge of this segment. These wing-sheaths are very faint and almost obliterated towards their tips, whilst their basal portion is more developed and is frequently marked with black lines on their edges and pale brownish lines upon the veins. The abdomen is white with a tinge of green, with the sutures, or at least the anterior ones, marked by a black line. The breathing pores form a row of oval black dots along each side, and a short distance above them the whole back is overspread with black, or varies in having broad black bands with the anterior portion of the segments white or on the fore part of the back tawny yellowish. The back is thinly covered with long white hairs, and on the sides and beneath are clusters of punctures forming round spots from which similar hairs radiate, these spots being placed in four longitudinal rows upon each side, the upper row above the breathing pores and the other three below, the lower spots smaller and with the hairs fewer and shorter. The tip of the body is black.

The Male Chrysalis differs notably from the female. It is a third smaller, glossy, and of a pale tarnished yellow color with the back black and clothed with long white hairs, thus differing from the European *antiqua*, which, according to Guénée, is black and bristly with reddish yellow hairs. It has the thorax much larger than it is in the female chrysalis, and the sheaths of the wings and legs are vastly more developed and larger, reaching two-thirds of the total length. On each of the three anterior segments of the back is an oval transverse spot, formed by short projecting crinkled scales of an ash gray color, which spots do not occur in the female chrysalis.

The moths come out from their cocoons in nine days, making their appearance about the middle of July. The caterpillars which are to become females feed longer and the moths are later in coming from their cocoons than the males. I have known male moths to come abroad before the last female caterpillars of the same brood had commenced forming their cocoons.

The MALE has the fore wings rust color or dull tawny yellow, largely clouded with blackish brown, which color forms a broad curved band extending across the wing forward of its middle, this band through the inner half of its length being forked or double, with the anterior fork broader. Beyond the middle a much broader wavy band crosses the wing, having upon its inner end a snow white spot shaped like a crescent, forward of which is a curved streak separated from the band except at its inner end. The outer part of this band is narrowed into a straight black streak, which extends obliquely forward and outward to the outer margin. And back of this is a brown cloud on the outer margin, reaching to the apex, forward of which it is cut asunder by an oblique grayish streak, a similar streak separating it anteriorly from the outer end of the brown band. A dusky cloud in the center of the wing extends lengthwise from one band to the other, and on its outer side is a paler rusty yellow spot, very faint, crescent-shaped, and margined by a brown line, which is more or less broken and irregular. The base of the wing is also brown on its outer side. The fringe is brown with a rusty alternation at the end of each of the veins. The hind wings are rusty brown, their fringe with very faint paler alternations towards the outer side. On the under side the wings are paler rusty yellow, and brownish on the outer side of the forward pair. The body is coated with hairs and the abdomen with scales of a smoky brown color. The latter has faint paler bands at the anterior sutures and a tuft of short black hairs on the back near its base. It is gray beneath and clothed with short rust colored hairs along the sides and longer brown ones at the tip. The broadly pectinated antennæ have the stalk gray and the branches blackish. My specimens of this moth measure 1.15 across the spread wings.

The FEMALE MOTH is wholly unlike the male in her color and form, and being destitute of wings she appears more like a short thick-bodied hairy worm than like a mature insect. When she comes out from the cocoon she is half an inch in length and half as thick, being broadest slightly forward of the middle. Her skin is black upon the back and dull greenish white upon the sides and underneath, and is coated over with short fine soft hairs

of a yellowish white color, which form pale bands on the edges of the abdominal sutures and a faint pale stripe along the middle of the back. The rudiments of the wings appear on each side of the thorax, in the form of small oval scales of a hoary gray color, which is the color of the legs also. The antennæ resemble short gray threads reaching only to the wing sockets, when they are turned backwards. Along their under side they are dark brown, with projecting sharp-pointed teeth, like those of a saw.

The female remains stationary upon her cocoon and there deposits her eggs, whereby her body becomes diminished nearly one-third from its original size. This operation so exhausts her that as soon as it is completed she looses her hold upon the cocoon and falls to the ground and dies. She thus lives only about twenty-four hours in her mature state, whilst the male continues to fly about, actively, for several days at least.

In one instance a female lost her foothold upon the cocoon, and falling, caught hold of the clapboard a short distance below it; and I relate the circumstance as showing how very little these wingless females are able to walk and move about, that she did not attempt to crawl back to the cocoon, but, clinging to the spot where she was, deposited her eggs there, upon the smooth surface of the board, only three inches below the cocoon.

The Eggs are placed in a cluster side by side, in nearly regular rows upon the outside of the cocoon, to which they are firmly glued. They are of a white color, like enamel, and of a globular form, with their upper part constricted and flattened, resembling a lid placed upon the summit of the egg. This lid is of a purer white color and opake, with a discolored band around its outer edge and with its center strongly depressed, forming a dimple, in which is a glossy pale brown dot.

The eggs are left naked and not covered over with the white frothy substance with which the female of the *leucostigma* covers and hides her eggs. And being left thus exposed, these eggs fall a prey to a minute parasitic insect, a black shining four-winged fly with pale tarnished yellow legs, which pertains to the Order Hymenoptera, the Family Proctotrupidæ and the group Platygastrides. In its size and general appearance it is very similar to the Mistaken Parasite, figured in my Sixth Report (Plate 1, fig. 4), and I name it the Egg-Parasite of the Vaporer Moth, although it is quite probable that future researches will show that it is not restricted to these insects but preys also upon the eggs of other moths of similar size. It differs generically from the Mistaken Parasite, in having a straight oblique branch given off from near the middle of the outer marginal vein of the fore wings. I present a detailed description of this fly.

Egg-Parasite of the Vaporer Moth, *Telenomus Orgyiæ*, new species. (Hymenoptera. Proctotrupidæ.)

Length 0.03, or to the end of the closed wings 0.05. Black and shining, with the legs dull pale yellowish. Head as broad as the thorax, twice as broad as long, convex in front, concave at base, and rounded on each side, its surface sparsely bearded, at least in places, with short inclined hairs; the eyes more densely and evenly bearded with short erect hairs. Antennæ black, clothed with a short inclined beard, half as long as the body, inserted near the mouth, elbowed, clavated, ten-jointed, the five last joints forming an elongated egg-shaped club. Basal joint long and thick, occupying one-third of the total length, slightly curved, rather thickest in the

VAPORER MOTH. THE PARASITE'S OPERATIONS.

middle, narrowing towards the base and very slightly towards the tip. Second joint twice as long as thick, obconic, and a third narrower than the basal joint. Third joint similar in length and thickness to the second, cylindrical. Fourth and fifth joints globular and of the same thickness with the preceding two. Sixth joint a third thicker, globular. Seventh and eighth joints thickest of all, their outline square, opposite sides straight and parallel, base and apex slightly convex. Ninth joint of the same form but a little smaller. Tenth or last joint narrower and a very little longer than the ninth, egg-shaped. Thorax broad egg-shaped with a deeply impressed transverse line across its disk back of the center. Abdomen sessile, smooth and highly polished, similar to the thorax in its size and form. Wings horizontally incumbent upon the back when at rest, smoky hyaline, the fore pair with a straight stigmal branch arising near the middle of the outer margin and running obliquely inward and backward, ending abruptly without being enlarged into a knob or head, its length about equal to one-third of the width of the wing. Legs much more slender than the antennæ and rather long, the forward pair shortest, with their shanks thick, elliptic-obovate, and having a strong curved spur on the underside towards the tip. Shanks of the other legs long and slender, and gradually thicker towards their tips, the hind ones longest. Feet long and thread-like, longer than the shanks on which they are respectively inserted, their basal joint longest and occupying a third of the total length, the second and fifth joints about equal in length and perceptibly longer than the third and fourth.

This parasite passes around and punctures the shell of each egg of the Vaporer Moth, inserting a minute egg of its own inside, from which hatches a maggot which feeds upon and consumes the contents of the moth's egg. Each one of the latter eggs is supposed to contain the exact amount of nourishment required for the growth of one of the parasites. Hence the parent fly is cautious to never puncture an egg which is already occupied, being aware that its young will perish from starvation should two of them happen to be placed in the same egg. In the instance which came under my observation, seven of these minute flies were engaged upon one cluster of eggs, walking slowly about and around them, and examining them with their antennæ; and with a magnifying glass I could distinctly see one and another of them with its sting inserted into an egg, thus leaving no doubt as to the nature of the work in which they were engaged. I managed to capture two of these flies, and being called away from home, on my return three days afterwards the remaining five were still present, busily engaged in their operations. On the following day, however, only two of them were remaining. That such a number of these flies should continue day after day upon the same cluster of eggs shows how pertinaciously they follow up this work, never abandoning it until they become fully assured that the last egg in the cluster has been ferreted out and inoculated. Although there were two other clusters of eggs at distances of only six and ten feet, not one of these flies discovered them—which indicates that there was some peculiarity about that particular cocoon, whereby such a number of these flies were able to find it and failed to detect the other two in its vicinity.

As the Common Vaporer Moth, *O. leucostigma*, covers her eggs copiously with a white frothy substance which dries and hardens upon them, completely enveloping and hiding them from the view, this parasite is unable to come at them to destroy them; and this is no doubt one of the causes if not the sole cause why that species is so much more numerous than the present one in our country.

It is rarely that the caterpillars of this moth will occur in such numbers on our trees and shrubbery as to excite any solicitude. Should they do so

our readiest mode for lessening their numbers will be to pick off each leaf on which one of them is standing and trample it under the foot, if one can find it in his heart to thus treat such beautiful objects as they are. Their numbers around our dwellings may also be lessened by searching for their cocoons under the edges of clapboards, in the grooves of the rough bark of trees, and similar situations, and wherever one of them is found with a cluster of eggs upon its surface, tearing it from its place and throwing it into the fire.

In conclusion, I may add that the Common Vaporer Moth has been very abundant in the city of Albany for several years past, where its larva has acquired the name of the Little Yellow Caterpillar. It here appears to be increasing with each succeeding year, and has this season (1863) been so numerous that in some of the yards and gardens I have seen large plum trees wholly stripped of their leaves by it and the rose bushes similarly defoliated. On this the 21st of July the caterpillars have nearly all disappeared for the season, and I have to-day met with the insect in all its different stages—some of the CATERPILLARS still remaining out upon the rose bushes, whilst most of them have formed their cocoons and changed to PUPÆ, some of which have already given out the PERFECT INSECTS, and the winged males, recognized by their smoky gray color and the white dot on the inner hind corner of their wings, are seen at rest on the shaded side of buildings, and occasionally a cocoon shows on its surface the milk-white patch of dry frothy matter under which the female has hid her EGGS. As these eggs will remain unhatched until next spring, this nuisance, the Yellow Caterpillar, might be greatly abated, were every person after the leaves have fallen, in autumn or in winter, to search for these cocoons under every projection in the walls of his buildings and in his fences, and upon every dead leaf which remains hanging upon the limbs of the trees and shrubbery, and wherever one of the cocoons is found having this white foam-like substance upon it, making it a point to tear it from its place and burn it.

8. HAIR-NECKED ROSE-BUG, *Macrodactylus barbatus*, new species. (Coleoptera. Melolonthidæ.)

Associated with the Rose-bug, devouring the leaves and fruit of roses, grape vines, apple and other trees, the latter part of June, a beetle like it in every respect, except that its thorax is slightly more broad than long, and is bearded with small erect short bristles.

As this report is being closed for the press (June, 1863,) specimens of the Rose-bug are sent me from Stillwater, Saratoga County, as an insect which is there making its appearance in vast numbers in the fields of young rye, corn and potatoes; and a gentleman from Saratoga Springs calling upon me, states that in some of the gardens there the grape vines are so thronged with these beetles, eating the fruit and leaves, as to threaten to ruin them, whilst there are great complaints of it also as devouring the young plants of Indian corn in the fields.

In my Second Report was given a description and figure of the Rose-

bug, *Macrodactylus subspinosus*, with details of its history and habits. In the eastern section of the State of New York, there usually occurs associated with this insect, individuals which we must regard as a second species, differing from it merely in having short stiff hairs upon its thorax, jutting up from the smooth surface like the beard upon a man's face, this beard being of a buff-yellow color, and differing also in the relative dimensions of the thorax, it being rather more wide than long, whereas in the common species its length slightly exceeds its width. Of the seven specimens just received from Saratoga County, two are of this kind. This hairy broad-necked species has generally been confounded with the other. Dr. Burmeister was the first to point it out as being distinct, and he supposes this to be the real *subspinosus* of Fabricius, and accordingly describes the smooth narrow-necked species under the name *polyphagus*, which had been applied to it in Melsheimer's Catalogue. Dr. Le Conte, in his synopsis of the Melolonthidæ of the United States, published in the Journal of the Academy of Natural Sciences cotemporaneously with the appearance of my Second Report, follows Burmeister in applying the Fabrician name to this hairy-necked species, and adopts for the smooth-necked species the name *angustatus*, heretofore given to it by Beauvois. And he supposes the two species to inhabit wholly distinct sections of our country, assigning New York as the locality of the hairy-necked beetle whilst the other is found only in the Southern States and Kansas. But different correspondents have sent me the smooth-necked species from different parts of the State of New York, from Massachusetts, Rhode Island, Pennsylvania, Maryland, Virginia, Ohio, Illinois, Kansas, and the Indian Territory south of Kansas. It is perfectly evident, therefore, that this species is not limited to the South and West, as Dr. Le Conte supposes, but occurs throughout the Northern and Middle States also. On the other hand, the hairy-necked species has never been found, that I am aware, except in the State of New York. My specimens of it are from the city of New York, from Albany, from the neighborhood of Utica, and from Washington and Saratoga Counties. So far as yet appears, therefore, this species occurs only in the valley of the Hudson River and its tributaries. As Dr. Le Conte cites Dr. Harris's Treatise as describing the hairy-necked species he must evidently infer that this species inhabits Massachusetts also. But this citation was probably made without due attention to the description of the insect given by Dr. Harris. Though he does not state whether the thorax of his insect is smooth or bearded, he says this part of its body is long and narrow, which precludes us from regarding it as this species, in which the thorax is wider than long. And knowing as we do that the smooth-necked species occurs in Massachusetts, we cannot doubt it was this which Dr. Harris had before him; as it was also the species from which the description given in my Second Report was drawn, as will be evident by reference thereto.

The question now remains, was I correct in pronouncing this smooth and narrow-necked species to be the *subspinosus* of Fabricius, or are Drs. Burmeister and Le Conte correct in applying this name to the bearded and

wide-necked species? As this Rose-bug is one of the most common and formidable injurious insects of our country it is important that we have its nomenclature correctly ascertained and permanently settled.

On referring to the fullest description which Fabricius has left to us of the species which he names *subspinosa*, that contained in his Entomologia Systematica, vol. ii, p. 178, we find it applies alike to both of the species, none of the terms which he employs giving any indication which one of the two he had in his view. And the same remark is true of the still more detailed description, cotemporaneously given by Olivier (Entomologie, i, 5, p. 70). There being nothing therefore in the original definitions of the *subspinosus* whereby we can decide to which of these two species this name rightfully belongs, if we were left to the general fact that the one species is common throughout the United States, whilst the other is quite local, occurring only along the Hudson River, where the other species is associated with it and is usually the more numerous of the two, the presumption would be strong that it must have been the former of these species which had found its way to Europe and was the insect with which these old authors were acquainted. But in addition to this, other incidental evidence is furnished us which must be regarded as decisive upon this subject. Fabricius cites the *M. elongata* of Herbst as being the same insect with his. If we admit this citation to be correct, it is conclusive upon the point at issue, Herbst's species with the "flachliegenden Härchen," the flat-lying little hairs, being evidently the smooth necked one. Fabricius further gives the West India islands as the locality where the *subspinosus* occurs. Surely this must preclude us from regarding an insect found only in the State of New York as being his species. It appears from Dejean's catalogue and from several other authorities that the same insect which is found in the United States, is found in different parts of the West Indies also, and from Lacordaire we learn that its geographical range reaches south into the republic of Colombia. Thus, the proof seems to be conclusive that it is the smooth narrow-necked species to which the name *subspinosus* rightfully pertains.

We are thus left without a name for the other species, and I therefore propose to term it the *barbatus*, the bearded or Hairy-necked Rose-bug. As already stated, it is the *M. subspinosus* of Burmeister and of Le Conte, but not of Fabricius, Olivier, Latreille, Harris, and others. In the description of *subspinosus* given by Latreille, occurs the phrase "thorace angusto," the thorax narrow, clearly showing it is not this wide-necked species to which he refers.

It is difficult to ascertain the dimensions of these Rose-bugs with accuracy, in our dried cabinet specimens, the thorax and head being inclined downwards much more in some of them than in others. My specimens of this Hairy-necked species vary in length from 0.30 to 0.38, showing there is no such difference in their size as has been reported, whereby this species can be distinguished from the other. Nor, on the underside of the abdomen in the females of the smooth-necked species do I detect any bristles, which are stated as occurring in it, on the middle of the four anterior segments.

In both species alike, the pygidium or exposed tip of the abdomen is usually black, but not unfrequently it is pale dull yellowish, and sometimes the whole underside of the abdomen is of this color. Thus only the hairiness and width of the thorax remain to us as characters which are constant and reliable, whereby to distinguish this species.

The transformations and habits of this insect are the same, no doubt, with those of the common Rose-bug, full statements of which have already been presented in my Second Report. And the same modes of combating and subduing it whenever it becomes numerous will require to be resorted to.

APPENDIX.

Historical Notice of the first starting of the Hessian Fly in this Country

In the account of the Hessian Fly given in my last Report, I state that it is a European insect, which was introduced into this country, probably in some straw used in package, by the Hessian troops which landed on Staten and the west end of Long Island, August 1776, but it did not become so multiplied as to attract general notice in that neighborhood, until 1779; and from thence as a central point, it gradually extended over the country in all directions, advancing at the rate of from ten to twenty miles a year.

In my History of the Hessian Fly, published in the Transactions of the Society for the year 1846, I endeavored to present as particular an account of the introduction of this insect and its subsequent advance from one locality to another as the information which I was able to find upon this subject enabled me to prepare. In that article, (page 325) the following statement is given of the first starting of this insect in this country:

"From the 'flax seeds' casually lodged in the imported straw, only a few flies would probably be evolved, to deposit their eggs upon the young wheat in the autumn of 1776; nor would these have multiplied to such an extent in the following spring as to attract attention at the time of harvest. But, increasing with each successive brood, by the harvest of the following year, 1778, we might anticipate its being observed, and by a year thereafter, it would become so numerous that its real character would no longer be in doubt. And in accordance with this, we are informed by Colonel Morgan, that 'the fly made its first appearance in 1778;' and Mr. Clark, who in 1787 went to Long Island expressly to gather authentic information respecting this insect, says in his report, 'I satisfied myself in the following particulars, namely: first, that the Hessian Fly made its first appearance there about the year 1779, so as to injure, and in some cases to destroy their crops of wheat.' And an anonymous writer in Carey's Museum (vol. i, p. 143) gives the same year as about the period of its discovery. We therefore regard the year 1779 as most probably the date when its ravages commenced."

The opinion which I thus expressed becomes somewhat modified by a statement which I meet with in the lately published Colonial History of our State, vol. viii, p. 783, which indicates that this insect had become more multiplied and had penetrated farther into the country in the year 1779 than my previous information had led me to suppose. From the document alluded to it appears that in December, 1779, a tory named John Pell, of

the town of Sheffield, near the southwest corner of Massachusetts, made his way to the city of New York, where he gave information to the British authorities, of the condition of the country between the Connecticut and the Hudson rivers, one of the items of which is as follows:

"That no wheat is to be bought for the Continental money—nor for hard money under twelve shillings (probably New England currency, i. e. two dollars) a Bushel, which is more than double the old price prior to the public troubles. That many dread a famine, the last Harvest being short on account of *a blast* which was general thro' the North country, and *a fly* which before the snow falls of this Winter devoured the green blades so that a part of almost every field, and some entire fields were perfectly eaten up and destroyed, and the fields in some instances resown or reserved to be ploughed up in the winter if the frost would permit or in the spring."

I think there can be no doubt it was the Hessian Fly, then newly arrived in the country and its habits wholly unknown, which occasioned the remarkable disasters to the wheat crop here stated to have occurred over the southwestern part of New England in the year 1779. What is here termed a blast in the wheat harvested that year was probably that shrinking of the kernels which the pupæ or "flax seeds" of the Hessian Fly cause when they are nestled at the lower joints of the straw, and which, if they were noticed at the time, would scarcely be suspected of occasioning this shriveling of the kernels, their location being so far distant from the heads. And the fly which destroyed the young green wheat in autumn to such an extent that many fields were plowed up and resown, was the succeeding generation of the same insects, nestled now in the roots and causing the young wheat plants to wither and die. This insect therefore, imported to our shores as we do not doubt in some straw landed at the west end of Long Island in the summer of 1776, and beginning to breed there in the fall sowed wheat of that year, in the course of three years or its sixth generation in this country, had become so multiplied and spread that it was destroying the wheat crop and exciting fears of famine over at least a considerable portion of the country between Berkshire County, Massachusetts, and the city of New York. It thus appears on the outset of its career upon this side of the Atlantic, to have advanced to the north twice as rapidly as it did to the east, whilst to the south and west its progress was very much slower than in any other direction.

As every fact relating to the first introduction of this important insect and its subsequent advance over our country merits to be carefully preserved, and as the statement which I have quoted above was written six years earlier than any which I had before been able to find, and is probably the first allusion to the Hessian Fly in this country which is now extant, I have deemed it of sufficient consequence to be thus particularly noticed.

The Earth-worm, *Lumbricus terrestris*, Linnæus.

The Earth-worm, the long, cylindrical, reddish worm, which is so very common everywhere in rich ground and is in such universal use as a bait

for angling, we cannot but regard as being identical with the corresponding worm of the European continent, named *Lumbricus terrestris* by Linnæus, though some have supposed it to be probably a distinct species. When we recur to the fact that this worm is so common in gardens that every box and pot of earth in which live plants are carried from one continent to the other, will be liable to contain some of them and transport them over the ocean, we see how very improbable it is but that the species of the one continent will be common on the other continent also.

As a notable instance of the manner in which men of science sometimes toil and waste their energies in heaping up piles of dust to be scattered and dispersed by the next wind which passes by, we have the fact that M. Savigny distinguished and described twenty species of these worms which subsequent naturalists regard as merely varieties of one common species.

We have here an example of a worm which is not the larva of an insect. This Earth-worm undergoes no metamorphosis; it always retains the form in which we are accustomed to see it. It is most nearly related to the leech and the hair-snake, and is accordingly associated with them in the class of animals to which the name "Worms" in strictness belongs. It consequently does not pertain to the department of my investigations. I however notice it, for the purpose of reporting some observations which have incidentally occurred to me, and which are deemed to be of interest as throwing additional light, particularly upon the food upon which this creature subsists, and upon the holes or burrows which it makes underground.

It is currently stated by authors that these earth-worms feed upon earthy matter, from which they digest the fine vegetable mold contained therein, and eject the remainder at the mouths of their burrows. By crawling about in the ground as they do, they are most important and serviceable agents in loosening the soil and opening it for the air and water to penetrate it. And by throwing out their castings at the mouths of their holes, they add to the depth of the soil, and cover tracts that are comparatively barren, with a superficial layer of fine, fertile soil. Hereby also, as many who read these lines will probably remember to have observed, a stone or chip which is lying upon the surface of the earth where the ground remains undisturbed, will in a few years become sunk wholly beneath it. It is some ten years ago, that, in flagging a walk in my yard, several large flat stones which were rejected as being too thin and unsubstantial for this work, were carried aside to an unoccupied part of the yard and laid upon the grass, with the thought that some use to which they might be appropriated would perhaps occur. By the grass growing over their edges they in two or three years were hid from view, and had become totally forgotten, till recently, happening to strike a hoe in the ground there, they were re-discovered. They were found to be sunk, each one, about an inch below the surface, being overlaid to this depth by fine gritty earthy matter, with only its upper part permeated by the roots of grass. I could attribute this deposit of earthy matter upon the upper side of these refuse flagging stones to nothing else than the operations of earth-worms. Instances of a

similar character are related by Charles Darwin, Esq., in a paper "On the Formation of Mould," published in the second volume of Proceedings of the Geological Society of London, one of which is that of a pasture field undisturbed by the plow, and which had received a heavy top dressing of lime twelve years and of cinders three years previously. On examination, lumps of the lime were found, forming a well marked white line at a uniform depth of two inches below the surface, and at the depth of one inch was a line of black spots, formed by the remains of the cinders; the soil below the white line being gravelly and differing very perceptibly from the fine mold above it. Such facts show us what important and valuable agents these earth-worms are, in keeping the superficial portion of the soil in a most salubrious condition for the growth of vegetation.

These worms also feed upon dead leaves and other decaying vegetation; and hereby they are liable in some cases to become annoying to the gardener. When making my garden a few years since, from among the refuse onions remaining in the cellar, a bed of escallions was planted. Soon after, I was surprised to find that the onions which had thus been set out were pulled over and lying prostrate upon the ground, all of them having their dead tops drawn into holes about the size of a goose quill which were perforated in the ground; and to enable the tops to be thus turned down into these holes, the whole onion had in several instances been drawn two or three inches away from the place where it had stood. They were immediately restored to their places, but next morning several of them were found again pulled down in the same manner. And thus, for some time subsequently, a portion of these onions were reset deeper and with the earth pressed more firmly around them, each day, and continued to be uprooted by night, several of them perishing from being thus disturbed. I was in doubt as to what creature it was that was attacking the onions in this manner—drawing the decaying tops into its hole by night that it might feed thereon during the day time without exposing itself to observation. The holes appeared like those of the earth-worm, but I did not deem this worm able to grasp bodies of such size as were these onions, and draw them along upon the surface of the ground. As it might possibly be some new and strange insect which had arrived and established itself here, I resolved to ascertain decisively what it was. Repairing to the spot with a lamp at different hours of the night failed to reveal the creature engaged in its operations, and I finally determined to trace one of the burrows, by digging, until I came to the animal in it. By inserting a straw in one of the holes, and crowding it down further and further as I carefully removed the earth from around it, I found the hole descended almost perpendicularly till it came into very hard compact soil below where the ground had ever been disturbed by the garden operations of plowing and spading. At length, on reaching a depth of about fourteen inches from the surface, the burrow abruptly turned from a perpendicular to a horizontal direction, and following it as well as I was able to do at such a depth and in such firmly compacted gravel, it here appeared to form one of a multitude of horizontal burrows, winding about in every direction, whereby the ground seemed to

be perfectly honey-combed. All doubts that it was the earth-worm which I was pursuing were now dispelled; and I became aware it would be impossible to find the animal by following it up in its burrow, as these burrows were now discovered to be interminable, and the worms would retreat from me therein with infinitely more celerity than I could follow them.

I hence conclude that the principal residence of these earth-worms is at a depth of some sixteen inches from the surface, and below where the frost of winter penetrates; and here, in places where the surface soil is rich and the worms are numerous, the earth is mined by their burrows running in every direction, like the streets of a populous city. Another fact indicating that the earth is thus mined, has occurred to my notice. In striking into the soil of the garden with an iron bar, making holes into which to set bean poles and for other purposes, I have repeatedly been surprised to find that the bar, after penetrating the firm earth to a depth of some sixteen or eighteen inches, would then come into remarkably loose soil, whereby, by merely working the implement backwards and forth, its own weight would carry it down some distance further—the bar sometimes going down with such suddenness and ease as to excite a suspicion that it would become lost from dropping into a cavern in the ground there. Other persons, I am sure, must have observed this same fact. Heretofore I have been at quite a loss to account for such a looseness in the soil at such a depth. I now suppose it is caused by the multitudinous burrows of these earth-worms.

From this underground retreat, holes extend upwards to the surface, from which by night the worms come abroad to feed and to draw a supply of food into the mouths of their holes that they may consume it unmolested during the day time. This drawing of food into the mouths of their burrows is a common habit of these worms. The middle of June, 1860, in examining a cornfield which had been much injured by the frost a few nights before, I observed the ends of the dead blades of the young corn were in numerous instances drawn into the holes of the earth-worms. And in grass lands I have also found the lower dead leaves of the grass, several inches in length, drawn into these holes in the same manner. It is probably by coiling one end of its body around the blades of grass that it draws them to the mouth of its burrow, the minute bristles with which each of its rings is furnished, aiding it in clinging to the substance which is thus to be moved. That they are able to hold to and draw over the ground bodies of such size and weight as were the onions, shows that they have a power of prehension and avulsion, a power of grasping and pulling, which much exceeds anything of this kind which they are commonly supposed to possess.

But, in addition to feeding upon earthy matter and upon dead and decaying leaves, these worms also attack vegetation which is green and growing. I have been reluctant to believe this, until instances have presented themselves to my notice, putting the fact beyond all question. They are particularly prone to fall upon and appropriate to their own use tender garden vegetables which have been newly transplanted, the leaves of which, being flaccid and pliant from being slightly wilted, they draw

into the mouths of their holes and consume, and not unfrequently the plants themselves are hereby uprooted and drawn away from the places where they had been set. In other instances, without drawing them under the ground, where two or three slightly wilted leaves are lying together upon the surface, keeping it moist and shaded from the sun's rays, these worms delight to ascend there in the day time and feed upon the under portions of the foliage. And when in this situation, on discovering the near approach of a person, they are so startled as to make a perceptible rustling and agitation of the leaves in their haste to retreat into their holes. Thus transplanted lettuce, turnips, etc., are liable to be injured and some of the plants to be destroyed by these worms.

Another calamity frequently befalls some portions of the beds in our gardens when the seeds sowed therein first start out of the ground. Rows of young plants which we to-day notice as having come up profusely and finely, it may be are to-morrow observed to have large vacant spots in them, and in a few days more perhaps not a single plant is remaining. Cut worms sometimes destroy small portions of the rows in this manner; but then some of the small wilted leaves are seen, drawn partly into a crack in the ground, at which place it is also noticed that the surface soil has been newly loosened by the worm in entering the ground there, and on digging the worm itself is found lying slightly under the surface. But here, the beds, or large portions of them, are swept clean, with no wilted leaves left, no disturbance of the soil, no trace whatever to indicate to us the enemy that has destroyed the newly sprouted plants, save only that holes of the earth-worms are seen here in the beds the same as in all the surrounding soil. And I am persuaded it is these worms issuing from their holes by night and feeding upon the tender newly sprouted plants, which occasions their sudden disappearance in this manner.

I may further remark that in young cabbages, beans, and other garden vegetation, we frequently see a large hole eaten in a leaf or a portion of its margin consumed, when no caterpillars, cut worm, or other insect larva to which we can impute this casualty, is to be found upon or anywhere near the plant. And I believe it is often these earth worms which thus wound the leaves, although to do so they must in some of these instances ascend the stems of the plants such a distance that little if any of their body remains upon the ground.

I have my life long deemed these worms to be perfectly innocent of harm and serviceable to us by keeping the ground loosened and porous. But within a few years past, having come to look particularly at their operations, I am forced to change my opinion. In our plowed fields, our meadows and pastures, they are probably to be regarded as doing more good than harm. But where they become so multiplied as they do in the rich soil of our gardens they are a pest and a nuisance.

Have we any remedy against these worms? Upon this point I have not yet sufficient experience to enable me to speak with confidence. I have observed that when a light approaches them in the night time they immediately retreat underground, and it therefore appears probable that if a

EARTH-WORM. A FORKED EARTH-WORM.

lighted lantern were placed in the garden during the night, none of these worms would come abroad near it. I have also noticed that if one of these worms is dropped upon a spot where the surface is sprinkled over with ashes or with salt, the worm writhes and twists apparently in misery, coiling and tying itself into knots as if endeavoring to wipe off the irritating substance from its skin. Around the vegetation, therefore, which I find to be molested by these worms, I am resorting to a top dressing of unleached ashes, with the hope of thus protecting it from them.

A singular monstrosity occurs in one of these worms which was found in my garden the past season. It is a young worm about three inches long, having the hind end of its body forked or divided into two branches nearly a fourth of its length. The forks are cylindrical, of equal length and thickness, and about a third less in diameter than the body forward of them. When it was first taken in the hand both forks were noticed to discharge their earthy feces alike. The structure, where the forks commence, may be briefly described as follows: The fork which is on the left side continues the rings of the body regularly onward, three of the rings successively diminishing in diameter reducing the thickness from that of the body to that of the fork; and the suture by which the first of these three rings is united to that which precedes it, opens widely apart on the right side, forming the base upon which the right hand fork is inserted—this fork showing a very slight contraction or neck at its commencement, whilst the left hand fork has no corresponding contraction at its base.

The specimen is preserved in a vial of spirits, in the Museum of the Society, the spirits having contracted it in length about one-third.

ADDITIONS TO LIBRARY, 1862.

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Illustrated Catalogue International Exhibition, London.
American Cyclopedia. Vol. xv., xvi.
Evening Journal Almanac.
National Almanac and Annual Record.
Grape Culture and Wines and Wine Making. By A. Haraszthy.
Annual Scientific Discoveries. D. A. Wells.

BY DONATIONS AND EXCHANGES.

Journal Royal Agricultural Society, England. Vol. 22d, part 2d, No. 48. H. Hall Dare, Secretary.
Franklin Almanac, 1862. B. F. Sanford, Cincinnati, Ohio.
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Medical Transactions, 1861. 1 vol. Same.
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Patent Office Report, Agriculture. 2 vols.
Journal Royal Agricultural Society of England. Vol. 23d, No. 49. H. Hall Dare, Secretary.
Geology of Vermont. From Geo. F. Houghton. 2 vols.
United States Coast Survey, 1860. Prof. A. D. Bache, Supt.
Meteorological Observations United States. From D. Holloway, Commissioner Patents.

from the farm, and work of cunning fingers from the parlor and the shop, we ought not to forget that our kinsmen and neighbors and friends, some of whom were with us a year ago, are now exposed to quick, unnatural death on distant fields of heroic strife. Yet how easy to lose thought of the war at a place like this, where all nature about us is so eloquent of peace, so suggestive of good will among men! In all these broad, green fields you hear no sound of angrier strife than the noon-day ticking of emulous crickets and katydids. In all these brilliant woods you see no shallow, half-covered graves. There is no smell of human slaughter, no hint of mourning and lamentation. October, as if it were the Joseph of months, is arrayed in its coat of many colors. The trees are gaily robed, as for a carnival.

> The gentian's sweet and quiet eye
> Looks thro' its fringes to the sky.

The birds have sung their cheerful good-byes, unconscious that their flight to warmer latitudes would be over armies that are deciding the sublimest, bloodiest issue in the history of our race. Throughout those golden, misty, pensive days of autumn, when the chill of sudden sunsets tells us the aged year is soon to die; while we are filling our barns and cellars with stores for the winter, let us be thankful to God that we are permitted to uphold our country's flag, and our Union's integrity, without sacrificing the prosperities of the farm and the workshop. Let us be devoutly thankful that with us the sanctities of the church and the fireside are not touched by the blight of war; that our gardens and farms and cemeteries are not trampled by the heels of rapine. The festival we keep to-day may remind us of a promised era, when swords shall be beaten into plowshares, and spears into pruning-hooks. In the late flowers of the garden, happy insects are murmuring idyls of peace. The flowers themselves are a prophecy of peace. Without shrinking from the duties and self-denials of a true patriotism, let us ask God to fulfil the prophecy, and to send us the Peace.

> O flowers! the soul that faints or grieves
> Now comfort from your lips receives;
> Sweet confidence and patient faith
> Are hidden in your healing leaves.
>
> Help us to trust Thee on and on,
> That this dark night will soon be gone,
> And that these battle-stains are but
> The blood-red trouble of the dawn.
>
> Dawn of a broader, whiter day,
> Than ever blest us with its ray,
> A dawn beneath whose purer light
> All guilt and wrong shall fade away.

At the close of Professor North's address, the society voted their thanks, and requested a copy for publication.

LEVI BLAKESLEE, *President.*

T. B. MINER, *Secretary.*

NINTH REPORT

ON THE

NOXIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK.

By ASA FITCH M. D.,

ENTOMOLOGIST OF THE NEW YORK STATE AGRICULTURAL SOCIETY.

INSECTS INFESTING GARDENS.

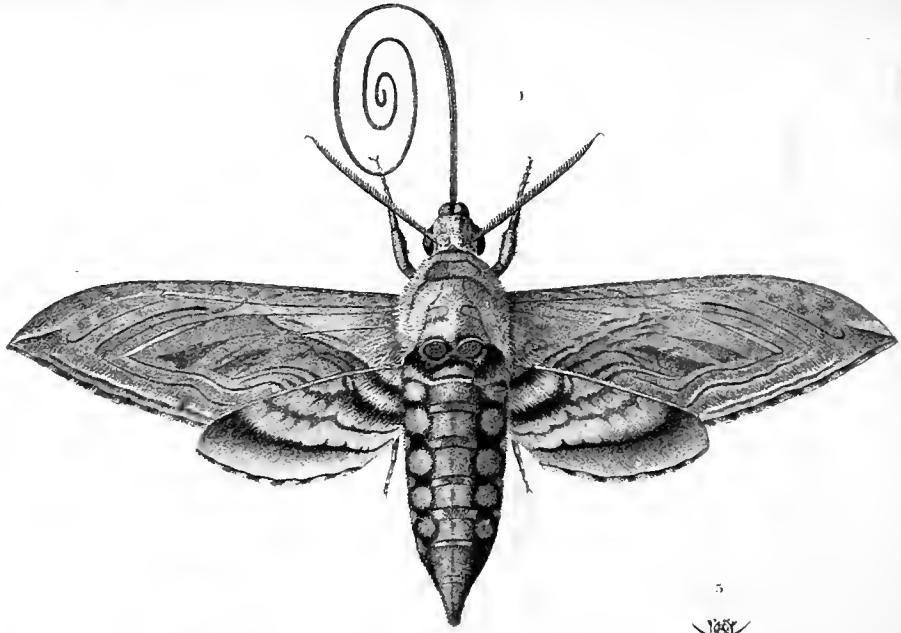
9. NORTHERN TOBACCO-WORM, POTATO-WORM, TOMATO-WORM, *Sphinx quinquemaculata*, Haworth. (Lepidoptera. Sphingidæ.) Plate 4, fig. 1.

Eating the leaves of potatos, tomatos, 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 underground 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

(Moth of Cut worm &c)



with which we have become more familiarly acquainted from seeing it so frequently upon the tomato vines ever since this vegetable came into general cultivation in our gardens. And it has obtained the names Potato-worm, Tomato-worm, and now Tobacco-worm, as it occurs upon one or the other of these plants, most persons supposing it to be a different insect in each case. These three plants are closely related to each other, all pertaining to the same Natural Order, SOLANACEÆ, and this insect feeds upon each of them without appearing to manifest any preference for one over the other. It feeds equally well, also, upon other species of the genus *Solànum*, to which the potato pertains. I once met with two full-grown worms upon a vine of the bittersweet (*Solanum Dulcamara*) which was growing so distant from any potatoes that it was evident they could not have strayed from that plant, but must have come from eggs which the parent had laid upon this vine, knowing it to be perfectly adapted for nourishing her young. It is probable that it can also nourish itself upon the stramonium, henbane, and most other plants of this Natural Order.

The tobacco-worm which is common at the South and such a great pest to the plantations there, is a different species, but so closely like this in its size, colors, markings and habits, both in its larva and perfect state, that the two insects were for a long time confounded together. It is now just a century ago that the miller or moth of the southern tobacco worm was scientifically named *Sphinx Carolina* by Linnæus; and it was fifty years later in 1802, that our insect was separated as a distinct species by Mr. Haworth, who gave it the name *Sphinx 5-maculatus* or the Five-spotted Sphinx, Hubner some years afterwards giving it the name *Celeus*. I suppose it to have been through an oversight that authors generally have copied the original name from Mr. Haworth in its masculine form, which is evidently an inaccuracy. Mr. Clemens in his Synopsis of North American Sphingidæ, (Journal Acad. Natural Sciences, new series, vol. IV, p. 166,) cites Dr. Harris as describing the *Carolina* in his Catalogue of North American Sphinges (Silliman's Journal, vol. XXXVI, p. 294), whereas it is clearly the 5-*maculata* which is there described under the name *Carolina*. He also gives both these species as being distributed generally throughout the United States. But over most of New England and New York the 5-*maculata* is the exclusive species. I have no knowledge of the *Carolina* as occurring except in the southern sections of our State, where, and throughout the middle States, the two species are found associated together; whilst farther south this disappears and the *Carolina* alone is met with, its geographical range extending onward through Mexico and the West Indies, and into South America, probably as far as the tobacco grows.

As already remarked, the two insects are closely alike both in their larva and their perfect states. The worms are of a bright green color, their skin is wrinkled transversely and is commonly dotted over with white, and they are both marked with a row of oblique white stripes along each side of the body; but in the southern worm there are no longitudinal white streaks meeting the lower ends of these oblique ones to form the V-like marks which we invariably see upon our northern worm. In their perfect state, the

millers of both species are of a gray color with a row of five yellow spots along each side of the body, these spots being bordered with black, and the wings are varied with brown clouds and obscurely marked with black lines, and on their undersides the hind wings are crossed by two blackish zigzag bands, which are also obscurely traced upon the forward pair. Thus they are so alike in their colors, and in so many of those spots and marks which are most conspicuous, and which the eye first notices, that you feel quite certain on looking them over, that they are both one species. It is only when you come to closely inspect some particular points that you detect such discrepancies as assure you they really are different insects. The plainest mark of distinction between them is the black bands which cross the upperside of their hind wings. In the moth of our northern Tobacco-worm you see two zigzag bands on the middle of the wings, the same as on the underside. But in the southern you observe in place of these a single broad band, which is very slightly if at all toothed or jagged along its sides. In addition to this, on the hind body of the former, you notice a slender black stripe along the middle of the back, of which there are no vestiges in the latter. These marks will suffice to enable any one who has either of these millers under his eye, to decide which species of the two it is.

We will next relate the biography of our insect.

The moths do not all make their appearance simultaneously, but come out one after another, mostly in the month of July, though continuing to occur abroad until the frosts of autumn have destroyed the flowers from which they are fed. During the day time they remain at rest, hid from view, and come out in the evening to feed and lay their eggs. From its thus appearing abroad upon the wing at the same hours when the musketos are most numerous and annoying, Drury states that the southern species has in some parts of the West Indies obtained the name of the Musketo Hawk, it being also supposed that it is attracted forth at that particular time in order to feed upon these petty torments. This, however, is a great error. The sole food of these moths is the honey of flowers, for obtaining which they are furnished with a remarkably long slender tongue, which, when not in use, is coiled up like a watch spring, and concealed between the palpi or feelers. It may be unrolled and drawn out by inserting a pin into the coil, and when fully extended is five or six inches in length. Thus it is especially adapted for probing flowers which have long slender tubes, such as the tobacco, stramonium, petunia, &c., whose nectaries are beyond the reach of bees and other honey-gathering insects. The moth resembles a humming bird in its motions, and also in the sound made by its wings as it is hovering around flowers and sipping the honey from them. The tongue is fully extended at such times; and hereby the moth is poised on its wings at a distance of some inches from the flower on which it is nourishing itself.

Its eggs are probably placed on the underside of the leaves of those plants on which its young feeds. The worms which come from these eggs are voracious feeders, consuming a large quantity of foliage and growing rapidly, whereby some of the earliest ones attain their full size by the end of July; but it is during the month of August that they are present upon

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 to 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 covers. 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 hairs, 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

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 hind side 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 wing 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 paralled 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 center 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-head 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 the tip forward and inward to the post-medial band, where it ends between the second and third veins. Its hinder portion is margined on its 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 the 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 particulary obvious in the hind one, are

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 brown, 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.

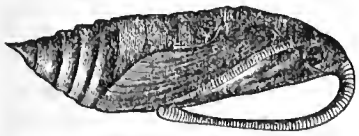
being shorter and less distinct. The surface of each segment of the body is crossed transversely by impressed lines and roundly elevated intervening spaces, giving them a ribbed appearance, there being eight of these elevated ribs to each segment. In viewing this larva the eye first of all notices a 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 month 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 forepart 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 hindmost breathing pore also has a much shorter and more faint white stripe

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 is 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 remarkably 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 inclosed 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



Tobacco-worm Pupa.

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 confluently 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 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

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 cyliudrical 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, opake, 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 inclosure 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

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 inclose 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 Kalmiæ* 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.

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 awakes 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 these 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 Chrysomela, by Illiger, to include a number of South American species which have the middle portion of the

breast prolonged into a horn-like point, wherefore the name; Doryphorus being a Greek word meaning a spear-bearer, and partienlarly memorable as the name of one of the most celebrated statues of the sculptor Polycletus. 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 *Doryphora 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 C. 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 patotoes 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 22d) 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

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 a 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 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

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 it 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

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 paraplenra 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 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-

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 round 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 paler 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

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 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. Itwas 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 incloses 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 replow it and sow it with a different crop. Thus, in consequence of the pre-

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 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 blight 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 over 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

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.

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 then 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 practised 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 hereby 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

protection. In order that this fall plowing should be effieacious, 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 skilful 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-rood 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-

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 above 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

sufficiently to hide itself from view. It is also much more irritable, more ferocious and combative. If two of them are inclosed 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 disinterred 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

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 dusky 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

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 wings, 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 gray 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 abjoining 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 Linnæus, 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 thereupon briskly roots and pushes the worm about and pinches it with his 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.

BEE-KILLER. A NEW INSECT. ITS CLASSIFICATION AND NAME.

13. NEBRASKA BEE-KILLER, *Trupanea 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 cylindric; 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 end. And in the dead specimens before me three bristle like processes

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 others 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

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 carrion-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

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.

AGRICULTURAL STATISTICS, 1863.

The blanks for the collection of statistics were prepared in due season and distributed throughout the State, in December, as required by the act of the Legislature. It was soon ascertained that the work would not be performed, *unless the transactions* of the Society and the Institute for 1863 could be had—of this, there was no assurance that they could be had until the close of 1864. We were advised that unless the books were ready the work would not be done, and the returns which are annexed are all that have been received up to January, 1865, being from *twelve counties*, only a portion of which are complete. If the transactions were printed and ready for delivery in September, as they formerly were, there would be little difficulty in obtaining competent persons to take the statistics as provided in the law; many suggestions have been made as to changes in the provisions of the law, substituting money for books, and placing the work in the hands of Trustees of school districts, or with the town assessors. The whole matter is submitted for the consideration of the Legislature.

To show what might be done, if the statistics were properly taken, we give the summing up of Steuben county for the year 1864, which is complete, and is in addition to the statistics of 1863 given in the annexed list:

Total value pasture and meadow lands	$2,146,174 00
Cereal crops	2,021,824 00
Root crops and peas and beans	427,537 00
Hay	18,150 00
Tobacco seed	7,461 00
Tobacco leaf	5,662 00
Hops	4,482 00
Bees honey	46,430 00
Bees wax	5,657 00
Neat cattle	30,040 00
Beef cattle	138,450 00
Dairies	1,139,688 50
Market gardens	10,084 00
Swine	829,621 24
Sheep	831,937 70
Poultry	58,470 47
Fruit crops	141,996 42
Horses	214,452 50
Sugar and syrup per year	42,356 00
Syrup	9,497 00

Grand total of all the agricultural industry of the county—$9,082,005.63 for the year 1864.

It will be seen by an examination of these returns, that should every county secure an annual return like the above, our farmers would very soon learn what crops would be most advantageous, what departments of industry most remunerating, and govern themselves accordingly.

B. P. J.

TENTH REPORT

ON THE

NOXIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK.

By ASA FITCH, M. D.,

ENTOMOLOGIST OF THE NEW YORK STATE AGRICULTURAL SOCIETY.

INSECTS INFESTING GARDENS.

14. Cucumber-beetle, *Galleruca (Diabrotica) Americana*, Gmelin. (Coleoptera. Gallerucidæ.)

Boring in the roots of the cucumber, melon and squash, and causing the vines to wilt and die; small, slender, white worms, black at each end; passing their pupa state underground and producing oblong, bright, lemon-yellow beetles, a quarter of an inch long or somewhat less, with black heads and three black stripes on their wing covers, which are common in the garden, gnawing the stalks, leaves and flowers of the same plants.

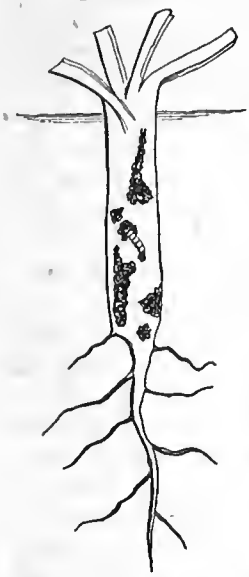
Decidedly the worst insect in our gardens is this yellow striped Cucumber-beetle, or "Cucumber-bug," as it is commonly but less correctly called. Hitherto this insect has been known to us only in its perfect state, gnawing the stalks and eating the leaves of the cucumber vines; and it is hereby so pernicious that it has all along been ranked as one of the greatest pests in the gardens of this country. Now that I have discovered what the larva of this beetle is, and thus find that it is more destructive and more difficult to contend against in this its young and growing state than it is afterwards when it has attained maturity, this insect assumes an importance it has not before been supposed to possess, and is left without a compeer in the garden in the depredations it commits and the vexatious losses which it occasions.

Early in the season, upon our first planting of cucumbers, melons and squashes, it frequently happens that particular hills of one and another of these seeds do not sprout so as to make their appearance above the ground, and we conclude the seed is bad, and very likely the next time we see the merchant from whom we purchased it, we berate him for imposing a worthless article upon us. It is an undoubted fact that in hundreds of instances

our seedsmen are censured for the bad quality of some of their seeds, when the particular kinds complained of have been perfectly good, but have failed to grow from some hidden and unsuspected cause—underground insects being one of these causes of failure, and a much more common one than is usually supposed—they, like the "worm i' the bud," nipping the tender growing point of the seed as soon as its germination commences, hereby totally destroying it.

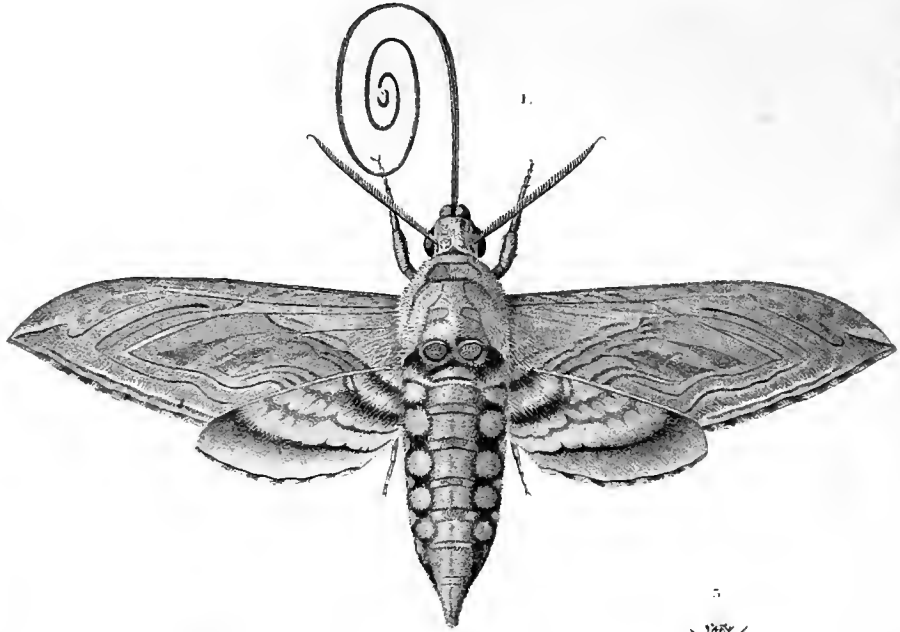
In other instances we notice our vines to be coming up nicely from the ground. Being thus measurably relieved from our solicitude respecting them, it may be we for a few days omit to visit them, when, on going to them, we are surprised to find that every plant has strangely disappeared from particular hills if not from the entire plantation, and the ground is as bare as when we first covered the seeds with the hoe. We thereupon hasten to replant all the vacant hills, little suspecting we are hereby providing the same enemy who occasioned the destruction in the first instance with another instalment of food, to favor him in growing up to maturity. This second planting most probably shares the same fate with the first, if the seed is even permitted to sprout from the ground. And on coming thus to learn that some hidden enemy is probably lurking about that particular spot, we abandon it and plant elsewhere, and thus succeed in obtaining a late crop.

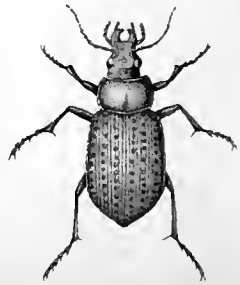
Finally, when our vines have escaped these calamities to which they are first liable, and are growing thriftily and are beginning to bear their fruit, a particular plant is discovered to have the leaves drooping and wilted through the whole length of the vine and its branches, and in a day or two after, it is all dried up, faded and dead. Ere long another vine in the same hill follows it, and perhaps another. I knew an instance some years ago in which all the vines in a garden withered and died one after another in this way, in a short time. On examining a vine which is thus drooping, no wound or other injury is anywhere visible upon the stalks or the leaves, and we therefore become assured the malady must be seated in the root, and on coming to inspect this part we immediately discover the cause of the disaster. The root is found to be irregularly eaten in spots and pierced with small holes, and its central pith is more or less consumed and spongy, with one or more worms, the authors of the mischief, lurking within it.



Cucumber root as bored by larvæ of the Cucumber-beetle.

The accompanying figure represents a root of the cucumber or melon of the natural size and structure. In these plants a thick, succulent, cylindrical root extends straight downwards an inch or two into the ground, when it becomes abruptly narrowed into a slender tapering rootlet of a more firm and leathery texture, the small fibrous rootlets being given off laterally from this tapered





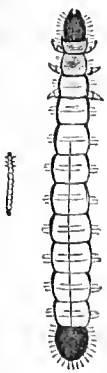
INSECTS, PLATE [illegible].

(*Moth of Cut worm &c*)

Lith of C Van Benthuysen, Albany NY

portion. It is the thick succulent part between the small fibrous rootlets and the surface of the ground in which this larva works, gnawing its surface in irregular spots of various sizes, as represented in the figure. Sometimes holes are bored directly through the root, transversely. More commonly, especially when the root is young and tender, the worm works in the centre, consuming the whole length of the pith from the surface of the ground downward to the tapered part. Sometimes only a part of the pith is destroyed. One young plant on being carefully taken up and examined, was found to have an inch in length of its root all eaten away, only the bark on one side remaining, rough and ragged, and almost severed at one point; whilst on each side of this eroded space all the central portion was consumed, downward to the slender rootlets, and upward, extending above the ground to the seed leaves, only the outer bark remaining. On removing the earth from around the root of a withering plant, a worm will sometimes be discovered lying on its outer surface, which immediately hides itself by crawling into some one of the holes in the root. And on dissecting the root, from one to a half-dozen worms are found inside, scattered about at different points. Moreover, when recently planted seeds are beginning to germinate, if the growing point which they send out chances to be found by one of these worms, it is devoured with avidity, and the worm entering the seed continues to feed upon the inclosed meat until this also is consumed. I have thus found them in several instances nestled inside of the large seeds of the squash.

The LARVA is represented in the annexed cut, greatly magnified, the small figure on the left side showing its natural size and appearance. It is a soft, slender, cylindrical worm, slightly tapered towards its forward end. It is of a dull white color, with the head and the last segment of the body black. Frequently some tawny yellowish stains are seen here and there upon its surface, some of which form traces of a stripe along the middle of the back. When crawling it is more elongated and more distinctly tapered anteriorly than when it is at rest, and it then measures 0.30 to 0.35 in length. It is composed of thirteen segments, faintly marked by impressed transverse lines at the sutures. Its head is but half as wide as the broadest part of the body, and is longer than broad, of a short oval form, flattened, and held obliquely downward and forward, with its base sunk into the first ring of the body. It is of a horny texture, polished and shining, coal-black or sometimes black-brown, with minute bristles scattered over its surface. The neck or second segment is shorter than any of the other segments, broader than long, stained with brown above, its anterior end concave for receiving the base of the head, and its underside bearing the first pair of feet. The segments of the body are nearly as long as wide, each having a small tubercle in the middle upon each side, which tubercles are broad, flat, and but slightly elevated from the surface, and are frequently made more distinct by being of a pale tawny color. Three fine

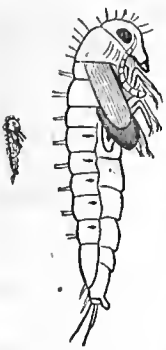


Larva of the Cucumber-beetle.

short hairs are also given out upon the middle of each side of the segments. The last segment is nearly the size of the preceding one, flattened and bluntly rounded at its end, polished and shining, usually black, but sometimes brown with the margin only black. On its underside this segment is white on its basal half, and bears a short large teat-like projection which is the anal proleg. Three pairs of short robust legs are placed anteriorly upon the under side of the three first rings.

When this worm is crawling over a smooth surface, it moves curiously, the fore part of its body advancing slowly but continuously, whilst the hind part alternately halts and hitches forward suddenly, step by step. In other words, the legs are constantly in motion, carrying the anterior end of the body along without any pause, whilst the hind end is held by the proleg at its extremity and only advances when it becomes stretched, when it gives a long stride forward and again halts, progressing about the twentieth part of an inch at each step.

When it is done feeding the worm forsakes the root and forms a little cavity underground, by turning itself around and around in the same place and crowding the dirt outward until it becomes compacted on every side of it, forming a little lump of such firmness that it will not crumble or break asunder from any motion given to the earth around it by the hoe or the plow. Inside of this cell the worm throws off its larva skin and becomes a pupa. Under this form it appears as represented in the adjoining cut, the small figure on the left hand side showing its natural size.



Pupa of the Cucumber-beetle.

The PUPA is 0.28 long and scarcely a third as broad, soft and flesh-like, of a white color tinged with yellow, with the first segment of the thorax sulphur-yellow. It is thickest anteriorly, tapering, conical, and bluntly rounded at the tip, the head and thorax and also the hind end thinly bearded with minute erect bristles of a tawny color, and each segment of the body having a transverse row of very minute hairs upon the middle of its back. The eyes are large, slightly protuberant, black and glossy. The antennæ, legs, wing-covers and wings are enclosed in separate sheaths, which are free and not at all adherent to the body. The wing sheaths are broader than those of the wing covers and project beyond them, and are of a smoky black color. Each suture of the back is marked by a blackish line, and the knees and feet are dusky. The tip of the body is furnished with a pair of small slender black sharp pointed spines.

A squash root containing six of these cucumber worms I inclosed in a jar of earth, and upon examining it three weeks afterwards, some of the cells which the worms had formed in the earth were found to contain pupæ and in others the fully formed beetles were lying in a quiescent state. As the worms might have been occupied some days after they were inclosed, in feeding and in forming their cells before they changed to pupæ, I infer they remain in their pupa form about a fortnight. What length of time the larva is occupied in feeding and getting its growth I have as yet no criteria from which to judge.

When this insect throws off its pupa skin and first appears in its perfect form, it is of a white color, the thorax only having a tinge of yellow; the three black stripes upon its wing covers however are then distinct and perfect in every respect. It is very soft and flaccid, and remains quiescent in its cell without any motion or sign of life, I think for several days, to allow the superabundant juices of its body to evaporate and its several parts to acquire sufficient firmness and strength to permit their active exercise. At length, sudden as though it had been touched with a shock of electricity, it awakes into full life and vigor, and with its feet and jaws it briskly attacks the walls of its prison, breaking an opening through them, and scrambles upward out of the loose surface earth of the garden and runs fleetly away, joyously exulting in its newly acquired life and liberty. One of these beetles which I confined in a vial upon its first coming out of its pupa cell lived without food until the fifth day after, vigorously gnawing the cork stopper of the vial in an effort to open a passage out for itself, and making therefrom a large quantity of chips like sawdust. During all this time its wing covers remained pure white, which leads me to think that it is only after the beetle has been feeding that its fluids obtain the coloring matter which gives it the bright yellow dress in which we are accustomed to see it clad.

The Cucumber BEETLE is glossy and shining, of a bright pale lemon-yellow color, varied with black. It is rather more than twice as long as wide. The females are larger than the males, measuring nearly or quite a quarter of an inch in length while the males are scarcely two-tenths of an inch. The *head* is narrower than the thorax, into which it is sunk to the eyes. It is of a coal-black color, including the mouth and palpi or feelers. On the middle of the forehead, is a deep round impression. The face is clothed with a minute beard, the hairs inclining downward. The eyes, occupying the sides of the head, are large, protuberant, and roundish oval. The antennæ are two-thirds the length of the body, slender, thread-like, minutely bearded, eleven-jointed, black with the three first joints yellowish white and somewhat hyaline. The first joint is longest, nearly thrice as long as thick, thicker towards its apex, where is a large black spot on the upper side and another one opposite on the under side. The second joint is smallest, egg-shaped with the larger end outward, and has also a black spot on its upper and another on its under side. The third joint is twice as long as the second but similar to it in thickness and is slightly narrowed towards its base. The remaining joints are more thick and successively become a very little shorter as they approach the apex, each joint being slightly narrowed towards its base. The *thorax* is less broad than the wing covers, more wide than long and nearly square in its outline, with its forward corners rounded and each of its hind ones forming a right angle. On its upper side slightly back of the centre are two dilated impressions or little hollows, placed side by side and sometimes more or less confluent with each other. The scutel is small, black, smooth and shining. The *wing covers* when fully closed are oblong-oval in their outline, being slightly convex on the sides and cut off transversely at the forward end. Their surface is thinly bearded over with minute short erect hairs, and is traversed lengthwise by elevated smooth ribs and intervening furrows. The ribs are nine in number on each wing cover, the first one from the suture being the most slender and the second one broad-

est. The fifth to the eighth ones are run together at their anterior ends, forming an elevated smooth shining spot upon the shoulder. In each furrow is a row of close shallow punctures. The wing covers are also ornamented with three parallel black stripes. The middle one of these stripes is placed upon the suture, occupying all the space inside the second rib. It is narrowed posteriorly to an acute point which ends before it quite attains the tip of the wing covers. The lateral stripes occupy the fifth, six and seventh ribs and the intervening furrows, commencing upon the shoulder and terminating in an abruptly rounded end on the posterior declivity of the wing covers, distant from the margin. The wings are large, transparent and smoky brown. The *underside* is black and shining, with the fore-breast or throat light yellow. The surface is minutely punctured and covered with a dense fine grey beard. The *legs* are yellowish-white and translucent, with a close inclined beard. The knees are black, and also the anterior shanks, the tips of the middle and hind shanks and the feet. The feet are four-jointed, the first joint being longest, about twice as long as thick, and a third longer on the hind feet. The second joint is short, but little longer than thick. The third joint is shortest and very deeply cleft or two-lobed. The last joint is inserted between the lobes of the preceding joint, and is long, slender and curved, thicker towards its tip where it is furnished with a pair of sharp claws which are forked or double.

This beetle was described first in the year 1781, by Fabricius, in his Species of Insects, vol. i, p. 148, under the name *Cistela melanocephala* or the Black-headed Cistela. Eleven years afterwards he changed its place to the genus *Crioceris*, in which there was already a species bearing the same name, wherefore he was under the necessity of re-naming our insect, and accordingly called it the *vittata* or Striped Crioceris. Four years previous to this, however, Gmelin, in his edition of the System of Nature, vol. iv, p. 1715, had for a similar reason entered this same insect under the name *Cryptocephalus Americanus*. Authors appear to have overlooked this name of Gmelin, whereby our insect has come to be universally known under the name given it by Fabricius. But as the name bestowed by Gmelin has the unquestioned priority, I do not perceive any valid ground on which it can be set aside. This insect being so prominent as a depredator in our gardens here in America, whilst it is unknown in those of the old world, renders Gmelin's name quite appropriate; although on several accounts the Fabrician name would be the preferable one if the established rules of nomenclature allowed us any liberty of choice in the premises. Olivier, more correctly than his contemporaries, determined the true place of this insect to be in the genus *Galleruca*, where it has since remained. Chevrolat, however, in Dejean's Catalogue, has proposed a dismemberment of this genus, giving the name *Diabrotica* to the section in which our Cucumber-beetle falls. Although the divisions which he proposes have never yet been characterized that I am aware, they may very probably be eventually adopted, at least as subgenera.

These Cucumber beetles come forth from their winter retreats and begin to appear abroad here in the State of New York as early as the commencement of May, and correspondents at the South have sent me specimens which were there captured a month earlier than this. As there are no

cucurbitaceous plants sprouting from the ground until two or three weeks after this time, it is obvious they are able to subsist on some other vegetation when they cannot obtain their favorite food. I first meet with them each year upon bushes of different kinds along the borders of fields and meadows, in which situations they continue to be found during the whole season. They are particularly common in May on the different species of thorn (*Cratægus*), from whence I have thought that the flowers and leaves of these shrubs very probably furnish them with a portion of their sustenance at this early part of the season.

So soon as the cucumber and its kindred plants begin to push themselves up out of the ground in our gardens, these beetles commence gathering around them, hiding themselves from our sight in the cracks in the dried surface of the ground, which the plants make as they force themselves out of the soil, and there lurking unsuspected, dropping their eggs around the plants and feeding upon the tender young stalks and the seed leaves. I find in my notes the following memorandum under the date of May 29th: "For several days I have noticed my young cucumbers and squashes were drooping and badly gnawed. The only insects I could see around them were numberless garden fleas (*Podura*) and a few flea beetles (*Haltica*), and it was a query in my thoughts whether these were causing the injury. All the plants have disappeared from several of the hills. Early this morning I went to all the hills without discovering any enemy that I thought could occasion their sorry condition. A hill having two dozen plants, some just out of the ground and others bursting from the seeds, has every plant drooping and many of them so badly wounded they cannot recover. While looking at their sad plight, I happened to notice a yellow striped beetle crawling out of a crack in the ground. He was instantly killed, and in disturbing the dirt in killing him two other beetles crawled up into sight. And now upon carefully examining, I found upwards of fifty of these beetles lurking there, just under the baked crust of the surface, wholly hid from view, nibbling and glutting themselves with the young tender leaves just beginning to push up from the seeds into daylight. I made out to pinch and kill every one of the villains, just as they were awaking apparently from their night's slumber. And now on opening the cracks in the ground at the other hills, I found from half a dozen to a dozen of these beetles at each of them. They evidently prefer the youngest, tenderest plants, to those which are more advanced."

As is well known, these beetles continue to infest the plants during the whole season; but after the stalks begin to shoot out into running vines, they are so robust and vigorous as to withstand the wounds they continue to receive from these insects. The texture of the plants has now become so firm and woody that the beetles only relish their most tender and succulent parts, such as the flowers and the leaves, particularly any leaves which are sickly and drooping.

In autumn these Cucumber-beetles are quite common upon the flowers of the golden rod, to which they are probably attracted to feed upon their pollen and petals. They are among the last insects which withdraw into

their winter quarters, some of them continuing abroad into the month of October.

On the subject of remedies, I may remark that these Cucumber-beetles being very shy and timerous, any new and unusual appearances about the cucumber hills may cause them to forsake them in some instances, when in others they will have no effect. Hence many of the remedies which have been proposed are of but slight efficacy and wholly unreliable, such as dusting the plants with ashes, snuff, plaster, &c. A few years since I noticed the following statement in one of our most respectable agricultural periodicals: "Charcoal a cure for the striped bug. It may be implicitly depended upon. Dust it on from a sieve or coal sifter. If the rains wash it off, put it on again. We have used soot with good effect, but recommend charcoal dust on the strength of the most reliable personal testimony. There is no humbug in it." As I had just then discovered that my vines were invaded by the Cucumber-beetle, I resolved to test the efficacy of this substance, and some other remedies. The history of the experiments thus made are briefly stated in my notes, as follows:

"June 16th. I dust powdered charcoal thickly over a hill of cucumbers, a hill of squashes and a hill of citrons. Another hill of squashes I turn up the leaves and dust their undersides with all the charcoal powder their hairs will hold.

I dust powdered soot thickly on another citron and a squash hill.

I dust ashes on another hill of cucumbers, all that will adhere to the hairs on the under and upper surfaces of the leaves and on the stalks.

I put a box (open at the bottom and top) around a cucumber hill and another around a squash hill—to observe which of these several measures is the most efficacious. Other hills are remaining without anything applied to them.

June 17th. On going to the patch of vines at noon, I find the beetles as numerous on the hills dusted with charcoal and with soot as on those not dusted. I notice one beetle crocked over as black as any son of Vulcan, and still wallowing and crowding around upon a leaf thickly covered with the charcoal dust. The hill on which I dusted the underside of the leaves appears to be no better protected thereby than the others. No beetles were on the hill dusted with ashes. One was found in one of the boxes.

June 18th. The hills dusted with charcoal and with soot continue to have several beetles upon them, and two were on that dusted with ashes. The boxes certainly are the most efficacious, there being no beetles in them, while but for them there would have been a dozen no doubt, on each of these two hills."

For more than twenty years I have made use of boxes, finding them a most reliable protection against these beetles. And placed over the hills soon after they are planted, whereby no beetles can get to the young plants to drop their eggs around the roots, I am inclined to think will be one of the most efficacious methods of saving the roots from being attacked by the larvæ. But our knowledge of these larvæ is as yet too imperfect to enable us to speak with confidence respecting measures for combatting them.

15. THREE-LINED POTATO-BEETLE, *Crioceris (Lema) trilineata*, Olivier. (Coleoptera. Crioceridæ.)

Eating the leaves of the potato in July and August; small yellowish worms with black heads and feet, in clusters on the underside of the leaves, wet and coated over with slimy filth; passing their pupa state under ground and producing oblong bright tawny yellow beetles a quarter of an inch long and having three black stripes on their wing-covers.

In the central parts of our State this past year (1864,) in the fore part of July, public attention became directed to a worm which was discovered eating the leaves of the potato vines. It was found to be quite common all over the potato fields, and excited considerable alarm. Having never been noticed before, it was thought to be a new enemy, which it was greatly feared would multiply and seriously damage this important crop. Accounts of it were published in some of the local newspapers, and a correspondent of the *Rural New Yorker* having transmitted specimens of it to that periodical, they were forwarded to me for information, coming to hand July 17th. These specimens being of a soft worm, and pressed in a paper envelope, were too distorted, dried and faded, to show definitely what particular species they were. An inspection of them, however, in connection with the information gathered from an article in the *Fulton* (Oswego Co.) *Patriot* under date of July 13th—to the effect that these potato worms resided on the underside of the leaves, and were "from a fourth to a third of an inch long and an eighth of an inch thick, red orange with a black head and six black legs on the forward half of the body"—led me to infer with considerable confidence that they were the larvæ of the Three-lined Potato-beetle, which occurs, more or less common every year, in the potato fields all over our country; though they might perhaps be the similarly shaped and colored larvæ of the fearfully destructive Ten-lined Potato-beetle of the West, newly introduced into our State in some unknown manner. An article embodying these facts and giving such a description of these two insects as would enable any one having either of them before him, to determine which species it was, was thereupon published in the *Rural New Yorker*. The public anxiety appeared to be immediately abated thereby, as I have heard nothing further of these worms.

Of the injurious insects which are constantly present in our potato fields, this Three-lined Potato-beetle is the most important. Living as it does, at the expense of one of our most valuable field crops, its history and habits merit to be generally known, although fortunately for us it never becomes so greatly multiplied as to occasion any serious injury.

These beetles begin to be seen abroad each year about the middle of May. Dr. Harris states (Treatise, 2d ed., p. 105) that the larvæ in autumn go into the ground and there remain during the winter in their pupa state, to give out the perfect insects the following spring. But, as I have found these beetles torpid under boards lying on the surface of the ground, as early as the 20th of April, I infer that it is in their perfect state that they pass the winter, like the Asparagus-beetle and other kindred species. The first individuals which I have met with abroad, in different years, have been upon the leaves of bushes and trees in the woods, from which it

would appear that they resort to the forests for a more secure shelter during the winter than they are able to find in the open fields. For a few weeks at the commencement of the season they sustain themselves upon whatever vegetation they meet with that is most palatable to them. About the middle of June, when the potato tops are become considerably advanced, they begin to gather upon them, and there take up their abode for the remainder of the season, feeding upon the leaves and eating large irregular holes in them, and ere long commencing to drop their eggs upon them.

The Eggs are of an oval form with the ends bluntly rounded. They are four hundredths of an inch long and scarcely half as thick, of a vitelline or golden yellow color, their upper end often showing a brown stain. They are smooth and glossy, being, for some time after they are deposited, coated over with a glutinous fluid, whereby they adhere to any smooth surface and leave a yellow stain upon it. They occur in clusters of some six to ten in number, placed irregularly, sometimes on the upper but oftener on the under side of the leaf, loosely adhering thereto and to each other by the glutinous fluid just mentioned, which, becoming dried before they hatch, glues them firmly in their several positions. I have sometimes met with clusters in which several of the eggs were destroyed, only their transparent shells remaining, empty and shrunken, their contents having been sucked out, no doubt, by the larvæ of some of the Golden-eyed flies (*Chrysopa* genus,) which flies are frequently met with in potato fields.

The eggs have been stated to hatch in about a fortnight, the larvæ from them taking up their residence on the underside of the leaf where they will be hid from view and shaded from the rays of the sun. They here commence feeding, usually at the apex of the leaf, but sometimes on one side. When engaged in feeding they stand regularly in a row, side by side, with their heads at the edge of the leaf. When their meal is finished they draw slightly back and are then huddled irregularly together. When they have consumed a fourth part of the leaf or thereabouts, they commonly migrate to another part of the stalk, taking up their abode on a leaf there, until they have consumed a similar portion of it. As they approach maturity they are less inclined to remain together in society, many of the larger worms being met with scattered about singly, whilst others are found associated, two, three or more together. And they now remain upon a particular leaf-stalk, frequently until they have consumed all or nearly all of the foliage growing from it.

The Larvæ are soft slug-like worms of an oval form, thickest back of the middle and very convex on the back. They are transversely wrinkled from impressed lines at the sutures and a more shallow impression on the middle of each ring; and low down on the sides are rounded tubercular elevations which have a minute beard. When young they are of an obscure olive yellow color, becoming brighter yellow as they approach maturity, a faint stripe low down on each side and embracing the breathing pores being clearer yellow than any other part of the surface. They are glossy and shining, more or less, as their bodies are wet or dry. Along the middle of the back is a black pulsating line, with a yellow stripe bordering it on

each side, and next to these stripes a dusky cloudiness is perceptible, forming a broad stripe upon each side, at least on the anterior part of the body. The head is about as broad as the first ring of the body, from which it is separated by a deep and widely constricted neck. It is flattened-spherical, smooth and polished, and of a coal black color. The first ring is black above, cut across in the middle by a pale longitudinal line. The three pairs of legs are glossy black, and are placed anteriorly, on the three first rings. Back of these, on the underside of each of the other rings of the body are two retractile tubercles serving as pro-legs. When fully grown the larva is over three-tenths of an inch in length, and is twice or thrice as long as wide, its dimensions varying very considerably as it is elongated and in motion or contracted and at rest.

These larvæ are commonly wetted over with a glutinous fluid which is copiously secreted from their skin. The most singular trait in their economy, however, is their habit of covering themselves with their excrement. The orifice from which this excretion is voided, instead of being placed at the tip of the last ring of the body as in all other insects, opens upon the upper side of this ring, forward of the tip, and in a direction to project the feculent matter forward upon the surface of the back. And the glutinous fluid with which the skin is wetted holds this feculent matter to the back, and at the same time prevents its drying and adhering to the skin. Thus it is by degrees pushed forward and molded to the convex surface of the back until it nearly covers it, like the shell with which the tortoise is covered. The larva is able to cast off this covering, at will, and renew it again in a few hours' time; and these cast off masses of excrement may frequently be noticed upon the potato leaves. The clusters of these worms being so wet and slimy and coated over as they are with this excrement present a most filthy and disgusting appearance.

Several of the foreign species of this genus, when in their larva state, have this same habit of covering their backs with a layer of slimy excrement. For what purpose do they coat themselves in this nasty manner? Writers generally have supposed it was to protect their soft tender bodies from the heat of the sun. This idea is naturally suggested from seeing these larvæ as we so frequently do, upon clear summer days when the warmth is quite oppressive, the wet with which they are covered giving them an aspect of such refreshing coolness. But there is reason to distrust the correctness of this opinion. These larvæ on the potato vines are always stationed on the underside of the leaves where they are shaded from the direct rays of the sun, and are elevated but a foot or two from the earth, the humidity arising from which keeps the atmosphere constantly cool down among the mass of foliage where they reside. On cool cloudy days they cover themselves with this excrement the same as on hot sunshiny days. Upon a cloudy day in July, when a north wind had reduced the temperature below sixty degrees, I removed its coat from one of these larvæ; and although there was no sunshine and no warmth or dryness to the atmosphere to induce it to renew its coat, it nevertheless did renew it, as I found on returning to it some time afterwards. Moreover, upon some of the hottest days of summer, when they should most need this protection, one and

another of these larvæ may be seen with their skins dry and destitute of this coating, yet without manifesting any uneasiness or discomfort from the privation. These considerations induce us to regard this opinion as not being well founded. Another supposition of authors, namely, that this coating serves to protect these larvæ from being devoured by birds, is probably correct, as no bird will be apt to relish a worm which is thus covered with filth.

The larva having attained its growth, it descends into the ground to repose during its pupa state, and there forms for itself a small oval cell, the walls of which are made firm and smooth by being wetted and plaistered over with a white frothy substance which the worm ejects from its mouth. A full grown larva which I had inclosed in a small box was discovered the next day to have cast off its wet filthy coat, and to have commenced inclosing itself in a cocoon, which it was forming upon the bottom of the box, from white froth which it was giving out copiously from its mouth. This froth was full of little air bubbles at the place where it had just then been emitted, but elsewhere it had become more dried and condensed, resembling the pulp of paper. Herewith the worm had then built a wall around itself, in the form of an oval ring, about the tenth of an inch in height. Two days after it was found to have completed its cocoon, which was of an oval shape, measuring 0.35 by 0.20, its external surface uneven, white, pliant and yielding, but afterwards becoming dry and hard.

I have not fed and reared this insect to observe with accuracy the time it requires to pass through its several forms and complete its growth. Dr. Harris states that the eggs are about a fortnight in hatching, that the larva gets its growth in about another fortnight, and that it remains a fortnight more in its pupa state. As these are the same periods which are given in books as occupied by the European *Crioceris merdigera* in obtaining its growth, we are in doubt whether Dr. Harris's statements are made from actual observation or are inferences derived from the analogy furnished by that species.

The insect at length emerges from the ground in its perfect form, a totally different creature in every respect from what it has previously been, save only that it still continues to subsist upon the potato leaves. It is now a bright shining, prettily colored beetle, so clean, so neat and tidy in its appearance that it would not be suspected of having been such a filthy, groveling, repulsive creature as it was in the days of its youth. On cloudy, cool days, these beetles remain at rest and concealed from view down among the foliage of the potato fields. It is on pleasant, sunshiny days that they are observed, standing here and there upon the leaves. They are shy and timorous, taking wing as you come near them, and flying a few yards away and again alighting. When annoyed or in distress, they make a peculiar creaking sound, by rubbing the tip of the abdomen briskly up and down against the hind end of the closed wing-covers.

It has been reported that there are two generations of these insects annually, the beetles coming abroad early in June and again towards the

end of July and early in August. But they are certainly present in the potato fields throughout the season, as are also their larvæ, at all the different stages of their growth. It is evident, therefore, that they are not periodical, but are continuously coming forth, one after another, and depositing their eggs, from the commencement of their operations in June until the chilly nights of autumn suspend their work.

This insect is closely related to the Asparagus-beetle, the history of which was given in my Eighth Report. And I have deemed it unnecessary to present figures of this beetle and its larva, as they would be little else than repetitions of the illustrations heretofore given of that insect.

This Potato-beetle received its scientific name, *Crioceris trilineata*, upwards of sixty years since, from M. Olivier, who described it, first in the Encyclopedie Methodique, vol. v, p. 203, and subsequently in his Entomologie, vol. vi, p. 739. This celebrated author appears to have been overlooked by Mr. Say, who has redescribed this species under the name *trivittata* (Jour. Acad. Nat. Sci., vol. iii, p. 429). And M. Chevrolat has still later described one of its varieties as a distinct species, under the name *immaculicollis*.

This BEETLE measures a quarter of an inch in length, the female being usually a trifle larger than the male. It is oblong, being rather more than twice as long as wide. It is convex above and beneath, with its opposite sides parallel and the thorax a third narrower than the abdomen and wing covers. It is glossy and shining, of a bright, tawny, yellowish red color, varied in places with black. The *head* across the eyes is almost as wide as the thorax. It has a transverse groove immediately back of the eyes, and another between the eyes above the base of the antennæ, and the front between these grooves is marked by three impressed longitudinal lines. The face between and below the antennæ is often paler yellow and is finely punctured and bearded with short hairs inclining downward. The eyes are protuberant and black, and have a conspicuous notch on their fore sides. The antennæ are about half as long as the body, thicker towards their tips, eleven-jointed, the joints very distinct, longer than thick, widening towards their tips, where they are furnished with a crown of short minute hairs. They are opake brownish black, with the three basal joints shining, the first joint being thicker than the following ones, globular and orange red. The second joint is smallest and shaped like a top. The apical joints are nearly cylindrical, the last one being at its tip abruptly tapered to a blunt point. The *thorax* is as wide as long. Its sides have a strong notch or constriction in the middle, forward of which they are regularly rounded, and back of which they are widened to the base. On the back are some scattered punctures, and towards the base is a shallow transverse groove, having in its middle a large impressed puncture. On each side of the back slightly forward of the middle is a black dot, usually of a large size but sometimes small. The scutel is quite small and black. The *wing covers* are lemon yellow and ornamented with three parallel black stripes. The middle stripe is placed upon the suture and gradually narrows backward to a slender line, which ends before it quite reaches the tip. The lateral stripes are broader, are placed slightly inside of the outer

edge, and terminate abruptly before they reach the margin. The wings are hyaline and smoky. The *underside* is bright tawny yellowish-red with a short black line on each side of the hind breast at the edge of the wing covers. The breast and abdomen are minutely punctured and bearded with short fine hairs. The thighs are of the same color as the underside of the body, and are furnished with a few scattered hairs. The shanks are also yellowish red on their bases and along their inner sides nearly to the tip, the rest of their surface being black, and they are clothed with a fine dense beard. The feet, too, are black with gray cushions on their soles. They are four-jointed, the two first joints being triangular and the third deeply divided into two lobes, between which is inserted the fourth joint, which is polished, long and slender, thicker towards its end, where it terminates in two short sharp-pointed claws.

Individuals of this species occur, which vary in some points from the description now given. The most common variation is in the ground color of the wing covers, which is frequently rich orange, only the outer margin, including all below the lateral black stripes, being of the ordinary pale lemon color. And in these instances there is a tinge of pale greenish-yellow along the edges of the black stripes. Though the variation now spoken of is very manifest in the living insect, it disappears after death, whereby it cannot be discovered in the dull and faded specimens of the cabinet.

But the most important differences occur in the black dots upon the thorax, which present us with the following varieties:

Variety *a*, *immaculicollis*, Chevrolat, having the thorax destitute of any traces of the two black dots.

Variety *b*, *unipunctata*, having one of the thoracic dots present and the other wholly obliterated.

Variety *c*, *tripunctata*, having an additional black dot, placed on the middle of the thorax in a line with the other two.

Of these varieties the first is rather common and the other two quite rare.

These beetles are not limited to the potato, but are equally common upon the stramonium and some of our other plants pertaining to the Natural Order Solanaceæ. Their yellow color and the three black stripes on their wing covers give them a marked resemblance to the well known Cucumber-beetle described in the preceding pages, which, however, is of a smaller size and has the head black, whereby it is easily distinguished from this its yellow-headed neighbor.

Although these beetles are more or less common every year in the potato fields throughout the United States, we have never heard of an instance where they have been multiplied to such an extent as to be severely injurious to the crop. If they should anywhere occur in such force as to be intolerably detrimental, their numbers may be readily diminished by passing along the rows of the potato vines and breaking off each leaf or leafless stalk on which a cluster of the worms is present, dropping it into the furrow in a spot where the ground is firm and hard, and drawing the sole of the boot over it, hereby crushing and destroying the filthy creatures. Dr.

Harris suggests "to brush them from the leaves into shallow vessels containing a little salt and water or vinegar." But, enveloped in slime and filth as they are, upon leaves which are so pliant and yielding, swaying aside on the slightest touch, it is quite impracticable to brush them off. Even when a leaf is immersed and swashed about in a basin of salt and water, diluted vinegar, or soap suds, I find they do not let go their hold, and can only be detached from the leaf by forcibly crowding and wiping them off against the brim of the basin. Even a feather dipped in coal oil and touched to them is little if at all regarded by them, further than to cause them to draw back and refrain from eating the leaf where it is wetted by this acrid fluid.

16. HOP-APHIS, *Aphis Humuli*, Schrank. (Homoptera Aphidæ.)

On the underside of the leaves of the hop, sucking their juices; small pale yellowish-green plant lice, sometimes in myriads, covering the upper surface of the leaves with their honey-dew, which afterwards becomes changed to a sooty black substance termed the black blight.

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, analagous 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 slighest 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 the 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, occuring 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 such specimens on exhibition at this time. Upon the first opportunity, I will procure and place in the Museum of our Society, specimens 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 opake, 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 observa-

tions. 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-aphis 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 phenomenon 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 the 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. F. W. Dogget, Esq., read a paper "Upon the weather in connection with Aphis Blight and the growth of Hops," before the London Meteorological Society, Nov. 28, 1854, a report of which we meet with in the Gardener's Chronicle of that year, p. 829. Mr. Dogget found, on comparing the fall of rain each month for a period of thirty-eight years, that "the years in which an excess of rain had fallen in or about the three months ending in September of *the previous year*—the three following months and the March following being both comparatively deficient in rain—were followed by a short crop of hops, arising from the Aphis blight; and on the contrary, when the quarter ending Septem-

ber of the previous year had been dry, an average or large crop had been grown. And when the quarter ending September had been wet and the December quarter very wet, a like result had followed." This, however, was found to be modified by the temperature. "When the weather of the previous year has been such as to indicate a blight, there may be partial recovery, if the temperature succeeding should bo hot,"—"with few exceptions, all the small crops were grown in years in which the temperature of the three summer months was below the average, and the large crops were produced in years in which the temperature of the like period was high."

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 hop 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 our 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 at present possess any definite information.

This aphis appears to be identical with that which has long been known in Europe as the worst enemy to 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.)

The young lice, or "nits," are of a watery yellowish-white color with black eyes. As they arrive at maturity they acquire a green hue. They moult a few times, whilst attaining their growth, and their white cast skins are numerous, adhering to the hop leaves and intermixed with the honey dew.

The flies or perfectly formed winged lice are green with the back of the thorax and the breast black. The abdomen or hind body has black bands upon the back and along each side is one or two rows of black dots. The legs are

pale yellowish, with the feet and the ends of the thighs and of the shanks black. The antennæ nearly equal the body in length and are black except towards their bases. The honey tubes are rather long, slender, and blackish towards their tips. The wings are transparent, with the stigma of a greenish gray color and the veins brown.

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 account of its habits and operations, as its importance merits. I therefore present the following history of the annual career which it runs, from an admirable article on the Hop, by J. M. Paino, Esq., in Morton's Cyclopedia of Agriculture, vol. ii, p. 55.

"The great destroyers of the hop crop, the Aphides, or long-winged flies, usually make their first appearance about the middle of May; fresh detachments often follow up their first incursion, throughout the whole summer.—Whence they come is at present a mystery; for, contrary to the vulgar opinion, the insects in the spring are viviparous; but if in the autumn visitation, when the flies are very different in external appearance, there is a change also in their economy, and they become oviparous, some of the existing difficulties will be cleared up, and this would account for certain phenomena, and their consequences, which we have often witnessed, but could not explain, excepting on this hypothesis.

"As soon as the aphides settle upon the hops, they suck the under side of the leaves, and immediately deposit their young—the aphis louse. The lice, too, are viviparous, and they 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 fly; indeed upon one hill of hops millions of lice are born and die, neither parents nor progeny having ever attained the condition of a 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 midsummer, 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 last; 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 plantations is most offensive. In an early blight, however, we have many instances recorded of extraordinary recoveries; for 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 especially 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. The condition of the plant, therefore, is never hopeless, however severe the attack may be, provided there is time for it to put forth its lateral or fructifying branches. We know also several instances in East Kent which occurred in the same year, when the planters sold their own 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 thirty to fifty pounds per acre.

"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 under side of the upper small leaves of the bine, 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 bine, so that the leaves assume a sickly brown hue, and curl up, and the bine itself ceases to grow and falls from the pole, the lice continuing till they perish for want of food; and thus, without the intervention of a favorable change, the crop is destroyed, and the grower may often consider himself as 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 decline and disappearance of these plant-lice is greatly expedited by other insects which destroy them; and in many instances it appears to be 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 aphis.

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 destoyers 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.

One of our most intelligent and successful hop growers, F. W. Collins, Esq., Morris, Otsego Co., informs me that he has five acres planted to hops. In 1863 the aphis appeared in his vicinity in such prodigious numbers and with such disastrous effect, that some of the yards around him were not picked and the best yards were much injured. But he had an excellent crop. And last summer, although the severe drouth diminished the yield of his vines, the quality of his crop was excellent whilst that of neighboring yards was poor. His success these two disastrous years, he is perfectly assured was due to birds. A large flock of barn swallows, to the number of several hundreds, have their residence near his hop yard. These swallows were flying about the vines continually. It could have been nothing but these insects that attracted them there. And by feeding freely upon them, as he is sure they did, they kept them so thinned and limited in number, that his crop has escaped injury.

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 aphis 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 infested 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 aphis 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 canvass 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.

17. BARBERRY-APHIS, *Aphis Berberidis*, Kalt. (Homoptera. Aphidæ.)

On the underside of the leaves of the barberry, through the summer, clusters of pale yellow and green plant-lice, each marked on its back with a black or dark green elliptic ring.

The barberry shrub (*Berberis vulgaris*, Linn.) is currently regarded as a native of the northern hemisphere in both the eastern and western continents. In Europe DeCandolle remarks of it that while in northern latitudes it is a valley plant, at the south it becomes exclusively a mountaineer, being on Mt. Etna the most alpine shrub of the sterile belt of that mountain, at the height of 7,500 feet. Here in America it appears under analogous circumstances, growing wild in the neighborhood of the sea coast in New England and New York, and upon the Alleghany range of mountains in Virginia and onwards south, although by some botanists the mountain shrub has been regarded as a species distinct from that of the sea coast. Spontaneously springing up so abundantly as it does in waste grounds of the maritime districts here at the north, it is rather remarkable that we do not meet with it growing wild in the interior of the country also, since at the south it occurs at a distance from the sea shore. But in all the inland portion of our State we only see a bush of it here and there, where it has been planted by the hand of man. Although it is justly esteemed as an ornamental, and is of some account also as a useful shrub, it is but little cultivated with us, the old prejudice that it blasts any grain which is growing near it, causing it to be distrusted and shunned. We therefore only meet with examples of it sparsely scattered at intervals usually several miles apart. Under these circumstances it is little liable to be discovered and preyed upon by any insect enemy. It accordingly is one of the most thrifty and cleanly shrubs which we have. During the extended period of my observations only one insect has made its appearance upon this shrub. Of this insect I here present the account.

A bush of the barberry planted in my yard before the commencement

of the present century, became infested with an aphis in the year 1846. How this insect came upon this shrub was quite a query in my mind. The nearest bush of this kind within my knowledge was two miles distant, with intervening hills, woods and streams of water. None of the insects appeared to acquire wings whereby it was possible for them to migrate and establish themselves elsewhere, until quite late in the autumn. And upon quite a thorough research which I was able to make, it did not appear that any insect of this kind had ever been noticed as occurring upon the barberry in any other part of the world. Under all the circumstances I was in doubt whether this insect could have come to this bush from some distant bush of the kind in the country around it, or whether by some peculiar condition of the atmosphere or other agency it might not have been spontaneously generated upon the shrub.

In the year 1851, in my Descriptive Catalogue of New York Homoptera, published in the Fourth Report of the State Cabinet of Natural History, page 65, I inserted this insect as a new species, under the name *Aphis Berberidis*. I soon after discovered that this name had a few years previously been given to a European species, by Kaltenbach, in his Monograph of the Plant-lice, page 95—a work which I have not seen. But from the information which I obtain from Koch (Aphiden, p. 30), and Walker (List of Homopterous Insects of the British Museum, p. 996), I entertain no doubt that the European *Aphis Berberidis* is identical with the insect to which I had given the same name in this country.

This insect continued to infest the same bush until the year 1855, when it failed to make its appearance, and has not since returned. At no time did it become greatly multiplied, nor was the shrub perceptibly injured by it. From the full notes taken on repeated examinations made in different years, I prepare the following description of the insect in its different stages of growth and the course which it annually runs.

The Barberry-aphis is started each year from eggs laid in autumn and which have survived the winter. So late as the middle of November I have observed the winged females busily engaged in depositing their eggs. They place them in the most secure and best protected situation which this shrub furnishes. At regular distances along the slender straight stalks of the barberry are permanent buds forming thick stump-like projections bearing in summer a crown of leaves from their summits and armed on their outer sides with three formidable prickles, so sharp that neither bird nor beast will be apt to come near them. It is in the axils of these buds that the female drops her eggs. When first extruded the eggs are very glossy and bright yellow, but by exposure to the air and light they soon change to a brown and finally to a jet black color. They lie loosely, as many as can be heaped together in some of the axils, the roughness of the bark aiding in holding them. But their attachment is so slight and insecure that they nearly all become dislodged by the storms of winter and fall off and perish. Any which remain are quickened by the warm days of early spring, the young lice hatching from them as soon as the leaves are sufficiently expanded to shelter and nourish them. If but a single egg survives the

winter it amply suffices to start these insects, since all that hatch from the eggs are females.

The young lice which are disclosed from the eggs rapidly grow up to maturity, casting their skins a few times as they increase in size. They do not acquire wings, nor do they produce eggs, but bring forth their young alive. In two instances which I carefully observed, these wingless females gave birth to six young in twenty-four hours, two of these being born in the day time and four during the night. The female is usually stationed in the centre of the leaf on its underside, her head towards the base of the leaf, and her young are settled along the midvein, some of them behind but most of them forward of her. She sometimes remains thus until the under surface of the leaf is almost covered with her progeny. But it appears to be the common habit of the female to stay but a day or two upon a particular leaf. She then forsakes her half dozen or dozen descendants and wanders away and stations herself upon another leaf for a similar period of time, thus planting small colonies upon a dozen leaves or more before she has finished bearing and expires of old age. Some of the young lice also sometimes wander off and locate themselves upon a contiguous leaf. And so it comes to pass that, so early as the middle of May, leaves here and there over the whole of the bush, become inhabited by these lice, there being commonly from six to twelve clustered together on each infested leaf. They are stationary and motionless, with their heads towards the base of the leaf, hugging closely to its surface, their antennæ and honey tubes turned backward and pressed to their bodies, their sharp needle-like beaks sunk into the leaf and sucking from it the juices. If the leaf be broken off, whereby the flow of sap through it begins to cease, they immediately discover it, become uneasy, and commence moving about and wandering away. Although they reside on the underside of the leaf, at particular times, owing probably to some peculiar condition of the atmosphere, many of them are seen upon the upper side, in the groove here made by the midvein.

Upon plucking a leaf and attentively examining the lice upon it with a magnifying glass, we find the cluster is made up of many small young individuals, and about an equal number of large older ones, all these being similar to each other in color, and a single large one wholly unlike the others in its color, this last being the mother of the group.

The small lice or young larvæ are short and thick, with the opposite sides of their bodies parallel. They are of a very pale yellow or yellowish-green color, the head often whitish and the eyes appearing like a small black dot on each side of it, with the legs and antennæ white, short, thick and clumsy looking, the antennæ not half as long as the body.

The larger lice, which are larvæ which have nearly or quite got their growth, are twice or thrice the size of the small ones and measure six to seven hundredths of an inch in length. They are egg-shaped, moderately flattened, and of a pale yellowish-green color, the head often paler, with coal-black eyes, and the body frequently shows a row of squarish grass-green spots along each side of the middle, sometimes with part of a second row outside of these, giving them a checkered appearance. The legs,

antennæ and honey-tubes are white, and the antennæ are about half the length of the body.

The wingless female, the single individual unlike the rest of the group, coincides with the mature larva in size, and in all the details above stated, except only the color of the body. In this it differs notably. Nor is it constant in its colors, different females being unlike each other, and the same female sometimes changing very sensibly in a short time. Some of these females are bright orange-red with all the middle portion of the back dull pale-green, frequently with two orange-red streaks on this pale ground, the streaks widening backward and uniting with the orange-red of the border. Others are very dull red with the middle of the back smoky, the sutures and a line along the middle of the back being greenish-white. The female is more plump and less flattened than the larva. In some specimens the feet and apical half of the antennæ are blackish, and the honey-tubes smoky with only their bases greenish-white. They are slighly shorter than the space from their bases to the tip. A short conical tail, little longer than thick, is protruded from the apex of the abdomen. The beak, which is white with its tip sometimes smoky, reaches to the middle pair of legs.

Such are the characters presented by these lice when they are first beginning to appear upon the leaves in May. As noticed at later periods of the season, the larvæ are mostly pale yellow, and the females pale, both being marked upon the back with a dark colored elliptic ring, formed by a stripe along each side towards the outer margin and extending from the head to near the tip, these stripes being black in the mature insect and deep green in the larva, and cut across by slender pale lines at the sutures.

The first season that these lice appeared, winged individuals were often sought for but none were found, until the month of November, when they became quite numerous. They were noticed at that time as being black and shining, with the breast and abdomen pale yellow, the latter black at the tip, and the legs dusky. When they were about disappearing eight years afterwards, winged specimens were found in plenty among them in May and June. These were fourteen hundredths of an inch in length to the end of their closed wings, pale greenish-yellow with the top of the thorax slightly dusky, the antennæ black except at their bases, the legs dusky towards their tips, the wings transparent with the stigma salt-white and the veins blackish. The relative distances between the veins of the wings, and the aberations from their normal arrangement which were observed are as follows:

Second vein about twice as far from the first at its tip as at its base, and rather farther from the third at its tip than at its base; its base equi-distant between the first and third veins. First fork at tip most commonly much nearer the tip of the second fork than of the third vein, and oftenest as near to the third vein as this is to the second. Second fork much nearer to the first fork than to the fourth vein. Fourth vein strongly curved, becoming straight towards its tip, commonly somewhat nearer the second fork than to the tip of the rib vein.

Variety *a*. Tip of third vein nearer the first fork than to the second vein. Common.

Variety *b*. Second vein in the left wing with a short fork near its middle.

Variety *c*. Second fork wanting in the left wing.

Variety *d*. Second fork in the left wing wanting, and second vein with a short fork near the middle.

Variety *e*. Second fork in the left wing wanting, and second vein in the right wing forked in the middle.

Variety *f*. Tip of the third vein nearer the second vein than to the first fork.

FLATTENED CENTIPEDE. ITS DEPREDATIONS.

The secretion and emission of honey dew is a trait in their economy which is almost peculiar to the Aphides—this secretion being in most of them very copious and going on continuously. It is, therefore, a singular circumstance that we meet with some species among these insects which are nearly if not entirely destitute of this secretion. In my account of the Grain-aphis in a previous Report, this destitution of honey dew was remarked as occurring in that species. This Barberry-aphis is another instance of the same kind. When we look at a cluster of them no drops of this fluid are to be seen at the tips of any of their honey tubes. No particles of it are sprinkled on the leaves under those occupied by these lice. No ants are standing among them nor travelling up the stalks to them to feed upon this sweetish fluid. And no perceptible blackness of the stalks is caused by this aphis.

The leaves of the barberry are of a thick, firm and somewhat leathery texture, whereby they do not become at all curled or otherwise distorted by these insects. And although their presence cannot but be injurious to the shrub by abstracting from it a portion of its juices and thus weakening it, in this instance which passed under my observation the health and vigor of the bush was not perceptibly impaired. No measures for destroying the lice were therefore resorted to or deemed to be called for.

18. Flattened Centipede, *Polydesmus complanatus*, Linnæus. (Aptera. Julidæ.)

Eating the roots of plants and other tender vegetation, and probably causing the anbury (club root) disease in cabbages; small, slender white and brown worms, from one to five-tenths of an inch long, flattened upon the back, and with numerous small legs appearing like a fringe along each side of the body; crawling everywhere over the damp surface of the ground by night, and withdrawing into the crevices under chips, stones and similar situations during the day time.

Upon coming to give particular attention to the different insects which occur in our gardens, and ferret out what they are doing there, I detect some important depredators to which our Treatises on Gardening make no allusion, and most of our gardeners are quite unaware of their pernicious character, although they have been accustomed to see them almost daily, their lives long. One of these is so very common in all our gardens, and appears to be the cause of such important injuries, that I am induced to report some of the observations already made, although my researches are still too limited for me to attempt to write out its complete history.

Early in the day when the earth is moist from the night dews, if engaged in sowing seeds, uprooting small weeds or any other garden work which causes us to closely observe the surface of the ground, we shall frequently see a small brown worm from a quarter to half an inch long, slender and snake-like, flattened upon its back and with a row of short thread-like legs appearing like a fringe along each side of its body the whole length. It is crawling slowly about, here and there, with many short turns, in making which it frequently doubles its body almost together. If you enclose it in a dry box or vial you will probably find it dead an hour afterwards. But put it in a vial of damp earth or wet moss and it will live there for months unless you allow it to get dry. You thus learn that it delights in a damp, humid atmosphere, whilst a dry situation is fatal to it. It therefore comes

abroad in the night time, wandering about over the moist surface of the earth in search of the nicest, daintiest food it can discover whilst the hours of darkness last; but when the morning arrives and the sun begins to dissipate the dampness of night and dry the top of the ground, it can no longer remain there. It accordingly travels around till it finds some crack in the ground or some crevice under a stone, a stick or a piece of board, where the sun's drying rays will not penetrate and the earth will remain humid during the heat of the day. Into this crevice it enters and there remains until the dews of night are again beginning to fall, enabling it to leave its retreat. Thus, on raising up a chip or fragment of board that happens to be lying anywhere in the garden, you will commonly find lurking under it a dozen or it may be fifty of these worms—the young smallest ones being white and the larger ones brown. And always in company with them will be observed some individuals of a different kind, having bodies more slender and perfectly cylindrical, which are the young of other species of this family of insects. When they chance to find a moist situation where they have an abundant supply of food they probably remain there night and day, having no occasion to wander away until the store is exhausted And others of their kind discovering the same spot, join in company with them, until the place becomes thronged with as many of these worms as can crowd themselves into it.

Next, we are most deeply interested in knowing on what these insects feed in the garden, that they are there assembled in such numbers. The remark of Latreille (Cuvier's Animal Kingdom, American edition, vol. iii, p. 249) that "these insects feed on dead and decomposed animal and vegetable matter," has all along been impressed on my mind as being without doubt "the truth and the whole truth" on this subject, until the following evidence assured me that they feed on living healthy vegetation. And I since notice accounts in other authors, concurring with my own observations. I make the following extract from my manuscript notes:

"August 24, 1864.—To-day on picking a cucumber around which the rains had washed the earth, burying it one-third under the surface, I find this buried underside to be literally covered with young flat-backed centipedes and a few round ones—the former mostly white, and of all sizes from an eighth to a half inch long. And I notice this underside of the cucumber has many clear, sweat-like, watery drops upon it, small and large; and on looking with a magnifying glass, it is perfectly plain to be seen that the skin of the cucumber has been extensively eaten by these worms, in irregular patches of different sizes, from the surface of which wounds it is that the watery drops ooze out like sweat. Here is positive proof that these worms are not limited to decaying vegetation, but attack also that which is healthy and growing. There can be no doubt, therefore, but that they will attack any other soft, tender vegetable substance lying upon the ground or roots underground, where they can lurk in a moist situation adapted to their habits."

As every one knows, many of the cucumbers in every garden are stunted, knurly and deformed, with gummy spots upon them, their substance hard and knotty, and their taste bitter. What causes them to be thus deformed

and worthless? Is it not from being gnawed and wounded by these centipedes? Had the cucumber mentioned above remained upon the vine, its wounded surface in healing would have become knobby and gummy, and in further growing it would have become crooked and deformed. I therefore think it is these insects, crowding themselves underneath cucumbers which are lying on or slightly sunk in the surface of the ground, and there nibbling and wounding the skin, that is one common cause of their becoming stunted, deformed and worthless.

A peculiar disaster sometimes occurs to the onion. When the bulbs are small, having attained but a third or half their growth, many of them cease growing and the tops gradually wither and die. And on pulling up those which are thus affected, it is found that most of the thread-like rootlets underneath have been severed at the point of their junction with the bulb, as smoothly and evenly as though they had been cut off with a knife, only a few of the central ones retaining their connection with the bulb. Indeed, some instances occur in which all the rootlets are cut off. What is it that thus severs these rootlets, and hereby arrests the growth of the onion when it is so small as to be valueless? When we raise one of these onions from the ground, we commonly find some of these young centipedes adhering to its underside, whilst more of them are lying among the severed ends of the rootlets in the bottom of the hole. And I make no doubt it is these worms that do this mischief. This disaster is most apt to occur, I think, when onions are growing thickly together. The bulbs crowding against each other as they increase in size, gradually raise each other up in an oblique direction, whereby a crevice is opened between the bulb and the earth in which it is imbedded. These centipedes wandering about upon the surface of the ground and coming to this crevice, enter it as is their wont, and there finding these rootlets, soft and tender, the very quality of food which they desire, they take up their abode there, and commence nibbling the rootlets and thus cut them off one after another. Seed and Top onions are frequently leaned over by the weight of their long stalks, thus opening a crevice on one side of their bulbs also, into which these worms will be liable to enter; though as their fibrous rootlets are less tender and delicate than those of young seedling onions they will be less liable to be eaten by them.

When engaged in setting out some young cabbage plants, I noticed a singular irregular warty swelling on the root of one of the plants. On a moment's inspection it was perceived to be a healed wound which had been made upon the root; and I recognized this swelling as being to all appearance the commencement or incipient stage of that remarkable disease of the cabbage, termed the anbury, or more commonly club root. If this root in its subsequent growth should be again wounded a few times in the same manner, it was quite evident it would grow into the large knobby canker-like excrescence which constitutes that singular disease—whose cause has never yet been ascertained, though it is commonly conjectured to be occasioned by some insect. The query hereupon arose in my mind, how did this plant come to be thus wounded? The plant it was noticed was badly crooked, apparently from having been bent down to the ground when

it was younger, probably by a shower of rain, and not having been able to again recover its perpendicular position. And this wound had been made just below the surface of the ground, upon the side where the force bending the plant had been applied. Several of the other plants which were similarly bent, were now observed to have similar warty swellings from healed wounds upon the roots, the wounds being in every instance in the same position, that is to say, with the top of the plant inclining from the side where the wound had been made. It hereupon occurred to me, that these plants being thus bent over, the upper part of their roots standing in the soft ground of the seed bed would participate in the violence and be carried slightly to one side in the same direction, thus opening a slight crevice upon their opposite side. And into these crevices some of these small young centipedes had probably crawled, and gnawed the tender white bark of the root to which they had thus obtained access, thus making the wounds the scars of which were now noticed. Obviously no worm residing underground would come to the roots on the same side in every instance, and wound them in this regular manner.

It will now, I think, be easily perceived how the club root in the growing cabbages is probably caused by these insects. The large thick leaves of the cabbage spreading out as they do but a few inches above the ground, keep its surface shaded, cool and moist, thus inviting these insects to the spot. A strong wind, blowing in one direction all day and repeatedly catching the leaves of the cabbage, gradually work it over to one side, thus causing the stalk to be inclined instead of perpendicular, (as we see in so many instances in every cabbage yard,) and hereby opening a crevice downward upon one side of its root. Into this crevice a multitude of these centipedes will soon be gathered, and will there take up their abode, feeding upon and eroding any tender succulent parts of the root which they are able to find. And this injury goes on augmenting, for as the vegetable increases in size its top becomes heavier, weighing the inclined stalk still further over and opening the cleft at its root wider and deeper, thus presenting new portions for the worms to feed upon. The root being thus continually wounded and irritated, an increased flow of juices to the part is produced and kept up, causing it to grow and swell out into the knobby fungus-like excrescence of the anbury. I feel very confident this is the way this disease is produced.

These young centipedes are equally as abundant in our grain fields as in our gardens. I, however, defer a further account and a full description of them until I shall have observed their habits more fully, and have only to remark in conclusion of this present notice that I have always regarded them as being identical with the species similarly common in the gardens and grain fields of Europe, named *complanatus* by Linnæus, the name *Polydesmus canadensis* being also given to one of the varieties of our insect described by Mr. Newport in his valuable monograph of this family, in the Annals and Magazine of Natural History, vol. xiii, p. 265.

INDEX TO THE TRANSACTIONS OF THE NEW YORK STATE AGRICULTURAL SOCIETY.—VOL. XVI. TO XXIV.

The index given in the Transactions of 1856 of the preceding 15 volumes, having been so favorably received, it has been deemed advisable to give the index of the succeeding volumes to 1864. These volumes contain much valuable matter for farmers, and will enable them to refer to any particular without requiring an examination of the several volumes to find the information which is desired.

Every contributor will find his name in the index and the title of his work. All who are desirous of consulting the transactions will find this index a very desirable assistance, giving with the preceding index a reference to all that has been done by the Society and its contributors.

B. P. JOHNSON, *Secretary.*

A.

ELEVENTH REPORT

ON THE

NOXIOUS, BENEFICIAL AND OTHER INSECTS

OF THE STATE OF NEW YORK.

BY ASA FITCH, M. D.

ONION-FLY AND WORM, *Anthomyia Ceparum*, Linn. (Diptera. Muscidæ.

Boring into the bulb of the onion at all seasons, causing it to wilt and decay; a plump, white, cylindrical maggot, pointed at the anterior end and obliquely cut off at its tip, passing its pupa state under ground, and producing an ash gray fly, having a row of black spots along the middle of the hind body.

The Onion-fly, *Anthomyia Ceparum*, is one of the most pernicious insects in our gardens, it being the parent of the white "grub," as it is frequently termed, but, as it has no distinct head, it is more properly a "maggot," which bores into and destroys the root of the onion.

This insect has infested the onion in Europe from time immemorial, and has been in this country many years, making its appearance from time to time in one neighborhood and another, and remaining several years, greatly injuring or totally destroying the crop. In many parts of New England and New York it was extremely numerous and destructive about the year 1854, and again in 1863.

In June, as soon as the young seedling onions are only an inch or two in height, these insects commence their depredations and continue them through the whole season, getting their growth and coming out in their perfect state one after another, whereby some of the flies are liable to be always present in the garden, in readiness to deposit their eggs, and maggots of widely different sizes are commonly met with in the same onion.

The eggs or "fly-blows" are loosely placed upon the onion

slightly above the surface of the ground, as shown in the accompanying cut, Fig. 1, some of them being dropped along the thin edge of the sheath or white membranous collar, which is formed by the base of the lower leaf, clasping around the stalk, and others are crowded into the crevices between the bases of the leaves, slightly above where they issue from this sheath. From two to six or more eggs are usually placed on particular plants here and there through the bed. They are perceptible to the eye, being white and smooth, four-hundredths of an inch (0.04) long, and a fourth as thick, and of an oval form, as seen in Fig. 4, where they are represented of their natural size, and in the lower figure magnified.

A few years since, a person from the northern section of our State calling upon me, informed me as a most important discovery that a Mr. Somebody in that vicinity had made, that these grubs came from germs or eggs contained in the seed, and that by merely wetting the seed a moment in boiling water, the vitality of these germs would be destroyed, and the crop grown from the seed thus treated would be perfectly free from this insect. And in the Country Gentleman (June 25th, 1855, p. 408), a correspondent advances this same theory. Why will persons venture in the public prints to state mere surmises and conjectures as being authentic and well ascertained facts? "If the light that is in thee be darkness, how great is that darkness!" The seed is the part, of all others, with which this insect has the least to do.

The minute worm or maggot which hatches from each egg, works its way downward inside of the sheath, its track being marked by a slender discolored streak, till it reaches the root, on which it feeds till it is wholly consumed, only the thin outer skin remaining. A small young onion furnishes only a small portion of the nourishment which one maggot requires, and commonly there are several maggots, big and little, feeding together upon the same onion. Therefore, when it is consumed, if there is another onion growing in contact with the first, or nearly so, they readily discover and invade it. But if no onion is growing near the first, when it is consumed they are obliged to go forth on an exploring expedition, scattering themselves in different directions, and each one crawling around in the ground, until he chances to come to another onion, or to one of the rootlets, which will serve to guide him to the bulb from which it issues. Thus, when the

seed has been thickly sown, and the young plants are crowded together, they are successively cut down, one after another, until a wide vacancy is produced in the row, all vestiges of the plants being gone, except on one or both sides, where is usually, first, a plant dead and turned yellow, lying flat upon the ground, the maggots having consumed its root and passed on to one or two of the next plants, which are wilted and drooping, and of a flaccid feeling, but still of a natural green color, and in the roots of these the young worms are nestled and feeding. And if these wilted plants be not disinterred, and the worms in their roots killed, they will next day have passed onward, destroying the next plants, and the next, until the whole row, it may be, will be cut down before the worms have got their growth and are finished feeding.

The first indication which we have that our onion bed is invaded by this enemy, we discover that two or three of the young plants are wilted down and lying on the surface of the ground, perhaps changed to a yellow color, and the plant next in the row to those prostrate ones probably has its lower or outer leaf similarly wilted and prostrate, although it is green and shows no wound or other indication of disease, and the other leaves of this plant are erect, and to the eye appear perfectly healthy; but on feeling them we find they are soft and flaccid, not firm and substantial like those of the unaffected plants. Thus by the feeling of the leaves we readily detect those plants which have worms in their roots.

On carefully digging up and examining the affected plant, if it is young and the root small and cylindrical, we commonly find it completely cut assunder as represented in Fig. 1, only the thin outer skin remaining, whereby the slightest pulling upon the top draws it up out of the ground. Later in the season, when the round bulb is beginning to be formed, as in Fig. 2, we find a hole perforated in its side, opening into a cavity in the interior, and the earth around this perforation is wet and slimy, forming a mass of filthy mud in which those worms are lying which are not engaged in feeding. And by this interior cavity the central leaves of the plant are severed from their connection with the fibrous

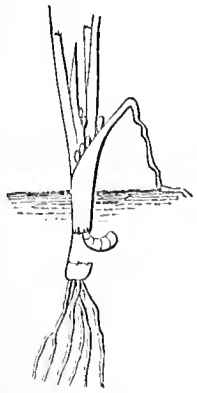


Fig. 1.
Young onion cut asunder.

rootlets, as shown in the figure, whereby it is now these central and not the outer leaves which first turn yellow and die; and all the upper portion of the root soon becomes soft and putrid, while the bottom part, continuing to be nourished by the fibrous rootlets, remains sound, and the worms now crowd into this part to feed, whereby it sometimes presents a wonderful appearance, being thronged with worms wedged together side by side in a compact mass, all with their heads downwards, eagerly consuming the last remains of food there is there, and only the rounded hind ends of their bodies exposed to view, these forming an even surface similar to the cobble stones of a street pavement, as represented in Fig. 3.

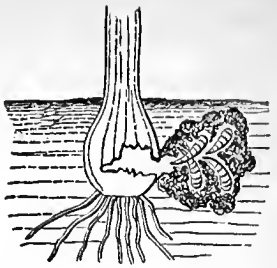


Fig. 2. Onion bulb perforated.

Fig. 3. Bottom of an onion crowded with worms.

Multipliers, escallions, and old onions planted for growing seed, are about as liable to be attacked as are the young seedling onions. And there would seem to be something peculiar in particular onions which attracts the flies to them to deposit multitudes of their eggs upon them. Thus an escallion, a month after it was set out, having wilted and turned yellow, the whole of its root was found to be a soft, putrid mass, of a most offensive smell, everywhere thronged with these maggots, of all sizes, some of them newly hatched and no larger than the eggs from which they came, others full grown, and others changed to pupæ and lying in the wet dirt in contact with the root. I judged there were upwards of two hundred maggots in this one onion, which was little more than a half inch in thickness. And though there was no sustenance now remaining for their nourishment, unless they feed upon the putrid as well as the sound substance of the onion, every crevice above ground, around the bases of the leaves, was occupied with eggs, to the number of about fifty, and many empty shells from which worms had recently issued. It was a mystery to me why such a multitude of worms should occur in this particular onion, and why flies continued to deposit their eggs upon it when it was already so overstocked as to furnish no food for their young.

ONION-FLY. LARVA AND PUPA DESCRIBED.

Fig. 4. Onion-fly eggs, larvæ and pupæ.

The larva is represented in the two middle figures of the accompanying cut, the upper cut being its natural size and the lower one magnified. It is shining, dull white, cylindrical, tapering to a point at its forward end, and when crawling and elongated nearly the whole length of the body becomes tapering. At the forward end the jaws appear under the skin as a short black stripe. Frequently a pale brown stripe or cloud is perceptible behind the middle of the body, caused by internal alimentary substances. The hind end is cut off abruptly in an oblique direction, forming a flattened surface, on which, slightly above the centre, are two elevated dots of a cinnamon-brown color and appearing somewhat like a pair of eyes; and around the margin are eight small projecting teeth, of which the two lowest ones are largest; and a little forward of these, on the underside of the body are two additional teeth, like minute feet, by the aid of which the maggot shoves itself forward when crawling.

The larva obtains its growth, in summer, in about a fortnight. It is then so plump and full fed, with its skin distended and glossy, that it sometimes seems to be too obese and lazy to crawl away, and it accordingly remains in the cavity inside of the onion to pass its pupa state. But as it is liable to be disturbed if it is lying here, by other younger maggots moving around and rubbing against it, it much more frequently crawls out into the wet slimy earth which is in contact with the onion. It here ceases to move, it becomes contracted and shorter in length, its skin hardens and changes to a tarnished yellow and finally to a chesnut color with a stain of black at each end. It is now in its pupa state, as shown in the two right hand figures of the preceding cut, its hardened outer skin forming a pod or case, inside of which the real pupa is inclosed —white, soft, and showing on its surface the wings and legs of the future fly in a rudimentary state.

The insect lies dormant in the ground in its pupa state about two weeks, the time varying, being shorter when the weather is hot and longer when it is cool. The hard outer shell then breaks open and a fly comes from it, which has a considerable resemblance to the common house-fly, though when the two are placed side by

side this is observed as being smaller and more slender in its form.

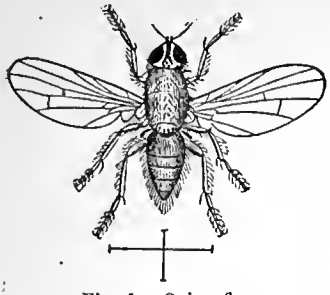


Fig. 5. Onion-fly.

It is represented in the annexed cut, Fig. 5, the cross lines showing its natural dimensions when its wings are extended. The two sexes are readily distinguished from each other by the eyes, which in the males are close together and so large as to occupy almost the whole surface of the head, whilst in the female they are widely separated from each other. These flies are of an ash gray color, with the head silvery, and a rusty black stripe between the eyes, forked at its hind end. And the species is particularly distinguished by having a row of black spots along the middle of the abdomen or hind body, which sometimes run into each other, and then forming a continuous black stripe. This row of spots is quite distinct in the male, but in the female it is very faint or is often wholly imperceptible. This fly measures 0.22 to 0.25 in length, the females being usually rather larger than the males.

On examining the diseased onions we find the operations of these worms vary considerably in different instances. Sometimes a round hole is bored, either in the side or the bottom of the onion, and only one worm is present. More commonly several worms of different sizes are found, and if the plant is young, with the root cylindrical, it is cut completely asunder, as represented, Fig. 1. If it is more advanced and the bulb partly formed, a large, irregular cavity will be found in its centre, as shown by Fig. 2, and the earth around the orifice is wet and slimy, forming a large, muddy mass, into which the maggots crawl to repose when not engaged in feeding. From being thus perforated and gnawed, the onion soon perishes and becomes soft and putrid, except its bottom part, which, continuing to be nourished by the fibrous rootlets, remains sound, and the larger worms thereupon crawl into this part to feed, whereby we sometimes meet with it presenting the appearance shown in Fig. 3, being thronged with worms, wedged together in a compact mass, as already described.

We learn from Bouché (Garden Insects, page 131), that the *Alysia manducator* of Panzer is the parasitic destroyer of different species of *Anthomyia*. This is a small black four-winged Ichneumon-fly, which in Europe is frequently to be seen upon and around

decaying turnips and other vegetables, its larva living inside of the pupæ of these flies, where on getting its growth it incloses itself in a yellow cocoon. Like other injurious insects which have come to us from the old world, the parasites, which in their native haunts prey upon them and constantly restrain their multiplication and destructiveness, have not yet found their way to our shores. The only natural destroyer of the Onion-fly which I have observed, are the Golden-eyed flies of the genus *Chrysopa*, in the order *Neuroptera*, a full account of which is given in my first report. I have repeatedly noticed one or more eggs of these insects, elevated upon their white hair-like pedicels, attached to the lower part of onion plants. In one instance ten of these eggs were found in this situation, placed at equal distances apart in a straight row, an inch and a quarter in length. It is undoubtedly that its young may feed upon the eggs of the Onion-fly, that the Chrysopa fly places them in this situation. Puncturing and sucking the contents of the eggs which the onion flies deposit, as is its habit, one of these Chrysopa larvæ residing upon an onion plant will ordinarily suffice to preserve it uninjured. Hence it will be seen what an important service they render us.

These flies have, in many instances, disheartened people from attempting to grow onions; and where the crop has been nearly or quite destroyed one year, we may confidently expect there will be enough of these insects in that place the following year, to ruin the crop, if it is sowed. I have thought in such cases, a farmer, by making an onion bed upon some remote part of his farm, where none of these flies are present, and where there is no garden so near that they will be apt from thence to find their way to the spot, may probably elude this enemy and obtain a crop uninjured by these maggots. And by wholly ceasing to grow the onion one year in the garden, these insects will wholly vanish therefrom, whereby this vegetable may thereafter be grown without molestation.

As it requires several young seedling onions to nourish one maggot until it grows to maturity, our mode of growing onions, in contact with each other in rows, in a bed together, accommodates this insect perfectly, enabling it to find the root of one plant after another, without the least difficulty. If we were to change our mode of culture, where this insect is present, and grow the onion in hills here and there among the other vegetables in the

garden, with only three or four seedlings in a hill, it is evident the young worms could nowhere find a sufficient amount of food to nourish them to maturity. Having consumed all the young plants in one hill, they will be unable to work their way through the ground to come at another hill, except it be by the merest chance, and will thus perish.

When an onion bed is attacked by these maggots, the only effectual mode of saving it from ruin is to look the plants carefully over and uproot every wilted one, and destroy the worms the root contains; since if they are not killed they continue at work, feeding upon one plant after another, until they are all or nearly all destroyed.

PUNCTULATED FLEA-BEETLE, *Psylliodes punctulata*, Melsh. (Coleoptera. Chrysomelidæ.)

On the cucumber, pie rhubarb, and other garden plants throughout the season, eating numerous small holes in the leaves; a brassy black and finely punctured flea-beetle with its shanks, feet and the basal joints of its antennæ pale obscure yellowish.

In addition to the Hairy flea-beetle which Dr. Harris mentions as infesting the cucumber, I find on these plants another species, closely similar, but on careful examination proving to be very different from it, having the first joint of the hind feet more long and slender than is usual in this tribe of insects, and inserted forward of or above the lower end of the shank, it thus belonging to the genus which Latreille has separated from *Haltica* under the name *Psylliodes*. This species is described by Dr. F. E. Melsheimer, in the third volume of Proceedings of the Academy of Natural Sciences, under the name *Psylliodes punctulata*, or the Punctulated flea-beetle, in allusion particularly to the forebody, the surface of which is covered with fine distinct punctures, as if made with the point of an exceedingly fine needle. But this character varies in different specimens, some having the surface so smooth, that these punctures become scarcely, if at all, perceptible.

This is the common flea-beetle upon the cucumber leaves in the eastern section of our State. I have also noticed it upon other plants in the garden. On radishes, one or more are sometimes seen associated with the Striped flea-beetle. The leaves of the beet are sometimes noticed as having scattered holes perforated in them, which are usually the work of this insect. The pie rhubarb which is cultivated in all our gardens for its thick, tender, juicy, acid leaf-stalks, as an early substitute for fruit in the making of

pies, has its leaves attacked by several insects, this flea-beetle being the most common one, at least in the forepart of the season. Both on the upper and under surface of the leaf it gnaws through the skin and eats the pulp, leaving the skin on the opposite side of the leaf entire, which becomes discolored, forming yellowish brown freckles, and as the leaf grows and expands, the skin at these points becomes torn and perishes, whereby holes through the leaf are formed. In this manner the older leaves often become riddled with holes of different sizes, the largest being about one-tenth of an inch in diameter. A few of the Hairy flea-beetles are commonly found associated with these upon the leaves of the pie plant, being readily distinguished by being usually of a smaller size and not at all glossy and shining.

These flea-beetles are frequently seen paired. The following incident is so remarkable and curious that it well merits to be here related. On the 4th of June, 1863, I noticed two of these flea-beetles paired, upon a leaf of the pie plant, when a minute Chalcidian parasite alighted upon the leaf quite near them. The male, hereupon, immediately descended, and went directly towards this parasite, as if he intended to walk over it; but it receded from him, stepping aside to avoid him, two or three times, till the male walked away. The Chalcidian then darted upon the back of the female, and appeared to be inserting its sting in the tip of the body of the female, when she gave a leap, and both disappeared among the foliage. I conjecture this Chalcidian to have been an egg-parasite of the flea-beetle; and that the eggs of the flea-beetle are so minute that the young parasite requires several of them to nourish and bring it to maturity, the same as in the case of the egg-parasite of the Hessian-fly as discovered by the late Mr. Herrick. And as it appears from the careful investigations of Mr. Le Kenx, that the eggs of this group of insects are few, and the females drop only one per day, to enable the young parasite to obtain the number of eggs it requires for its sustenance, the parent, watching her opportunity, deposits one of her eggs internally in the ovaries of the flea-beetle or in the passage way therefrom, and the parasitic larva which hatches from this egg, taking up its residence there, consumes the eggs of the flea-beetle, one after another, as they become developed, whereby none of them will be extruded until after the parasite has obtained its growth and ceased to feed. Most singular and truly wonder-

ful as such a provision of nature would be, it is the most probable conclusion I am able to arrive at from the facts observed.

The transformations and habits and the remedies for this group of insects will be found fully stated under the Striped flea-beetle.

CABBAGE-FLY AND WORM, *Anthomyia Brassicæ*, Bouché. (Diptera Muscidæ.)

The roots of the cabbage eroded and bored, and the young plants hereby often killed by a white maggot having its flattened hind end margined around with minute teeth, whereof the lower two are larger and their tips notched; the pupa underground, producing an ash-gray fly, having on the hind body a black stripe along the middle and a narrower black band upon each of the sutures.

The young plants of the cabbage are liable to be destroyed by maggots excoriating the surface and boring into the interior of the roots. In the years 1856 and 1857 they were very destructive in different parts of the State, appearing quite early in the season and attacking the young plants in the seed bed, destroying them so extensively that in many neighborhoods it was impossible to obtain plants for setting out. My attention was first called to this insect, by receiving from Prof. Wm. Hopkins, then of Genesee College, stems of young cabbages containing these maggots, which it was stated, were at that date, June 16th, 1856, ruining all the cabbage and cauliflower plants in his and his neighbors' gardens. From pupæ which were also remitted me a fortnight later, I obtained flies, answering to the description given of the European *Anthomyia Brassicæ* of Bouché, the larvæ also coinciding with the characters stated as pertaining to the larvæ of that species; wherefore I make no doubt it is the same. It continues to infest the roots through the season, which are better able to withstand its attacks, the more they are grown. At the time of gathering the cabbages in autumn I have repeatedly noticed this maggot, burrowed in the bark of the root, or, in two or three instances just beginning to enter it, with the end of its body projecting stiffly out, like a peg driven in half its length.

These maggots infest the turnip and ruta baga also, mining an irregular burrow in the interior, or inhabiting eroded spots upon their outer surface. Sometimes a small roughened spot is seen, appearing like a crack in the skin of the turnip, with its edges rough and ragged and turned outward, and on pairing off this roughened spot a plump white maggot is come upon, lying in a cavity it has there made for itself. At other times a larger eroded spot occurs, which is filled with wet and slimy dirt. On remov-

ing this dirt the surface is found to be rough and warty, with little grooves here and there, in each of which is a maggot. Sometimes also a maggot is seen with only its anterior end imbedded in the turnip, leaving a third or half the length of its body projecting out therefrom.

And I am unable to discover any point in which these worms in the roots of the cabbage and turnip differ from those in the radish, or any character by which the flies bred from the one can be distinguished from those of the other. Nor from the descriptions of authors do I gather any marks whereby *A. Brassicæ* and *radicum* are well distinguished from each other. Curtis (Farm Insects, p. 143,) states that the larva of the latter is similar to the former, but is of a yellowish olive color, the larva of *A. Brassicæ* being given as yellowish white. But, according to my observations, the larvæ are invariably pure white when we first come upon them in their burrows in the roots; and it is from exposure to the light that they acquire a yellow tinge, which becomes deeper as they are more exposed. And the flies seem, from the descriptions given by the same author, to be only different in this, that those of the *radicum* have the face ochreous reflecting satiny white, with a rust colored stripe on the forehead, whilst in *Brassicæ* the face is said to be silvery gray, with a black streak on the forehead, in the female shading into chestnut color in front. The experienced observer will scarcely be able to persuade himself that these slight differences in color are anything more than accidental and of sufficient value to indicate a specific difference as existing between these insects. We know the larvæ which occur in the same root are liable to have the two spiracles on the truncated tip of the body vary in their color from ochreous or cinnamon-yellow to smoky and black. But I have not examined the flies bred from the respective roots of the radish, cabbage and turnip, in a sufficient number of instances to lead me to a decided opinion respecting their identity.

I have noted the following characters as presented by the larvæ in the roots of cabbages. They occur of different sizes at the same date, the largest measuring 0.30 in length, They are footless and white, composed of ten or eleven visible segments. On the throat or underside of the pointed end the jaws appear as a bifid black internal streak. The hind end is bluntly cut off and

flattened, with two elevated tawny yellowish dots or spiracles on the disk, and around the margin is a row of twelve conical fleshy points, the lower two larger and forked at their tips, the next one on each side equally long but narrower and acute-pointed, and forward of these last is another transverse row of similar points.

The pupa is formed by the larva's contracting into an oval form, about 0.20 long and 0.07 thick, the size, however, varying in different examples, and the external skin becomes dry, stiff and hard, of a yellowish white color at first, but gradually growing darker until it becomes chestnut-brown, continuing to show on its surface the sutures of the larva more or less distinctly, and the little points around the margin of the hind end which were soft and flesh-like in the larva are changed to dry hard immovable teeth or spines. This dried and hardened outer skin now forms the case or cocoon, within which the real pupa is contained, which shows upon its surface the legs and wings of the future fly in their rudimentary state.

It lies dormant in the ground about a fortnight in its pupa state, and then gives out the perfect insect, which is a two-winged fly, resembling the common house fly, but somewhat smaller in size, measuring 0.20 in length to the end of its body, and 0.26 to the tip of the closed wings. It is of an ash-gray color, and with three black stripes on the thorax or fore body, and on the hind body a black stripe along the middle of the back, and a black band upon each of the sutures. In the male the head is silvery white, the eyes coppery red in the living specimen, and very large, nearly in contact above—having between them a black stripe, which is much broader at its commencement at the base of the antennæ. The antennæ, feelers, and legs are black. On the crown of the head, the legs, and the hind body are black bristles, and on the fore body are coarser ones arranged in rows. The hind body is of a cylindric-conic form, its under side with a black stripe in the middle and black bands on the sutures, similar to the upper side. The wings are hyaline, ciliated with fine bristles along the outer or costal edge nearly to the tip. At the apex of the first vein is a slight notch, where is a coarser bristle.

The female differs in having the eyes smaller and farther apart, and the black stripe between them is much broader, and is tinged with tawny red in its middle, and forked at its upper end, with a small black spot between the forks. The black stripes on the fore

body are obsolete, as are also the black bands on the sutures of the hind body.

This Cabbage-fly is so closely related to the Onion-fly that the same remarks made respecting the remedies for that species will apply equally well to this. In the *Country Gentleman*, May 14, 1857 (vol. ix, p. 319), E. Sanders reports that one of the Albany gardeners had saved his plants from the general ruin of the preceding year, by sifting powdered tobacco upon them—so much only as to lay a fine dust upon the leaves, and repeating the application if the dust is scattered off by a high wind or by rain. It is confidently stated that the fly will not alight upon the dusted plants to deposit its eggs. If this is an effectual remedy, it will no doubt be equally effectual against the radish fly and other flies of this genus.

STRIPED FLEA-BEETLE, *Haltica* (*Phyllotreta*) *striolata*, Illiger. (Coleoptera. Chrysomelidæ.)

Gnawing numberless little pits in the leaves of the cabbage, turnip and radish, and perforating with holes the thin leaves of the mustard and other cruciferous plants; a small, black, shining flea-beetle with a broad wavy pale dull yellow stripe upon each wing-cover.

The Striped flea-beetle is one of the most common insects in the garden through the whole season, attacking all the numerous garden plants and flowers which pertain to the natural order *Cruciferæ*, and when these plants are young and tender, wholly destroying them if neglected. Thus the injury sometimes occasioned by it is quite serious. In the market gardens around Albany I am told that some years whole beds of cabbage plants are destroyed by it, sometimes within the space of twenty-four hours, so suddenly is it liable to invade the beds in immense numbers. Mr. Lawrence, a former member of the State legislature, informed me that this flea-beetle had been very destructive in the year 1856, in all the gardens around New York; he had planted six acres to cabbages in his own grounds at Flushing, and to such an extent were the plants wounded and killed by these insects that he finally cultivated but one acre, and only accomplished this by repeatedly setting new plants wherever those disappeared which had been set previously. And the last of June, after the plants are grown so large as to survive their depredations, the beetles cluster upon particular leaves, those usually which are next inside of the large, tough outer ones, and feed upon their margins, commencing near the base and working along to the apex, eating the upper surface

and the parenchyma, whereby a wide space upon the border becomes excoriated. And in August, after the cabbages are headed, scores of these beetles are to be seen upon nearly all the large, loose outer leaves, which are freckled all over with whitish dots from their bites, causing them to turn yellow and perish.

The radish is the earliest vegetable, common in our gardens, which the striped flea-beetle infests. It no sooner appears above ground, with its small tender leaves beginning to put forth from between the two seed leaves, about the middle of May, than the beetle makes its appearance upon it, and the leaves soon become thickly freckled with the wounds the insect makes, hereby greatly retarding the plants in their growth.

They fall upon the leaves of the turnip, also, as soon as they begin to put forth, two or three crowding themselves together frequently upon one small leaf, and eating it full of holes.

To those much admired flowering plants, which every amateur florist strives to raise in the greatest perfection, the Brompton and Ten Weeks Stock (*Mathiola annua*), these flea-beetles are the greatest of pests, riddling the leaves of the young plants with holes, thus stunting them in their growth and rendering them puny and dwarfish, and utterly ruining them if the insects are allowed to continue unchecked in their depredations.

They equally molest the pretty Virginia Stock (*Cakile maritima*), which is so much prized for the profusion of its bright little flowers, not only eating the leaves but also, whenever a flower puts out, one or two of these beetles are apt to immediately locate themselves upon it, feeding upon the delicate petals, and thus destroying all the beauty of the blossoms unless care is taken to keep them expelled from the plants.

The rocket, candytuft, and all other cultivated flowers which pertain to the order *Cruciferæ* are more or less attractive to these flea-beetles.

But the plant of all others of which they are most fond, is certainly the mustard (*Sinapis nigra*). Wherever a weed of this starts up in the garden, it will be seen sprinkled over with these striped flea-beetles in much greater profusion than any other plant. Its leaves are so thin that the beetles in feeding gnaw entirely through them, whereby, so early as the middle of June, the mustard leaves are everywhere found riddled with holes. A hungry beetle continues to eat the leaf until he makes a hole an eighth of

an inch or more in diameter. But most of the holes are small perforations, scarcely large enough to admit a pin. These holes in the young mustard leaves are edged with white, forming a little ring of this color around the margin of the perforation, which is bordered on its outer side by a blackish ring. The holes are mostly circular, but some of them are oval or oblong. In the thick, succulent leaves of the cabbage, radish, &c., they merely nibble little pits which do not reach through the leaf. Some of these are in the upper and others in the under surface of the leaf, and these nibbled spots are of a pale grayish color, giving to the leaves a speckled appearance.

A peculiar mark is frequently observed upon the leaves of turnips, beets and other plants in the garden. The first thought which is apt to strike the mind upon noticing this mark is, that a crinkled dead worm of some kind has been lying upon the leaf, and has in some way made there an exact print of its form. And if this mark is particularly inspected, it will be observed that it gradually increases in its thickness, through its several crooks and turns, from its commencement to its end. These marks are really produced by minute worms living in the interior of the leaves, feeding upon their green pulpy substance, and leaving the skin unbroken—mining a serpentine track, which increases in thickness as the worm grows to a larger size. These worms are termed leaf miners. It is the larvæ of these flea-beetles which make most of these marks which occur in the turnip and other leaves in the garden. The accompanying Fig. 6 represents a turnip leaf with two of these worm tracks in it, and also showing holes perforated by these flea-

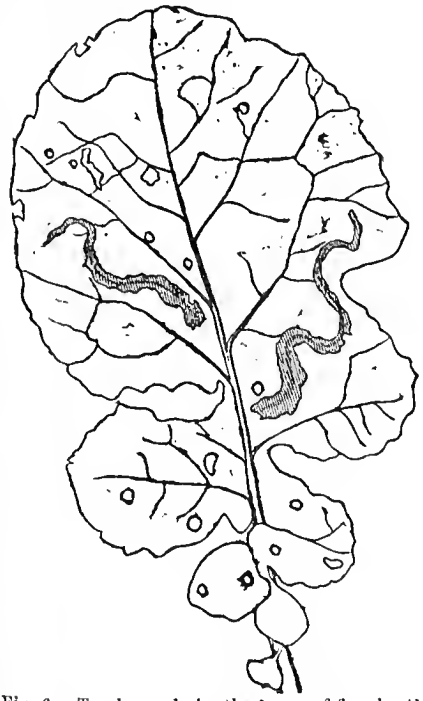


Fig. 6. Tracks made by the larvæ of flea-beetles.

beetles, and now enlarged in size by the subsequent growth of the leaf.

It is but recently that the larva state and transformations of this genus of insects has been discovered. We owe it to the careful investigations of Mr. H. Le Keux that we are now made acquainted with the complete history and economy of these little beetles. From his valuable paper on this subject, published in the Transactions of the Entomological Society of London, vol. ii, p. 24, the following statement is derived. It refers to the common European species, *Haltica* (*Phyllotreta*) *nemorum*, which, both in its appearance and habits, is almost identical with our American Striped flea-beetle. This account will consequently apply to our insect in every respect, it is probable, as exactly as though it was the insect upon which the observations were made.

Mr. Le Keux states that if the spring be early and warm the sexes begin to pair in April, and continue doing so till September. The female deposits her eggs upon the under side of the leaves of the turnip, and probably, also, we suppose, of the cabbage, radish and other plants upon which she dwells. She lays apparently about one egg per day. Ten pairs laid only forty-three eggs in a week. Although this was in a state of confinement, the correctness of the estimate is supported by the fact that in leaves taken from the field and having as many as six larvæ in them, these larvæ were of such different sizes as to indicate that their ages varied from each other.

The *eggs* are very minute, oval, smooth, and partaking of the color of the leaf on which they are deposited. They are hatched in ten days, and the little maggots immediately upon coming from the shell begin to eat through the skin of the leaf, and to form winding burrows by feeding on the pulp. These burrows become plainly visible to the eye after the larvæ have left them, and the skin of the leaf along their track is withered and discolored; but in the early stage of their formation they are difficult to discover, and it is only by holding the leaf up between the eye and the light that they can be readily detected.

The *larvæ* are pale, or of a golden yellow color, fleshy and cylindrical, with six feet placed upon the breast, and a proleg at the end of the body. The head is furnished with jaws and large dark eyes, and the first and last rings bear dark patches. They become full fed in about six days, when they leave their burrows

and bury themselves in the earth not quite two inches below the surface, selecting a spot near to a turnip, where its leaves will protect them from wet and from drouth.

Here in the earth they become immoveable *pupæ* or chrysalides, which are brought to maturity, it is supposed, in about a fortnight, when the beetle emerges from its tomb to again fulfill the laws of nature.

Thus, from the careful observations and experiments of Mr. Le Keux, it appears that the female beetle lays but few eggs compared with most other insects, and that it requires a period of about a month to carry the animal through its different stages, up to the time when it becomes a perfect beetle again—namely, it remains an egg ten days, a maggot six, and a pupa fourteen days. The beetles themselves are rather long-lived, for they have been kept from July until the following February.

In its perfect state as we meet with it upon the leaves in our gardens, our American Striped flea-beetle is of an oval form, twice as long as thick, and usually measuring one-tenth of an inch in length, though individuals of a slightly smaller size are not unfrequently met with, these being usually males. It is of a shining black color with the surface covered with very fine shallow punctures. The *head* is small and deeply sunk into the thorax, with the eyes and mouth slightly protruding above the general level of the surface. The antennæ are inserted near each other slightly above the nose, in the middle of the face, and are about half as long as the body, and very plainly grow thicker towards their tips. They are composed of eleven joints, which are rather compactly united together, the first joint longest and gradually thickened towards its tip, as are the remaining joints, which are about a third longer than thick, the last joint being oval and pointed at its end. The three first joints are pale dull yellow, and the others black. The *thorax* or forebody is more broad than long, broadest at its base and gently narrowing to its apex with the sides convex. The *wing-covers* when closed together are oval in their outline, and twice as wide as the thorax, and four times as long. On the middle of each is a broad, irregular stripe of a pale tarnished yellow color, occupying about a third of the width of the wing-covers. This stripe begins almost upon the base, inside of the middle, and extends at first obliquely outward and backward a short distance, and then turns directly backward, its hind end being bluntly rounded and slightly turned inward towards the suture. The middle third of its length is narrow and slender, from having as it were a half oval notch cut from it upon its outer side, this notch including about two-thirds of its width, but being sometimes more sometimes less deep. And slightly forward of this notch, on the outer side of the stripe, at the point where it turns from an oblique to a longitudinal direction, is a rounded, sometimes an angular projection, with the point in the latter case directed forward. The *legs* are black with the knees and feet pale dull yellow. The hind thighs are very thick and stout, whereby they are adapted for making a strong leap, and their shanks on the outer side towards the apex are fringed with coarse bristles, rendering the foothold more secure when in the act of leaping, the other parts of the surface of these as of the other shanks being clothed with an inclined beard. The feet are four-jointed, the first joint longest and equal to the two following ones in its length, the second joint shortest, the third deeply divided into two lobes, these three joints having short inclined bristles on their upper side, and their under side furnished with brushes of fine hairs, enabling them to cling and walk with facility, up the

Fig. 6. Striped flea-beetle.

STRIPED FLEA-BEETLE. SCIENTIFIC NAME. LEAPING POWER. WINTER QUARTERS.

sides of glass and other smooth surfaces. The fourth joint is inserted between the lobes of the third joint, and is slender, gradually more thick to its end, where it is furnished with two minute claws.

These beetles vary in having the slender middle portion of the pale-yellow stripe upon the wing-covers entirely obliterated, leaving only the two ends of the stripe, and thus forming four spots upon the back of the closed wing-covers. This four-spotted variety was described previous to the normally marked insect, by Fabricius, in the year 1801, who gave it the name *Crioceris bipustulata* (Systema Eleutheratorum, vol. i, p. 464). But as this is only the name of a variety, it is not entitled to stand as the designation of the species. On a subsequent page (469) of the same volume, Fabricius described the species more correctly, naming it *Crioceris vittata*, but he had already given this name to another species of this genus, hence it could not be employed to designate this species also. In 1806 it received the name *striolata* from Illiger (Magazine, vol. vi, p. 148), and by this name it has since been currently designated.

A small black beetle, with two pale yellowish spots on each of its wing-covers, which is very common in our gardens, so much resembles the four-spotted variety of this flea beetle, that correspondents have sometimes sent it to me, supposing it to be the same insect. It is the Four-spotted Bembidium (*B. 4-maculatum*, Linn. Fauna Suecica, vol. i, p. 813), a species common to Europe and this country. By noticing its motions, it will readily be distinguished from the flea-beetle. It never hops, but, sparkling like a diamond in the bright sunshine, it runs briskly in a very serpentine or zigzag track, a few inches, till it gains some crack in the ground, or other covert, in which it abruptly disappears. It feeds on other insects—its strength and agility enabling it to overpower those that are much larger than it in size.

This Striped flea-beetle and all the group of insects to which it pertains, and which form the genus *Haltica*, are readily known by the great thickness of their hind thighs, which gives them the power of leaping to a prodigious distance, considering their small size. They are able to leap about eighteen inches, which is about 216 times the length of their bodies. They seldom walk, and when at rest they sit with their hind legs folded under them, ready to skip away in an instant, if any danger approaches them. But it is during the warmth of the day and in the clear sunshine that they are thus active. After sundown they become more sluggish,

and are less on the alert, and leap with much less quickness and force. They also fly with facility in the warm, clear sunshine.

These beetles are not limited to the garden, but occur everywhere in the meadows and pastures. They live through the winter in a torpid state, and may be found under the loose bark of trees as well as among the fallen leaves, in the cracks of old timber, in the hollow stalks of straw and stubble, and all similarly sheltered situations. Inactive as they are during the inclement months of winter, the warmth of the hand is sufficient to revive them in a few minutes, and an unusually mild day occurring at any time in the winter will allure many of them out from their retreats.

On the first fine weather of spring, warmed by the genial heat of the sun and cheered by his rays, these flea-beetles arouse from their slumbers and come forth from their winter-quarters, leaving them for sunny situations, where they may be seen in considerable numbers, sitting on the sides of buildings and fences, or sunning themselves on dry banks and on projecting clods of earth, protected from the cold wind. In the gardens some of them may be seen abroad some years in March, and in April they begin to appear on the crops in the fields; but May and June are the months in which their most general and fatal attacks are made, when the vegetation is young and tender, and easily killed. Even before the sprouted seeds shoot out from the ground, I have reason to think the plants are frequently destroyed by these flea-beetles feeding upon them in concealment under the surface. It often happens to the cabbage that not a plant makes its appearance in the bed where the seed has been sowed, in which cases the seed is commonly inferred to have been worthless, but in most of these instances it is more probable that the young plants in their way out from the ground have been consumed by these flea-beetles. And, as I have already published in No. 23 of my series of entomological articles in the *Country Gentleman* and in the *Cultivator*, 1860, page 270, a correspondent at Solsville, Madison Co., N. Y., sent me this Striped flea-beetle with the statement that they early in June were "committing great depredations upon the bean crop. They eat mostly under ground. After the beans are well sprouted and within half an inch of the surface of the ground, they bore minute holes on the inner side of each half of the bean, and it is, of course, stunted, and soon turns black. They sometimes attack the stalk below the bean, also, and follow it down an inch or

more." And through the summer and the fore part of autumn different crops continue to suffer from these pests. Mr. Curtis states that sometimes so late as the middle of September the turnip crop, in England, is liable to be destroyed by them. They are everywhere abundant from May till October, amongst the grass in meadows and pastures and in the fields of grain, for plants occur everywhere which are adapted for their sustenance; but the most abundant supplies of the most palatable food for them is found in the gardens, and hence they are there present in much greater numbers than in any other situation. They appear to have the greatest relish for the leaves of the mustard, turnips of all kinds, cabbages and cauliflowers, radishes, and horse-radish; but they are by no means fastidious respecting their food, and readily sustain themselves on hedge mustard, water cresses, and all other plants of the cress group, pepper-grass, shepherds' purse, &c.

They delight in the bright sunshine, and avoid shaded situations. This was very evident one season when I had cabbages set upon the south side of my garden where the fence cast a deep shade upon the outer row. This row it was very observable was wholly free from these beetles, when they were common on the next row only two feet distant, and on all the other rows in the patch. It consequently follows that warmth and sunshine are far more favorable to their multiplication than cool cloudy weather, and that in hot dry seasons they will be most numerous and destructive. Showery weather after a long drouth, and cloudy days with gleams of sunshine, render them abundant, as such seasons do the greater portion of insects. It is in clear sunlight and warmth that they delight. Dampness and wet does not appear to be at all repulsive to them, for it is common to meet with some of them upon water cresses growing in rivulets and marshy pools, if they are but exposed to the strong light of the sun.

Without attempting to notice the numerous remedies for these flea-beetles which correspondents are every year communicating to our agricultural periodicals, I will only speak of those with which I am familiar from personal experience, as this will comprise everything which it is necessary to know for combatting and destroying them.

As these beetles are very shy and timorous, whenever I see

them on radish, cabbage, or other leaves in the garden, I have always been accustomed by striking the hand menancingly towards them, and by brushing and shaking the plants, to dislodge and scare them away. There is very little efficacy in this, however, unless it be repeated two or three times daily, for the insects all return to their favorite locations, immediately after the threatened danger passes by, and in an hour will be found again as numerous upon the leaves as they were before. But if they are frequently disturbed upon any particular plants they will be apt to forsake them and take up their abode in other quarters where they can remain unmolested.

Being so timorous and fearful, the thought occured to me, that something upon the plan of a "scare-crow" might, perhaps, be efficacious in protecting plants from these beetles. I accordingly, a few years ago, crumpled an old newspaper together, tieing a packthread around it and suspended it above a bed of turnips, to swing backwards and forth with the wind, the lower edge of the paper brushing slightly against a few of the leaves. The result was, those leaves only that were brushed by the paper were free from beetles. A leaf over which the paper was frequently whirling and swinging, quite close to it but without touching it, appeared to be as much infested by them as any leaf in the bed.

Mr. LeKeux experimented with several substances. He found that washing over the plants with sulphate of potash had no effect upon the flea-beetles. Powdered sulphur, strewed one-tenth of an inch thick, did not deter them from attacking the plants. Snuff, assafœtida, and a powder called "anti-tinea," for preserving furs, proved equally powerless. They did retire from smelling salts (carbonate of ammonia), and died immediately on being exposed to the effluvia from it; but a small bit placed an inch from the plant would destroy it also.

With regard to lime, Mr. Le Keux states that forty bushels per acre, spread upon the ground immediately before the seeds were sown, did no good. And when the turnip plants came up, and the beetle was observed attacking them, lime-dust was thrown over them, so that many of the plants were quite white with a coat of it; after which as many flies were found upon those as upon any that were free, and they were eventually devoured. Mr. Curtis (Farm Insects, p. 27), quoting this statement, observes that it is contrary to his own experience; for a plot nearly eaten off by

these beetles, recovered on being well dusted with lime. And he cites Mr. Birk, who says that he used slacked lime with perfect success, and although profusely, it did not at all injure the plants.

Dusting the infested plants with lime, plaster, ashes, soot, Scotch snuff, sulphur, &c., or with two or three of these substances mixed together, are measures which have been extensively resorted to in this country, and the efficacy of which are everywhere known by experience. The beetles pretty generally forsake the plants which are thus dusted. I am inclined to think the efficacy of these dry powders is partly due to the embarassment they give the beetles, by preventing them from leaping with their customary agility—their feet being unable to get a firm support for making the leap, when standing among this loose dry powder. I extract from my memoranda one of the several observations I have made, on the effects of dusting the plants with these substances: "June 15, 1863. My young cabbage plants, now some six inches high, are much infested with the Striped flea-beetles. They gather upon the upper sides of the leaves, in the bright sun-shine, and towards the base of the leaf they eat into the soft pulp, or parenchyma, thus forming a large, rough, raw spot, to which the minute garden fleas (*Podurida*) delight to resort. On other leaves they eat similar rough streaks along the border. Two days ago I sprinkled with my hand, dry unleached ashes on six rows of the cabbage plants, and sulphur on four rows. The effect has been most happy. I to-day find no flea-beetles or garden fleas upon any of the plants which were dusted with ashes, and only a few of the leaves dusted with sulphur have any upon them, whilst the rows of plants which were not sprinkled are much infested. And the wounds made by the beetles are healed. I now sprinkle air-slaked lime upon four of the remaining rows. I notice that the beetles do not throw themselves off from the leaves so quickly when the lime powder strikes them, as they did when the ashes began to fall upon them, and I think the ashes are to be preferred to any other substance for protecting plants from these flea-beetles."

But although these substances, ashes especially, usually suffice for driving these flea-beetles from the plants, my observations assure me of the fact, that a season occasionally arrives when they fail of having any perceptible effect. The insects at times become more bold and fearless than is their common habit. Numbers o t~ em will cling to the leaf, regardless of the dust falling upon

them; and some individuals being stationed in the little pits which they have eaten in the thick texture of the leaves, and others down in the axils at the base of the leaf-stalks, pertinaciously remain, regardless of any jarring or shaking of the plants, and are only dislodged by crowding them out from their lairs with the point of a knife or other implement. And though the plants be kept well dusted over with ashes, and the beetles be repeatedly driven off from them, they immediately return to them again. It was, no doubt, a season when these insects were thus froward and bold, when Mr. Le Keux failed to perceive that lime, sulphur, snuff, &c., had any effect in expelling them from the plants. What is the cause of their thus varying from their ordinary timorous habits, we know not. One occasion, when we particularly noticed their clinging to the plants in the garden so persistently, the season was quite backward, with rains falling almost daily in May and June.

But this dusting of the plants with ashes, lime, &c., is only a palliative remedy, valuable as a temporary resort when we have no better means at hand for averting this evil. It leaves the insects as numerous as they were before. It does not subdue the enemy; it merely drives him away from one point, and leaves him in full force to make his attack upon some other point. It should be our aim to kill and lessen his numbers, and hereby so weaken his force that he will not be able to do us serious injury. The best mode of accomplishing this will probably be most clearly imparted to the reader by another extract from my memoranda, reading as follows:

"June 21, 1864, I discovered that my young cabbage plants were being considerably injured by the Striped flea-beetles. Many of the leaves had a wide strip upon their border excoriated, with several of the beetles present upon these particular leaves, feeding and extending the injury. I thereupon sprinkled the leaves copiously with ashes. But the rain soon after washed off the ashes, whereby the single application was but partially successful. I then turned some large half-grown chickens into the garden, and watching their movements, I saw them spitefully picking at these cabbage leaves. I thought it was the cabbage they were picking; but keeping my eye upon a particular leaf which I saw a chicken picking at, and going to it I found the leaf was not at all wounded. It was therefore evident it was these

flea-beetles which the fowl was picking from the leaf. I afterwards noticed them repeatedly at this work, first picking off from the leaf, and then off from the ground under it—it thus being plain that a portion of the beetles leaped to the ground for safety as the work upon the leaf was going on, but failed by this resort to escape from the piercing eyes of the chicken. And a few days after I found these flea-beetles had totally disappeared from the cabbages, and were seen no more that season. Most of them had no doubt been devoured by the chickens; a few may, perhaps, have fled to safer quarters. An old hen getting into the garden commenced helping herself freely to the leaves; but the chickens only want the beetles which are on the leaves."

I would further say, every owner of a garden in city, village or country, should make it a regular practice to rear at least one brood of chickens each year in the garden, keeping the parent hen confined under a small coop placed somewhere in the midst of the grounds, and allowing the chickens to run freely about and forage for themselves, until they are grown so large as to begin to molest the cabbages, cucumbers or other vegetation. The number of these flea-beetles, centipedes and other injurious insects and their larvæ, which a brood of chickens will search out and consume in getting their growth, is immense, and is by far our most convenient, most economical and effectual resort for keeping our gardens clear of these vermin.

We have another important and invaluable animal to aid us in this work. Next to chickens, toads are beyond doubt our best safeguards against these and other noxious insects. A few of them should always be kept domesticated in every garden. How very serviceable these animals are in destroying this striped flea-beetle, is amply shown by the statement of a "Brooklyn bee-keeper," made at a meeting of the American Institute Farmers' Club, as reported in the New York Tribune, August 30, 1864, p. 6, col. 6. He says he saw a toad snap up one or two bees from the ground, and fearing he was living on the bees, he killed him, and examined his stomach and found no bee or part of a bee therein, but "two long, hairy caterpillars, and numerous heads and parts of beetles; but the bulk was made up of a sort of cabbage beetle or flea, jet black, of small size, with a hard shell, which I had noticed very abundant on my cabbages and turnips."

From what has now been stated, it will be seen that we need

never suffer from this insect. By raising a brood of chickens annually in our gardens, and having the toad domesticated there, we can readily prevent these striped flea-beetles from becoming multiplied and injurious. And if these animals cannot be procured, and these beetles get to be numerous and detrimental, we can usually protect the plants from them by dusting them with ashes. Thus we have remedies against this insect which are so easily obtained and applied, and are so efficacious, that we can scarcely desire anything further in the premises.

CABBAGE APHIS, *Aphis Brassicæ*, Linn. (Homoptera. Aphidæ.)

On the leaves of cabbage and ruta baga through the season, sucking their juices; dull greenish plant lice, solitary or in clusters, the winged ones varied with black.

One of the insects most common upon the cabbage and from which it suffers much injury is the plant-louse. From July to the close of the season it may be found at all times upon some of the leaves of almost every plant, either wandering about solitary, or stationary and closely crowded together in clusters covering portions of the surface. It inhabits for the most part the upper sides of the inner leaves and the under sides of the outer ones. It is in the former case that it is most pernicious, by sucking the juices from and weakening this part, whereby it heads tardily and imperfectly, or, if the lice are numerous, no head is formed and the plant is worthless. J. L. Edgerton, of Waverly, N. Y., states (Country Gentleman, July, 1857, p. 80), that his patch of cabbages the year before, comprising 350 large, thrifty plants, were attacked by lice just as they were beginning to head, and in three weeks every plant was covered by these vermin, and he lost the whole, neither ashes or salt having any effect upon them.

Each cluster of these plant-lice is composed of wingless individuals of different sizes, all of which, except the smallest ones, are coated over with a gray meal-like powder. And a few very small black lice, having wings, are commonly standing here and there among and around these mealy wingless ones. And in almost every colony there may be noticed one or more bright yellow maggots. These are the larvæ of one or more species of flies pertaining to the genus *Syrphus*, which feed upon and destroy the plant-lice. Lady-bugs and other destroyers also abound in their vicinity. And we frequently see places upon the leaves where the mealy powder and the white cast skins show that a colony of these

lice has recently been located, which has been wholly broken up by these destroyers, not a living insect being left.

The ruta baga or Swedish turnip also frequently suffers from this Cabbage aphis, the under side of the curled leaves being sometimes densely covered with them, of all sizes. In August, September and October, the old wingless females are seen, resting stationary, with their bills inserted into the leaf pumping out its juices, surrounded by their young broods, all similarly employed, with here and there a winged male walking lazily about over the backs of his kindred.

The cabbage was no doubt introduced upon this continent with the first arrival of European settlers, it is so readily grown from the seed. And this aphis no doubt followed it ere many years, the live insects or their eggs having probably been brought here in cabbages forming part of the stock of provisions on shipboard. It has long been well known in our country. In 1791, the old New York Agricultural Society, in its circular of inquires (Transactions, vol. i, p. 14), asks for replies to the query, "Do you know how the lice or flies that infest cabbages and turnips can be overcome?"—showing that seventy years ago this insect was a pest in the country, of such importance that a remedy for it was earnestly desired.

Upon particularly inspecting a colony of these plant lice, it will be observed that the smaller, young ones or larvæ, are egg-shaped and of a dull pale green color, and their bodies are dusted over with pruinose matter resembling a pale grayish powder. Their antennæ and legs are smoky or black, and in some individuals a row of minute black dots may be discovered along each side of the back, and on the hind part other dots inside of the row. The smallest, recently born larvæ, however, differ from the others in being destitute of any gray mealy coating, and also in being more narrow and somewhat cylindrical in their form, with the head narrower than the anterior end of the body, and the antennæ and legs dull white.

Fig. 8. Wingless female.

The *females*, or largest wingless individuals in the colony are also coated over with gray meal-like powder. They are less than a tenth of an inch in length, egg-shaped and of a dull yellowish green color, the eyes black and also two large spots on the crown, and one on each side of the

neck. The antennæ are also black, with the third joint dull yellowish. The body is plump, large and unwieldy in its aspect, with the breathing pores, and several dots on the back, black, and on the hinder part some vague blackish transverse streaks. The honey-tubes are short and black, as are the legs also, the base of the thighs being pale greenish.

The winged individuals, Mr. Curtis takes it for granted, are males, but they certainly are, at least for the most part, females, and show the end of the ovipositor slightly projecting like a tail at the tip of the body.

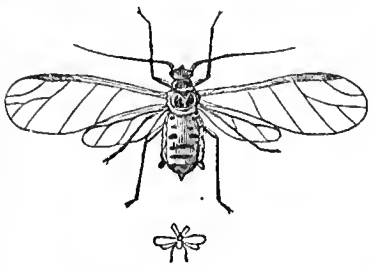


Fig. 9. Winged female.

These *winged females*, represented in the cut, Fig. 9, the lower figure showing the natural size, measure 0.075 in length to the tip of the abdomen, and 0.14 to the end of the closed wings, and their width from tip to tip of the extended wings is 0.18. They are of a dull greenish color, varying to pale dull yellowish, and largely varied with black. The head, neck and forebody on its upper side are black and shining. The horns or antennæ are two-thirds the length of the body, more slender towards their tips, and black. On the neck, one or two pale yellowish bands are sometimes perceptible. The hind body is usually pale green, with dark green or black bands on the back, which are often narrowed or somewhat broken asunder in the middle and have one or two dots or small spots at their outer ends in a longitudinal row; the honey-tubes scarcely equal the distance to the tip and are black with their bases pale yellowish. The legs are black with the basal half of the shanks and of the thighs pale yellowish. The wings are hyaline and iridescent, their stigma pale greenish and their veins black or dark brown. The distance between the first and second veins at their base, is a little more than half that between them at their tips; third vein further from the second at the tip than at the base, and a little nearer to the second at the base than the second is to the first; first fork a little nearer to the second fork than to the third vein, and a little nearer to the third vein than the third is to the second; second fork very little nearer to the fourth vein than to the first fork; fourth vein slightly curved and very little nearer to the second fork than to the tip of the rib-vein.

Usually these plant-lice are not present upon the cabbages or turnips in such numbers as to occasion any anxiety. Their natural destroyers ordinarily suffice to keep them in check. But when, as in the case of Mr. Edgerton, they throng the vegetation in such hosts as to threaten its ruin, I should drive short stakes among the cabbages or turnips and spread a sheet, a large piece of canvass or old carpeting over as many plants as the cloth would cover, and burn tobacco in cups here and there underneath, till I was certain the smoke had filled the whole space. Hereby every aphis would instantly be smothered. I should then remove the cloth and with clean water from a watering pot wash the plants

thoroughly. I should then inclose and treat another portion of the plants in the same manner, and another, until I had gone over the whole. Tobacco smoke will cleanse any plant from lice where it is so applied as to penetrate between the leaves sufficiently to reach every insect upon them. And this is the only known remedy which is certain and infallible. All others are merely palliative.

Soap suds, which are so often recommended, will kill all the young tender lice, and leave most of the old ones alive, to each commence founding a new colony.

Mr. Curtis, in his Farm Insects, p. 70, makes the following remarks on the subject of remedies for these cabbage plant-lice:

Protected as the aphides are in the wrinkles of the leaves, which they themselves have caused by the pumping up and extravasion of the sap, it is, I think, impossible in the open field to apply any effectual remedy for the extirpation of this prolific tribe. When it is in our power, the best plan would be to cut off the diseased leaves as soon as the presence of the insects is detected, and crush them completely under foot, or put them into a sack and carry them away to be destroyed by boiling water. Watering the plants with equal parts of tobacco-water and lime water is said to be the best mode of destroying the aphides in gardens; and if plants be washed with tobacco-water alone—about half a pound of tobacco to a half gallon of hot water—it will kill the aphides; and if applied warm it will kill them the sooner. Strewing tobacco on hot cinders will soon rid a green-house of this pest; and sprinkling tobacco-dust upon trees, when the dew is upon the leaves, is an infallible remedy; but these applications would avail but little in the field, even if it were practicable to employ them. Sprinkling of lime-dust is likewise considered a very effective cure, but not in wet weather, when the lime not only loses its caustic quality, but the aphides so perfectly secrete themselves, that it is impossible to annoy them. I have been astonished to see plants swarming with them on the first dry day after long continued and very heavy rains.

RADISH-FLY. MAGGOT BORES RADISH ROOTS.

RADISH-FLY AND WORM, *Anthomyia Raphani*, Harris. (Diptera. Muscidæ.)

Boring in the roots of the radish; white maggots thrice as long as thick, their bluntly flattened hind end margined with minute teeth, of which the lower two are larger and notched at their tips; the pupa lying underground and producing ash gray flies having on the hind body a black stripe on the middle of the back crossed by narrower black lines on the edges of the rings.

The leaves of the radish are perforated with small holes by the same Striped flea-beetles which infest the cabbage leaves. But the worst enemy of this vegetable is the larva of the Radish-fly, *Anthomyia Raphani* as it is named by Dr. Harris, although it appears to be identical in every particular with the European *A. radicum*. This larva is a maggot which eats spots in the skin of the radish and also bores an irregular yellow track in the white interior of the root, rendering it hard, stringy and unfit for the table. Hereby a large portion of the radishes grown in all our gardens are every year worthless, and many never attempt to grow this vegetable, in consequence of its liability to be thus worm eaten. It is only my earliest sown radishes, each year, from which I obtain any that are fit for use, and for several years past, this first sowing has also been a total failure. The worm and also the pupa differs in no respect from those of the Onion-fly, that I perceive, except that at the hind end the two larger teeth on the middle of the underside are slightly notched or two-toothed at their tips, instead of being tapered to a single point. The flies, too, are very similar, but here three faint brownish stripes are perceptible on the thorax or fore-body, and upon the hind-body in the male is a black stripe along the middle of the back, which is crossed by narrower black lines on each of the sutures.

Sometimes the wounds of the radish are merely superficial, consisting of round pits ate in the skin, and possibly it is some other worm living in the ground which gnaws these shallow holes. These may be wholly cut out with the knife, in preparing the radishes for the table, and thus their injury is unimportant. But at other times the maggot is found in the root, in a burrow which it has bored, running irregularly about in the interior, to the length of one or two inches, forming a tawny yellow streak in the white succulent substance of the root. Sometimes these streaks run everywhere through the root. The external orifice is wet and slimy, and the worm is frequently noticed reposing here at the mouth of its burrow, its blunt hind end forming a plug as it were to the hole. When disturbed it retreats inward, moving along its

burrow with agility, by alternately contracting and elongating its body.

The larva is 0.20 long, elongating itself to 0.25 when crawling. It is about three times as long as thick, appearing to be more short and broad than the larva of the Onion-fly. It is white, shining, cylindrical and tapering to a point anteriorly, where the jaws appear under the skin as a short, black, movable line, its anterior end when protruded forward becoming split, and then seen to be two sharp hooks, which are curved downward, and when the animal is crawling these hooks are pressed downward against the surface to aid in locomotion. The body is divided by transverse lines into eleven or twelve segments, and when the head is exserted thirteen segments can be counted. At the hind end of the back a pale tawny yellowish dorsal stripe is faintly visible. The hind end is abruptly cut off, obliquely downward and slightly backward, forming a flat surface, having above its centre two conspicuous spiracles or elevated dots, their surface opake and rugose, and their color sometimes tawny yellow, sometimes black. This flattened hind end has a number of small acute teeth around its outer margin, of which the two lower ones are thicker, of a brownish color, and slightly notched or two-toothed at their tips in the large but not in the smaller young larvæ. Above these on each side are three teeth, distant from each other, the middle one nearer to the upper than to the lower one.

When full grown they change in the ground to reddish brown pupæ, similar to those of the onion and cabbage maggots. The insect remains in this state two or three weeks, when the fly hatches and crawls up out of the ground, with its wings crumpled up, and climbing up the side of a clod or any perpendicular surface which it finds, these members expand and assume their proper form before they become dried and firm.

In these Radish-flies the two sexes differ materially. The *male* is ash gray and very bristly; the large compound eyes occupy most of the surface of the head and are almost in contact upon the crown. There are also three minute eyes at the base of the crown. The face is silvery gray, almost white in some reflections of the light, with a long black streak on the forehead, which is pointed at its hind end. Below this streak are the black three-jointed antennæ, the basal joint being small, the second large, the third largest and oval, with a two-jointed pubescent bristle on the back, the first of the joints being very minute. The fore-body is oblong, whitish on the sides, with three faint interrupted dusky stripes upon the back. The hind body is shining gray, rather small and elliptical, tapering to the apex, with a black stripe down the back, the edges of the segments and the region of the scutel being also black. The two wings are large, transparent, iridescent, laid the one upon the other in repose, the longitudinal veins extending to the margin, with two

transverse veinlets in the disk. The peisers are pale yellowish. The six legs are black and bristly, the feet five-jointed, ending in two little claws, and two large pale leathery lobes.

The *female* is of a uniform ash gray color, excepting the silvery white face and pale sides of the fore-body. The eyes are widely apart, with a bread black stripe between them, which is shaded into chestnut color in front. The hind body is larger than in the male and conical towards its apex. The wings have a tinge of yellowish at their bases. The species measures 0.22 in length, and 0.45 in width across the extended wings.

This species is so closely akin to the cabbage and the onion maggots, that the same remedies will be efficacious for it, which are mentioned in the accompanying account of those insects.

HAIRY FLEA-BEETLE, *Haltica (Macrocnema) pubescens*, Illiger. (Coleoptera. Chrysomelidæ.)

On the tomate, potato, petunia, &c., throughout the season, gnawing small holes through the leaves; a small black flea-beetle clothed with fine short whitish hairs, and having pale dull yellowish legs and antennæ.

In addition to the Striped flea-beetle, of which the full history is presented in the foregoing pages, several other species of these minute flea-beetles occur in our gardens, and would be more noticed if the species mentioned were not so extremely numerous as to quite eclipse them by attracting to itself the principal attention. Next to it in numbers is one similar to it in form, but smaller in size and not at all glossy, of a black color throughout, except the legs and antennæ, which are pale dull yellowish.

As the Striped flea-beetle infests the cruciferous group of plants, this occurs mostly upon vegetation pertaining to the natural order *Solanaceæ*. It is to be found in abundance upon the tomato from May till September, perforating the leaves with small holes. It infests also the petunia, being according to my observation the worst insect enemy which we here have upon this much esteemed flowering plant. Young seedling plants are liable to be seriously injured by it. On first becoming aware of their presence upon a small cluster of young petunias only an inch high, I found eighty of these insects, one season, in company with a few individuals of the striped species. It sometimes occurs quite common upon hop leaves, eating numerous small holes therein, as is its habit upon whatever plant it stations itself. I have observed it upon the bitter-sweet in company with the tortoise beetle (*Cassida clavata*,) the latter eating larger holes in the same leaves.

But the leaves of the potato appear to be its favorite food. From about the middle of June till the end of the season, it almost every

year occurs upon this plant in great abundance, every leaf often showing from one to five or six of these beetles upon it. And the potato leaves are sometimes noticed so profusely pierced and riddled with holes that little more than their ribs and veins are remaining untouched. Destroying the leaves to such an extent as it does in seasons when it is particularly numerous, it must certainly be quite detrimental to this important vegetable.

Having given a full account of the larvæ and transformations of this genus in connection with the Striped flea-beetle, it is unnecessary to repeat the same details here.

The HAIRY FLEA-BEETLE is eight-tenths of an inch in length, oval, convex, black, and opake or destitute of any glossiness. It is clothed with thin, short, whitish pubescence. Its head is black, with the eyes prominent, and the horns or antennæ of a clay yellow color, clavate, and ten-jointed, the two basal joints elongated, the third joint a little shorter, the tips tinged with dusky. The fore body is covered with fine punctures, and shows a transverse groove near the base; it is more wide than long, slightly narrowed before, with the sides convex. The scutel is minute. The wing covers have eight rows of coarse punctures placed in slightly impressed furrows, with a shorter similarly punctured furrow on each side of the scutel. The wings are large, transparent, folded and withdrawn under the wing covers when not in use. The legs are clay-yellow with the thighs, at least the hind pair, blackish brown and very thick; the shanks are rather short, the internal angle forming a curved lobe at the apex, which is cut off obliquely; the feet are four-jointed, the third joint two-lobed, the apex furnished with two claws; the hind pair very long and inserted on the inside of the shank, with the basal joint as long as all the others united.

The same remedies which are employed for the striped flea-beetle will be equally efficacious for this species.

This is named the cucumber flea-beetle, *Haltica Cucumeris*, by Dr. Harris. I am not certain that I have ever met with it upon the cucumber, all the flea-beetles which have occurred to my observation upon that plant proving, upon close examination, to be not this species, but the very similar one named *Psylliodes punctulata* by Dr. F. E. Melsheimer. In one instance where potatoes and cucumbers were growing side by side, and the potato leaves abounded with this species, I made a careful search for it upon the cucumber leaves, but without being able to find a single individual, all the flea-beetles thereon proving, when carefully inspected, to be the *punctulata*.

WIREWORMS. IMPORTANT PESTS. EXTENSIVE DEPREDATORS.

WIREWORMS, *Cratonychus communis*, Gyllenhal, and other *Elaters*. (Coleoptera. Elateridæ.)

The roots of the turnip, potato, and numerous other garden plants and field crops, eaten, and the crops frequently destroyed by long, slender, tough, tarnished yellow worms, which finally change to slender, elliptical beetles, which, if placed on their backs, with a snap throw themselves upward to regain their feet.

I propose in the following pages to present as full an account of the wireworms, their habits and economy, as my means of information will enable me to prepare. Those who are sustaining most vexatious losses from these pests, are frequently, in our agricultural periodicals, calling for all the information that can be given. "We want a Wireworm Essay;" "Inform us, at least, of every remedy that has been tried;" such are the calls which are ever and anon being made. My own observations will enable me, I think, to present a more accurate and satisfactory account of our American wireworms than has before been given the public. The late Mr. Curtis made, probably, the ablest investigation of these insects which has ever been accomplished. We shall make free use of the valuable information embraced in his report, published first in the Journal of the Royal Agricultural Society, and subsequently in his volume entitled "Farm Insects," these wireworms forming the subjects of the sixth and seventh chapters of this volume. And on the subject of remedies, we shall glean much important information from several of the agricultural periodicals both foreign and domestic.

Mr. Curtis well remarks, that of all the insect enemies with which the farmer, and he might also say the gardener, have to contend, there are none which are more fatal in their effects and more difficult to overcome, than the wireworms. To destroy these pests and prevent their ravages, baffles the efforts of the most skillful and ingenious. Most of our insect enemies limit their depredations to a single species of plant, or, at least, to the plants of a particular group or natural order. Thus the attacks of the striped flea-beetle are confined to plants of the order Cruciferæ; those of the onion-fly, to the onion; the midge and Hessian-fly, to wheat; the curculio, to the pomaceous and stone-fruits, &c. But the wireworms may almost be termed omnivorous. There is scarcely a product of the farm or the garden which is exempt from their ravages. They destroy, alike, the coarsest vegetables and the nicest flowers. And being thus unlimited in their operations, the amount of mischief they do is almost incalculable. Says Mr.

Alvord (Cultivator, 1864, p. 115), "I, for one, would willingly pay a large sum to be informed how I could rid my farm of this troublesome pest, for I have lost more in the injury and destruction of my crops from the depredations of this worm, than from all other insects, birds and beasts combined, and after years of fruitless effort and experiment to destroy them, or to prevent their ravages on my crops, I have come to the conclusion that for the present I must bear with the loss which I annually suffer from their ravages, as all the different methods which I have tried to guard myself against them, have thus far proved of no avail."

Mr. Curtis states that in Britain, every grub and worm found by the farmer and gardener at the roots of their crops, including centipedes and the larvæ or maggots of gnats and Tipulæ, have been confounded together under the appellation of "the wireworm," and that in so respectable a periodical as the Gardener's Magazine, figures have appeared as the larva and pupa of *Elater segetis*, or the true wireworm, which were undoubtedly taken from some insect not belonging even to the same order. And he correctly remarks that such errors are sadly mischievous in a publication expressly intended to convey information to all classes, and no subsequent correction can entirely eradicate a blunder and its effects, when once circulated by the press. Although, in this country, many errors and crudities in relation to insects are being published, of the very many persons who have mentioned the wireworm in conversing or corresponding with me, I recollect no one who applied this term incorrectly, and in but rare instances has the inquiry been made of me, whether the centipede might also be termed a wireworm. No such error, I think, as that complained of abroad, is at all prevalent here.

These wireworms are the progeny of the Elater group of beetles, which constitute the genus to which the name *Elater* was given by Linnæus, and which naturalists in our own day have divided into a number of genera which are grouped together, forming the family ELATERIDÆ in the order COLEOPTERA. These beetles are known to every one from their curious manner of recovering their upright posture when they chance to fall upon their backs. Their legs being too short to enable them to turn over, they have the faculty of giving a sudden snap or spring, whereby they bound upward several inches, and in falling usually alight right side up,

or if they fail of doing so, they repeat this spring again and again, until they succeed, resembling the feats of an acrobat or tumbler, and with each spring making a loud click, similar in sound to the ticking of a clock. They have hence received the names of "click-beetles," "spring-beetles," and "skip-jacks" in England, and in this country I do not recollect to have ever heard them designated by any other name than that of "snapping-bugs," although snapping-beetles would be a much better term. From their appearance when about to make a skip the Indians called them the "neck-breaker," or the "insect that breaks its neck."

These Elaters or snapping-beetles are an extensive group of insects, and there are consequently many kinds of wireworms, these worms being the Elaters in their larva state. We meet with them in two very different situations, a part of them being found underground where they feed upon the roots of plants, and another portion residing under the loose bark of diseased and decaying trees, feeding there upon the putrid wood. They have been called wireworms from their long, slender, nearly cylindrical forms, their smooth, shining surface, and the tough, leathery texture of their bodies. It would be expected that these wireworms would closely resemble the larvæ of the Buprestis family of beetles, as this family and the Elaters are so closely alike in their perfect form, that, in the systematic classification of insects, authors have been unanimous either in placing them side by side or uniting them into one group under the name *Sternoxes* or Breast-spined beetles. Their larvæ, however, are very dissimilar. On the other hand, the close resemblance of the wireworm to the meal-worm has been remarked by every one, although this pertains to a group which is widely separated from the Elaters in our systems of classification.

On coming to submit a number of wireworms taken from different situations to a particular examination they are found to differ from each other in various particulars. Most of them show an impressed line along the middle of the back, but in some specimens this line entirely disappears. The surface is usually covered with punctures, fine or coarse, but is sometimes perfectly smooth. But the most remarkable differences occur in the structure of the last segment of the body.

WIREWORMS. END OF THEIR BODIES OF MANY SHAPES.

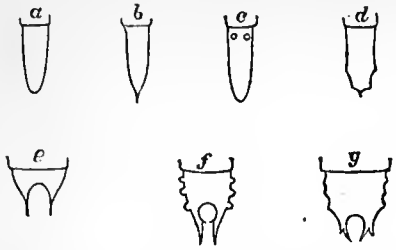


Fig 10. End of the body of different wireworms.

The annexed cut will give the reader a view of the principal variations which take place in this part. In some specimens this last segment is simply conical and bluntly rounded at the end, as represented at *a*. In others it tapers to an acute point with a sharp prickle projecting from the end, as at *b*. Others, as shown at *c*, are similar to one or the other of the preceding, but have on the back of this segment near its base, two conspicuous punctures resembling breathing pores, and thought by some entomologists to be such. Others have the tip flattened and rough, with its edge showing three or five tooth-like points on angular projections, as represented in the cut at *d*. In all the instances of these four different forms of this part, variously modified as they are in different specimens, this last segment is much longer than wide, and the worms have a narrow, long and slender form. In the remaining examples they are shorter and thicker bodied, and have the last segment about as broad as long, and roundly notched or forked at its end. In some instances this last segment is convex and smooth, and ends in two conical sharp points, as represented at *e*, these points being in most instances curved upward. Others have the back of the last segment flattened and rough, appearing as though it had been impressed with a seal, the margin on each side being elevated and smooth, with three or more projecting teeth. Some of these as shown at *f*, have the two forks tapering to sharp, upturned points, each fork usually having a small lateral branch. Others, as at *g*, have the forks blunt and notched or two-toothed at their ends. But it is not probable that these differences in their structure have any important influence upon the habits and economy of these wireworms, the different species which reside underground being alike in their manner of life, so far as is known.

Before describing the species we will relate the origin and growth of these insects. The sexes having paired, the female beetle deposits her eggs; but exactly where these are placed has never been ascertained that I am aware. The eggs hatch minute wireworms, which feed and grow, and at length change to pupæ, from which the beetle comes out in its perfect form.

WIREWORMS. HATCH FROM EGGS. TWO TO FIVE YEARS IN GROWING.

I once observed a female of the short-horned Elater, *Ludius brevicornis*, at the root of a recently-set cabbage plant, where she sank herself down in the earth the whole length of her body, her swollen abdomen showing she was on the point of extruding her crop of eggs. Everything indicated that she was about dropping some of these upon the root of this plant. Other business was too pressing at the moment to permit me to wait and watch her subsequent movements, and I accordingly inclosed her in a vial. Two days after I could not discover any eggs yet dropped in this vial, but at the end of three days more, on examining, I found 126 eggs had been deposited. They were scattered about, irregularly, singly or several in a cluster together, not glued to the damp surface inside, though perhaps they would have become adherent if dried.

The eggs were broad oval and quite small, only three hundredths of an inch long, of an opake white color, smooth and glossy, soft and rupturing on being gently pressed upon, the fluid within forming a shining, varnish-like, colorless spot upon the surface where it dried.

The worms which come from these eggs must be so very minute as to be nearly or quite invisible to the eye, and they grow very slowly. The Swedish naturalist, Bjerkander, in his account of the wireworms, published nearly a century ago, stated that they are five years in growing to their full size. I am not aware that any one has since investigated this subject, all subsequent writers contenting themselves to copy his statement. The opinion is impressed upon me that these wireworms, for the most part, are only two years in growing to maturity. There are two facts which lead me to this inference. First, when I have obtained several worms of one species, I have repeatedly observed they were of two sizes only, the smaller ones about half as large as the larger ones, indicating them to be respectively one and two years old; whereas, if they were five years in growing to maturity they would occur of all sizes. Although Mr. Curtis met with a variety of sizes at the same time and around the same turnip root, he remarks that possibly two kinds were present. Second, where explicit statements are given of the crops destroyed by wireworms, I observe that this destruction always occurs the first and second years after the ground has been broken up from grass. Is the crop of the third year ever harmed? But if these worms were

five years in obtaining their growth, a considerable number would be remaining the third and fourth years, injuring the crops of those years. It, however, may very probably be the case, that in cold northern countries many worms are double the number of years in growing to maturity that they are in more mild and temperate climates. Were our summers but half as long as they are, it appears evident it would require two years to produce the same advance in the growth of a worm that is now accomplished in one year. Hence it may be that in Sweden, where Bjerkander's observations were made, these wireworms are, as he states, four or five years in attaining their growth, when, in more southern and temperate localities, only half that time is required.

As they increase in size they moult or cast off their skins, probably thrice, like most other larvæ—the skin at the anterior end of the back cracking asunder, and the worm drawing itself out through this opening. They are quite soft, tender and pale colored immediately after leaving their old skin, but by exposure to the air soon acquire their normal color and firmness of texture. The young worms are white or nearly so, and become more tinged with tarnished yellow as they approach maturity. They are of a cylindrical form, somewhat depressed or flattened. The head is more strongly flattened and wedge-shaped. The mouth is rather small, with stout, horny jaws of a black color. The antennæ are placed near the anterior angles of the head, and are quite small and only three-jointed, the basal joint being largest and the terminal one short and narrow. Behind the antennæ, on each side of the head, is a minute black dot resembling an eye. The body is composed of thirteen segments, including the head, the third and fourth or two last thoracic segments being shortest. On the under side, the second, third and fourth segments are each furnished with a pair of short legs, which are inserted near the hind edge of each segment. The legs are four-jointed, and at their ends is a strong claw of a brown color. The fifth and each of the following segments, except the last, has on each side a minute dot, which is the breathing pore. The last segment has on its under side towards its base a retractile pro-leg, which also appears to be the orifice from which the castings of the digested food are evacuated. The different forms of this last segment have already been described on a preceding page.

As stated by Mr. Curtis (Farm Insects, p. 155), when the wire-

worm has arrived at maturity, it descends a considerable depth into the earth, forms an oval cell there, entirely composed of the surrounding particles of soil, and not even lined with silk. It then casts its skin again, and becomes a pupa or chrysalis, generally, it seems, at the end of July or beginning of August. It is long and narrow in form, like the perfect insect, but of a yellowish white color; there are two minute spines projecting from the anterior angles of the thorax; all the organs of the mouth are visible, the horns and legs are folded or incumbent upon the breast, and the wing-cases as well as the wings are small, and the least developed of any part; the scutel and abdominal segments are distinct—the apex being furnished with two moveable spines and two lobes terminated by nipples in the middle beneath.

Of course, at this period of its life the animal is at rest, being deprived of the power of locomotion, and is consequently no longer injurious. Several were found in their pupa state on the 26th of July. In Sweden, Bjerkander states that the wire-worms which he reared entered into their pupa state in the month of July, and that the beetles came forth in their perfect state about the tenth of August. They remain in this state two or three weeks; but many no doubt pass the winter, buried and protected from casualties and the rigor of that inclement season. When, however, the appointed time comes, they burst from their shrouds and the earthly tombs they inhabit, and rising through the soil, arrive at the surface, changed to perfect beetles, but of a whitish color, soft, and extremely tender. Exposed to the air and light, their bodies harden and their color gradually changes, so that in a few hours they have attained the horny coat which covers them, and assumed the tints which the Author of nature has assigned to the species.

The parts of the animal which were previously indistinctly seen, as through a veil, are now distinctly visible, and the legs, wings, and all the members are liberated, to give action to its body and animation to all its senses. They walk and run like dogs, with their heads inclining downwards, and their noses close to the ground. When they leap, their legs are applied closely to their bodies, and by the same means they drop down when the plants are approached upon which they are resting. These snapping-beetles have small heads and eyes—the latter minute, hemispherical, and reticulated, a portion being frequently concealed beneath

the margin of the thorax. The two horns or antennæ are generally slender and eleven-jointed, and are received, when at rest, into two grooves beneath, in the breast; the thorax is more or less four-sided-oval, the hind angles projecting and forming spines; the wing-cases are long and narrow, covering a pair of ample wings which are plaited lengthwise like a fan, with the tips folded over when they are at rest. They have also six legs for walking; the anterior pair is a little the shortest, and the hinder pair the longest; the thighs are stout; the shanks are simple; the feet are as long as the shanks and are all five-jointed, the basal joint the longest, except in the anterior pair, and the last joint is furnished with two curved, acute claws. In this state its habits are quite altered; instead of the ravenous, destructive wireworm, it is now become an active beetle, running up the grass and readily flying to flowers, to which it resorts for food; the sexes also pair, and the male probably dies soon after—the female being longer lived. At the tip of her body is a longish horny ovipositor, which is easily protruded; it is flat and linear, the apex conical, thickened, and forming two lobes, each of which is projecting and hairy; at the tips are two minute obovate appendages, with two hairs at the apex.

Allusion has already been made to the remarkable power which these beetles have of recovering their natural position when they chance to fall upon their backs. Their legs not being long enough to enable them to turn themselves over therewith, they are furnished with a curious apparatus for this purpose. Between the first pair of legs arises a spine, with two small teeth at its base and sometimes one above, towards the apex. Upon the breast are two oval cavities into which the second pair of legs is inserted, and behind these cavities are the hips or trochanters to which the third pair of legs is attached. At the interior margin of the breast is a long cavity into which the spine is pressed, and the insect when on its back, by bending downward its head and tip raises this spine with such force that the point is jerked out of the cavity that holds it; bringing the centre of the back suddenly upon the plane, a spring is produced which raises the insect many inches from the ground, and turning over in the air it usually alights upon its feet—the height of the leap depending greatly upon the hardness and smoothness of the surface of the plane, and some species can bound much higher than others.

One of our American snapping beetles has been particularly

noticed in consequence of its close resemblance to the European *Agriotes segetis*, the species which produces "the true wireworm." It is the insect which is entered in Dr. Harris's Treatise as being the *Agriotes obesus* of Say. Among our American Elaters this has such a corpulent aspect, that Dr. Harris was probably hereby led on a hasty examination to ticket it as the species named *obesus* by Say, and subsequently having forgotton but that he had compared it with the description given by Say, he published it without any intimation of doubt as being that species. It is very evident he could not have fallen into an error so palpable, except in some such inadvertent manner. Dr. Le Comte regards this insect as being the *mancus* of Say. I greatly doubt its being that species, which is stated to be black, whereas this is constantly dark brown with the wing-covers paler. It is manifestly the species described by Dr. F. E. Melsheimer (Proceedings Acad. Nat. Sci., vol. ii, p. 217) under the name *Agriotes truncatus*, this name having been originally given it in the old Melsheimer Catalogue published in 1806.

This TRUNCATED SNAPPING-BEETLE, which has been thus named in allusion to the outerior edge of its head, which is not rounded, but ends abrubtly, as though it had been cut off in a transverse direction, is remarkably short and thick, as represented in the accompanying figures, the smaller one on the right hand side showing its natural dimensions. It is of a dark brown color with the wing-covers a shade paler than the anterior part of the body.

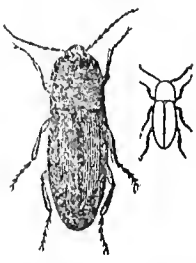


Fig. 11. Truncated snapping-beetle.

It is in lands unfavorable for tillage and which permanently remain in grass that I have met with this beetle, and in no other situation. At any time during the months of April and May if I hunt for insects in old pastures and meadows, either on low intervals along streams of water or on dry hillsides abounding in rocky ledges and hereby unadapted for plowing, I commonly come upon one or more specimens of this beetle, usually lurking under stones and sticks lying loosely upon the surface of the ground, but sometimes mounted up upon weeds. It is thus rendered pretty certain that it is exclusively the roots of grass that the larva of this species infests. And a wireworm corresponding with this beetle in its diminutive size, which I have met with in grass lands,

and have found in two instances perforating the roots of Timothy grass, I believe to be this insect in its larva state.

Fig. 12. Wireworm of Truncated snapping-beetle.

This wireworm, a side view of which is given in the cut, Fig. 12, is very slender, cylindrical, somewhat flattened along its underside, and having its surface smooth, glossy, and without any impressed line along the middle of its back, and with some fine hairs towards the apex of each ring. The last segment is nearly twice as long as broad, its basal half cylindrical and the remainder of its length tapering and ending in a subacute point. On its upper side towards the base are two conspicious dots resembling breathing-pores. It grows to six tenths of an inch in length.

The TRUNCATED SNAPPING-BEETLE is three tenths of an inch or slightly more in length. Its head and thorax are blackish brown with a slight glossiness, and are closely punctured and clothed with fine, short, incumbent hairs of a dull yellowish color. The *head* is more broad than long, and is inclined almost vertically. It is slightly convex and cut off transversely at its anterior end. The mouth and eyes are black. The antennæ are pale dull yellow, about as long as to the base of the thorax, thread-like, eleven-jointed, the first joint thickest and longest and narrowing slightly towards its base, the following joints obconic, the second one perceptibly though but very slightly longer than the third, all the following ones moderately compressed, the terminal one oval. The *thorax* is scarcely as long as wide, very convex on the back, narrowest at the forward end, the anterior half gradually rounded inward, a shallow groove along the middle of the basal half, the hind angles prolonged backward and very slightly outward, into a sharp point or spine, which has a short elevated line on its upper side and a more prominent longer one on its outer side. Scutel broad oval. *Wing-covers* about three times as long as the thorax and equalling it in width, slightly widest across the middle, convex, each with nine deeply impressed and punctured striæ, the interstices between which are slightly convex, finely wrinkled transversely, and furnished with minute punctures, the alternate interstices faintly wider. *Underside* dark brown and densely punctured. Legs pale dull yellow, the feet five-jointed, the four first joints successively diminishing in length, the fifth double the length of the preceding joint and ending in a pair of small, simple claws.

The Elater which is most frequently seen in our gardens is the *Cratonychus communis* of Gyllenhal, or the COMMON SNAPPING-BEETLE, which is represented in the annexed cut, Fig. 13. It is of a dark chestnut color, covered over with short fine prostrate hairs of an ash gray color, its wing-covers having rows of punctures resembling the stitches in a garment, and its forebody with an impressed line in the middle.

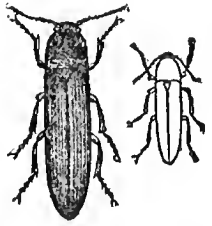


Fig. 13. Common snapping beetle.

This is well entitled to the name it has received, it occurs so plentifully in such a variety of situations in all parts of the United States. During the months of April, May and June, it is most abundant. Its numbers then diminish and it nearly or quite disappears in August, but is again met with in September and through the following months. Many years since a corner of my

garden having been neglected through a few seasons and becoming overgrown with quack grass, in April a perfect swarm of these beetles were there gathered, basking in the warm sunshine, having probably hatched from wireworms which had there been nurtured. They occur quite frequently in strawberry beds and similar places where the dense foliage furnishes a hiding place for them. And out of the garden they abound among the grass in pastures and meadows, and on the leaves of the apple and other fruit trees, and those of the oak, birch and other forest trees. Upon the approach of cold weather they resort to old and decaying trees to pass the winter, crawling under the loose bark of their trunks and into the crevices in rotten wood, where they are met with at the close of autumn and in the beginning of spring, a few being also found under stones and fragments of wood lying upon the ground.

The wireworms which I meet with in the garden are nearly all of one particular kind. I hence have little doubt they are the larva of the Common snapping-beetle, as this also is of much more frequent occurrence in the garden than any other species of Elater. This garden wireworm grows to an inch in length and is particularly distinguished from other wireworms by having three obtuse teeth at the end of its body, the middle one of which is more projecting and prominent than the lateral ones. A dorsal view of this worm is given in the cut, Fig. 14.

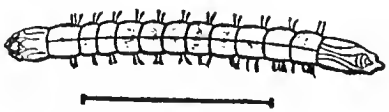


Fig. 14. Common wireworm.

It is of a cylindrical form, moderately flattened, its surface smoothly polished and shining, with a strongly impressed line along the middle of the back and a few fine bristles placed in a transverse row upon the hind part of each segment. It is tarnished yellow, of a deeper tint than usual, one segment at each end being much darker, of a livor brown hue, and the mouth black. The last segment is nearly twice as long as broad, its anterior half smooth, with two impressed lines above, diverging forward, and an impressed line upon each side of the back. Its posterior half narrowing and bluntly rounded at the tip, its upper side flattened, rough, with a wide shallow groove in the middle. The hind edge with three angular projections or obtuse teeth, and forward of those, on each side, another very slight and more obtuse projection. The younger and half grown worms of a much paler color.

In its perfect state the COMMON SNAPPING-BEETLE is slightly over a half inch in length, different specimens varying in their dimensions from less than five to nearly six tenths of an inch. It is a long, narrow beetle, about four times as long as wide, its wing-covers tapering from their base, almost imperceptibly at first, and more strongly as they approach their tips, which are bluntly rounded. It is glossy and of a dark chestnut or blackish brown color, the preserved specimens frequently showing in places obscure chestnut clouds

WIREWORMS. ABOUND IN LOW, DAMP AND PEATY GROUNDS.

upon a blackish ground. The antennæ, feelers and legs are paler, of a dull yellowish or reddish brown. The surface above and beneath is coated over with fine, short, incumbent hairs of an ash gray color. The *head* is slightly convex, with close and confluent punctures, its anterior edge rounded. The antennæ if turned back will reach the base of the wing-covers. Their first joint is largest, the second is smallest and only half as long as the third; the fourth and following joints are compressed, triangular, widening from their bases to their tips, where they are cut off transversely, thus giving them a resemblance to the teeth of a saw; the last joint is shaped like the head of a spear with the base outward. The *thorax* is convex, scarcely longer than wide, its opposite sides parallel at base and then curving regularly inward to the anterior angles; the surface with numerous, deep punctures, which become more dense and confluent towards the outer sides; a shallow impressed line along the middle, which does not reach the anterior edge; basal angles prolonged backward and slightly outward into stout spines, which are blunt at their tips, and have two elevated lines on their upper surface, the inner line being very slender and minute, their outer side showing a deep groove between two elevated lines; a short, impressed line on the hind edge of the thorax. Scutel broad oval, almost circular, its surface closely punctured. *Wing-covers* with rows of deep punctures, the intervening spaces flat and with very minute punctures; suture sometimes paler, reddish brown. *Underside* unicolor with the upper end with similar glossiness, punctures and pubescence. Legs dull reddish brown, at least on their inner sides; feet distinctly five-jointed, the first joint double the length of the following ones, the fourth joint smallest, the fifth more slender and longest, and ending in a pair of claws, which are toothed like a comb along their undersides.

With the expectation that I shall be able to ascertain the beetles by which are produced some of the other more common kinds of wireworms which we meet with in the soil, I defer to another occasion a further description of our species. It remains for us to review the different kinds of vegetation which falls a prey to the wireworms, and the remedies which have been resorted to and recommended for opposing them.

Wireworms are liable to occur everywhere in the soil, there being no situation, probably, in which they may not at times be found. But some situations are more favorable to them than others. The low, moist, cold grounds adjacent to marshes and streams of water, are situations in which they uniformly appear to be most numerous. Those low grounds especially which are of a peaty quality, of a black color, and abounding in vegetable matter, appear to be most thronged with these worms. Says S. Brown, of North Wilmington, Mass., in the Boston Cultivator, July 27, 1861: "Last September I plowed a piece of bound-out pasture ground. A part of it was a clay colored, sandy loam, the rest a damp, black soil. In May it was again plowed, manured in the hill, and planted with corn. The wireworms destroyed every grain planted in the black soil, and left that planted on the light colored soil unmolested." And one of Mr. Curtis's informants states that on the lower parts of fields bordering on marshes,

where the land is springy and friable, barley, turnips and beets have generally fallen a sacrifice to wireworms, and such land is most subject to their attacks.

In all other situations than low, damp grounds, it is where lands have remained in grass a number of years that wireworms are liable to become greatly multiplied. Says a correspondent of the Cultivator, 1861, p. 284: "We seldom see a field badly troubled with them, that has not lain to grass some years. * * * The only way to prevent their infesting our farms, so far as I know, is to break up and seed down often, never allowing land that has been infested with them, or that which may be supposed to be well adapted for them to work in, to lay to grass longer than one or two years."

There are but few crops, moreover, that they will not attack, although there are particular vegetables to which they undoubtedly give a preference. But this may be owing, at least in part, to the larvæ of different species not having exactly the same tastes.

The plants which wireworms are known to attack, or at least are recorded as attacking, are grass, Indian corn, wheat, rye, barley, oats, potatoes, turnips, mangel-wurzel, cabbages, carrots, beets, onions, lettuces, rape, hops, strawberries, irises, pinks, carnations, dahlias, lobelias, and numerous other garden flowers.

Grass appears of all kinds of vegetation to be that which is most attractive and palatable to wireworms. They abound alike in the roots of the coarsest sedge and other wild grasses on the borders of marshes, and in those of our most delicate pasture grasses, the June and Kentucky blue grass. As has been already mentioned, I have met with them boring into the bulbous roots of the Timothy, and sending out a swarm of Elaters from the fibrous roots of the quack grass. They resort alike to the scanty carpeting of dry, rocky hills, and the luxuriant growth of rich interval meadows. In short, as Mr. Curtis observes, it may be received as an axiom, that wherever grass will grow, the wireworms may be found, for the roots of the various species all afford sufficient nourishment for their support. Pasture and meadow lands, consequently, are always stocked with them. And it hence follows that these lands when newly broken up often swarm with them, whereby the crops that we attempt to grow on these lands fall a prey to this pest.

Indian corn being usually the first thing planted on lands newly

broken up from grass, is the crop which is oftenest destroyed by wireworms. And this is a casuality of such frequent occurrence and of which our farmers are so fearful, especially if the weather after corn-planting is cold, wet and backward, that it is a common practise to occasionally uncover some of the hills, to ascertain the condition of the seed. And when making such examination nothing excites so much apprehension as the discovery of one kernel and another in the condition represented in the annexed Fig. 16.

Fig. 16. Wireworm attacking corn.

The wireworm has become quite generally known, in this country, more, probably, from its being seen thus bored into kernels of newly planted corn, than from all the other situations in which it occurs. These wireworms being found more or less numerous in the corn-hills furnish a criterion from which a judgment is formed as to the destiny of the crop. Thirty-six of these worms are reported as having occurred in one hill of corn, in Erie county (Rural New Yorker, 1857, p. 246.) An equal or greater number has probably been counted in some other instances. In a cornfield badly infested with wireworms, I noticed they were of two kinds, some having the end of the body as represented Fig. 10, *e*, others being similar to *g*.

Wheat is sometimes greatly injured by the attacks of wireworms. Their presence is indicated by the dying of the lower leaves, and when the worm has eaten through the root the whole plant withers and falls to the ground. Mr. Curtis observes that their attacks are said to be continued through the entire winter; but this, he thinks, is doubtful; for during severe frosts, they descend into the soil, like the larva of the cockchafer, and of our American May-beetle, retiring deeper and deeper as the cold increases. Early in the year they make ample amends for their fast, if they really do cease feeding during the winter, by the vigor with which they then attack the growing grain.

Barley is frequently greatly injured, particularly when the spring months are cold and dry, the young plants changing from a healthy green to a sickly yellow where these worms are at work upon the roots.

Oats are generally the crop which in England suffers most severely, being there sown upon land newly broken up. The danger, it is observed, is greater, the longer the land has pre-

viously been kept in grass. The ravages of these worms are sometimes so great that the farmer is compelled to immediately lay the land down again to pasture, to very great disadvantage, it being evident that where the wireworms are so numerous, no grain crop can be profitably grown.

Potatoes also suffer greatly, and it is observed that in some districts the crop is severely injured, whilst in others where the wireworms are equally numerous upon the turnips, it escapes. Sliced potatoes are said to be far more liable to be injured than tubers which are planted whole.

Wireworms are sometimes found in a closed cavity deep in the interior of ripened and stored potatoes. The walls of the cavity are of a dark brown color and of a loose, spongy and porous texture. In these instances it is probable that the worm bored into the small young potato, which continuing to grow, the track by which it entered became closed and wholly obliterated. It is the common wireworm of the garden, described on a preceding page, which I have met with in these cavities.

Mr. Hope states (Trans. Entom. Soc., London, vol. iii, p. 154) that the hops in Kent and other counties of England, have been repeatedly injured by the wireworm.

Cabbages are liable to be destroyed by them. When this crop is gathered in autumn, I have often noticed wireworms among the roots, sometimes with their bodies sunk half their length therein.

The turnip appears to be the most infested by these worms of any root crop. They are present in it the whole year round, though it is to the young plants that they do the most serious injury. When suffering from the attack of this worm the plants have a sickly aspect, with the outer leaves yellow, and on drawing them up out from the ground, the skin is discovered to be gnawed and one, two, three or more wireworms are invariably found upon or around it. They sever the young root, from half an inch to an inch below the base of the leaves, and often gnaw and consume it higher up. In Europe, where the turnip is a much more important crop than it is with us, the damage which is frequently caused by these wireworms is immense.

The roots of pinks, carnations, picotees, and several other cultivated flowers are much preyed upon by these worms. They attack the pink and carnation at the bottom of the stem, near the root,

and pierce it with holes in every direction, the only indication of their presence being the dying of the plant.

Mr. Curtis observes that, as the wireworms will not voluntarily leave the field in which they were hatched, until they have arrived at their perfect state and become beetles, it is impossible by any change of crops to remedy the evil, unless we could discover some vegetable which they absolutely dislike—or, by plowing, harrowing and keeping the soil perfectly free from weeds or plants of every kind, especially the grasses, they might be starved out. Whether they can fast for a long period is very doubtful, for it is principally in their perfect state that insects can live without food for an extraordinary space of time. Some importance, however, must be attached to the generally received opinion that it is in all probability whilst the surface of the field is undisturbed that the eggs are deposited. Consequently the crops that follow pasture land when broken up, are most likely to fall a sacrifice, for several succeeding years; and it will be the same when clover ground is plowed up; whereas, when the ground is occupied with potatoes, corn, and similar crops, no eggs, or very few, are laid in the field; but many of those which had been deposited from one to four years previously in the grass are hatching one after another, and the larvæ are gradually increasing in size and appetite, and consequently becoming daily more mischievous. If a grain crop follow potatoes in a field infested by wireworms, it will be liable to suffer greatly. Bjerkander says, "In the spring and autumn they have good appetites, and I have often observed that a single worm has bitten from eight, twelve, to twenty stalks in one place; and if one destroys so much, what may not thousands do?" And it will be almost useless to resow the ground where a crop has been destroyed by wireworms, unless the soil be first freed from them by repeated plowings, when poultry, birds, and the frosts of winter may have lessened their numbers; and the farmer must remember that the wireworms cannot possibly increase in number unless fresh eggs be laid by the snapping-beetles, and of this, there can be no danger from the end of September to the end of March.

With regard to the best modes of culture for keeping the wireworm in check, Mr. Salisbury, in his Hints to Proprietors of Orchards, page 109, gives the following sensible advice: It is an insect much complained of by farmers whenever they turn up land that has been cultivated with clover or grass, and it in gen-

eral does great injury to the grain crop which succeeds. It should be noticed that clover or other plants of such description, give protection to this insect; it is bred in the roots of these plants, and the land is so well stocked with it, that it attacks the grain and other succeeding crops very much to their injury. Land of this description is therefore unfit for grain immediately on breaking up. Turnips or potatoes are not so liable to injury from this insect; but the best preventive is probably a summer fallow, and burning the rubbish on the land before cropping, by which means the eggs which are laid in the stalks are destroyed, and the live worms die for want of nourishment. Soot and lime will also kill this destructive worm. Before breaking up old lays, it should always be a point with the farmer to examine the then existing crop, and observe if any of these insects are in the roots and stalks, and if so, to apply the above as a preventive previous to sowing a crop of grain in the land.

As the wireworms are fond of the potato, it was long since recommended by Sir Joseph Banks to employ slices of this tuber as a trap with which to catch them. Several contributors to the Gardener's Chronicle concur in this as being the best mode of freeing the garden at least, from this troublesome visitor. One of these merits to be here transcribed. Mr. Adan says (vol. iii, p. 301): "I send you an account of destroying the wireworm, which I have adopted for some years, my ground being full of them, so that I could neither grow sweet-williams, picotees, bulbs, lettuces, nor indeed any succulent plant, without their boring, running up and eating the hearts out. Near these plants I now place half a potato, with the eyes cut out to prevent its growing, and run a pointed stick through the middle of it, and peg it into the ground, covering it over with about one inch of loam, and in a day or two I have pulled out by the tail from fifteen to twenty of them from one slice of potato." It is recommended by some persons to lay the slices of potato on the surface, although there are others who consider that they may be buried two or three inches deep. Slices of turnip, cabbage, beet, parsnip, carrot, apple, and young lettuce plants, it is reported will answer the purpose equally well as the potato.

Many think highly of hand-picking, its effects being certain, and being done by children is not expensive. In Kirby and Spence's Entomology, p. 104, it is stated that Mr. G. Pearce of

Pennane Goran, in November 1838, saved an acre and a half of turnips sown to replace wheat destroyed by the wireworm, and attacked by hosts of these larvæ, by setting boys to collect them, who, at the rate of 1½ pence per 100, gathered 18,000; as many as fifty worms having been taken from one turnip. Thus, at the expense of only £1, 2s. 6d., an acre and a half of turnips, worth £5 to £7 or more, was saved; while, as the boys could each collect 600 per day, thirty days' employment was given to them at 9d per day, which they would not otherwise have had. Mr. Curtis states that Mr. Eley of Hounslow, gave him the following statements regarding three acres of drilled wheat infested by wireworms, and which were hand-picked by women in March, 1846. The dead plants were dug up with square-pointed knives, and the wireworms picked from the roots into small jugs; at the end of every two rows they were emptied into a large jar, from which escape was impossible. The total quantity taken and destroyed in this manner, from the three acres alone, was more than 60,000; the expense of collecting them was trifling, being not more than 10d per 1,000, at which price the women could earn good wages. The ground was gone over two or three times, and the worms were counted every night. And in June, 1845, he had five acres of Swedish turnips very much affected by these wireworms. A woman was set to dig the plants that were dead or dying, and to pick up the worms; she was seventeen days at one shilling per day, and collected 41,600 worms. It is added that the wireworms are much easier caught from the turnips than from the wheat; as many as twenty-five in several instances have been found attacking a single turnip.

It is supposed there are some particular kinds of vegetation which are distasteful and repulsive to the wireworms, and on which they are unable to feed and sustain themselves, and consequently if a crop of this kind be grown the worms will all vanish, perishing from hunger or escaping into the adjoining fields, and hereby the ground can be prepared for succeeding crops which will be uninjured.

In Europe, woad, a plant heretofore in extensive use by dyers for coloring purposes, has attracted much notice, as being of this kind. Respecting it, Mr. Curtis says, I learn from Dr. Roy, that, on breaking up damp meadow and pasture land in Lincolnshire, if it be sown with woad instead of corn, the wireworm will be got rid

of. It may be repeated two years, after which splendid crops of oats and potatoes may be obtained from the land.

From the testimony we have respecting white mustard, this would appear to be a crop which effectually secures the succeeding crops of wheat or other grain against these insects. Mr. Tallent's account of his experiments with this plant, read before the Northamptonshire Farming Society, and published in the Country Times newspaper, September, 1831, and copied from thence into several publications, is so interesting and satisfactory that I here repeat it: "White mustard seed will protect the grain from the wireworm, and this fact I have demonstrated perfectly to my own conviction. I first tried the experiment on half an acre, in the centre of a fifty acre field of fallow, which was much subject to the wireworm. The mustard seed being gathered, the whole field was fallowed for wheat, and the half acre that had been previously cropped with mustard seed was wholly exempt from the wireworm; the remainder of the field was much injured. Not only was the half acre thus preserved, but in the spring it was decidedly the most advanced part of the crop, and the prosperous appearance which it presented, caused me to repeat the experiment, by sowing three acres more of mustard seed in the worst part of a field of forty-five acres, also much infested with the wireworm. The remainder of the field was sown with early peas, which, with the mustard seed, was cleared in the same week. The land was then plowed for wheat; and I had the pleasure of noticing these three acres to be quite free from the worm, and much superior in other respects to the other part of the field, which suffered greatly. Thus encouraged by these results, I sowed the next year a whole field of forty-two acres, which had never repaid me for nineteen years, in consequence of nearly every crop being destroyed by the wireworm; and I am warranted in stating that not a single wireworm could be found the following year, and the crop of wheat throughout, which was reaped last harvest, was superior to any I had grown for twenty-one years. I am, therefore, under a strong persuasion that the wireworm may be successfully repelled and eradicated by carefully destroying all weeds and roots, and drilling white mustard seed, and keeping the ground clean by hoeing."

Mr. Loudon is of the opinion (Gardener's Chronicle, vol. vii., p. 675), that the wireworm cannot eat the roots of the mustard, most

probably from their acridity, and there being no other roots in the soil for them to live on, and no weeds or other plants being permitted to grow during the season but the mustard, the insects necessarily die of famine.

In this country, attention has been much directed to buckwheat, as being a crop which cleanses the ground in which it is grown from these vermin. It is remarked in the Cultivator (1859, p. 107), that this grain seems quite offensive to the wireworm, and growing close and thick, it leaves nothing for them to feed upon, and thus starves them out. Hon. A. B. Dickenson, in his address before the Courtland County Agricultural Society, in the year 1855, said: "I have heard it stated that five bushels of salt to the acre, or one hundred bushels of lime, would destroy wireworms. I have tried both; and have sowed ten bushels of salt to the acre, and they only laughed at my folly. I tried one hundred bushels of lime, as recommended, and they fattened on my bounty. I have only proved one remedy for the rascals, and that is to break the sod and sow it to buckwheat; plow late and as often as possible in the fall, and then sow it to peas in the spring; with the like plowing next fall, they will not disturb any crop the next season." It is scarcely necessary to cite other notices of this remedy. Objections are made to it as being an inferior, uncertain crop, which leaves much of its seed in the ground, growing to the injury of the succeeding crops. And the experience of A. G. Percey, as reported in the Rural New Yorker, (vol. xiii, p. 86), casts doubts upon its efficacy. He states that having had two acres of corn, growing in a low spot in an old meadow, totally destroyed by wireworms, he sowed the ground the last of June to buckwheat and a strip of corn, to notice if the latter would be more eaten than the former. And the worms appeared to relish the buckwheat quite as well as the corn, destroying between a quarter and a half of each of these grains. Winter wheat was sown upon this ground the following autumn, and was almost all destroyed. Oats were sown upon it the next spring and a heavy crop was obtained, uninjured by the worms. It merits to be noticed that this was the third year that the ground had been under the plow, thus indicating that the worms had all completed their growth and had left the soil the two previous years.

Bjerkander made several experiments, to ascertain by what means the wireworms could be destroyed. He placed several

worms in tea-cups, filled with different substances, and found the result to be as follows: Amongst garlic, the worms lived nine days; in water, four days; among leaves of the spruce fir, fourteen hours; leaves of the fir, ten hours; leaves of *Ledum palustre*, nine hours; leaves of the Dutch myrtle or sweet gale, *Myrica gale*, two hours. From these results, he thinks "it ought to be tried how useful it might be, in winter and summer, to mix in the heaps of manure fir leaves, *Ledum palustre* and *Myrica gale*, of which vegetables the dung would smell, which might probably be disagreeable to the vermin; and if they did not die in consequence of it, they might, perhaps, leave the fields."

The late Judge Delafield in his Agricultural Survey of Seneca County (Transactions New York State Agricultural Society for 1850, p. 523), closes a brief account of the wire-worm with the statement that exposure to the frosts of winter will destroy them; therefore autumn plowing is essential. Upon this measure it is remarked editorally in the Country Gentleman, and in the Cultivator, 1859, p. 107, that by fall plowing the winter arrangements of these worms are disturbed, and their lives finished by the extreme cold. A repetition of this course for a few years will lessen their numbers materially. To fit sward land which was infested with wireworms, for corn, we should manure and then plow immediately before planting. By this means the worms would be buried out of the way, and supplied with plenty of food in the roots of the grass, so that they would not injure the corn to any extent; such has been the experience of many farmers. For any crop suited to green sward, the same would be a good course; but beyond corn and potatoes, there are few crops which succeed well, and hence most would do better if the sward were plowed late in the fall. Land planted to corn as above, should invariably be plowed in autumn for the next crop, or the product would be likely to be destroyed or largely injured by this pest. An effectual method to rid the land of wireworm is to plow very late in the fall, and work thoroughly the next season, until time to sow buckwheat, which if sowed the next year also—following the same plan of fall plowing and culture—will totally eradicate them, giving at the same time two valuable crops. The Rural New Yorker (1866, p. 357) also directs to fall plow late, sow two barrels of salt per acre, and manure well the next spring; and your chances will be good for a paying crop. On the other hand, a correspondent

states in the Cultivator, 1861, p. 284, that fall plowing has frequently failed. "One instance of this was a ten acre lot adjoining my land, that was plowed very late, and if I am not mistaken, finished in December, and freezing up very soon after. The next spring it was planted to corn, and the whole destroyed, except about one acre in one corner that run up on a sandy and gravelly ridge. This lot had lain in grass six years. The cultivated grasses to which it had been seeded having run out and been followed by June and wire grass, it was undoubtedly in a very favorable condition for the wireworm. It was also the kind of land, a rich, loose, dark colored soil, containing considerable vegetable matter, which is most liable to be infested with them." And Silas Brown, of North Wilmington, Mass., in the Boston Cultivator, July 27, 1861, says: "I made a great mistake in plowing my land the last fall, as I not only lost the labor of the fall plowing, but brought a greedy set of worms to the surface to devour the seed put in by the spring plowing. Land designed for corn, and that is subject to wireworms, ought never to be plowed in the fall previous to planting, as these insects naturally incline to the surface, where they make an attack upon the seed as soon as planted. After many trials of fall plowing, on different kinds of soil, I am wholly in favor of spring plowing for corn. The planting ought to be done as soon as possible after the ground is plowed, before the worms have time to shift their places from the roots of the grass to the planted seed."

Draining, by changing a moist, cold soil into one that is more dry, warm, and genial to the crops we cultivate, cannot but have a most beneficial effect in breaking up favorite haunts of the wireworms and diminishing their numbers. Instances, however, have been reported, both at home and abroad, in which the worms were increased by this measure. This, we think, could only have been from some accidental cause and of but temporary duration. It is so universally remarked that these worms are the most numerous and destructive in cold, damp soils, the benefits which will result from draining cannot be doubted.

Compacting the ground, after sowing, by heavily rolling it, or driving sheep over it, is a regular practice with some farmers in England and Germany, to preserve the crop from wire-worms.

Lord Albemarle recommends that rape-cake should be used as a manure, powdered and sown over the field. He says, if it does not destroy the insects it at least saves the crop from their attacks.

The wireworms are said to be more fond of this than of any other food and will not trouble any crop of plants if they are supplied with it. J. H. Charnock, of Lennoxville, Canada East, gave a very interesting communication in the Country Gentlemen and Cultivator (1865, p. 77), in relation to this substance. He directs to break the rape cake into small lumps about a half inch thick and spread them over the ground, to the amount of three hundred weight per acre, and plow them in before sowing. These lumps he says will be found afterwards to be filled with worms in all stages from repletion to death and decay. And besides being such a perfect vermifuge it is a powerful fertilizer. If the worms are so fond of this substance as is stated, it is entitled to more general attention than it is receiving.

The benefits of highly manuring and promoting a rapid, vigorous growth of the crop are admitted on all hands. Manure, it is stated in the Cultivator (1859, page 107,) is well known as one of the best remedies for the wireworm. Some farmers adopt the following mode of applying it. The land for spring crops is plowed very late in autumn, the later the better, so that the cold may effectually chill them; and during winter manure is applied to the land, with three or four bushels of salt, and if practicable, twenty or thirty bushels of ashes. The two latter may be applied early in spring, and if the manure is made into compost with turf, loam, and sand the previous autumn, with the salt and ashes added at that time, and the compost applied early the following spring, it will succeed well.

Hog manure is stated by D. Thomson, of Adams Basin, N. Y., to be an entire preventive of the wireworms from injuring the crops. He reports in the Rural New Yorker (vol. vi, p. 133,) that the part of a field in which hog manure was scattered and plowed in, yielded a good crop, when that of the unmanured part of the same field was destroyed. And dropped in the hill in certain rows, these rows were unaffected, when the adjoining unmanured rows were entirely cut off.

Guano, it is stated in the same periodical (1862, page 29,) applied to the crop when it is planted, is the best preventive of their attack. It is found to be very offensive to the worms, and either destroys them or drives them away.

It remains for us, in conclusion, to mention the birds as being our best friends to assist us in destroying the wireworms. The

robin is very fond of these worms. The blackbirds and thrushes are constantly hunting the grass for them and other larvæ and pupæ. But the bird before all others for his efficiency in this work is the crow, in this country, and his brother, the rook, in Europe. Wireworms and their progenitors the snapping-beetles are the favorite food and the principal sustenance of these birds. And some idea of the importance and value of their services may be obtained from the following exceedingly interesting statement of Mr. T. G. Clithero, in the Magazine of Natural History, vol. vi, p. 142: "In the neighborhood of my native place, in the county of York, is a rookery, belonging to W. Vavasour, Esq., of Weston, in Wharfdale, in which it is estimated that there are 10,000 rooks; and one pound of food a week is a very moderate allowance for each bird, and that nine-tenths of their food consist of worms insects, and their larvæ; for although they do considerable damage to the fields for a few weeks in seed-time and a few weeks in harvest, particularly in backward seasons, yet a very large proportion of their food, even at these seasons, consists of insects and worms, which (if we except a few acorns and walnuts in autumn) compose at all other times the whole of their subsistence. Here, then, if my data be correct, there is the enormous quantity of 468,000 pounds, or 209 tons of worms, insects, and their larvæ, destroyed by the rooks of a single rookery in one year. To every one who knows how very destructive to vegetation are the larvæ of the tribes of insects, as well as worms, fed upon by rooks, some slight idea may be formed of the devastation which rooks are the means of preventing."

It is stated in the Rural New Yorker (1862, p. 29,) that the crow can distinguish by the eye what no farmer can—every plant which has a worm at its root; and that to obtain these insects it will frequently tear up in a short time large patches of turnips. We should incline to doubt the statement that it can accurately distinguish every plant which has a wireworm infesting its root, but we see the same statement is made of the rook also. Mr. Curtis informs us that, to pick the worms from the growing crops is the occupation of the rook when he is seen gravely surveying a turnip or corn crop, and with astonishing sagacity selecting those plants only which have a few yellow leaves outside—the sure indication of the presence of the wireworm and other insects. He states that a gentleman in Norfolk, who well understands this subject, says:

WIREWORMS. FED TO YOUNG CROWS.

"The rooks convey the first tidings of the presence of this formidable enemy by hovering over a field in flocks, and actually pulling up the turnips by the roots to search for them, and I cannot but believe that their sagacity directs them to the infested plants, which are distinguished by their drooping leaves and dark unhealthy aspect." An equally observant friend in Surrey, says: "The rooks are accused of doing injury by pulling up the wheat, but I, as well as others here, believe that they pull up the attacked plants to get the wireworms, and do not touch the healthy plants." Another informant states that during a period when the wireworms were abundant the rooks were busily occupied amongst the barley, and where it looked sickly they had drawn the earth away from the roots to find the wireworms, and where they had been "working the earth" none of these worms could afterwards be found. But a still stronger and incontrovertible evidence in their favor is the fact, that in the rooks which have been shot, a few grains of corn only were found in their stomachs but abundance of wireworms and other insects.

But for an occasional word in the statements above quoted, it would be thought it was the crow of this country to which reference was being made. That it is the worms that they are in pursuit of and not the corn, in the plants they scratch and pull up, has been conclusively ascertained. These wireworms and their parents, the snapping-beetles, appear to constitute the principal nourishment of the crow. He is educated into a relish for them from his infancy. His taste for them is acquired in the nest. I am informed by F. B. Ashton, of White Creek, N. Y., that in breaking up a crow's nest in which the birds were unfledged squads with only pin-feathers started out upon their skin, he found their stomachs literally stuffed and distended with Elaters, each bird having between seventy or eighty of these beetles in its crop, mixed up with a few plant bugs. This fact shows the valuable service which the crow does us in destroying these pests. Each of the young before leaving the nest, has, fed to it by the old birds, some thousands, probably, of these snapping-beetles.

We close this subject for the present, expecting to again resume it when we shall be able to present an account of the particular beetles from which some of the other kinds of our American wireworms are produced, in addition to the two which we have herewith described.

COUNTY ASSOCIATIONS.

Albany.

To Col. B. P. Johnson, *Sec'y N. Y. State Agricultural Society:*

The twelfth annual Fair of the Albany County Agricultural Society was held on the Washington Parade Ground, in the city of Albany. The Fair was a success beyond any ever before held in this county. At the annual meeting, held on the 30th of February, 1866, Mr. Jacob Messenger was elected President; Mr. Jacob Simmons, Vice-President; Mr. J. M. Bailey, Secretary, and Mr. John J. Mull, Treasurer. During the month of January last, J. M. Bailey resigned, and the present Secretary was elected to fill the vacancy. The officers of the society being supported by an excellent board of managers, determined to hold a Fair which would be a credit to themselves and an honor to the county. This they believe was accomplished, though not without a great deal of hard work. The lack of interest felt for the success and welfare of the society by so many prominent citizens, both in the city and in the country, was the greatest difficulty the officers had to encounter; and it was only after repeated efforts that this indifference was overcome. The officers, believing it essential that the interest of both the city and county should be more practically united than they had previously been, called a public meeting at the City Hall. This meeting was largely attended by many prominent men of the county. The enthusiasm that was manifested and the interest that was awakened at this meeting seemed to infuse a new life into the society, and from that time there was an interest manifested in the success of the then coming Fair that the most sanguine hardly hoped for. At an adjourned meeting, an auxiliary association, "The Albany City Merchants and Manufacturers' Association," was formed by the citizens of Albany, with Mr. Wm. J. Scott as President. This association devoted itself more exclusively to the mercantile and manufacturing department. Too much praise cannot be given to Mr. Scott and his associates for the energetic manner in which they thus aided the officers in their labors and contributed to the success of the Fair.

Mr. Wm. C. Schuyler was assigned the museum department,

TWELFTH REPORT

ON THE

NOXIOUS, BENEFICIAL AND OTHER INSECTS,

Of the State of New York.

BY ASA FITCH, M. D.

BUFFALO TREE-HOPPER, *Ceresa bubalus*, Fabricius. (Homoptera, Membracidæ.)

Wounding raspberry stalks, grape vines, and apple twigs, in autumn, by piercing them with numerous holes placed regularly in a straight row some two inches in length or more; a beech-nut shaped tree-hopper of a grass-green color, and having anteriorly on each side a short sharp point projecting horizontally outwards and resembling the horns of a bull or buffalo.

A figure of this insect and a brief general notice of it was given in my Third Report (Transactions 1856, page 335). Important additional facts in relation to it have since been obtained, whereby I am now able to present a full account of its habits and transformations. Some of these facts have already been communicated to the public in an article in the *American Agriculturist*, June, 1862 (vol. xxi, p. 172).

In the winter and spring a peculiar kind of crack or scar is sometimes observed on the twigs of the apple, cherry, willow and other trees, extending lengthwise of the twig, from half an inch to three inches in length. It occurs on twigs which are nearly or quite a quarter of an inch in thickness, and two or more of these scars are sometimes seen at different points along the same twig. Their surface is raised slightly above the level of the bark and has a rough, cankered appearance, with a deep crack along the middle, in which crack a row of small holes is more or less distinctly to be seen, extending the whole length of the scar. Upon splitting the twig it is discovered that these holes are bored downward into or quite through its pith, in an oblique or slanting direction, each hole being somewhat bent or curved, and occupied by the egg of an insect.

BUFFALO TREE-HOPPER. ITS EGGS. IN A ROW OF HOLES.

These *eggs* are shining, yellowish-white, cylindrical, with rounded ends, and about four times as long as thick, their length being a little more than the tenth of an inch, and exactly filling the holes for about two-thirds of their length.

If a twig be pared off with a knife upon the side opposite to the scar and crack, until the ends of the eggs are come upon, these are there observed to be arranged in two rows, although the holes in the bark are in a single row. And in splitting a twig in two to expose the holes, if it be done accurately, half the eggs will remain in one piece, and half, alternately with these, will be in the other piece. This curious arrangement is evidently caused by the artistic manner in which the ovipositor is inserted into the twig. Instead of sinking this implement inward through the exact centre of the pith the insect gives it a direction slightly to one side, first to the right, next to the left, then again to the right, thus alternately changing with each hole she successively perforates. Hereby the eggs have more space between them than they would have were they deposited in a single row. I conjecture it is to enable the eggs to swell and increase in size without crowding against each other, that they are thus arranged. Although it is quite an anomaly for an egg to grow and enlarge, the fact is well ascertained that the eggs of some of the saw-flies which are deposited in the soft and spongy pith of plants do swell and become larger before they hatch than they are when first laid. And the eggs of this tree-hopper have such a plump appearance, and fill the holes so compactly that it would seem they must have been smaller to admit of their being crowded into a space so contracted.

These same scars occur also in grape vines. But it is in the stalks of the raspberry that they are most common and occasion the most damage. They are met with in the stalks of the wild black raspberry or thimble berry as it is sometimes called (*Rubus occidentalis*), and of the red raspberry also (*R. strigosus*); and they are liable to be quite numerous in the cultivated garden raspberry (*R. Idæus*). In the *Rural New Yorker*, May 11, 1867 (vol. xviii, p. 151), Dr. F. H. Guiwits of Clinton, Michigan, states that "Almost every cane of my raspberries, both black and red, has been pierced by some insect depredator, with small perforations the size of a pin, in each of which, in the pith of the cane, I find an egg about an eighth of an inch long, of a whitish color. These perforations occur in rows and very close together. The rows are

from half an inch to half a foot long, and sometimes several rows on a cane. Above these nests the cane is dead. The most of them are as much as two feet from the ground. The prospects of my berry crop are diminished at least one-half in consequence of this."

In a black raspberry stalk I count eighty-one punctures in a row three inches and a fourth in length, indicating that this number of eggs was laid by one of these tree-hoppers at one time and without any remission of its work. The number of holes in a row one inch in length I find to be from twenty-five to twenty-seven.

In the year 1858 the apple trees at Akron, Ohio, and its vicinity, were extensively injured by these wounds upon their twigs. The malady attracted the notice of H. W. Howe, Counsellor at Law, of that place, who forwarded to me specimens of the wounded twigs, and some correspondence hereupon followed between us. Upon being informed how much of a novelty these wounds were, and that the insect making them was unknown, he devoted particular attention to this subject, and at length was so fortunate as to detect the culprit in the very act of piercing these holes, and specimens of it were thereupon sent to me. It is thus to Esq. Howe that we are indebted for knowing what insect it is which causes these wounds, and the manner in which it makes them.

This insect begins to be seen soon after the middle of July, each year, and remains till the end of the season. It is so common throughout the Northern States and Canada, and has such a peculiar form that every observing person has probably at some time noticed it. It is from three to four-tenths of an inch long, of a light grass-green color faintly freckled with whitish dots, and is three-sided, like a beech-nut in shape. At its forward end, jutting out horizontally upon each side is a short sharp-pointed process, these two projecting points looking like a pair of horns, giving it some resemblance to a bull or buffalo, from which circumstance it has received its name. It may frequently be seen on the small limbs of the apple tree, the locust and other trees in our orchards and yards, standing with its head towards the base of the limb. It there remains perfectly motionless and quiescent. But if the finger approaches it, with a sudden strong spring it darts away with such velocity that the eye is seldom able to follow it or even catch a glimpse of the direction in which it has thrown itself.

The piercer, lancet or ovipositor, the instrument with which this tree-hopper perforates the holes in the stalks of the raspberry and

BUFFALO TREE-HOPPER. ITS LARVA. SUCKS THE SAP OF PLANTS.

the twigs of trees, closes into its sheath much like the blade of a pocket knife in its handle. It is plainly to be seen thus closed and lodged in a groove on the underside of the body at its hinder part. To perforate a hole, Esq. Howe informs me this piercer is held obliquely forward and downward, like a knife blade a quarter opened. Being in this position and its point pressing against the bark, it is by a forward movement of its body that the insect thrusts it downward through the bark and soft wood and into the pith. An egg is then passed through this implement down into the hole it has made, and it is thereupon withdrawn and placed in position for making another hole. The wounds which it thus makes are scarcely perceptible at first, but become more and more conspicuous with age. It was the last of September when Esq. Howe discovered the insect at this work, and some of the wounds in the twigs he judged from their appearance had been made a month earlier.

The eggs remain in the pith of the stalks or twigs where they are deposited, through the winter and spring, hatching the fore part of June. They do not produce worms, but small active larvæ which resemble the parent insects in their shape.

The *larvæ*, when I have first noticed them, about the 20th of June, were one-tenth of an inch long, 0.06 high and about 0.03 wide. They are of a compressed triangular form, of a leaf-green color, and a soft fleshy texture, with two rows of long spines along the back, eleven in each row. These spines are soft and flexible, and bearded with fine bristles. Two are placed upon the summit of each segment except the head and the tip. They project upward and curve outward, except the forward pair which are curved strongly forward over the head, and the hind pairs which are inclined backward. The head and legs and the lower edges of the body are bearded with fine bristles. The last segment is a cylindrical tube equalling in its length the three or four segments forward of it. This tube has a pair of small spines at its tip on the upper side and is bearded with fine bristles along its underside.

These larvæ station themselves upon the succulent stalks of plants, at the axils of the leaves, where they so much resemble the young buds which start out at this point, that it is only on looking particularly that they are detected. They stand there motionless, with their beaks inserted into the stalk, sucking its juices, which constitute the nourishment of this insect both in its larva and its

perfect states. They are hereby pernicious to the vegetation on which they occur, as well as by wounding it to insert their eggs. The juices of the dahlia appear to be especially palatable to them, for they infest this much more than any other of our cultivated plants, and unless resisted they are liable to become gathered upon this plant in such numbers as to occasion it much injury.

In seasons when these leaf-hoppers are noticed as being so common upon our fruit trees and shrubs as to excite apprehensions that they will be detrimental, it will be well to frequently shake and jar the vegetation on which they abound, in order to frighten these insects away; for they are so shy and timorous that I think few of them will remain where they find they are liable to be thus disturbed, but will fly away to the fields and forests where is vegetation that will accommodate them as perfectly as does that of our orchards and gardens. When young, small and destitute of wings for flight they are less agile than when they are full grown, and are more easily captured; and it will be well, the latter part of June, to occasionally look over the dahlias and other cultivated plants on which any of these young ones are discovered, and pick off and destroy them, in company with the young of the Yellow-lined Leaf-hopper, which, as stated on a subsequent page, frequently occur upon these same plants.

YELLOW-LINED LEAF-HOPPER, *Gypona flavilineata*, Fitch. (Homoptera, Tettigoniidæ.)

Puncturing the leaves of the dahlia and extracting their juices in July and August, a flattened oval pale green leaf-hopper, about 0.40 long, with eight faint yellow stripes upon its thorax, the middle ones prolonged upon the head and scutel.

RED-LINED LEAF-HOPPER, *Gypona octolineata*, Say.

An insect similar to the preceding in size, form and habits, but having the stripes upon its thorax bright red and also the veins of its wing covers.

These two insects will best be considered in connection, being so intimately related that they have been regarded as only varieties of one species, although to the eye they differ conspicuously in their color, and the one is common whilst the other is quite rare.

They were first noticed by Mr. Say, who in the year 1825 published a description of the Red-lined species in the *Journal of the Academy of National Sciences*, vol. iv., page 340, where he also refers to the yellow-lined species as being a variety of the same

insect. He had before him but a single specimen of the former and probably a few only of the latter. In 1851 when my Catalogue of the Homopterous Insects in the *State Cabinet of Natural History* was published I had met with only two of the Red-lined species but had gathered as many as I desired of the others. Their colors were so widely different and were so constant in every instance—the yellow-lined ones being of both sexes, and no part of any one of the multitude of examples which I inspected presenting any tinge of red to indicate to me that the two colors might gradually pass into each other—that I did not hesitate to regard them as being specifically distinct, and treated them accordingly. But as Mr. Say indicates no doubt of his correctness, I could not divest myself of the suspicion that he had seen some instance in which the stripes were partly red and partly yellow, or so colored otherwise as to be intermediate between the two extremes. Years passed away, and I continued to collect numbers of the Yellow-lined insects without meeting with any example to shake my confidence in the correctness of the view I had taken. Upon meeting with the larvæ and pupæ of this species on the dahlia, the query occurred to my mind, whether, if an individual that was young and growing were to sustain itself a portion of the time upon the brilliant red flower leaves of this plant, it might not acquire a red color thereby, and thus grow to be the Red-lined instead of remaining the Yellow-lined species. And I was revolving it in my thoughts how I could test this by experiment, when, in August 1865, I was taken quite by surprise in meeting upon the dahlia with what appeared to be one of these Yellow-lined Leaf-hoppers having the basal half of its thorax pale with the stripes upon it crimson and the inner margin of its wing covers also tinged with this color. Thus, after I had been gathering and inspecting these insects upwards of twenty years, a specimen such as I was in pursuit of presented itself to me, seeming to be intermediate between the two species in question, having its stripes partly red and partly yellow. I had all along suspected that Mr. Say had seen a specimen similar to this, which had led him to regard the Yellow-lined examples as a mere variety, and I hereupon supposed that I was probably in error in elevating them to the rank of a distinct species. A few weeks afterwards, a second specimen similarly colored presented itself to me, and now, three years later, a third one comes to hand. And upon noticing that these three examples were nearly alike, the

POINTS OF DIFFERENCE BETWEEN THESE TWO SPECIES.

same parts taking on the red color in each instance and thus indicating this coloring to be constant, it began to appear as though these were a third species instead of a connecting link between two remote varieties. I thereupon resolved to give this matter a thorough re-examination, to determine the true relations of these respective individuals to each other. During nearly a score of years another specimen of the Red-lined species has come to me, whereby I have three examples of it before me for comparison, and quite a number of the Yellow-lined species. I first remark that several of the latter are of a larger size than either of the former, and that each of the partly red examples are small, though some Yellow-lined males are equally small. And I next notice the important fact that the partly red examples are each one males, and those which are wholly red are females, and from my notes I learn that the red specimen in Dr. Harris's collection is also a female. It thus appears that this remarkable difference in their colors is sexual. Mr. Say, however, states that the specimen from which he drew his description was a male. But I am constrained to suspect he was in an error. In females which are newly disclosed from the pupa, and before the ovipositor has been protruded for use, the tip of the abdomen is small and undeveloped, whereby they at first glance appear to be males, and in such cases it is only on a close examination of good specimens that the sex can be accurately determined. Further observations will, I think, establish it as a fact that the Red-lined specimens are all females and those that are partly red are their males, as some other species of this family present equally remarkable differences in the colors of the two sexes.

On coming next to particularly examine and compare the several specimens, I discover such differences in some of the details of their structure, their colors and also their habits, as conclusively show the yellow-lined ones to be a distinct species from those which are partly and wholly lined with red. The latter have the whole surface of their wing covers netted with veins and veinlets, whilst the former have them thus netted only at their tips, the longitudinal veins on the disk and base of the wing covers being unconnected by short transverse veinlets, save in the middle cell, which is crossed by three or four of these veinlets, the corresponding cell in the red-lined species always having a larger number than this. On the head of the yellow-lined species the two middle stripes are parallel

and equidistant from each other their whole length, whilst in the red-lined species they converge and are united together through the anterior half of their length. The eyelets or ocelli are placed within the outer sides of these stripes in the former species, whilst in the latter they are wholly outside of the outer edges of these stripes. Other differences which are less conspicuous it is unnecessary to mention. One point, however, in which they differ in their habits merits to be stated. Notwithstanding the Yellow-lined Leaf-hopper is so very much more common and so frequently inhabits the vegetation around our dwellings, I have never known an instance in which it has been attracted by the light of the lamp to enter open doors or windows upon summer evenings; whilst of the six specimens, male and female, of the Red-lined Leaf-hopper which I have in hand, four were taken within doors, either alighted around a lamp in the evening, or upon the closed windows by day, these latter having doubtlessly entered the lighted rooms in the evening and flew to the windows to escape when daylight arrived.

I may here remark further, with regard to these pretty rose red insects, which we are liable to meet with within our dwellings, and which look as though they might be thus colored from being stained with blood, that they are extremely agile, darting with such velocity as almost to be imperceptible; and without any rustling of its wings or other noise to indicate its approach, one of them drops in the glare of the lamplight upon the papers close beside our hand, so suddenly and silently that, seeing it where it had not been a moment before, it seems like a spectre that has supernaturally arisen there.

The history of one of the specimens in my hands is so singular and interesting that it is well entitled to be narrated. It was brought to me by a physician from a neighboring town who gave me the following account: A patient under his care, a young lady, vomiting in a clean white washbowl, suddenly noticed this bright red insect in the bowl, upon the matter vomited, and she and her attendants were certain that she had thrown it from her stomach. He wished to know if this was possible, and if an insect like this had ever before been seen. I was able to immediately show him another specimen exactly like the one he brought, and to assure him that this latter had never been touched by the digestive juices of the stomach, or it would have been soiled and its bright colors faded thereby; it had not even been wetted, or its thin delicate

wings would have been wrinkled and matted together like a wet disheloth. The insect was undoubtedly present in the sick room, and being probably attracted by the white glistening surface of the washbowl, it darted towards it and dropped into it so suddenly that it was not perceived until it had alighted.

This Red-lined Leaf-hopper is so rare and so seldom seen that these few facts in relation to its habits become the more valuable. As to the extent of territory which it inhabits we only know that Dr. Harris met with it in Eastern Massachusetts, and Mr. Say captured the specimen from which he described the species in Missouri, and appears never to have found it in Pennsylvania.

The Yellow-lined Leaf-Hopper is a rather common insect in New York and New England, and specimens sent me by correspondents show that its geographical range extends west to Kansas and south into Arkansas, and very probably it exceeds these limits. It occurs in a variety of situations, being met with in gardens, meadows and forests, nourishing itself on the juices of nearly all kinds of plants and trees without manifesting a preference for any particular species of vegetation, unless it be the dahlia, on which I every year detect a number of them and their young. In addition to this plant I have noted it as occurring upon asters and other cultivated plants, and on the leaves of oaks, walnuts, the beech, maple, birch, willow, and on the dogwood and some other shrubs.

The larvæ and pupæ precede the perfect insects in their appearance. They begin to be observed in June, and are met with in much the same variety of situations as the mature insects, which they resemble in form and also in their motions and habits, except that they are incapable of flying. The larva is like the pupa in most respects, but is smaller and more pale, even translucent and watery in some examples, and the bristle of its antennæ is longer than the body, tapering, and very slender towards its tip.

The PUPÆ are a fourth smaller than their parents and have the same flattened oval form. They are of a light bluish green color and are clothed above with short white hairs with a fringe of longer ones around the sides of the hind body. A pale stripe extends from the front of the head along the middle of the back to the end of the body; and the segments are margined with confluent spots of grass green and pale yellow. Beneath, the hind body shows a pale yellow stripe along each side. The legs are pale green, with the feet watery whitish. The bristle of the antennæ is brown and nearly as long as the body.

The YELLOW-LINED LEAF-HOPPER in its mature state varies in length from 0.35 to 0.45, the smallest individuals being males and the largest ones females. Its

body is of a nearly regular oval form, but when the wing covers are fully closed it is more tapering posteriorly and more pointed at its tip than in front. It is strongly flattened, and more convex across the closed wing-covers than in front. The surface is smooth and slightly glossy. It is of a very pale green color, fading when long preserved to very pale dull yellowish, the underside being paler. The *head* is flat, semicircular in front, concave at the base, narrower than the thorax, more than twice as broad as long, with a slender impressed line in the middle. The ocelli are nearly as distant from each other as from the eyes. Six stripes of a pale yellow color extend longitudinally from the base to the anterior edge. These become faded and indistinct in most of the preserved specimens. The two middle stripes are parallel to each other and have the ocelli inserted in their outer sides. The outer stripes occupy the inner sides of the orbits of the eyes. The antennæ are pale yellow, their bristle brown and equalling the thorax in length. The *thorax* is nearly flat, its surface finely striated transversely, and occupied by eight parallel longitudinal stripes of pale yellow, which are sometimes as wide as the intervals between them, sometimes much narrower. The scutel has the six middle stripes of the thorax prolonged across it, the outer ones merely forming a triangular spot upon its outer angles. It is crossed by an arched suture slightly back of the middle, which has its ends turned abruptly backward. The *wing covers* are destitute of transverse veinlets except at their tips and in the middle one of the longitudinal cells.

The RED-LINED LEAF-HOPPER has the body shaped the same as in the foregoing species and 0.43 long in the female. This sex has the *head* red and more or less striped and spotted with yellowish white. A narrow triangular spot of this color is placed on the middle of the base, extending half the length of the head and ending in a very narrow acute point. A second spot is placed behind the ocellus, reaching from its orbit to the base, commonly with its outer anterior angle prolonged outward and forward in an oblique streak reaching half way to the outer edge forward of the eye; this spot being also sometimes extended forward, passing the inner side of the ocellus and reaching nearly to the anterior edge. A third spot is placed also on the base equidistant between the second spot and the eye. It is small and triangular, extending nearly to the outer end of the oblique streak. The face is sometimes pale yellow with the upper border red; at other times it is pale red more or less clouded with pale yellow. The antennæ are commonly red, their bristle black, long, slender, tapering, nearly half the length of the body. The *thorax* is yellowish white with the posterior half of its surface stained with red in the middle. It is finely striated transversely and is crossed lengthwise with eight bright rose red stripes which are commonly very distinct and narrower than the intervals between them, but varying in different specimens. The two middle stripes are the most regular and smooth, often slightly thicker at their anterior ends and nearer approached than they are towards the base. The second stripe is uneven and somewhat dislocated in its middle, ending abruptly without attaining the anterior edge, its forward part bent inward and almost touching the middle stripe and in one instance uniting with it. The two remaining stripes united at both their ends and sometimes through their whole length, the outer one broader and placed but slightly inside of the outer edge. The scutel has the impressed suture across its middle strongly curved and the ends not abruptly turned backward as they are in the males; its color is red, with a yellowish white stripe in the middle which ends at the curved suture, and on each side of this is a

slender stripe of the same color, which is widened at its hind end and reaches the margin at the end of the curved suture; this stripe being often obliterated and only its posterior end remaining in form of a triangular marginal spot; on the hind part is a curved transverse yellowish line, its ends joining those of the curved suture, and with it inclosing a transverse red spot of a regular oval form, the surface of which is finely striated transversely. The *wing covers* are salt white, with the veins and veinlets red, and a red stripe on the outer border extending two-thirds of the length, edged with a white line upon its outer side. The wings are salt white with very fine slender red veins. On the *underside* the abdomen is pale yellow, sometimes having stains of red along the sides. The ovipositor or egg tube is brown and at its tip black. The legs are pale red, the hind pair long and slender with their thighs pale yellow.

The *males* of this Red-lined Leaf-hopper are smaller than their mates, measuring only 0.35 in length, and, as the reader is aware from what has already been stated, they differ remarkably from the other sex in color, being of a greenish instead of a rosy red hue, with the stripes of the thorax and the veins of the wing covers deeper green or olive, only the base of the thorax and the inner edge of the wing covers being colored as they are in the female.

The ground color of the males corresponds with that of the other sex, they being very pale green or greenish gray, above and beneath. The head has the yellow stripes wholly obliterated, except the basal ends of the two middle ones. The eyes and ocelli are frequently of a vivid crimson color in the living insect. The thorax has a large spot on its basal half as in the female, but of a different color, it being ochrey yellow or sometimes pale gray. This spot varies greatly in size, sometimes extending to the middle of the thorax, and sometimes but half this distance, and embraces the ends of four and sometimes six of the longitudinal stripes. And where these stripes pass upon this spot they lose their yellow color and become red as in the female, but of a deeper tint of crimson than they are in that sex. Forward of this spot and upon each side of it these stripes totally disappear, except the two middle ones, which are very faint watery green in the living insect and dull olive in preserved specimens. The scutel has two red spots on its base, at the ends of the two middle stripes of the thorax. Its outer angles are opposite the end of the third stripe, and a triangular spot commonly occupies these angles, which spot is red when the end of the third stripe is red, but when the ends of only four of the thoracic stripes are red this spot is of a dull ochrey yellow color. In one of the specimens before me this spot is larger, occupying all that portion of the scutel which is back of the end of the second stripe of the thorax. In another specimen it is small, and in the third example before me these spots and the two between them are wanting. The wing covers vary in the extent of the red color on their inner margins. In one instance only a narrow space adjoining the scutel is faintly tinged with red, and at the tip the slender marginal vein and the veinlets which join it are deep crimson. In the two other instances now under my eye the tips and a broad stripe extending the whole length of the inner margin is gray with the veins and veinlets in this stripe bright red. The remaining veins and veinlets and a stripe along the outer margin are olive.

LEAF-HOPPERS. REMEDIES. FLOWERY PRIMROSE-MOTH. ITS NAME.

Upon our choice flowering plants we can illy brook these insects even in limited numbers, knowing that each one of them is daily wounding and bleeding the leaves and thus robbing the plants of some of their vigor and thriftiness. They are most easily captured and killed when they are young and unable to escape from us by flight. Therefore, any cultivated plant on which we frequently see these leaf-hoppers should be inspected about the middle of June, to ascertain if a brood of young insects is growing up on it, and if they are found to be present the whole plant should carefully be looked over and every young hopper that is seen should be picked off and destroyed. The vigorous growth of the plant will be much promoted by thus relieving it from these parasites which are living at its expense.

FLOWERY PRIMROSE-MOTH, *Alaria florida*, Guenèe. (Lepidoptera, Noctuidæ.)

Eating a hole in the flower buds of the Evening Primrose (*Œnothera*), and thus cutting the petals asunder; a pale green 16-footed worm with three deeper green stripes, and on top of its neck two dull cherry red spots; its pupa state passed under ground; the next year, in July, producing a light yellow moth with bright rose red fore wings, having a broad light yellow hind border, its width 1.25.

A rare and most beautiful moth, found by Mr. Edward Doubleday in his collecting tour through our State in the year 1837, was in 1852 figured and described by M. Guenee, in the *Suites a Buffon, Lepidopteres*, vol. vi, p. 171. He found it to be intimately related to another elegant moth somewhat smaller in size, which had long been known to the world from the fine figure of it contained in Smith and Abbott's *Lepidopterous Insects of Georgia*, where it received the name *Phalæna* (*Noctua*) *Gaurœ*, this name being given it from the plant on which its larva feeds, the *Gaura biennis*, the stalks of which are represented as being sometimes stripped bare of their leaves by this larva. These two moths are so similar to each other, and so different from the other species nearest related to them, that M. Guenée associates them together in a new genus, which he names *Rhodophora*, i. e., rose-bearing or having a rose color, and he terms our New York species the *Rhodophora florida*, the flowery or elegant rose-bearer. M. Guenée was evidently unaware of the fact that the Georgia insect had already been made the type of a new genus, named *Alaria* by Mr. Westwood, from whose manuscripts this name was published in 1841, by Mr.

Duncan, in editing the volume on Exotic Moths in Jardine's Naturalist's Library (Entomological series, vol. vii, p. 200.) This name, which appears to have been also suggested by the wings being so prettily colored, having been first published, seems entitled to stand as the designation of the genus. *Alaria florida* will thus be the correct scientific name of our New York insect.

Upon my becoming acquainted with this moth through the figure and description of M. Guenée, I was much surprised that I had never met with a specimen of it. It was not till the summer of 1858 that I first saw it in nature, an individual being then brought me by Wallace Freeman, jr., from Adams, Mass., where it had entered an open window in the evening, attracted by the light of the lamp. Four years later, a specimen in like manner entered my own dwelling, flying rapidly and wildly around the lamp for a half minute, and frequently striking against the table, until falling upon a spot where it was shaded from the dazzling glare of the light, it there rested quietly until I obtained the implements for securing it. Finally, a flowering plant which I have recently introduced into my garden has been invaded by a worm which I discover to be the larva of this lovely moth. A brood of these larvæ has appeared upon this plant each of the two seasons it has now (1867) been blooming in my grounds, furnishing me with specimens of the moth, and enabling me to trace its history and transformations. From these facts it appears that though this insect is so rare that a collector may not meet with it once in a lifetime, if circumstances come to favor it, it may suddenly become common, temporarily, in particular localities.

The Evening Primrose, *Œnothera biennis*, which florists by cultivation have improved into such a large and very splendid flower, is liable to have its petals amputated when they are upon the point of expanding from the full grown buds, and all the beauty of its flowers hereby destroyed, by a green sixteen-footed worm, which is readily known by a peculiar mark, it having two dull cherry red spots or blotches upon the top of its neck.

In that magnificent variety of the Œnothera, the *grandiflora Lamarkiana* of our florists' catalogues, the stalk sends out a number of lateral branches, each bearing a long raceme of flowers at its end, the raceme elongating and continuing to grow a succession of flowers from July to the end of the season. Thrifty plants usually grow in a regular pyramidal form to a height of four or five feet,

and each of the branches puts forth about four new flowers daily, arraying the plant in such a mass of bloom as renders it an ornament of stately splendor. These worms occur evenly distributed, one upon each branch, the flower buds growing thereon each day, supplying them with the exact amount of sustenance which they require. Thus each bud as they mature from day to day is visited in its turn. When it first begins to attract notice the worm is about half the length of the elongated bud, up which it crawls from the stalk, till the whole of its body is standing upon the bud, thus bringing its head about opposite the middle of the bud. It then commences gnawing into the bud, boring a round hole therein of sufficient size to admit its head, which it sinks downward, farther and farther, eating through the folded mass of petals, nearly or quite cutting them asunder, and severing also the stamens and pistil. Thus when the flower comes to burst forth from its bud at the close of the day, it is but half its normal size, and presents a most rueful aspect with the outer ends of its petals gnawed and ragged, and all the beauty of their natural appearance destroyed. The worm having finished its meal withdraws its neck and head from the hole and moves a short distance downwards, and there stands motionless for a time, for its food to digest, its body being so similar in size and color to the long tube forming the base of the flower bud that it is liable to escape observation unless the search for it is sharp. When it has rested awhile it crawls farther downward till it comes to the branch, or till it can reach the next bud of the branch, up which it mounts and makes another meal. One bud would amply suffice for its nourishment twenty-four hours if it would continue to feed upon it till it had wholly consumed the petals and stamens, which are rolled compactly together within it. But instead of this it adopts the most destructive course it can pursue, forsaking the bud as soon as it has perforated it sufficiently to cut its petals asunder. Being so needlessly wasteful in its propensities we feel less compunction in destroying it than we otherwise should, knowing what a beautiful thing it finally becomes.

Sometimes the mutilation is less complete, either from the worm being smaller in size or interrupted in its operations. And the flower thus comes to present, usually, a very curious appearance. The worm eating through the four petals when they are closely folded together, when they come to expand each is commonly cut in the same manner; a large roundish hole, it may be, is taken

LARVA DESCRIBED. LIVES SEPARATE AND ALONE.

out of the centre of each petal, the holes all being of the same size and shape, the work appearing at first glance to have been done artificially and in a most dextrous manner.

The LARVA is cylindrical, tapering slightly at each end, and grows to one inch in length, when crawling elongating itself to 1.15, and is 0.18 thick. It is clothed with fine, shortish, scattered hairs which are placed symmetrically. Its ground color is pale green, of a yellowish or apple green tint when full grown, but usually pea green when it is smaller. Along the middle of its back is a stripe of a deeper grass green color, and a similar one upon each side of the back. These three stripes extend from the neck to the middle of the penultimate segment. Each of the lateral stripes has a dull cherry red spot at its anterior end, placed on each side of the middle of the neck or first ring, and in rare instances the anterior ends of these lateral stripes are of this color for a short distance. Before it is fully grown the lateral stripes are sometimes faint or wholly wanting; and low down on each side is an elevated fold of the skin which forms a faint stripe of a paler color than the ground. The head is a third narrower than the neck and is held obliquely downward and forward. It is slightly paler than the body and is clothed with fine erect hairs.

A variety of the larva occurs, of a dull pale brownish yellow color, with the stripes olive or dull brownish green. In one instance a young larva 0.60 long was observed wholly destitute of the red spots upon the neck.

These worms exhale a disagreeable odor, which is particularly strong and offensive when several are placed together in a closed box. When they are thus confined they soon become wet with perspiration, and die in one or two hours. They are slow in their motions and are very unsocial and intolerant of each other. If one meets another they act very cross and spiteful, and turn away to avoid each others' vicinity. They live solitary, each one remaining upon his own raceme of flowers and travelling only the few steps from one flower bud to the next. And if the branch is cut off and inserted in a flower pot of earth the worm persistently remains upon it, even after it has ceased to flower, and refuses to forsake it until the cravings of hunger oblige him to wander away and seek sustenance elsewhere. He then spins a silken thread from his mouth, perhaps as a clue to guide him back to his own branch again should he be unsuccessful in finding a new residence; for he does not appear to spin this thread ordinarily in passing from one flower bud to another, nor does he usually suspend himself by a thread when knocked or falling from the place where he is standing. One of these worms which I placed in a glass jar in which was a young bug which I was rearing—one of the Reduvius group, which subsists upon and destroys other insects and their larvæ—

FLOWERY PRIMROSE-MOTH: LARVA. WINTER RETREAT UNDERGROUND.

was not immediately attacked by the bug, it having been recently fed. The worm thereupon with its threads wove a close web over itself in a corner of the jar, whereby the next day the bug was unable to get at it to devour it.

It was the middle of September when I first discovered these worms, they being then grown to three-fourths of an inch in length. The next year they made their advent in full force nearly two months earlier. Thus they are liable to be present among the flower beds at all times from the middle of July till the end of September—the parent moths not coming forth simultaneously to deposit their eggs, but appearing one after another, for a period of at least six weeks, in July and the fore part of August, whereby it comes to pass that small young worms and those that are grown to their full size are seen upon the plants at the same time.

When the worm is done feeding it crawls down the stalk to the ground and there buries itself to pass its pupa state, underneath the plant on which it has been fed. Thus the whole distance which it customarily travels, from the time it hatches from the egg until it enters its pupa state scarcely exceeds four or six feet. The instinct to bury itself immediately upon its coming to the ground is so strong that its only care seems to be to avoid encroaching upon the places of sepulture of others that have preceded it in descending from the same plant. Upon reaching an unoccupied spot it hastens to inter itself. Even if it chances to be upon one of the hard trodden walks of the garden, it does not go further, to seek for a softer spot, but at great labor bores a cylindrical hole of sufficient size to admit its body, directly downwards, where the earth is so firmly compacted that we would suppose it quite impossible for a soft worm like this to penetrate it.

It remains underground through the autumn, winter and spring, coming out in its perfect form the following summer. As already intimated, the first moths begin to be seen abroad at the commencement of July, and others continue to come forth till the middle of August. These moths may be met with during the day time, resting openly exposed among the wilted flowers of the Œnothera. Although they are classed with a group of moths that are day-fliers, I have never seen one of them take wing by day. They appear to fly but little. It is probable that the narrowness of their wings incapacitates them from flying so readily and freely as do their kindred. A moth which was standing upon a flower stalk of the

primrose, upon my attempting to impale it dropped itself to the ground without so much as opening its wings to fly, and merely sought to crawl under some covert there for concealment, freely mounting upon my hand when placed in its way, and appearing very dull in its motions and as though it were drowsy and stupefied under the influenc of some narcotic.

The two sexes are remarkably alike in size, in color and in the structure of their antennæ. The only particular in which they perceptibly differ is in the termination of the body, which in the female tapers to a simple point whilst in the male it is furnished with large flattened valves which are fringed and densely coated over with hairs. The female probably drops her eggs singly here and there upon the flower buds of the primrose.

This MOTH has a slender body, the dried specimens both of the male and female most commonly measuring 0.60 in length, and 1.30 in width across the extended wings. The *head* is bluntly rounded in front and is smoothly clad with hairy scales which are usually white, but in some examples pale red. The antennæ when turned backwards surpass the thorax in length, and are thread-like, being scarcely thicker towards their bases than at their tips. In both sexes very short minute hairs project along their undersides. They are of a white color with the underside pale orange. The palpi or feelers project horizontally forward, their tips slightly surpassing the front. They are covered with rose red hairs which are smoothly pressed upon the surface, with the very small apical joint visibly protruding at their tips. The spiral tongue about equals the antennæ in length and slightly surpasses them in thickness towards its base when viewed in front. The *thorax* is densely covered with white hairs, their ends forming an even, smooth surface. The collar is usually of a delicate rose red color, but in some specimens white. The fore breast is bright rose red. The *abdomen* is rather slender, conical, projecting farther back than the extended hind wings, and in the males ends in large flattened valves which are fringed and densely coated over with straw-colored hairs. Its surface is smoothly covered with short white scales, those on the hind edges of the segments being straw yellow. The underside is pale red, except at the tip. The *legs* are rose red and on their underside white, the thighs having each a tuft of long white hairs underneath. The anterior shanks are short with a strong brown claw at their tips and two or three spines above, in a row with it, and on the opposite side a row of several brown spines. The middle and hind shanks are rather long and slender, with a pair of long spurs at their tips, and the hind ones with a second pair placed above those at the tip. The fore *wings* are narrow, being 0.58 long and but half as broad in their widest part. They are straight on their outer or costal side, rounded at their tips, their hind edge from thence straight to the middle, where it is slightly rounded and again becomes straight till it approaches the inner angle, the inner edge being also straight two-thirds of its length. These wings are of a delicate bright rose red color, with the axilla white, and the hind border pale bright yellow, this last color varying in its width, in different specimens occupying from a third to less than a fourth of the

wing. The red portion is slightly wavy on its hind edge, usually having two round notches, the outer one a little outside of the middle and distant from the outer side of the wing, the other more than half way from this to the inner side. And commonly upon this red portion faint clouds of a paler color are perceptible, but vague and indefinite. Frequently, however, a very faint, grayish band may be discerned, extending from the middle of the inner side obliquely across the wing, parallel with and a little forward of the hind edge of the red portion. And in some specimens this grayish band is perfectly distinct, and forward of it the central portion of the wing between the two principal veins (the intercostal area) is of the same grayish color, and in this paler space appears a small round spot, and back of it upon the anterior edge of the grayish band a squarish transverse spot, of the same rose red color as the ground, their edges indefinite, these spots appearing to represent the two stigmas common to the wings of this family of moths. The hind wings are white tinged with yellow. The underside of both pairs is pale yellowish with the outer sides pale rose red.

When an insect of such beauty as is this moth appears in the grounds around our dwellings, rivalling in the delicacy and elegance of its colors the finest flowers which we cultivate, remaining at rest where it is openly exposed during the day as if to invite us to approach and inspect and admire it, the question arises whether we shall war upon and destroy it, or allow it to remain undisturbed as being an ornament which will interest and delight every one who beholds it. If unmolested it will probably continue for some years wherever it makes its appearance, until an uncongenial season arrives or parasites multiply to destroy and suppress it. But to have one of our finest flowers every year mutilated and divested of all their beauty by the broods of ugly looking worms which these moths produce is scarcely to be endured, even though these worms are so similar to the flower-buds on which they stand as to be unobserved except upon a close inspection. When I first discovered these worms and became aware of the pernicious work in which they were engaged, I waged a war of extermination upon them—with pincers detaching from the plants every one I could find, dropping it to the ground in the hard beaten path and drawing the sole of my boot over it. With my closest scrutiny several worms were overlooked, and were searched out and destroyed upon the following days. But when I came to know that these worms would grow into these elegant moths, they found more favor in my sight. I then allowed a number of them to get their growth and leave the plants before I began to search for and destroy them. It was in my mind to check this moth from becoming greatly multiplied, but to cherish and preserve it in moderate numbers in the

grounds around me; and I had it in view to grow one or two plants of the evening primrose in some obscure corner of my garden for the exclusive accommodation of these worms, and remove to them or destroy the worms that came upon the plants in other parts of the grounds. But as these pages are going to the press (1868) I am able to state that the insect has this year entirely disappeared, although quite a number of the larvæ interred themselves the previous season. Whether it was aware that a large portion of its numbers was being destroyed and that the situation was therefore an unsafe one for it to remain in, or whether the unusual severity of the last winter's cold or some other atmospherical change has caused it to perish, I am unable to say. And whether it will be possible for us to keep these beautiful moths about our gardens and yards in such moderate numbers as not to be a nuisance to us remains to be ascertained.

For several years a specimen of a third species pertaining to this interesting and lovely genus, has been in my cabinet, vieing in the richness of its colors with the two species already known. It was captured in the Indian Territory west of Arkansas by my valued friend William S. Robertson. It measures one inch in width across its extended wings, and is of a bright ochre yellow color, with its fore wings deep crimson and crossed by two curved and zigzag white lines.

The anterior white line or band crosses the fore wings slightly forward of their middle, and to the eye resembles a figure 3 rudely marked upon the wing, it being composed of successive curves and angular points jutting forward upon each of the three principal longitudinal veins. It is slender, ragged and uneven through most of its course, but is widened abruptly at the outer fourth of its length, where it is also stained with tarnished yellow, and continues broad from this point to the outer margin. The posterior band begins on the inner margin near its hind end, and at a third of its length approaches quite near the anterior band. It then turns toward the tip of the wing, this middle portion being a slender, smooth, zigzag line, jutting backward in a row of very slender and acute angular points upon the veins, to the number of five or six. Finally, towards its outer end it bends more forward and attains the outer margin at right angles with it, ending thereon half way between the outer end of the anterior band and the tip. Between this band and the hind edge is a sprinkling of white scales forming a faint cloud-like subterminal band. The hind wings are white, their outer posterior half pale red, as is also the fringe. The underside of both pairs is dull sombre crimson with only a small portion of the base and inner side whitish. The abdomen is leaden gray on the back and pale red on the sides and beneath.

The rich lively color of the wings of this moth, appearing as though they were deeply dyed in the ruby wine, brings to mind as

its namesake the goddess of pleasure, represented as a beautiful young woman elegantly dressed and adorned. I have therefore termed it the *Alaria Volupia.*

OHIO CURRANT SAW-FLY, *Pristophora rufipes?* St. Fargeau. (Hymenoptera, Tenthredinidæ.)

Eating the leaves of the currant and the gooseberry in July, clusters of small, cylindrical, pea-green worms with blackish heads; growing to three-eighths of an inch in length, and then entering the ground and enclosing themselves in cocoons the size and shape of kernels of wheat, and producing a black, four-winged fly with light brown legs.

This insect made its appearance in such numbers as to attract notice about ten years since, in the vicinity of Cleveland, Ohio. Our knowledge of it is obtained from a very intelligent account, published in the *Ohio Farmer* of July 24th, 1858 (vol. vii, p. 233), from the pen, we suppose, of Dr. J. P. Kirtland. It was about five years previous to that date, that the writer says he first became aware of the presence of this new enemy, from noticing particular places among the currant bushes, where the leaves had been much eaten, evidently by broods of worms, although none of the worms could then be found, they having, no doubt, completed their growth and gone into the ground to repose during their pupa state. And it was not until the year then current that he had succeeded in finding these worms at their work upon the leaves, whereby he had enjoyed a good opportunity to watch their transformations and obtain a satisfactory knowledge of their history.

The worms are described as being of a pea-green color, with the head brownish black. The segments of the body are slightly wrinkled, and along each side is a row of protuberances, or warts, of the same color as the body. Like the larvæ of most of the saw-flies they have twenty feet, six being placed upon the breast or underside of the three first rings, twelve upon the abdominal segments, and two at the tip or hind end of the body.

These worms live together in clusters and eat the leaves, commencing at the edge and devouring all except the coarse veins. As they move about they spin a very light web from leaf to leaf. When young they are difficult to perceive, being so small in size. They often take shelter in the axils of the leaves, and will also drop themselves to the ground when disturbed, spinning a fine thread of silk as they descend, in the same manner as the measure

worms. They feed upon the leaves of the cultivated gooseberries as well as those of the red currant, and seemed to be most fond of Houghton's seedling gooseberry, from the small plants of which they had entirely stripped the leaves.

How long these worms are engaged in feeding and obtaining their growth is not stated. They are about three-eighths of an inch in length when fully grown, and the head is then lighter colored than when younger. They then forsake the bushes and crawl into the ground, where they enclose themselves in brown oval cocoons, which are about the size and shape of kernels of wheat. They remain in these cocoons only about a week, in the summer season, but the last or autumnal brood lies in the ground in its pupa state through the winter. In coming out, the insect bursts or gnaws off the end of the cocoon, and leaves it lying in the form of a lid.

In its perfect state it is described as being 0.20 in length and 0.42 in width across its extended wings. The head, thorax and abdomen are black, and the legs light brown. The wings are hyaline, with the stigma and veins brownish. The surface of the wings is covered with minute hairs standing erect at a considerable distance apart.

In size and the color of its body and limbs, it appears to be identical with the European *Pristophora rufipes* of St. Fargeau, but the information which is furnished us is too limited to enable us to decisively pronounce the two insects to be the same.

The writer says that air-slacked lime sprinkled over the leaves will destroy these worms, as will also a mixture of whale oil soap and water. Tobacco water also has the same effect. But all these remedies require to be thoroughly applied. Hellebore powder, as mentioned under the next species, will doubtless be the most efficacious and economical remedy for this species also.

CURRANT-WORM and SAW-FLY, *Nematus trimaculatus*, St. Fargeau. (Hymenoptera, Tenthredinidæ.)

Stripping bare of their leaves the currant and gooseberry bushes throughout the season, but most numerous in June and in August; flocks of pale green twenty-footed worms with numerous black dots, a black head, and the neck and last ring of the body yellow, three-fourths of an inch long; passing its pupa state underground and producing a yellow four-winged fly having three large black spots on its thorax often united into one.

An insect which of all others is most interesting to the inhabi-

tants of a large portion of the State at the present time is the new worm upon the currant bushes. Introduced upon this side of the Atlantic about twelve years ago, it has been multiplying and extending itself over the country in all directions, and within two or three years past has arrived in numerous localities in the northern, eastern and southern sections of the State, showing itself such a formidable destroyer as to attract much public attention, and every item of information relating to its past history, its habits and remedies is sought for with avidity.

This currant worm has been known many years to European gardeners and men of science, as being the very worst of all the enemies by which the gooseberry and currant are attacked. It would appear to have made its advent there at a recent date. So multiplied and destructive as it has been in Europe in our day, it is remarkable that it was wholly unknown there a century ago. It was not till the year 1823 that it was first noticed and described, by a French entomologist, Count Le Pelletier de Saint Fargeau, in his treatise upon the saw-flies (*Monographia Tenthredinum*, page 69,) who named it the Three-spotted Saw-fly, *Nematus trimaculatus*, in allusion to the three black spots on its thorax. *Nematus Ribesii*, *Tenthredo Grossulariæ*, and *Tenthredo ventricosa* are also names which have been given it by different writers. The gooseberry is much more largely and the currant much less cultivated in Europe than in this country, and consequently this insect in Great Britain is popularly named the gooseberry saw-fly, and its larva, which, wherever it is known in our country is called the currant worm is there termed the gooseberry caterpillar.

For several years, about twenty-five and thirty years ago, this insect became multiplied to an unusual extent and was very destructive, at least in England, and was much noticed in the Horticultural and Scientific publications of those days. In the year 1841 its ravages appear to have been most severe, transcending everything that had been previously experienced. In the *Gardener's Chronicle* of that year, page 597, C. Lawrence says, "I never recollect any season in which this pest made such determined and repeated attacks upon the gooseberry and currant trees. I have always found hand-picking the only sure mode of arresting their progress, but this season that was unavailing; for after employing many persons to pick off and destroy the caterpillars and looking over the trees to see that the work was effectually done, in the course

AN EFFECTUAL REMEDY CALLED FOR. HELLEBORE MOST EFFICACIOUS.

of a week I found the grubs as thick as ever. I had the picking repeated, with the same result. I could not think whence they came, knowing they did not come, as my old gardener would have it, from the blighty air. On examining the leaves carefully from the edge of which the mature caterpillar had been picked, I observed a numerous progeny, on the under surface, of very minute caterpillars, hardly visible from being exactly the color of the leaf. I then had every leaf picked, on which a caterpillar was found, into a basket and burned them, and suffered no further inconvenience. I therefore recommend to pick and destroy every leaf on which a caterpillar is found." Mr. L. seems to suppose the minute young worms were the progeny of the mature worms which had been picked from the leaves and destroyed—an idea almost as crude as that of his ancient gardener, who supposed they were generated by "the blighty air."

An anonymous correspondent (page 501) says his gooseberries in the spring were much infested with the caterpillars. He tried various ways to destroy them. Fresh slacked lime throwed over the trees had no effect whatever, and to see if quicklime would kill them or not, he covered some of them with it, but they soon were seen creeping out of the lime and making their escape. At last he had recourse to hand-picking, and by perseverance destroyed all the caterpillars in his small garden, and thought he had thus done with them, for this year at least. But he had that morning discovered to his surprise that his trees were again covered with the destructive things, and that the leaves were also lined with eggs, the same as in the spring. He says, "Various remedies have been proposed for their destruction, none of which, I think, are effectual, except hand-picking, which in large gardens would be a tedious operation, and my object is, to induce some of your more experienced correspondents to attend to this subject, and find out, if possible, some ready mode of destroying the caterpillar, or of otherwise preserving the trees from its destructive ravages." To this the editors of the *Chronicle* add—"We most sincerely desire to hear of some *effectual* remedy for this pest."

This call brought a number of responses, certifying to the efficacy of White Hellebore (*Veratrum album*). H. Groom (page 533) directs to make a strong decoction of the root, adding a handful of green tops of elder, and syringe the bushes with this when cold. He supposes the decoction drying on the leaves poisons the cater-

pillars. R. Lymburn states that he has for some years used hellebore and found it very effectual. In his district it is quite generally used. He says, he some years ago had a valuable lot of plants which were like to be altogether destroyed. He kept a man picking off the caterpillars eight days, with great expense and little execution. He had tried quicklime, potash and soda without effect; and tobacco juice is apt to kill the foliage. He then tried hellebore, and a half pound of the powder completely cured all his bushes. A man held up the branches to expose the underside of the leaves, whilst he dusted them with the forefinger and thumb, wherever a caterpillar was to be seen. The powder must be dry, and if it is not it should be toasted before the fire. It disperses into a cloud, and wherever a particle reaches a caterpillar it collapses as if stabbed, and in an hour or two nothing but the skin is left. Some dust it up from below with a puff, sending it upon all the bushes, which is less trouble but a waste of the powder. Some dust it from above with a dredge box, but it does not reach the caterpillars so readily in this way. A great many prefer an infusion of the powder in water, which is said to be very efficient. Disappointments have arisen from the powder having lost its pungency by being long kept and damp, which may be known by its making only a faint impression on the nostrils. It will then do no good.

The editors thank several others for communications to the same effect. The following year other attestations of the value of this remedy appear, and the editors say (page 381), "There is no longer any doubt respecting the efficacy of genuine hellebore powder in destroying this pest."

In 1841 also appears in the *Gardener's Chronicle*, page 548, a most valuable paper upon this Gooseberry and Currant Saw-fly from the able pen of Mr. Curtis, it forming No. 14 of the "Ruricola" series of Entomological articles which he communicated to the public through that periodical. It is accompanied with an excellent wood cut illustration showing the eggs along the veins of the leaves, the larva feeding, the cocoon, and the fly magnified. And we cannot do the reader a better service than to here extract a portion of this important paper.

Mr. Curtis introduces the subject by observing that "Most of the Hymenoptera or Flies with four transparent wings are beneficial to man, the immense family of Ichneumons, the minute Diplo-

lepidæ, and the powerful Sand-wasps being all parasitical animals, which by depositing their eggs in the bodies or upon the skins of the larvæ of noxious insects, keep them within certain limits; otherwise it is doubtful whether any crop would reward our toils. Such, however, is not the character of the Saw-flies, or Tenthredos as they are termed by Linnæus; for there are few insects that prove more fatal, when favored by congenial seasons. It is only a few years since whole districts of turnips were completely consumed by Athalia spinarum. Our beautiful Rose-trees are subject to the attacks of five different species, and amongst them Hylotoma Rosæ which skeletonizes the leaves; then our Plum, Cherry and Pear trees have the upper cuticle and parenchyma so completely rubbed off by the shiny, slug-like larvæ of Tenthredo Cerasi, that the crops, especially of Pears, are often materially injured. Our Raspberry bushes also are subject to the invasion of another species; and the extensive devastations of the Gooseberry Saw-fly are fresh in the memory of every cultivator."

After describing the fly, he says, "The flies emerge unheeded from their tombs the beginning of April, and the female soon deposits her eggs close to the sides of the principal nervures on the underside of the leaves, which is very remarkable, for all the females of this extensive family are furnished with an instrument called the saw, for the purpose of cutting into the leaves and stalks, and introducing the eggs between the cuticles or under the bark." Although it may be "very remarkable" that these flies do not employ their saws for sinking their eggs into the texture of the leaves, it is by no means unusual, our Rose Saw-fly and several other species merely dropping or very slightly gluing their eggs to the surface of the leaves.

"In about a week the larvæ hatch, and commence feeding on the leaves on which they are stationed, and soon riddle them full of small holes; thus they go on, feeding and changing their successive skins as they increase in size, until they are three-fourths of an inch long, when they are seen scattered around the edges of a partly demolished leaf, holding by their fore legs, with their tails turned up, or lying on one side.

"There seems to be a succession of broods, from the early spring until October occasionally; but the greatest numbers are congregated in May and the beginning of June, when, I understand they have caused twenty to thirty pounds of damage in a market

garden near London in one season; but in the neighborhood of Blandford last year, the second attack of the Gooseberry bushes in July and August was, if possible, more devastating than the first. Having defoliated a bush, leaving nothing of the foliage exceptiug the footstalk and sometimes a portion of the main rib, and being arrived at maturity, they cast their skins again and then lose all their black spots, becoming of a uniform pale green with two little black dots on the head, the spaces behind it and towards the tail retaining the yellow tint. After resting awhile they descend into the earth, and spin a yellow-brown cocoon, formed of silk and gluten of so thick a texture that it is impervious. From these the summer broods of flies come up in less than three weeks, but the autumnal ones remain in them, curled up in the larva state, until the following spring, when they change to pupæ, in time to produce flies as the currant and gooseberry trees are coming into leaf.

"There are two modes of proceeding to rid our gardens of this terrible scourge: to catch the flies, or search for the eggs and cut off the infested leaves, is scarcely practicable; our plan is, therefore, to look for the caterpillars; for small as they are at first, they are easily detected by the perforated leaves; and when half grown they are visible enough, and after that period they commit the greatest havoc, having inordinate appetites, and scarcely ceasing from their gluttony except when their jackets become so tight that they are obliged to change. Hand-picking is, therefore, attended with great success in small gardens, but in plantations it is easier to sprinkle strong lime-water, as it is termed, over the leaves, which will destroy the caterpillar; or syringe the bushes well, and then dust them with quick lime, having previously laid a good quantity round the stem to prevent their re-ascending the bush; it is said also that water heated to 140° Fahrenheit, and thrown forcibly upon the bushes, through the rose of an engine or watering-pot, will kill the larvæ, without injuriug the tenderest leaves on the bushes. The other method alluded to is, to destroy the pupæ; and this seems to be best effected by scraping away the earth from the roots early in the spring, and drawing it into a deep trench between the bushes, covering it over and tramping it well down. If boiling hot water be used, either in autumn or spring, to kill the pupæ, it should be put upon the earth when it is quite dry; the soil must be lifted two inches, and returned as soon as the

water is poured in, that as the heat passes off it may destroy the animals encased in their shells."

Mr. Curtis evidently had not noticed the then recently published statements of the efficacy of white hellebore as a remedy for this pest, or he would not have failed to allude to it.

For many years past we meet with no allusions to this saw-fly in the foreign periodicals, whence we infer it has so far ceased its ravages that it no longer attracts public notice.

We now come to the advent of this formidable scourge in our own country. As the worm goes into the ground early in autumn to lie dormant in its cocoon through the winter, it was undoubtedly in this state that it was brought across the Atlantic. Some European gardener in transmitting, probably, some choice foreign variety of the gooseberry to some one of the Rochester nurserymen, we suppose, took up roots which chanced to have some of these cocoons lying in the balls of earth around them—he being little aware of the calamity he was thereby inflicting upon us and upon our country through all coming time.

According to the published accounts these worms were seen on the currant bushes around Rochester, certainly in the year 1857, and perhaps one or two years earlier. We have indications, however, that these worms were on the currant bushes in Canada West previous to their appearance in the vicinity of Rochester. In the *Genesee Farmer* of February 1857 (vol. 18, p. 67) is the following communication: "I would beg to call your attention to a green worm, which proves very destructive to our currant bushes in this section. It makes its appearance early in June. In the first place it is very small; it eats the leaves, and in about a month the bushes are completely stripped of their leaves, at which time the worms are about an inch in length. If you or any of your readers, would be so kind as to inform us how to prevent the ravages of this destructive little worm, you would no doubt confer a great favor on many of your readers in this community.—D. C. Houseberger.—Rainham Center, C. W." From the few points here given us—a green worm, appearing early in June, and in a month stripping the currant bushes bare of their leaves, and growing to about an inch in length—it would seem that the worm referred to could be no other than this which we have under consideration, and that this worm therefore was defoliating the currant bushes some sixty miles west of Buffalo in the year 1856, and perhaps earlier. The

editor states that there is no such enemy upon the currant bushes in the vicinity of Rochester, and that the description given of the appearance and habits of this worm is so general that we are unable to definitely decide what it is. He suggests that it may be the larva of the saw-fly so destructive to the gooseberry and currant in some parts of Great Britain, which might readily reach this country with the large quantities of these plants which are annually imported; and he presents Louden's description of this insect, desiring his correspondent to study closely the habits of this enemy and communicate the result of his investigations. But we meet with nothing subsequently published to give us more light respecting this Canada worm.

The first notice referring explicitly to this worm as an inhabitant of our country, we believe, appeared in the *Rural New Yorker* of July 24, 1858 (vol. ix, p. 239). To show that it was a new enemy, quite different from the yellow measure worm, the larva of the American Currant Moth, a description and illustrations of the latter were given in the issue of the preceding week, stated to be derived from our paper upon this moth, which appeared in the *Transactions of the State Agricultural Society* for the year 1849. A cut, figuring the worms, the cocoon and the fly accompanies the description given of them. The first announcement in this country of this dreadful pest will be perused with interest, although it repeats some things which have already been stated. It is headed "The Gooseberry caterpillar," and reads as follows: "In our last we gave a description of the American Currant Moth, and now we present another enemy of our currant and gooseberry bushes, and one which proved the past season even more numerous and destructive than the former. How long since this insect was first seen in the country, or whether it is a native or an emigrant, we cannot say. But of the fact of its having taken almost entire possession of our currant bushes, and of its very close resemblance to the Gooseberry Saw-fly of Europe, there can be no doubt.

"The flies emerge from their winter quarters in the ground the latter part of April or early in May, and soon after the female begins to deposit her eggs on the underside of the newly expanded leaves, choosing the sides of the veins or nervures as a fitting place. With the saw-like appendage, for which the family is remarkable, the female commences cutting into the leaves, and in the opening deposits her egg. The larva is hatched in about a week, and com-

FIRST PUBLISHED NOTICE AND DESCRIPTION OF IT.

menees feeding on the leaf, increasing in size and frequently changing its skin, till it is about three-quarters of an inch in length. It is now of a dull pale-green color, the first thoracic segment being deep yellow, the penultimate being also of the same color; the feet, tail and head are black, and each segment is dotted black also, some having as many as twenty-four spots arranged in lines down the back, while those on the sides are more irregular, with one large one at the base of each foot. They have six pectoral, sharp, horny feet; the fourth segment appears destitute of feet, but the six following are each furnished with a pair of legs, which assist them in walking; they have also a pair of feet at the extremity of the last segment.

"In the fly state it assumes an ochreous color; the body is orange, sometimes bright; the wings are iridescent, and, when expanded, are about two-thirds of an inch in length; the antennæ are almost as long as the body, bristly, brownish above, and nine-jointed; the crown of the head and eyes are black, as are also three large confluent spots in the centre of the trunk, and also a large patch on the breast or sternum.

"The broods of caterpillars appear in succession occasionally from March till October, but in greatest numbers in June. Sometimes they severely attack the gooseberry in July and August, and after denuding the bushes of their foliage, they descend into the earth, spinning themselves a yellowish cocoon of an elliptical form, and remain in their pupa state till the following spring. Those of the earlier summer brood descend in like manner but in the course of three weeks, or less, undergo their transformation, and again appear as perfect flies.

"Syringing the bushes, on the first appearance of the caterpillars, until the foliage is well wetted, and then dusting them all over with powdered caustic lime, is effective. The operation should be performed at least two or three times to secure their destruction, and the earlier it is done the better. Watering with lime-water has much the same effect, and covering the ground under the bushes with fresh tanner's bark is also advantageous. The most radical cure, however, is to remove the soil under the bushes to the depth of three inches, and to dig pits two feet deep and bury the soil in them, substituting that taken from the pits for that which has been removed. Water heated to 140 degrees and applied by the syringe or garden engine, has been found destruc-

tive to the caterpillars, while the foliage has sustained no injury. The practice of striking the stem of the bush suddenly with a mallet, so as to cause the caterpillars to fall to the ground, where they may be bruised to death with the back of the spade or trodden under foot, is sometimes attended with much injury to the stem and bark of the tree. If the insects are not too numerous a good deal can be done by hand-picking."

Thus, on its first appearance, this worm was so plainly announced and shown to be a new and different species from the measure worm of the currant moth, that some of the correspondents of the agricultural periodicals are scarcely excusable for having afterwards confounded them together.

The next notice of this insect appeared in the same newspaper, May 28th of the following year, saying "It is only two years since our attention was first attracted to this insect. How long ago it was first seen in the country, we cannot say." And the description given the preceding year is repeated. This statement, with that of the *Genesee Farmer*—that there was no such insect in that vicinity in February 1857—strongly indicates the spring of 1857 as the time of its first appearance in Rochester.

The *Rural New Yorker* of August 4th, 1860 (vol. xi, p. 247), in a general article upon the currant, its varieties, mode of culture, &c., speaks as follows of this insect: "The currant is subject to no enemies or diseases of particular importance, except the *Currant Caterpillar*, which for four or five years past has caused great trouble and anxiety to the growers of this fruit, and a partial or total loss of the crop, and in some cases of the plants. This insect is supposed to be the same as that which is known in England as the grub of the *Gooseberry Saw-fly*. It is thought to have been imported from Europe with gooseberry plants. Rochester seems to be the centre of its operations, and in many places fifteen or twenty miles distant it is unknown. Mr. Hoag, of Lockport, stated at the last meeting of the Fruit Growers' Society, that he saw a few on his plants, for the first time, the present season. Their spread would no doubt be checked, if every one, on its first appearance, would make a diligent effort for this purpose; but where it becomes numerous it is, to say the least, very difficult to save the plants from destruction. They commence their ravages soon after the young leaves appear, and as a new brood of insects appear every two or three weeks, the cultivator generally becomes

discouraged, and retires from the contest. In England they destroy, we believe, only the leaves of the gooseberry, but in this country, where gooseberries are scarce, they commence at the few gooseberries that may be within their reach, and then attack the currants, seldom leaving while a leaf remains. The black currants they do not relish." And a description follows, similar to what has been given above, of the fly, its larva, and the remedies for destroying them.

H. Hubbard, editor of the *Chenango Union*, informs the *Rural New Yorker* (vol. xii, p. 199) that in the spring of this year, 1860, he purchased several new varieties of gooseberry from a Rochester nursery, and planted them in his garden at Norwich, N. Y. They grew well, until one day in the month of June, to his astonishment he noticed they were nearly stripped of their leaves. On a closer examination he found the cause to be the Saw-fly worm, which he had never seen before, although he had always cultivated gooseberries. They before fall defoliated his old bushes also, every remedy which he tried being of no avail.

In the same periodical, June 8th, 1861 (vol. xii, p. 183), a Canandaigua subscriber states that large numbers of small, green worms, had lately appeared on his currant and gooseberry bushes, making great havoc with the foliage. The editor observes, that he has been fighting this same worm for several years, and with very little success. He is a foreigner, doubtless imported from Europe with currant or gooseberry plants, but is more at home here and thrives better than in his native land. He adds that it is no doubt the same as the Gooseberry Saw-fly of Europe. In another notice of this insect, a fortnight later, the editor states, "White hellebore, powdered and dusted on the leaves, or blown on with bellows, is recommended by English gardeners, and has proved successful here." It is reported, in a meeting of the Fruit Grower's Convention of Western New York, that Mr. Harris of the *Genesee Farmer*, first suggested hellebore as a remedy for this worm.—(*Country Gentleman*, vol. 25, p. 413.)

In 1862, a correspondent of the *Rural New Yorker*, at Erie, Pa., states (vol. xiii, p. 183), that the worm had been in that place one or two years. Dr. Sylvester, of Lyons, N. Y., says (p. 115), that he first saw the worm there in 1860. At Fulton, N. Y., C. S. Rust (*Country Gentleman*, vol. xxx, p. 94), reports that it appeared this year, completely destroying the foliage first of the gooseberry and

then of the currant bushes. As we have no accounts of it elsewhere in that part of the State at this time, it was probably brought direct to Fulton in plants obtained from Rochester.

The editor of the *Rural New Yorker*, this year reports (p. 199), that he had uprooted and burned all his bushes, and now having planted a few new ones, they are growing thriftily, and the fly does not come near them, it having been starved out or emigrated to better quarters. H. H. Doolittle, however, says (vol. xv, p. 119), he finds that cuttings and one year old plants are not attacked, though when they become older than this they enjoy no such immunity.

When attending the State Fair this year, at Rochester, October 2d, I had a very interesting visit to the Mount Hope Nurseries of Messrs. Ellwanger & Barry, and inquiring with respect to this currant worm, was informed by Mr. Barry that it had this year appeared in their grounds for the first time. A numerous brood of the worms, in June, had totally defoliated the bushes at the single point which they occupied. They then disappeared until a short time before, when, what was evidently the progeny of the previous brood had spread themselves over a much greater extent of the bushes. He supposed they were then still present, but upon repairing to the spot, not a worm could we find, although they had been immensely numerous there only a few days before. The rueful aspect of the bushes stripped quite bare of their leaves attested what greedy cormorants these worms are.

In 1863 the worm made its appearance at Utica and other points in Oneida county, as I learn from several sources, coming like an invading army, thronging the bushes, and through the entire season keeping them so completely defoliated, in this and the following years, that they were mostly killed, and the few surviving plants were so weak and puny as to be valueless. Mr. J. Dagwell informed me he had about a hundred currant and gooseberry bushes, and soon after these worms came upon them, his whole family one day turned out with cups in hand, and in an hour or two picked a bushel of worms, without getting all that were on the bushes. In 1866, residents of Utica informed me they had not seen a currant that year, so universally were the bushes ruined in and around that city.

At Watertown, Mr. W. Ives informs me, this insect made its appearance this year, and kept the bushes so destitute of leaves in

most of the gardens, that in three years they were nearly or quite dead. He says the worms appear to be more numerous on low interval lands and along streams of water, than they are in elevated, airy situations upon the hills.

In Albany also, this insect arrived this year, wholly defoliating the currant and gooseberry bushes in many of the gardens.

In 1864, I visited Albany the last of May, to see this worm and its works. In most of the gardens which it had invaded last year it was equally, and, if possible, more destructive this year, and had now spread itself into many gardens in which it had not been seen before. From specimens taken to my own residence, I obtained the flies, from which I saw that the Rochester editors were in all probability correct in regarding this as being the European Gooseberry caterpillar; but I had not in my hands at that time such full descriptions of that insect and its habits as that I felt perfectly assured of their identity.

In 1865 it reached Rhinebeck, making its appearance in the garden of Hon. E. W. Heermance. He informs me it was just as the currants were about commencing to turn red that a whole swarm of most voracious worms were discovered upon a particular bush, eating it naked of its leaves. Some lime and ashes were dusted over the bush, and the worms immediately vanished, and he congratulated himself that he had so easily got rid of these disagreeable visitors. But the worms, without doubt, had then got their growth and were on the point of leaving the bush and going into the ground, and the alkaline powdering did nothing towards driving them away; for in three or four weeks after, the same worms appeared again, and were now scattered in thousands upon every currant and gooseberry bush in his garden—being so numerous that he was disheartened from attempting to subdue them, and in a few days they had everywhere stripped the bushes bare. He has not heard of their being in any other garden in his vicinity.

In Albany it was not so destructive as in the two preceding years, nor had it spread itself into the country around in force, except it might be in some particular gardens, whilst in others not one of these worms had yet been seen.

In 1866 it first appeared in numerous places in Washington and Saratoga counties. It did not come suddenly in full strength, but insidiously in limited numbers, lurking low down between and underneath the bushes, where it was seldom seen until it had been

CURRANT-WORM. REMAINS LATER IN DAMP THAN IN DRY SITUATIONS?

present some time, and was then accidentally found. I first discovered it in my own garden on the 18th of June. Being engaged in weeding under a currant bush, I noticed that the leaves had been cleanly eaten from a twig which was hid from view underneath the foliage. Surprised and wondering what currant insect there was that could have done this, in looking further I espied a cluster of worms occupying the leaves of two other twigs contiguous to this one, from one to a half dozen worms standing upon the underside of each leaf. It required but a slight inspection to assure me they were the larvæ of this Currant saw-fly about two-thirds grown. Hereupon examining all my bushes I found a spot denuded of leaves and indicating that a small flock of worms had been feeding there and had probably got their growth and gone into the ground. Another defoliated place was found, where were eleven mature worms, mostly scattered one upon a leaf, the remainder of this flock having no doubt buried themselves. These defoliated spots were in hidden situations and of such small extent that probably one fly produced them, dividing her eggs into separate parcels for the better concealment and security of her young, instead of depositing her whole stock in one place. A currant bush growing alone in my yard was also found to have about a third of its foliage consumed, and thirty-one worms were counted, scattered everywhere over it, one or two upon a leaf, some of them small, others mature, and others no doubt had finished feeding and buried themselves. No worms as yet occurred upon my gooseberries, these furnishing no places for them to feed in such perfect concealment as they found upon the currants. Every leaf upon which a worm was detected was picked and dropped into pots of earth to be fed, that I might observe their further growth and transformations. From this time onwards, none of these larvæ were seen upon my bushes, until the middle of August, when, around the same places where they had previously occurred, were found a number of them half and two-thirds grown, scattered and but one or two upon a leaf. The annual fall of the leaves from the currant bushes was then taking place, whereby no considerable number of larvæ could find sustenance upon them. I think in moist situations and soils of clay loam the currant and gooseberry retain their leaves to a much later period than they do when growing in more elevated, dry, gravelly loam, thus enabling the autumnal broods of these

larvæ to continue feeding much later in the former than in the latter situations.

In 1857 the flies did not appear in such force in my garden as I expected. The spring was wet and backward, and I did not search my bushes until the beginning of June, when I discovered worms upon them in numerous places, some of them already grown nearly to their full size. Through this season, whenever a worm was discovered the leaves around it were promptly dusted with hellebore; and the bushes continued in full leaf through the season, no very manifest defoliation being perceptible in any place. Through this section of the State, this year, in particular gardens the currant bushes were wholly denuded of their leaves. In many other gardens these worms were known to be present in numbers more or less formidable and threatening; whilst in many others it had not as yet been seen. Numerous inquiries were addressed to me, in reference to this insect. A summary statement of its history, habits and transformations, which I wrote in reply to one of these correspondents, in which was also set forth in the most decided terms the efficacy of hellebore as a remedy, was published in the *Saratogian* newspaper of June 20th, and was copied into several of the other local newspapers, whereby this remedy was much resorted to, and with the most satisfactory results.

The insect continued to advance, appearing this year in many localities beyond those which it reached the preceding year. I am informed by Dr. Gile, of Poultney, Vt., that it arrived in that place this summer, and that in a hunting excursion in the wilds of Northern New York, at Indian Lake, Hamilton county, in the forest fifteen miles distant from any other settlement, he saw the currant bushes covered with these worms, and twenty miles beyond this, at Jessup's settlement, he noticed these same worms thronging a bush of wild gooseberry, which was probably the *Ribes hirtellum*. Although it is reported that it does not feed upon the wild black currant, *R. floridum*, there is no doubt but that it relishes the several species of our native gooseberries, *R. lacustre*, *Cynosbati*, *hirtellum et rotundifolium*, one or more of which are growing everywhere in our woodlands, and it will consequently be able to advance through an unbroken wilderness as readily as through districts that are cleared and cultivated.

In the historical account which has now been given of the introduction and progress of this insect in our country, many of the

facts relating to its habits and economy have incidentally been stated which it will be unnecessary to particularly repeat now, when we come next to treat upon its transformations and describe the different forms in which it appears.

The flies break forth from the cocoons and emerge from the ground, in our State, the latter part of April. The exact date of their beginning to appear will vary in different years, as the season is early or late, and will be a week or more earlier in the southern than in the northern sections of the State. Everywhere some of them will come forth in season for the sexes to pair and the females to commence the deposit of their eggs just as the leaves of the gooseberry and currant are bursting from their buds and beginning to unfold.

The EGGS are placed on the underside of the leaves. Mr. Curtis states they are placed close by the side of the larger veins. Those which I have observed have mostly been glued lengthwise along the summit of the ridges formed by the larger veins. They are shining, watery-white and translucent, of a short cylindrical form with rounded ends. Before hatching they become more opake, and swell and increase in thickness but not in length. They hatch in six or seven days, in summer, but in the cool weather of early spring the period is probably longer.

The YOUNG LARVÆ when they come out from the egg shells are watery-whitish and translucent, six times as long as thick, and one tenth of an inch in length. Their bodies are cylindric with the heads thicker, more shiny and pale dirty yellowish-brown, with three conspicuous pairs of feet placed on the breast. When they begin to eat, their bodies immediately acquire a green tint and their heads become smoky. They, on leaving the egg, distribute themselves over the disk of the leaf, avoiding its margin, and each one eats a small round hole through the leaf, whereby it becomes riddled with these holes. They continue eating the edge of the hole, enlarging it, and as soon as it is sufficiently large to receive them they stand in it, with their backs strongly bent. They move backwards as they continue to eat, each one along the edge of its hole, enlarging it more and more, till the holes meet and become confluent and oblong, occupying the spaces between the veins, and being of different sizes, with two, three or more worms now eating along the edges of each hole, until it extends to the outer margin of the leaf, thus taking all or nearly all of the parenchyma of the

leaf and leaving only the veins. They drop a multitude of little black grains upon the leaves below them, which enable us frequently to discover broods of these worms which would otherwise escape our search.

When one leaf is consumed they migrate to another. And as they increase in size, so often as their skins become uncomfortably tight, they cast them off and come out in a new dress. These evacuated skins are frequently seen, having their tips hooked around a leaf-stalk or the margin of a leaf, with the head end hanging downward, looking as though the worm in wriggling out of it had dropped itself to the ground. They are a shrivelled and distorted mass, the skin being of a flesh-red color wherever it is seen in the interstices between the shining black warts, which occupy most of the surface, the black bristles and black anterior legs projecting out in every direction—the black, shining head, similarly bristled, appearing at one end of the mass, split asunder into two segments.

As they increase in size they become more voracious, and were a whole brood to continue together, one leaf would not suffice to feed them an hour. They, therefore, separate, and as they approach maturity become more subdivided and scattered around the spot which they occupy, until commonly only one, two or three are found on a leaf, which they commence eating at its tip, consuming it more and more as they progress towards its base. They continue to increase in size with each successive change of their skins, until they attain three-fourths of an inch in length.

The LARVA when nearly or quite mature is about six times as long as thick, and of a cylindrical form, very slightly tapering towards its tip, which is usually held in a curved position, either downward, upward, or to one side. It is shining and greasy-looking, of a pale bluish green color with the neck and the segment next to the last pale greenish yellow. It is ornamented with numerous elevated polished black dots, each one of which gives out a short black bristle. These dots are symmetrically placed in rows running both lengthwise and crosswise of the body, there being along the back twenty-four dots in each row. Each abdominal segment has three transverse rows, with four dots in the first, six in the second and ten in the third, with an additional dot between the lower ends of the second and third rows, and another much larger one below the ends of the first and second rows, this last dot having two others below it, on the base of the prolegs. On the thoracic segments the dots are fewer in number and differently arranged. The extreme tip of the body is tinged with yellow, with a black spot on its upper side, and two short horn-like processes. The head is black, highly polished and studded over with bristles. On the underside are three pairs of true legs, anteriorly, on the breast, which taper to a sharp point and are black and shining. With these the larva clings to the leaf when it is feeding. They occupy the three first

rings, and the fourth ring is destitute of legs, but on each of the six rings following it and also at the tip is a pair of short, thick, fleshy, retractile prolegs, of a pale color, which the larva protrudes to aid it when crawling.

When they are done feeding they cast their skins again, and then become very much changed in appearance from what they have previously been, all vestiges of the shining black dots having vanished, and the worm being now of a very pale pea-green color, almost white, with the neck and the penultimate segment sulphur yellow, and the head pale like the body, with a small black dot upon each side. When it has come out thus colored it crawls slightly away from its cast-off skin, and then remains at rest and motionless about five or six hours. It then crawls down the currant stalk and goes into the ground, burying itself slightly under the surface. It here incloses itself in a yellowish cocoon of a very dense membranous texture and a regular oval form, in which it changes to a pupa, and lies reposing for about a fortnight. In two instances in which I particularly observed the dates, it being in the month of June, the flies came forth, one on the twelfth the other on the fourteenth day after the worm entered the ground.

The FLIES are 0.38 long to the end of the abdomen and wings, but in the preserved specimen the abdomen shrinks and the body measures but about 0.30 to its tip. They are 0.70 in width across the extended wings. The *head* is black and shining, very slightly clothed with short gray pubescence. The edges of the orbits of the eyes are distinctly of a dull whitish color in the living specimen, but after death this color fades and becomes imperceptible. There is also a dull white spot between the antennæ. The mouth is more clear dull white, the jaws or mandibles being black, except at their bases. The antennæ are black, their undersides dull brown; they are three-fourths the length of the body, slightly more slender towards their tips, nine-jointed, the two first joints small, the third joint slightly if at all longer than the fourth, the remaining ones successively slightly diminishing in length and thickness. The *thorax* is palo yellow, shining, and clothed like the head and antennæ with short gray pubescence. It has on the back three large black spots occupying the elevations of the lobes, which spots are usually more or less confluent, and back of these are smaller black transverse spots. Beneath, the middle of the breast is black, a black spot anteriorly occupies the collar, and on each side is a triangular black spot, placed obliquely, below the wing sockets. On the last segment are two elevated dull white dots. The *abdomen* is bright wax-yellow, fading after death to pale lurid brown; its base above is smoky. The *wings* are hyaline, slightly smoky; the veins and the thickened outer edge of the upper pair ending in a callous spot called the stigma, are black, the inner side of the stigma sometimes having a pale tinge. The upper wings have one marginal and four submarginal cells; the first submarginal cell is quadrangular and nearly equilateral, its inner anterior side longest; the second cell is elongated hexangular, twice as broad anteriorly as posteriorly, the two veinlets at its ante-

rior end equal or the inner one slightly longer than the outer, receiving two recurrent veins, the hind one but little forward of the hind end, and having a brown dot back of the centre and slightly nearer the inner than the outer boundary; the third cell is small, quadrangular and twice as long as broad, usually widening backward, joined by no recurrent veinlet; the fourth cell as long as the second and double its width, its hind end twice or thrice the width of its anterior end, sometimes incomplete, the vein on its inner side being more or less atrophied. The *legs* are dull white, the hind pair having the feet and tips of the shanks black. Several of the parts which are black in the living insect fade to brown in preserved specimens.

In many neighborhoods it is a mooted subject whether the fruit which ripens on bushes which have been thronged by these worms is not poisonous and unsafe to be gathered and used. Rumor is ever ready to report that in the next town one or two children have died from eating these currants. Meeting a man who desired to know my opinion upon this subject, I was told he had heard a strenuous advocate of this poison theory, relating in a public place that he had my authority for saying that such currants were poisoned and ought never to be used. This illustrates how unscrupulous men are apt to become when excited by controversy. Those who are so prejudiced against using these currants ought never to taste a worm-eaten apple, for assuredly a worm crawling around inside of a fruit and feeding upon it will be much more apt to impart poison to it than one which merely walks over or rubs against its smooth outer surface. When the bushes are stripped bare of their leaves, the fruit which ripens on them will not be so plump and perfect, it will be slightly wilted and shrunken, and possibly such fruit may not be quite so healthy as that which is perfectly grown—though an apple which is slightly wilted from being worm-eaten is more palatable and also more digestible than one which is fresh and sound. But that such currants are "poisonous," in any sense of the term, I am confident is erroneous. I bind upon the skin of my arm a worm which has just now been killed by hellebore. At the end of six hours I have not felt the slightest smarting or irritation of the part; and on removing the worm the skin is not at all reddened, as it would be were there any acrid or vesicatory property pertaining to this larva as there is to several other insects and their larvæ. And we have no evidence that any poisonous quality whatever, pertains to these worms.

A most important topic is yet remaining to complete our account of this terrible pest to the gardener, namely, a notice of the most

important remedies for destroying it and saving the currant and gooseberry bushes from its ravages.

The remedy which transcends all others in its efficacy for destroying the larva of the Currant Saw-fly, is the root of the white hellebore, *Veratrum album*, either dried and ground into an impalpable powder, or a decoction made by boiling it in water and when cold sprinkling the leaves therewith from a watering pot. Words fail us for suitably expressing the value of this substance. In the whole round of remedies for injurious insects we know of no other one that is so efficacious, we know of no other one that possesses such virtue for destroying any insect as does this substance for destroying this larva. It is a sovereign cure for the evil. It is a specific. It operates like a charm. Easy of application and certain in its effects, it is all that can be desired. The larva does not require to eat it. It kills the moment it touches. In the words of R. Lymburn, "wherever a particle reaches a caterpillar, it collapses as if stabbed," yes, as if stabbed to the heart. Every one who notices this powder as it falls upon a worm will confirm the literal truth of this statement. The worm is instantly convulsed with a death spasm, rolls off the leaf and drops lifeless to the ground. It is "a spectacle wonderful to behold." But if standing on the underside of a leaf where the powder does not touch it, when it afterwards comes to eat a particle of it, its doom is sealed with equal certainty.

In addition to the statements of the efficacy of this remedy, which have incidentally been made in the foregoing pages, a few others may here be presented.

D. G. had 3,000 gooseberry trees so covered with caterpillars that in a few days not a leaf would be left. He got six pounds of the white hellebore powder, and dusted the plants over from a large pepper box, and it completely killed all the caterpillars upon them. (*Gardener's Chronicle*, 1842, p. 365.)

The *Ithaca Journal* says: "We know from repeated experiments that powdered hellebore sprinkled on the bushes in quite limited quantities, will clear the worms in double quick time. We have succeeded in completely eradicating them from ours, and have the promise of a superb crop."—(*Rural New Yorker*, vol. xv, p. 207.)

S. Edwards Todd, of Auburn, states that he has found that pulverized white hellebore will effectually destroy every worm in less

than an hour, without injuring either the fruit or the bushes. (*Country Gentleman*, vol. xxiii, p. 383.)

W. B. Smith, of Syracuse, says he has effectually destroyed these worms on a plantation of half an acre, by dusting white hellebore over the leaves. It was not necessary to cover all the leaves nor to apply it on the under side, as the first mouthful which any one took, killed it. The powder is retained by the rough surface of the leaves but is quickly washed from the glossy surface of the fruit.—(*Country Gentleman*, vol. xxvii, p. 110.)

Numerous other published statements to the same purport with the preceding might be presented, but it is unnecessary. Within the circle of my acquaintance, every one who has used this remedy expresses himself as being perfectly satisfied and delighted with its operation, except in a single instance. One friend informs me he could not perceive that it had any effect. And in the *Gardener's Chronicle*, 1842, p. 349, a correspondent states that he completely covered several larvæ with hellebore powder, and confined them under a wineglass on paper strewed with this powder, several hours, and they appeared to experience no inconvenience whatever. It does not admit of a doubt that in both of these instances a worthless article was used. If it really was hellebore which these two persons received from the druggists, it was so old and had been lying so long in the drawers of the shops that it had entirely lost its properties. The purchaser should assure himself that the article which he obtains is genuine, as this is so readily ascertained. Hellebore is such a powerful sternutatory that it has long been in use as the basis of those snuffs which are designed to excite violent and continued sneezing, and the smallest pinch of its powder, brought near the nostrils, by the tingling sensation it produces in them will sufficiently attest its genuineness. And in dusting it over the bushes, one soon learns to stand where any slight breeze which may be in the air will not waft any of the finer particles to his own face. It is ground into such an exceedingly fine light powder that it can only be used with economy when the atmosphere is nearly or quite still, so large a portion of it is wafted away and wasted if any wind is blowing.

Much the most convenient mode of dusting this powder far down between the bushes or elsewhere that a worm occurs, I find is to put about a gill of it into a small bag made of very fine muslin, and tie the mouth of this bag around a stick about eighteen

inches long. Using the stick as a handle, the bag can readily be passed in among the bushes to any point where a worm is seen, and a slight shake being given, it sifts the powder out upon the very leaves on which we desire to dust it. The slightest quantity distributed over the upper side of a leaf is equally as effective as a thick coating would be.

The green hellebore, *Veratrum viride*, of our country, a plant growing everywhere in our moist meadows, and commonly called "poke," with its large leaves prettily plaited lengthwise, and so compacted together as to give it some resemblance to a cabbage, is so closely like the white hellebore of Europe that botanists are not fully agreed that the two are really distinct species. The root of our American plant will undoubtedly be as efficacious for destroying this currant worm as is the imported hellebore. But this latter is so readily obtained from the druggists at such a moderate price, and comes to us ground to such a fine dust, and ready for immediate use, that we have no occasion for resorting to the latter. But if in any place the white hellebore cannot be had, our American plant is everywhere at hand; and a decoction of its roots sprinkled upon the bushes from a watering pot, will undoubtedly be found to be perfectly effective.

Next to this remedy, the most effectual one for subduing this insect and saving the currant and gooseberry bushes from its ravages, appears from the experience of many persons to be the slow and tedious process of hand-picking. Some have recommended gathering the flies when they first issue from the ground in the spring. Robert Gray, of Dristwich, states in the *Gardener's Chronicle*, 1855, *p.* 281, that he spent an hour or two in the morning for a few days and caught several hundred flies, thus lessening their numbers so that but few eggs were afterwards found on the leaves. And R. Varden, of Seaford Grange, writes (*p.* 317) that through the middle of April (the flies coming forth there somewhat earlier than they do here in New York) his men before breakfast tapped the bushes with a stick, when the flies would generally dart to the ground and could be easily secured, thus sometimes getting nearly a pint of them, their bodies full of eggs. There cannot be a doubt this is a very advantageous step to take.

Slacked lime sifted upon the leaves two or three times a week seems to be the next most successful remedy for destroying the worms, but the testimony as to its efficacy is quite conflicting.

COAL ASHES. ROAD DUST. OTHER REMEDIES.

An item has lately gone the rounds of the newspapers, stating that "Robert J. Swan, of Geneva, keeps his currant bushes entirely free from currant worms by the use of coal ashes. Cover the ground about each bush four or five inches deep for a distance of two feet on each side. The mechanical sharpness of the ashes prevents the soft larvæ from rising through them." I think this may be a valuable measure. It is not probable that the fly on hatching would be able to make its way up though such a depth of these ashes, or that the larva will bury itself in them to form its cocoon. We doubt whether the insect will remain where it is so much discommoded.

I. H. Robinson, of Rochester, finds that frequently sifting coal ashes over the bushes when the dew is on, prevents the ravages of these worms. (*Rural New Yorker*, vol. xiv, p. 255.) And of a similar purport is the following:

If road dust or the fine dust from any dried clods is sprinkled on infested bushes, the caterpillars will soon disappear, says a correspondent of the *Gardener's Chronicle*, 1842, p. 526. And in the *Rural New Yorker*, vol. xvi, p. 183, H. Stanton, Jr., of Syracuse, states that fine dry road dust sprinkled and thrown up under the bushes wherever the worms appear will destroy them and completely stop their ravages. He tried it the preceding year with perfect success. We cannot think any inert powder like dust or coal ashes will be of any avail except to put the worms to the inconvenience of traveling away to leaves that are clean.

Whale oil soap, two pounds dissolved in a few gallons of hot water, and sufficient water added thereto to make fifteen gallons, is reported by R. N. Parke, of Waterloo, N. Y., to destroy these worms upon a few applications. (*Rural New Yorker*, vol. xii, p. 199). This has been extensively used, some being satisfied with it, others finding little or no benefit from it.

Quite a number of other articles—sulphur, sulphur fumes, salt, soot, wood ashes, strong soap suds, decoction of foxglove, tobacco water, copperas water, &c.—have been brought to notice by one and another, in the public prints, as remedies for these currant worms, but have failed to gain any public confidence in their efficacy.

As none of the foreign accounts which we have seen allude to any parasitic enemy of this Currant Saw-fly, it seemed quite improbable that it would in this country meet with any such enemy, to

CURRANT-WORM. EGGS DESTROYED BY A PARASITE.

lighten from us the task of combatting it and diminishing its devastations. But our valued friend J. A. Lintner, of Schoharie, greets us with the glad tidings that he has discovered we have such a foe to this formidable scourge. An egg parasite of this saw-fly inhabits our State, an exceedingly minute Hymenopterous insect, which inserts its eggs into those of the saw-fly, that its young may subsist upon and consume the contents of those eggs. This diminutive little fly has probably existed hitherto upon the eggs of some one of our American saw-flies similar in size to those of the Currant Saw-fly; and it has now discovered that the eggs of this newly arrived foreigner are equally well adapted to its wants. And so multiplied has this little friend of the gardener become, that in Utica Mr. Lintner finds that among fifty eggs of a saw-fly upon a currant leaf, there will not be more than four or five that will hatch currant worms, all the rest being occupied by the little maggot, the young of this parasite. At Schoharie, also, where the saw-fly has arrived more recently than at Utica, he finds this parasite is now beginning to appear. Everywhere this little creature is no doubt following upon the tracks of the saw-fly, and within a very few years after the one arrives in any place the other will be there also, and will speedily become so multiplied as to quell and extinguish it. This is a most important discovery, and renders it quite probable that in this country this currant worm can never be but a temporary evil. Whenever circumstances favor it and enable it to multiply and become numerous in any section of our country, this little enemy, its mortal foe, will speedily be there to subdue and stamp it down. Thus nicely are the works of nature balanced, and no creature is permitted to usurp a place in her domain which does not belong to

THIRTEENTH REPORT

ON THE NOXIOUS, BENEFICIAL AND OTHER INSECTS OF THE STATE OF NEW YORK.

By Asa Fitch, M. D., Entomologist of the Society.

Bean aphis, *Aphis Rumicis*, Linn. (Homoptera. Aphidæ.)

Crowded together in clusters upon the top of the stalks and under side of the leaves of the English bean, the poppy, dahlia, and several other plants, a small black plant-louse with pale shanks, the pupæ with a row of mealy white spots along each side of the back.

This aphis is one of the most pernicious insects of the group to which it pertains. So much notice has been attracted to it in England that in different sections it has there obtained the names of the black dolphin, the collier, and the black fly. It is liable to suddenly become excessively numerous, and when thus multiplied it falls upon plants other than those which it ordinarily infests, and plants which are widely dissimilar in their nature and not at all akin. And it is also liable to suddenly vanish and totally disappear. We are informed by Mr. Curtis (Farm Insects, p. 387) that, "During the summer of 1847 the prodigious swarms of this aphis which suddenly covered the young shoots and under sides of the leaves of almost every plant, so that the surface was blackened by them, was unprecedented, as far as can be ascertained, and it excited the attention of the public generally. * * * They died in closely packed groups, with their beaks thrust into the leaves, and their wings erect; and possibly were either poisoned by feeding on juices not adapted to their constitutions, or they might have been held fast by the drying of the leaves in which their rostrums were imbedded. * * None were observed the following year." He also states (p. 68) that in the year 1854 this aphis was excessively abundant, everywhere in England. In a communication to the Gardener's Chronicle, the last of August in that year (p. 550), he reports that about the beginning of that month there were myriads of this species in the neighborhood of London, and on the

evening of August 1st they were seen in prodigious numbers near Highgate, and soon covered the plants in the gardens, causing considerable mischief to the dahlia buds. They died, however, in two or three days, after some very heavy showers occurred. He further states that they had done great injury to the turnip crops in Yorkshire. A letter from Mr. Lister, with specimens, informed him that hundreds of acres of late sown turnips were almost destroyed by these flies. Mr. L. had five acres which were quite destroyed, and several more that were much injured.

Hitherto it has been the current opinion of naturalists that every plant had its own parasites — one or more species of plant-lice living upon it and unable to subsist upon any other member of the vegetable kingdom. Linnæus hence supposed it was unnecessary to give any descriptions of these insects, deeming that the several species were amply distinguished by simply naming the plants to which they respectively pertained. But the more accurate researches of the present day have greatly modified this view, and have shown that the same species of aphis is liable to occur upon different plants which are related to each other, and which pertain to the same botanical genus, or even to different genera of the same Natural Order. And some species occur which are still more ubiquitous, sustaining themselves upon plants which are quite dissimilar, and which pertain to different Orders. Thus the species of these parasites are now known to be much less numerous than has hitherto been supposed, many of them having received several names in consequence of their occurring upon different plants. We have a notable instance of this in the aphis now under consideration. Establishing itself and subsisting as it does upon quite a number of plants and trees which are more or less dissimilar in their nature, it has confidently been regarded as a distinct species on each of these plants and trees, and has thus received a corresponding number of names. But when we come to fully study the characters and marks which this aphis presents in each of the stages of its development, the exact form and size and colors of the different parts of its body and of each of its several members, the position of the veins in its wings, and especially the peculiar row of flocculent snow-white spots along each side of the back of its pupa, the size and shape and situation of each of these spots, we are furnished with such an assemblage of diagnostics as enables us to clearly recognize this species on whatever plant we meet with it. And, finding them to be identical in such a multitude of particulars, we shall not be able to persuade ourselves they are different species, however dissimilar the

vegetation may be on which they occur to our notice. Mr. Francis Walker, who has investigated this family of insects so thoroughly, in his several notices of the present species (Annals of Natural History, 2d series, vol. 5, pp. 17, 73; Zoologist, vol. 6, p. 2247, and Appendix of vol. 7; and List of Homopterous Insects in the British Museum, p. 981), has shown what a number of names have been given it by different authors. And I make one addition to the list which he has given.

It was first named *Aphis Rumicis* or the dock plant-louse, by Linnæus, in his Fauna of Sweden, published in 1746. He merely states in connection with this name that it is the aphis of the *Rumex Lapathum.*

Aphis Craccæ, the next name it received, was first given by Linnæus in the tenth edition of his System of Nature, vol. 1, p. 452, published in 1758, as being the aphis of the tufted veteh, *Vicia Cracca.*

Aphis Atriplicis, the aphis of the garden orache, *Atriplex hortensis*, was the third name given by Linnæus, in 1761, in the second edition of his Fauna of Sweden.

Aphis Fabæ, the aphis of the bean, *Faba vulgaris*, appeared in 1763, in Scopoli's Entomology of Carniola, p. 139.

Aphis Genistæ, the aphis of the dyer's broom, *Genista tinctoria*, appeared in the same work with the preceding.

Aphis Acetosæ, the aphis of the field sorrel, *Rumex Acetosa*, was a fourth name given to this insect by Linnæus, in the twelfth edition of his System of Nature, vol. 2, p. 734, published in 1765.

Aphis Aparines, the aphis of the bedstraw, *Galium Aparine*, was the next name given, by Fabricius, in his Systema Entomologia, p. 735, which appeared in 1775.

Aphis Euonymi, the aphis of the spindle tree or burning bush, *Euonymus Europæus*, appeared also in the same work, p. 736.

Aphis Papaveris, the aphis of the poppy, *Papaver somniferum*, appeared in Fabricius's Genera of Insects, p. 303, published in 1777.

Aphis hortensis, on the tops of the garden orache, was published by Fabricius in his Species of Insects, vol. 2, p. 387, which appeared in 1781. He subsequently abandoned this name, becoming assured it was the same insect with *A. Atriplicis.*

Aphis Viciæ was proposed in the same work, p. 390, as a substitute for the Linnæan name *Aphis Craccæ.*

Aphis Chenopodii, the aphis of the pigweed, *Chenopodium album*, was published in 1800 by Schrank, in his Fauna Boica, vol. 2, p. 109.

Aphis Thlaspeos, the aphis of the shepherds' purse, *Thlaspi Bursa-pastoris*, appeared in the same work, p. 118. And also *Aphis Galii scabri*, which Mr. Walker supposes to be this same species.

Aphis armata, a species named by Hausmann, was published in 1802, in Illiger's Magazine, vol. 1, p. 439.

Aphis Laburni, the aphis of the *Laburnum vulgare*, we next have, named by Kaltenbach in his Monograph of the plant-lice, p. 85. And the *Aphis Galii* and the *Aphis Euphorbiæ* of the same author Mr. Walker thinks are probably this species also.

Aphis Dahliæ, the dahlia plant-louse, described by Mosley in the Gardeners' Chronicle, in 1841, p. 628, is the last name which this insect has received to our knowledge.

We come next to notice the different kinds of vegetation which are attacked by this aphis, and the effects produced by its attacks, which are sometimes very curious. Those who have been accustomed to regard the aphides as being each a species pertaining to a particular plant or to plants which are closely related and very similar to each other, will be astonished with the number and still more with the great dissimilarity of the plants and trees on which this black aphis of the bean establishes itself and rears its broods of young.

The plant to which this insect is most injurious and which has caused it to be so much noticed, is the English or Windsor bean, one of its coarser varieties being also called the horse bean—the *Vicia Faba* of Linnæus, *Faba vulgaris* of the botanists of the present day. In our own country this bean is less cultivated now than formerly, the bush and the pole beans, *Phaseolus vulgaris* and *nanus* being so much preferred to it. Watson (American Home Garden, p. 117), assigns as one of the causes of its being so little cultivated: "If but a slight drought comes upon the plants in their growth, the black aphis will eat them up." But in European husbandry this bean is extensively grown and is a common field crop, which is frequently injured and sometimes destroyed by this insect. Dickson (Practical Agriculture, vol. 2, p. 597), says: "In such summers as are dry, beans are liable to be much injured by the attacks of the black fly, or what is often termed the dolphin, the whole field in particular cases being in danger of being destroyed in the course of a few days. It is mostly on the tops of the plants that the insect first appears." Mr. Curtis (Farm Insects, p. 355), says: "Their first appearance is very sudden, and their increase so prodigious, that crops suffer severely from their visits. In 1833 the beans were almost totally destroyed by them in Yorkshire. In 1841 they were abundant in my garden near the

Regent's Park; but in 1842 I never saw one on the spot, yet the beans around Sandgate in the same year were very much injured by them." He further states that, having once established themselves upon the bean-tops, they breed at a rate which would be incredible, if it were not well attested, often making the bean-stalks as black as soot. They exhaust the plants by sucking the sap, so that when they abound, it is in vain to calculate upon a good crop, if they be not speedily arrested. The remedy practiced by all good cultivators, we are told, is, to cut off the tops of the plants with a scythe or other sharp implement, on the very first appearance of the insects upon them. Mr. Curtis adds to this, that these severed tops should be gathered into a heap upon one side of the field, and burned, or should be buried in a pit and trampled upon, for if they are left in the field many of the insects will crawl from them and regain the living plants. But it strikes me that if the tops of the plants are merely cut off the favorite nesting places of the insects are destroyed, so that it will be unable to settle and thrive and multiply upon the plants in its customary manner.

Several other plants of the same natural order, LEGUMINOSÆ, to which the bean pertains, are liable to be infested by this black aphis, namely, the tufted vetch and the dyer's broom, already mentioned on a preceding page, the Spanish broom *Spartium junceum*, and the black bean *Dolichos Catiang*. On the Laburnum also, *L. vulgare*, large families of this insect occur, their punctures curling and distorting the leaves of this tree in a remarkable manner.

In the order POLYGONACEÆ, the dock, as already stated, was the plant on which Linnæus first observed this aphis, and from which it has thereby obtained its scientific name. It occurs on the *Rumex acutus* and other species, and will no doubt be met with on these plants in this country. It also infests the two common species of field sorrel in Europe, and I have seen the stalks of the *Rumex Acetosella*, the common field sorrel or "red top" of this country covered with it. I suppose this to be also the aphis which sometimes invades our buckwheat, *Polygonum Fagopyrum Linn.*, *Fagopyrum esculentum* of our present botanists, completely covering particular stalks of this grain and so exhausting them of their juices that none of their kernels probably become filled. I have not been able to meet with this buckwheat aphis in my own vicinity, and only know it from specimens and statements received from correspondents. And the insects of this family are so soft and tender and so diminutive withal, that in drying they lose their colors and become so shriveled and distorted

that, in most instances, it is impossible to identify their species from preserved specimens. The middle of September, 1866, a letter from the late Robert Howell, of Nichols, Tioga county, stated that in that vicinity many of the stalks of buckwheat were then covered with aphides, which were of different sizes, some of them having wings. Among the specimens inclosed in this letter was one of the winged lice, which closely coincides with dried specimens of the bean aphis. Yet its body, black when it came to hand, might have been green when it was alive. And it is only an inspection of living specimens that can assure us whether this buckwheat aphis really is identical with the species now under consideration.

In the order PAPAVERACEÆ, this aphis infests the opium poppy, as already noticed on a preceding page.

To some of the plants of the order CHENOPODIACEÆ it appears to be most strongly attached. Upon that common weed in our gardens and plowed fields, the pigweed, *Chenopodium album*, it has occurred to my notice very much oftener than on any other plant. During the latter part of the season a slight search anywhere will usually reveal some of these weeds infested with this aphis. The insects occur crowded compactly together and covering all the upper part of the stalks, and smaller clusters are located below, in and around the axils of the branches. Four different kinds of lice will be noticed in these clusters, namely, larvæ or young lice, wingless females, pupæ and winged females. One or two ants are quite constantly in attendance upon each flock. When frosty nights arrive, wingless females cease to be developed, and the colonies then come to be composed of pupæ and winged females, with very few young lice; and the ants then cease to be seen. The autumn rains diminish their numbers, but flocks continue to be noticed on some of the more sheltered plants till about the beginning of November, when the driving winds and storms of rain and sleet kill and wash them away. Wherever the orache potherb, *Atriplex hortensis*, is cultivated, it also is quite liable to be infested with these elfs. Mr. Curtis states that when this aphis became so immensely multiplied in July, 1847, the under side of the leaves of the beet were literally covered and black with the winged females, sticking in closely packed phalanges, and in that position they died within a few days, without killing any of the plants.

The order CRUCIFERÆ furnishes another common weed in our gardens, namely, the shepherd's purse *Thlaspi* (*Capsella*), *Bursa-pastoris*. Next to the pigweed, I have most frequently met with this insect upon this plant; and it is interesting to observe that it was on

these same plants that this aphis attracted the particular notice of the Bavarian naturalist Schrank, seventy years ago. The stalks of this weed and the under side of its leaves may frequently be seen toward the close of the summer, coated over and black with these lice; ants also, being usually present with them. The turnip too, is sometimes attacked and greatly injured by them. The statement of Mr. Lister, that in 1854, hundreds of acres of turnips, in Yorkshire, England, were almost totally ruined by them, has been given on a previous page.

In the order Rubiaceæ, the bedstraw or cleavers, *Galium Aparine* and other species, is sometimes seen with flocks of these black lice crowded together in places upon the slender stems. Many years ago, upon the sweet, liquorice-flavored leaves of the *Galium Circæzans*, I met with an interesting aphis, an account of which may appropriately be introduced in this connection. It occupied the under side of the leaves, and by its punctures it caused each side of the leaf to turn backward, until it became doubled together, resembling a pod, with the aphides inclosed inside, as if to represent the seeds in those pods. This was in the middle of June. Later in the season, when the leaves became older and more firm and rigid they, perhaps, will cease to double together in this manner. The pupæ were but four-hundreths of an inch in length, of a dirty, yellowish-white color, with the wing-scales, the honey-tubes and the feet black. The winged lice were slightly over one-tenth of an inch in length, and black with the abdomen bright grass-green, the legs pale, with the feet and honey-tubes black. I had ticketed these specimens *Aphis Circæzandis*, a name which the species may appropriately retain, should further researches show it to be undescribed. From my notes taken at the time I met with this insect and from a re-examination of the specimens of it in my cabinet I have drawn up the following description:

Aphis Circæzandis, winged female.—Length 0.12 to the end of the wings; head and thorax black; abdomen grass-green; honey-tubes black, short, equaling but half the distance from them to the tip. Legs pallid; feet black; knees, at least the hind pair, dusky. Wings hyaline; stigma opake, salt-white; veins dark-brown, rib-vein white, third vein abortive at base a very short distance.

Wing veins.—Second vein slightly curved, twice as distant from the first vein at tip as at base, base slightly nearer the first vein than the third, tip about a third farther from the first vein than from the third. Third vein nearly or quite a fourth farther from the second vein at tip than at base, tip slightly more distant from the second vein than from the first fork. First fork at tip thrice as far from the third vein as from the second fork. Second fork very short, its tip much nearer the first fork than

the fourth vein. Fourth vein curved, its tip a third nearer to the second fork than to the tip of the rib vein.

Variety *a*. Second vein equidistant between the first vein and the third at base and also at tip.

Variety *b*. Third vein at tip equidistant between the second vein and the first fork. Second fork at tip equidistant between the first fork and the fourth vein.

Variety *c*. Third vein emitting a branch, half way from the base of the first fork to the tip, the branch curved, approaching the first fork and then receding from it, not attaining the margin.

In the order UMBELLIFERÆ, the *Eryngium campestre* is said by Fonscolomb to be attached by the bean aphis. The parsnip, Mr. Curtis states, was attacked in July 1847, in the same manner as the beet, noticed above; the under side of the leaves were crowded and black with the winged lice. But, as they all perished within a few days, none of the plants were killed by them.

In the order CONVOLVULACEÆ, we are informed by Mr. Curtis that the underside of the leaves of the convolvuli became covered with these lice, at the time of their visitation in 1847.

In the order SOLANACEÆ, on the leaves and young shoots of the potato, this aphis settles itself, in some force at times, Mr. Curtis says; but he has never seen it on this plant in such numbers as to injure the produce.

In the order COMPOSITÆ, the dahlia is liable to have its young shoots invaded and the flower buds blasted by this insect. Among the plants mentioned by Fonscolomb (Annales Soc. Entom. de France, vol. 10, page 163), as being the residence of this aphis are the following members of this order: the burdock, the Canada thistle, the large common thistle, the star thistle *Centaurea Calcitrapa*, the yellow vegetable oyster *Tragopogon pratense*, the chamomile and marigold. He also thinks this is the species which he has observed upon the young shoots of the succory.

In the order GRAMINEÆ, Mr. Walker describes a variety of this aphis which occurs upon the manna grass *Poa* (*Glyceria*) *fluitans*, common in the wet grounds of Europe and this country.

Finally, in the order CELASTRACEÆ, an aphis has infested a thrifty young burning bush or spindle tree, *Euonymus Americanus*, growing in my yard, whereby I have enjoyed a most favorable opportunity for studying it and observing its habits the whole season through. It is clearly the species named *Aphis Euonymi*, by Fabricius, which he obtained upon the *Euonymus Europæus*, a small tree or shrub intimately related to our American spindle trees. And it is also the *Aphis Rumicis*, the insect now under consideration. I speak with

full assurance upon this point. A comparison of this aphis upon the burning bush with that upon the pigweed shows these insects to be identical in every particular, in each of the stages of their development. Although Mr. Walker ranks them as distinct species, it will be seen that the description which he gives of *Aphis Euonymi* (List of Homopt. Ins. in British Museum, p. 987) is the same, almost word for word, with that of *Aphis Rumicis* (ibid., p. 983).

Further researches will no doubt detect this aphis upon several other plants and trees in addition to those named above. The list now given, however, amply suffices to show how numerous are the kinds and how dissimilar are the qualities of the vegetation on which it feeds. It seems almost incredible that the same aphis should nourish itself with equal readiness upon the sharp acid juice of the sorrel, the milky and powerfully narcotic poppy, the intensely bitter chamomile, and the bland, insipid pigweed, thistle, manna grass, and other plants. It renders the suggestion of Mr. Curtis, in a quotation upon a preceding page, altogether improbable, that it in some cases is poisoned by feeding on juices not adapted to its constitution.

It was the middle of May that I first noticed this black aphis upon the burning bush. My attention was attracted to a singular phenomenon which the leaves of this shrub presented. Toward the end of almost every limb one or more of the leaves was curiously doubled backward, forming a four-sided follicle or little bag or box, each having a family of these black plant-lice inclosed therein. This folding of the leaves in this uniform and remarkable manner had been produced by the lice stationing themselves upon the midvein on the under side of the leaf, and inserting their sharp beaks into it and sucking out its juices, causing it to contract in such a manner as to form three folds or plications, extending obliquely across the leaf in the form of an italic capital letter *N*, and dividing the leaf, which is of a regular elliptic form, twice as long as wide, into four equal triangular parts. And being bent backward to a right angle at each of the three folds brought the edges of the leaf evenly together, making a four-sided box, in the form of a three-sided pyramid, with its base constituting the fourth side. These leaves were thus folded together in such an exact, such an artistic manner, as to make them quite a curiosity. If a piece of paper is cut into an elliptic shape and folded together into four equal triangular parts, it will be seen on opening it apart that the edges will come together with much exactness, to form a closed four-sided box, and will thus illustrate the operations of these insects.

Thus each family constructs of one of the leaves a house, a four-sided room, for its residence, in which it dwells wholly hid from view, sheltered from the rains, and secure from molestation by birds or other enemies. Although there were several thousands of these black lice upon the bush, their presence would not be suspected; not one of them being anywhere visible, so effectually had they secreted themselves in their domicils.

Occupying the cavity of each of these folded leaves were a multitude of young lice, a number of pupæ, several wingless females, and usually two or three winged females which had newly acquired their wings. No winged lice except those that were newly hatched were met with. And the pupæ being so plenty, it was evident that it was their habit on acquiring wings to withdraw from the maternal roof and fly away to establish themselves elsewhere. Ants also, usually two in number, were in the cavity of each leaf.

Aware that these lice would probably very soon become so multiplied as to arrest the growth of the bush and make it puny and feeble, as they were so protected that no remedy applied to the leaves would reach them, I picked off the folded leaves, dropped them together on the ground, and trampled to death the vermin they contained, leaving only a few infested leaves from which to learn their further history.

Supposing them checked from increasing to become injurious, it was the first of June when I again went to inspect this bush and its parasites. The rapidity with which the few I had left upon the bush had multiplied, was astonishing. They no longer attempted to hide themselves by closing the leaves around them. The green succulent ends of the limbs, along their under sides, were crowded with these black lice, covering them about half way around, leaving the upper side vacant. The young leaves at the ends of these limbs were corrugated together and contracted into little tufts. The larger leaves growing farther down upon the limbs, had the midveins on their under sides occupied by numbers of the lice; and several of these leaves were either rolled or coiled and distorted; but none of them were now drawn regularly together to form a closed box or bag, as they were a fortnight before. Others of the leaves being older and of a more firm and rigid texture, were not at all wrinkled or distorted by the cluster of lice on their midveins. All the lice were fixed and stationary in one or the other of the two situations now mentioned, the under side of the young green twigs at the ends of the limbs, and the midveins on the under side of the leaves.

The upper surface of the leaves growing below the places where clusters of these insects were located, became speckled with a white substance, which was usually in dots of different sizes; this being the honey dew ejected by the insects and falling and drying upon these lower leaves. And an aphis might sometimes be seen with a small mass of this same white substance adhering to the tip of one of its honey tubes, evidently formed by excreted honey dew which had evaporated upon the end of the tube.

Of the immense number of lice upon this bush at this time, nearly all were found to be pupæ, varying considerable in their size. Only here and there could a small young louse be found, hid or partly hid under these pupæ. Wingless females were rare, and were usually alone on the midvein of a leaf, or with two or three young around them. Scattered among the pupæ were winged lice, all of them newly hatched. It is evident that these winged individuals all leave the bush soon after acquiring their wings.

As it was mostly pupæ that were on the bush at this time, and these were flying away as fast as they obtained wings, it is probable that within a week the bush would have been evacuated of everything except the few small young lice and wingless females. But so thronged and overburdened with these vermin as it then was, it seemed to call for instant relief. I therefore prepared a basin of strong soap suds, and, with a sponge wetted therein, I wiped the lice from the under side of a multitude of the leaves. To cleanse all the infested leaves in this manner was a task too formidable to be attempted. Where I could do so, I bent the twigs and the mass of wrinkled leaves at their ends, downward, and immersed them in the solution of soap in the basin. In other instances I let a streamlet from the sponge fall upon the tips of the twigs and run down along their under sides, so as to wet all the lice that were clustered there.

Upon examining the results of this treatment the next day, I found multitudes of the lice were killed thereby and were hanging to the twigs, suspended by their beaks inserted therein. Others had been dislodged by the streamlets, and were washed together in small masses which had lodged along the limbs. But it was only those that had been wetted that were killed. Many were lurking in the corrugated leaves at the ends of the twigs to which the soap solution did not penetrate. From these and other places where they had remained dry they were now coming, and were beginning to reoccupy the washed twigs. I had hoped that wetting the twigs and leaves with such a strong solution of soap would perhaps so infuse their surfaces with

alkali that the lice would for a while be repelled from again locating themselves thereon; but I now saw it had no such effect.

After the check they had now received they did not again multiply to throng this bush oppressively. They continued to infest it, however, till the close of the season. The green new twigs that put forth at the end of the limbs soon grew to be too hard and woody to be adapted to their wants, and it was only on the under side of the leaves that they were met with during the summer and autumn. And the leaves were then become so firm and rigid that their punctures ceased to wrinkle or have any other perceptible effect upon them.

The center of the under side of the leaf is the point where these lice are usually stationed. Here most commonly but one or two, but sometimes six or even nine or twelve small young lice were located —foundlings, forsaken by their parents—the winged females being accustomed to alight upon a leaf and give birth to one or two young, and then fly away, but in some instances remaining until ten or twelve young are deposited. Sometimes two winged females are found on the same leaf. Much the larger portion of the young lice appear to be the offspring of winged parents. As they have occurred to my observation, wingless females are much less numerous than winged ones in this species. They are met with on the leaves with their progeny huddled closely around them. I suspect, however, that they do not place all their young upon one leaf; after a number have been deposited I think they leave them and wander away to another leaf. I once saw a wingless female travel quite a distance from a leaf on which were four young lice, but I had no assurance that these were her offspring.

In several other species of plant-lice which I have observed, the wingless females are twice as prolific as the winged ones. In each of these species the wingless females uniformly give birth to four young and the winged ones to two, in twenty-four hours. In this bean aphis the wingless appear to be little, if any more, prolific than the winged females. In June I imprisoned a wingless female and also two winged ones, during two nights and one day, at the end of which time I found three young lice with the wingless female, and five with the winged ones. But they will probably be found to be more prolific than they were in this instance.

Mr. Curtis (Farm Insects, p. 356), says: "Where the eggs are laid remains a mystery. It cannot be upon the beans, and as the apterous specimens are the precursors of the winged ones, they are not able to

transport themselves in the first instance." As the wingless females are not able to transport themselves, it is evident that it must be by winged females that the first lice are placed upon the bean and most other plants. And there being an abundant supply of food for them on the bean tops, whereby they have no occasion for migrating elsewhere, the first generations mature into wingless females. But when the bean or other plant becomes overstocked and so crowded that there are no accommodations for any further numbers thereon, it is winged females that are developed, which will be able to fly away and find food and situations for their young elsewhere. I thus infer, from having found them all growing into winged females so early in the season as the first of June, upon the burning bush when it had become fully occupied.

Where the eggs are laid and how this insect is carried through the winter has hitherto been a mystery, as Mr. Curtis observes. Upon this important point I am able to shed some light. When examining a pigweed on which were some clusters of these black lice the latter part of October, I discovered a smooth shining egg, of a dull green color, adhering to a dry and crinkled dead leaf, and another crowded into a crevice of another dead leaf. These eggs had no doubt been quite recently placed in these situations. Later in the season I examined several other infested weeds, but was unable to find any eggs upon them. In November, meeting with a weed that was thronged with pupæ, I transplanted it into a flower pot and brought it in doors, to ascertain whether on maturing and having no other place to lay their eggs, they would stock this plant with them. But on acquiring wings they all flew away without making any deposit thereon. It was therefore evident that the two eggs which I found, were only placed on the dead leaves by accident, and that these insects do not lay their eggs upon the plants which they inhabit, or at least upon those which decay at the end of the year.

It has heretofore been shown in these Reports that the aphides do not perish on being frozen and that, in some instances at least, they survive the rigors of winter and return to life with the return of spring. And on noticing such numbers of these winged lice coming forth on the very verge of winter, and so late in the season that the inclement weather would scarcely admit of their then making a deposit of their eggs, I have been impressed with the belief that a portion of these flies would gain coverts where they would gradually become torpid from the advancing cold of the season and would be protected from injury during the winter, whereby with the return of

spring they would revive and complete the work which they had been prevented from accomplishing in the autumn. I am thus led to think that this insect is carried through the winter both in its perfect state and in its egg state.

Since the preceding paragraphs were written I have been so fortunate as to discover the winter quarters of this insect, whereby the place and manner in which it is carried through this period of the year is no longer a mystery. And the opinion which I have above expressed, that many of the mature insects live through the winter, receives full confirmation.

Upon a mild day in December, on examining with a magnifying glass the bark and twigs of the burning bush which had been infested with this aphis during the preceding summer, I meet with its eggs in abundance. The new buds of this bush are at this time from an eighth to nearly a quarter of an inch long and are growing appressed to the bark. And it is in the crevice along each side of these buds, between them and the bark, that the female aphis places her eggs. Sometimes but one or two, at other times several eggs occur along one or both sides of a bud. They are so minute that, notwithstanding their sparkling black color, the eye is scarcely able to perceive them, except in places where several are clustered together. They lie loosely in the crevice, not fastened by any gummy substance. The buds have perhaps swollen somewhat since they were placed here, whereby they are more firmly held in their places. Their shells, or rather the soft membrane by which they are covered, is very weak and tender, so that to raise one of them out of the crevice with the point of a needle, requires to be done carefully, else it will be ruptured, a dirty watery fluid coming therefrom.

A discovery still more interesting was made in this examination. Here and there crowded under these buds a wingless aphis nearly full grown, was found, lying motionless and torpid with the cold. One of these occurred openly exposed upon the smooth bark. Apparently when it was wandering about in search of a suitable crevice into which to crowd and secrete itself, it had been overtaken by the increasing cold and became so chilled it was unable to move itself any farther, and instinctively fastened the hooks of its feet into the surface of the bark to hold itself securely thereto, as it sank to sleep. In that exposed situation the winter's storms of driving snow and sleet would probably have dislodged it, and it would have fallen to the ground and perished. But most of these aphides would undoubtedly remain secure and safe in their hiding places, through the winter,

and with the warmth of spring will awake and return to life, and by giving birth to young will start the species for another year's operations.

Upon the cutting off of some of the twigs which they occupied and bringing them in doors, the warmth of the room immediately awakened them and they commenced walking about. They are prone to leave the twigs and wander away, and the following morning they had all disappeared. As they each showed the end of an ovipositor protruding from the tip of their bodies like a short tail, I suppose them to be adult females, contracted from their normal size by their exposure to the cold. As they differ from the summer broods in several particulars, a description of this winter variety of the females is herewith presented.

It only remains for us to describe this insect in the different forms in which it occurs to our view. As has already been stated, upon particularly noticing a swarm of these plant lice it will be seen that specimens of four different kinds occur among them, as follows: 1st, young lice, which are distinguished by their smaller size; 2d, wingless females, these being the largest individuals which are destitute of wings; 3d, pupæ, which are readily recognized by their snow-white spots; 4th, winged females, including all the specimens with wings. In addition to these, is the egg state, in which the insect passes the winter, the eggs hatching young lice, which, on growing to maturity, produce living young instead of eggs. And the young lice grow up, some into wingless females, others into pupæ, and these change into the winged females. I have never met with a male. Winged specimens which, from their smaller size or other dissimilarities, I have thought, might perhaps be males, on being observed, have invariably been found to produce young.

The EGGS are of a dull green color when newly laid, but by exposure to the light and air they gradually change till they become jet black. They are so minute that when placed upon white paper the eye merely discerns them to be black atoms that have more length than thickness. With a magnifying glass they are found to be smooth and very glossy and shining, of a regular oval form and rounded at the ends, and twice as long as thick. They measure two hundreths of an inch in length.

The LARVÆ OR YOUNG LICE vary in size and form with their age, at first having the opposite sides of the body parallel and the antennæ and legs short and clumsy. When they are grown to 0.03 or 0.04 in length they have become oval, but rather more full back of the mid-

dle than forward of it, and are bluntly rounded at each end with the tip slightly angular. The antennæ are from a third to half as long as the body, and the legs are of corresponding length. The honey tubes are merely elevated angular points. These young lice are of a dull black color, with the antennæ and legs pale, the tips of the antennæ, the feet, knees and hind thighs usually varying from smoky to black.

A variety has the body of a grayish or lurid green color, but commonly changing to black as it approaches maturity. These green larvæ are more common in the early part of the season. And on some kinds of plants most of the young lice are of this variety.

The PUPA varies remarkably. When the insect first attains this form it is smaller and destitute of some of the most prominent characters which it subsequently presents. It is but 0.07 long, sometimes only 0.06 in length, and is of a dull sooty black color, its legs and antennæ very obscurely varied with pallid, the abdomen without any mealy-white spots, and the thorax not swollen nor abruptly widened. Indeed, it is only recognized as being a pupa at this time by the wing-scales on each side of the base of the abdomen, these being small and of a dull greenish color. The basal half of the thorax begins to become perceptibly swollen and to take on a dull green color, and white spots on each side of the back become more and more distinct, and it gradually thus acquires its complete pupa form and characters.

In its perfect pupa state it is 0.08 long, sometimes slightly over this, and is oval with the opposite sides nearly parallel, the anterior end bluntly rounded and the opposite end tapered to an obtuse attenuated point. It is slightly flattened and convex both on the back and the under side. The *head* is nearly cubical, rather more wide than long, separated from the body by a transverse deeply impressed line, the eyes projecting in form of a rounded protuberance on each side at base and occupying more than half the length. It is sooty black, sometimes dark dull green, often with the vertex slightly dusted over with a white mealy powder, imparting to it a grayish tinge. The antennæ are half as long as the body, more slender toward their tips, black, with a dull pale tinge toward their bases, which is sometimes scarcely perceptible, sometimes very distinct, and sometimes the whole of these organs are pale with only their tips black. The *thorax* is composed of two very distinct and dissimilar parts; the anterior part small, transverse, no wider than the head, sooty black, often dusted like the head with a white mealy powder; the posterior part large, twice as broad as the anterior, abruptly widened, transverse, having a peculiar swollen and blistered appearance, and being of a dull lurid greenish color, the shoulders rounded, an obtuse longitudinal impression on each side of the back dividing this part into three lobes, the lateral ones sometimes paler than the middle; the wing-sheaths appearing as oval scales, one on each side, projecting backward, appressed to each side of the abdomen and reaching about half its length, but being sometimes more sometimes less developed, black, often pale toward their bases. The *abdomen* forming about half of the total length, its tip tapering to an acute and often an acuminate point, color sooty or coal black, sutures marked by transverse impressed

lines, honey-tubes short, reaching but half way to the tip, black; second segment with a downy or pruinose white spot on each side of the middle of the back; three next segments each with a short pruinose white band on each side of the back, the upper ends of these bands in a line with the spots on the second segment, the first and second bands contracted or almost interrupted in the middle; sixth segment often with two small faint white dots between the honey-tubes; seventh and eighth segments each with two conspicuous pruinose white spots placed at the corners of an imaginary square and in line with the upper ends of the white bands. The *legs* are pale, usually dull and obscure, with the feet black, and also the ends of the shanks, the knees and the hind and sometimes the middle thighs.

The WINGLESS FEMALES are sooty black and from 0.08 to 0.10 long and two-thirds as wide, their bodies egg-shaped, or including the head pear-shaped, the head and first segment of the thorax being narrow, their opposite sides parallel, their length and width, when taken together about equal, the head being cut off transversely in front. The antennæ are little more than half the length of the body, yellowish-white, dusky or black toward their tips, and their two short basal joints black. They are slender and tapering, seven-jointed, the two first joints short and thick, third joint longest; sixth shorter than fourth or fifth; seventh slender and double the length of the sixth. Beak black, held under the breast when not in use, its end reaching the middle pair of legs. Abdomen frequentiy showing pruinose whitish dots, more or less distinct, along each side of the back; honey-tubes short, scarcely half as long as the distance from their bases to the tip; tail-like ovipositor protruded frequently to half the length of the honey-tubes. Fore legs pale, yellowish-white; knees, tips of shanks and feet black. Middle legs the same, with the thighs black or smoky. Hind legs black, their shanks pale, except at the tips.

The WINGED FEMALES are black and glossy, and measure 0.08 to the end of the body and 0.16 to the tips of the closed wings. Their antennæ are half the length of the body, more slender toward their tips, black, with the basal part usually more or less pale. They are seven-jointed, the basal joint thickest and short, more broad than long, broadest at base and narrowing thence to its apex; second joint similar in length, but less thick, somewhat globular, and twice the thickness of the following joints; third joint longest of all, and rather thicker than the following; fourth but little shorter than the third; fifth little shorter than the fourth; sixth shortest of all, except the two first, of similar thickness to the two preceding joints; seventh joint long and slender, double the length and half the thickness of the sixth; these joints varying, sometimes in the same specimen. Abdomen plump oval, without spots, along each side an elevated ridge and a row of punctures; honey-tubes short, equaling but half the distance to the tip; ovipositor protruding sometimes half the the length of the honey-tubes. Legs black; shanks pale whitish, their tips black; fore thighs pale, rarely smoky; middle thighs smoky or black. Wings clear, hyaline and glassy; veins slender, black or brown, third vein abortive at its base a slight distance; rib vein pale or white; stigma opake, white, somewhat dusky; second vein rather more than twice as far from the first vein at its tip as it is at its base; third vein much farther from the second at its tip than at its base, farther from the second at base than the second is from the first, its tip a little nearer the first fork than the second vein; first fork at its tip nearer to the second fork than to the third vein; second fork at tip equidistant between the first fork and the fourth vein; fourth vein curved, its tip much nearer to the second fork than to the tip of the rib vein. Lower wings little more than half the length of the upper pair; second vein very little farther from the first at tip than it is at base, its tip equidistant between the first and the tip of the rib vein.

Variety *a*. Second vein at base equidistant between the first and third veins. Common in Europe, very rare in America.

Var. *b*. Third vein at tip equidistant between the first fork and second vein.

Var. *c*. First fork at tip twice as far from the third vein as from the second fork.

Var. *d*. First fork at tip equidistant between the third vein and the second fork. Common in Europe, but not found as yet in America.

Var. *e*. Second fork at tip nearer to the fourth vein than to the first fork

It will be observed that I have described the veins of the wings as they are given by Mr. Walker in a paragraph which he designates as being a variety of this species. But on the different plants and shrubs of this country upon which this aphis has occurred to my observation the venation of the wings has uniformly been after this formula; and I have never seen what Mr. Walker regards as the normal venation, except in the European specimens of this species in my cabinet. The separate items of this formula, however, have been met with in particular specimens, all except the one which I have above designated as Var. *d*.

The wingless female when hibernated to pass the winter season differs in several of its characters from its appearance at other periods of the year, as will be seen from the following description:

Variety, HIBERNATED WINGLESS FEMALE. Length 0.065. Of an elliptic form, broadest across the middle, tapering at tip to an acute point, and bluntly rounded at the forward end; flattened on the back and moderately convex, clothed throughout with scattered hairs. Color dull black, not at all glossy; back of the honey-tubes having a tinge of gray. *Head* more broad than long, nearly hemispheric in its form. Beak more thick than the forward shanks, its end reaching to the middle pair of legs, its color pale yellowish white. Antennæ not half the length of the body, very slender, not half the thickness of the legs, more slender toward their tips, habitually held curved to a semicircle, with their tips applied to the surface; pale, with the outer two-thirds of their length dull black; seven-jointed, the two first joints small, thick and short, the third joint longest, the sixth shorter than those next it, the seventh long and slender, double the length of the sixth; these organs variable in the details of their structure, the two sides frequently differing in the same individual. *Thorax* widening backward, an impressed line across its middle marking the suture whereby the back is divided into two segments. *Abdomen* with faint transverse impressed lines visible in places, imperfectly marking the sutures; each side elevated into a rounded ridge, with a row of punctures commonly visible in the groove along the inner side of this ridge. Honey-tubes short, their length less than half the distance from them to the tip. End of the ovipositor slightly protruded and resembling a short tail little longer than thick. *Legs* pale, glossy, dirty yellowish white varying to dirty olive their whole length; four forward shanks more slender than their thighs; hind shanks thicker and longer than the hind thighs. Feet extremely slender and short, blackish; when highly magnified found to be a third the thickness of the anterior shanks, and appearing to be formed of a single joint which is four times as long as thick, slightly narrowed at its base and at its tip furnished with a pair of hooks.

BLACK-LINED PLANT-BUG, *Phytocoris lineatus*, Fab. (Hemiptera. Capsidæ.)

In June, freckling with rusty yellow spots the leaves of the currant, weigelia and other shrubs, and withering by their punctures the flower-buds of the dahlia, rose and other plants; an oblong bright lemon yellow bug three-tenths of an inch in length and marked with four black stripes.

The latter part of May and in June, two or three contiguous leaves of the currant, the weigelia and several other shrubs and plants may frequently be noticed with several small blackish spots, looking very much as though they had been spattered with drops of pale ink which has become dried upon them. It is usually some of the more tender young leaves at or near the ends of the stalks which are thus freckled. The spots which appear earliest in the season are small, mere dots of an irregular roundish form. Those which are made at a later date are longer, nearly or quite one-tenth of an inch across. When the leaf is held up between the eye and the light these spots are found to be semi-transparent, and a close inspection shows that they are caused by the opake green pulp or parenchyma of the leaf having been removed, only a slight stain of green remaining on the transparent skin of the upper side of the leaf.

When they are two or three days old these spots become changed to a yellow or brownish yellow color, the leaves then appearing as though they were struck with rust (parasitic fungi of the genus *Uredo* or *Æcidium*) or some similar disease. They are now much more conspicuous and more apt to be noticed than when they first appear. And those parts of the leaf where they are most dense, after some days become dead, dry and brittle; and in the end, by the winds rustling the leaves together and violence from other causes, these dead portions become broken away, making ragged holes in the leaves or notches in their sides.

Newly made blackish spots continue to appear, day after day, interspersed among the yellow ones where they are not dense, or upon the contiguous leaves one after another, until frequently several leaves become thus freckled. On searching for the cause of this mischief, upon the under side of a leaf on which the blackish spots occur, there will usually be found a small glossy bug of a tawny yellow and black color, in the fore part of June, or later in the season a larger pale yellow bug striped with black. It quietly resides upon the under side of the leaf where it is hid from view, nourishing itself by inserting the point of its sharp needle-like beak into the leaf and sucking the soft juicy pulp from each cell which it punctures, thus producing

the spots, which appear alike upon the upper and under surfaces of the leaf. It would be thought there were one or more insects upon each leaf, to make such a multitude of these discolored spots, but ordinarily, though three, four or more leaves in a place are affected, only one insect is found, rendering it evident that he has passed from one leaf to another and that all the mischief has been done by him alone. Each leaf is punctured some hundreds of times, the spots being in places so close together that they run into each other, though over most of the surface they are slightly separated.

Some years these bugs become much more numerous than usual, and then, instead of being scattered about singly, they become gregarious, gathering together in flocks upon particular plants or masses of vegetation, injuring by their punctures nearly all the leaves and quite destroying many of them.

But its attacks are not limited to the leaves. It is prone to also fall upon the flower buds of some of our choicest flowering plants. To these it is most pernicious, causing the buds to wither and die. It is in this way that this bug does the greatest damage. Its punctures are so fatal to the flower buds and they perish so speedily that many persons suppose the buds to be poisoned by its stings.

The dahlia (*Dahlia variabilis* and *coccinea* in all their varieties) appears to be the plant to which this bug is most strongly attached, and to which it does the greatest injury. Upon the dahlias in my own grounds some of them have frequently occurred; but whenever one has been noticed it has been picked off and destroyed if it did not elude capture; and as they have never been numerous with me I am unable to speak from personal observation of the manner in which this plant is injured by them. In the year 1858, I learned from A. F. Chatfield, the florist in Albany, that upon all his dahlia plants that year, when the first flower bud put out these bugs assembled upon it, puncturing and poisoning it so that it withered. Two or three new flower stalks would then shoot forth from the base of this one, the buds on which would be attacked and destroyed in the same manner. Others would then put out from the bases of these, to share the same fate. Thus it went on, the whole season through. An enormously broad mass of leaves and stalks, fully three feet in diameter, thus grew from each of the dahlia roots in his garden, without a single flower from all the multitude of flower buds which had thus been developed. D. F. Heffron, of Utica, informed me that in the summer of 1864, these prettily striped yellow bugs so infested his dahlias that only three or four little imperfect flowers were produced. And

in all the gardens in and around Utica that year, the flower buds were so universally killed by this insect that no dahlias were there to be had. Other instances, of similar purport, might be cited; these, however, amply suffice to show how extremely pernicious this bug is liable to be, to this favorite flowering plant.

Upon the rose I have met with this insect, puncturing the flower buds and causing them to perish. Other plants which put forth their flowers in June and July it will no doubt be found to attack in the same manner.

On passing along a row of currant bushes, in the month of June, two or three contiguous leaves will here and there be noticed, freckled with yellow spots, and having one of these bugs secreted upon their under side. But I have never known them to invade the currant in sufficient force to occasion any appreciable injury.

To the weigelia it appears to be much more attached and more pernicious, sometimes ruining the foliage of this beautiful flowering shrub. This present season (1870), a weigelia growing in the Evergreen Cemetery, Salem, N. Y., so early as the second week in June, was so thronged with these bugs that scarcely a leaf remained which was not freckled with rusty yellow spots, and many of them were wholly destroyed. At the end of the month nearly all of these insects had been obliged to leave this shrub, its foliage being dry and dead to such an extent that they were no longer able to nourish themselves thereon. A few yards distant was another of these shrubs which remained green and thrifty, with very few of its leaves discolored with spots from the punctures of this bug. Why did one of these shrubs remain unharmed when the other was so badly injured? The only cause to which I could impute this difference, was, that the former was growing in the shade of other bushes and trees, whilst the latter was openly exposed to the sun. And it would hence appear that vegetation which is growing in the sunshine is much more liable to be injured by this bug than in shaded situations.

On the bittersweet or henbane, *Solanum Dulcamara*, I have also known it to occur in such numbers as to destroy a portion of the leaves. On this shrub the spots are of a grey color, which its punctures produce on the leaves. I once found it quite numerous upon a patch of tansy. In one or more instances I have also met with it, freckling with its punctures the leaves of the plantain, soapwort, snapdragon, sumach and burning bush.

Upon the green succulent ends of thrifty stalks of the raspberry I have sometimes noticed blackish spots, identical in their appearance

with those made upon leaves by this bug. These spots, in some instances, have extended along the stalk the length of a foot or more. No insect has been present when I have discovered these spots, but I have supposed they were caused by the punctures of this bug.

Though I have not met with it in its winter quarters, it is evidently in its perfect state, that it passes this period of the year, secreted probably among fallen leaves, or under pieces of boards lying on the ground, in crevices, and other situations where it will remain dry. Coming forth upon the opening of spring, it no doubt lays its eggs upon the young stalks of the dahlia and other vegetation on which the immature bugs afterward appear. These, during the larva state, are so small and their punctures are so slight that they are not noticed. It is not till they have grown into their pupa state the latter part of May, that their wounds begin to freckle the leaves so plainly with spots that they attract observation. The bug is then about three-twentieths of an inch in length and of a flattened oval form and a shining tawny yellow color, the hue of beeswax, varied in places with black, white and lemon yellow. Its size, colors and several other characters are so dissimilar to those of the adult insect that we give a full description of it.

The PUPA is 0.15 long and half as wide, flattened and of a regular oval form, its sides evenly arched, its surface smooth and shining, of a bright tawny yellow color. The *head* is rather small, broader than the anterior end of the thorax, transverse, oval. Viewed in front it is triangular, its lower angle with an elevated polished coal black nose, ending in a tapering four-jointed trunk which is held backward under the breast, reaching nearly to the base of the middle pair of legs, and is of a pale watery color with its tip black. The eyes occupy each side of the head and are smallish, protuberant, egg-shaped, black-brown. The antennæ are two-thirds the length of the body, clothed with fine short inclined hairs, tapering, four-jointed, black; the basal joint pale, shortest and thickest; second joint longest, nearly thrice the length of the first; fourth joint scarcely half the length of third. The *thorax* is thrice as broad as long and strongly narrowed from its base to its apex, its hind angles rounded, each side raised into a thin outer edge; its color tawny yellow faintly bordered with white on the anterior edge and with a faint white stripe in the middle, its basal third white with a large black spot on each side of the middle and a small oblong spot on the outer angle, this latter being sometimes diminished to a short black line. The *abdomen* is tawny yellow with a faint lemon yellow line along the middle and two rows of faint yellow dots on each side and two large black dots at the tip. On the under side it is tawny yellow with a black spot at the tip which is notched or forked at its anterior end. In the males the abdomen is orange red, and on each segment is a broad black band occupying the anterior half of its length and ending at the outer row of pale yellow dots. The *wing-sheaths* reach half the length of the abdomen and are black and polished, with a broad lemon yellow stripe between them, and a white stripe on the middle of each, which does not reach the tip. The *legs* are obscure watery whitish, with two dusky bands near the tips of the thighs, the hind thighs having also a black stripe on their front side at the base.

One after another of these bugs changes from its pupa to its perfect state upon different days in the fore part of June. Among a large number found on the eleventh day of this month, only one was remaining in its pupa state. With this change they are abruptly increased to double their previous size, now measuring a quarter of an inch in length to the end of the body and three-tenths of an inch to the tips of the wing covers. Their colors are also more bright and different from those of the pupæ. It is a pretty insect, being, when newly captured, of a bright grass green or apple green color, with the head and neck orange and four stripes on the thorax and wing covers jet black. In drying, specimens lose their green color and become bright lemon yellow. The females are much more numerous than the males, and their colors incline to be paler and their stripes and other black markings smaller.

This bug is of an oval form much more than twice as long as wide, flattened, moderately convex both on the back and the under side, with the surface on the upper side smooth and shining and destitute of any hairiness.

The *head* is small, more broad than the anterior end of the thorax, but scarcely half as wide as its broadest part, four times as broad as long. Viewed in front it is triangular. In the male it is orange red, in the female orange yellow. The nose is represented by an elevated oblong black spot, to the lower end of which the beak or trunk is joined. This reaches slightly beyond the base of the first pair of legs. It is tapering, four-jointed, orange yellow, the first joint black in front, the second joint black on the sides, and the last half of the fourth joint black. The eyes occupy the outer corners of the head, and are smallish, protuberant, oval, and blackish brown. The antennæ almost equal the body in length. They are slender, tapering, bearded with fine, short, inclined hairs, black, with their basal part pale yellow. They are four-jointed, the first joint thickest and slightly longer than the width of the head, thicker toward its tip, its surface glossy and uneven; second joint more slender than the first and double its length, scarcely thicker in and beyond its middle than toward its base; third and fourth joints quite slender and thread-like, the third rather longer than the first, the fourth but half the length of the third.

The *thoraæ* is more broad than long, its sides straight and strongly converging, its base twice as broad as its apex, the basal edge straight in the middle and curving forward on each side with the outer corners bluntly rounded; the apex margined by a roundly elevated line of a lemon yellow color, the surface convex and inclining obliquely downward and forward. Across its anterior third it is roundly elevated, smooth and polished, and of the same color as the head, this elevation having on its anterior face near the middle two shallow punctures, and commonly a similar puncture on each shoulder; and in the middle of its hind edge is a slight depression in which two shallow punctures close together may usually be seen. The remainder of the surface is minutely punctured and lemon yellow, with four black stripes, which are larger in the males, the middle ones often as broad as long, more broad than the space between them, widening backward and almost twice as broad at their hind as at their fore ends, with their hind ends slenderly separated from the hind edge; the outer stripes slender and more than four times as long as broad, separated from the outer edge by a slender yellow line, and the space between them and the inner stripes

nearly as wide as that between the latter. The scutel is large, triangular, lemon yellow, sometimes orange in the males, its outer angles black, this color thus connecting the middle stripes of the thorax with those of the wing covers.

The *wing covers* at their base equal the thorax in width, and become slightly wider across their middle. They are of a leathery texture with the hind ends thin and membranous. The leathery portion is bright lemon yellow, minutely and irregularly punctured, ending in a triangular piece which is separated by a transverse suture. On each wing cover are two black stripes, continuous with those upon the thorax. Outer stripe commencing as a slender point on the anterior end of the outer margin, gradually widening and receding nearly half its width from the margin as it extends backward, its rounded hind end commonly touching the transverse suture, and beyond this is a large black dot, upon the triangular piece slightly forward of its center. The inner stripe is usually broader than it is on the thorax, as is also the space between it and the outer stripe, whilst between it and its fellow the space is narrower here than on the thorax and scutel. The membranous ends of the wing covers are black and united with the hind ends of the middle stripes, and the outer end of their curved vein is pale yellowish in the females. The wings are smoky black and translucent, with opake black veins.

The *under side* is orange yellow, in the male red, and without spots or marks in some specimens whilst others have a black dot on each side of the breast, a black spot on the end of the body, and sometimes forward of this spot is a short band on each segment.

The *legs* are long and slender, the hind pair much longer than the others and their thighs thicker. They are dull yellowish white, translucent and glossy. The thighs are long, cylindrical and bearded with fine short hairs and along their under sides a few longer ones. Toward their tips are two black bands which are sometimes united more or less, the upper band commonly broader, and on the four forward legs both bands extending but half way around. The trochanters or small smooth lobes on the base of the thighs are frequently black, and the fore thighs sometimes have an oblong black spot or cloud immediately below the trochanters. Hind thighs usually with a black line on their outer side, extending their whole length above the bands. The shanks are a third longer and much more slender than the thighs, cylindrical, bearded with small black spines, their tips black and a short black line on their outer side below the knee. The feet are more slender than the shanks and are three-jointed, the two first joints little longer than thick, the last joint nearly as long as both the preceding, and black except at its base, with a pair of brown claws at its tip.

Varieties, *a*. The outer black stripe on the thorax wanting.

b. The black dot at the end of the outer stripe on the wing covers wanting.

c. The black bands above the knees wholly wanting, or replaced by one or two dots on the outer and inner sides of the hind pair.

These bugs are extremely shy and constantly on the alert to escape notice. When approached they quickly and adroitly slip around the edge of the leaf to its opposite side, where they will be hid from view. Thus on coming to a mass of shrubbery on which there are hundreds of them, their presence will not be suspected, not one of them being anywhere visible. But upon bending a stalk aside so as to bring the other surface of its leaves into view, here and there one of them will be seen, standing quietly on its

leaf with a look of perfect innocence and as if unconscious of any guile or deceit; yet watching its opportunity to do so unobserved, it again expertly dodges around to the back side of the leaf. If the hand approaches to seize it, it quickly drops itself down among the foliage beneath. Or if one hand is held under the leaf, whereby it in dropping falls into it and the fingers are closed upon it, ere one is aware, it slips out at some opening between them and falls among the leaves or into the grass. It does not incline to take wing except as a dernier resort. By its long, stout hind legs it is adapted for skipping; and its mode of progression is quite singular. It walks briskly a few steps and then gives a skip, throwing itself two or three inches, and it then pauses and looks around, apparently to see if anything has noticed and is following it. It then walks a few steps further and gives another skip and again stops and looks back; being evidently aware that when it is moving it is much more liable to be seen by some enemy then when it is standing still.

These bugs which we meet with grown to maturity and paired in the middle of June, lay a crop of eggs from which another generation completes its growth before the end of the season. Thus there are two generations annually.

This insect having only a single strongly curved vein in the membranous ends of its wing covers, and the two last joints of its long four-jointed antennæ very slender, will pertain to the family Capsidæ in the order Hemiptera. And as the second joint of its antennæ is cylindrical and not thickened toward its tip, and the fourth joint is notably shorter than the third it will belong to the genus *Phytocoris*.

It is undoubtedly the species which Mr. Say describes under the name *Capsus 4-vittatus* at page 20 of his pamphlet on the Heteropterous Hemiptera, published at New Harmony, Ia., 1832, and republished in Trans. N. Y. State Ag. Soc. for 1857, p. 784. We notice his description is taken from a female specimen, and is erroneous in saying that the black dot at the end of the exterior stripe is annulated or inclosed in a ring of a different color. He also says the lateral stripes on the thorax are marginal. But the thorax shows a yellow edge along the outer side of these stripes; they, therefore, in strictness, are not marginal but sub-marginal.

Mr. Say closes his observations on this species with the query, Can this be Lygæus lineatus, F. Syst. Rhyng., p. 234? This is an important point to be determined. Fabricius, in the work cited, defines the *lineatus* to be ferruginous, or in other words, rusty yellow

or tawny, the thorax and wing covers yellow, lined with black, and inhabiting North America. This coincides so closely with our insect that we know not why Mr. Say doubted its being this species, unless it be that the black marks are too broad to be termed lines. But was not Mr. Say aware that Fabricius is by no means exact in limiting this term to slender marks? And in this insect the outer mark through most of its length is frequently so slender as to be a line rather than a vitta or stripe. For a more particular description of the *lineatus* Fabricius refers to a previous work of his, the supplementary volume of his Entomologia Systematica, p. 541, where he first named this species. We there meet with a description quite as full and exact as that given by Mr. Say, and to the same purport in almost every respect. We notice two or three phrases, however, which might render it doubtful whether our insect is the species referred to. We are told the *lineatus* is the exact size of the *campestris*. Specimens of the latter in my collection, received from Prof. Boheman of Sweden, are smaller than our insect. But Zetterstedt, Ins. Lapp., p. 273, and others, have remarked, what is also very obvious from the characters assigned to the *campestris* by Fabricius, that his insect can scarcely be the same with that to which Linnæus gave this name. It is therefore uncertain what species it is to which Fabricius refers. Again, we are told the scutel is black at its base. This is not strictly correct; it is black only on each side of its base and not in the middle. Such slight inaccuracies as this, however, are not uncommon in the old authors. In this case, moreover, the base of the scutel may have been obscured by the manner in which the specimen was pinned.

We come, finally, to notice a much more important discrepancy. This occurs in the opening of the description, the first clause of which, translated, reads: "Head black, antennæ ferruginous." To coincide with our insect this should be, "head ferruginous, antennæ black." As the remainder of the description so accurately applies to our insect, the query at once suggests itself, is there not here a clerical error? In copying this first clause have not the terms been inadvertently transposed? We of course are obliged to take the description as it stands, unless we have satisfactory evidence that it is erroneous. But how is it possible for us to know if there is such an error as we have suggested? Obviously a reference to the specimen from which Fabricius drew this description would conclusively settle this point. We are informed he met with this and some half dozen other North American insects

which were new to him, in the collection of Mr. Herschel.* We know not whether those specimens are still preserved, whereby it will be possible to conclusively determine the point in question. Is there any other mode in which it is possible for us to obtain light upon this subject? We observe that in the phrase "head ferruginous antennæ black," the terms head and black impress the mind more strongly than the terms antennæ and ferruginous, and thus there is a tendency to bring them together. We also observe that this great master of our science, Fabricius, was by no means so careful and exact that we can confide in the descriptions he has left us as being always accurate and free from errors. Of this inadverteney we are at present forcibly reminded, from a fruitless endeavor to ascertain the correct orthography of the person's name in whose collection he met with this insect. Upon glancing through the Ent. Syst. suppl. and the Syst. Eleut. we meet with this name in sixteen instances, and find it given as Hirshel, Hirshell, Hirsehel, Herschel and Hersehell, it occurring five times under the first and five times under the fourth form. And now, when we come to attentively consider the characters which are assigned to *lineatus*, we shall discover them to be so contradictory as to render it evident there is an error in the description. As already stated, the species is first briefly defined as ferruginous, with the thorax and wing covers yellow lined with black. We are next informed that the head is black. Thus we are told that the head is black, the thorax and wing covers yellow, and yet the predominant color is ferruginous. The latter statement is obviously inconsistent with the former. We find further, that the only parts mentioned as being ferruginous are the antennæ, the anterior part of the thorax and the body on its under side. If we paint a specimen of our insect with the head black and the antennæ rusty yellow, whereby it fully meets the details of this description, the ferruginous anterior border of the thorax becomes so inconspicuous that it is only noticed upon a

*We notice that one of these is named *Cicindela obscura*. This species of Fabricius appears to have been overlooked by recent writers. From the short definition of it in the Syst. Eleut. 1, 238, Mr. Say supposed it to be the species which is now currently known as the *C. modesta* of Beauvois. But the original description, Ent. Syst. suppl. p. 61, informs us that the *obscura* corresponds in size with *C. Germanica*. Specimens of the latter insect now before me are much smaller than the *modesta*. We are also told that of the two white marginal points, the anterior one is on the base of the wing covers, whereas in *modesta* it is on the outer margin near the base. Thus the species which Mr. Say describes as the *obscura* is clearly a different insect from that to which Fabricius gave this name. What is stated of the latter as to size, color, position of the white points and the lunule at the tip, coincides with none of our Cicindelas except some varieties of the *punctulata* of Olivier. This species is described by Fabricius in this same connection, under the name *micans*, of which he remarks, it is exactly the size of *obscura*, of which it is perhaps a mere variety. It thus becomes quite evident that the *obscura* of Fabricius is nothing but one of the black varieties of *punctulata* in which the white points on the wing covers are mostly effaced.

close inspection, and I think no one in describing such a specimen would give its ground color as ferruginous; it would be termed yellow or black. The thorax and wing covers being yellow it is evident the head with the under side must be ferruginous to render this the predominant color.

Finally, when we further take into consideration the facts that this is a common species throughout the United States, and that it is a pretty insect, which an amateur collector would take special pains to secure, it is altogether improbable it would be overlooked and another insect be found almost identical with it but so extremely rare that it has never been met with in our day.

In view of all the circumstances, therefore, we think it cannot be doubted that this is the insect which Fabricius had in his view.

We have been induced to state thus fully the grounds on which we are led to adopt the Fabrician name for this insect, deeming they will settle a subject which would otherwise remain in doubt. From this discussion the general reader will perceive how embarrassing it is and what an amount of research is often required, to determine the legitimate scientific names in natural history.

As respects remedies for this bug, the probable efficacy of shading infested plants and shrubs from the sun has already been mentioned. Hand-picking is the only other measure which we have to notice. Most of these bugs will elude capture by dropping from the leaves and secreting themselves among the vegetation on the surface of the ground. But, so timorous and shy as they are, if they are daily searched for and routed from their quarters, it is probable they will soon forsake the situations in which they find they are so frequently disturbed.

LILAC MEASURE-WORM, *Priocycla Armataria*, H. Schœffer. (Lepidoptera. Geometridæ.)

In September, eating the leaves of the lilac by night, and by day hanging from the twigs with their heads downward; a slender humpy ten-footed dark brown worm over an inch long, with three bright yellow spots on each side of the hind part of the body; passing the winter in a cocoon under fallen leaves and rubbish, from which the last of June comes a pale rusty brown moth, with scalloped wings, an inch and a quarter across when extended, both pairs having a dark tawny yellow band across their middle, and their underside bright orange, crossed by a blackish brown line.

An interesting insect of our State, a delicate miller or moth, pertaining to the Ennomos group, in the family Geometridæ, which had escaped observation until our own day, is found on examination to be so different from all the species akin to it, that it constitutes the type

of a distinct genus, of which genus itself is as yet the only known member. Occupying a position of such prominence, it becomes important to know the measure-worm from which this moth is produced, wherefrom to ascertain the characteristics of the caterpillar or larva state of this genus. I find this measure-worm to be of a peculiar type, differing prominently in its structure and other characters from all the larvæ which are known in the genera related to it. It thus, equally with the perfect insect, justifies the separation of this species as a distinct genus. The singular habits of this worm, moreover, will render an account of it interesting alike to the general reader and the student in science.

We meet with this measure-worm feeding upon the leaves of the lilac. But as it is a native insect of our continent and the lilac was introduced here from abroad, it will undoubtedly occur upon the ash or some other one or more of our indiginous trees or shrubs which are nearly related to the lilac.

In the first period of their lives the small young worms are of a slender cylindrical form, and of a dark liver brown color, with shining black heads, which are of the same thickness as the body. The mouth is white, and on the body are four white bands, which with a magnifying glass are found to be composed of short white lines placed upon the sutures side by side and lengthwise of the body. They have three pairs of legs placed upon the breast, a pair of thick prolegs at the end of the body and a second pair a little forward of these last; and on each side of the back the three or four middle segments each show a small tooth-like protuberance projecting horizontally outward.

The young worms eat small holes through the leaves, mostly along each side of the mid-vein. And when not engaged in feeding they all station themselves upon the underside of two or three contiguous leaves, where, clinging with their hind feet, the hang downward in a grotesque posture, having the middle of their bodies bent into a half circle with the two ends remaining straight. They continue for hours stiff and motionless in this position, hanging downward perpendicularly, with here and there one it may be, holding itself in an oblique direction. They do not feed upon rainy days, and then remain in this posture, fastened to the under surface of the leaves the whole day through.

When they are grown to a larger size and have shed their skins they are considerably changed in their appearance. They are then of a sooty brown color with three very bright yellow spots on each

side of the hind part of the body, these spots being such a peculiar mark and showing so conspicuously upon the dark ground color of the body that the eye notices them much more than any other character pertaining to these worms. Some spots and lines of a whitish color are seen here and there, and the surface is also observed to be uneven, from little conical humps which project out at different points, four of these in a row on each side of the back being the most conspicuous. It will also be noticed that they vary in color, some being less dark than others. Even the same specimen frequently varies in a short time in its hue and in the distinctness of its whitish markings.

A more full description of these worms here follows:

The LARVA grows to nearly an inch and a quarter in length, and is slender and nearly cylindrical, with short bristles scattered over its surface. It varies in color from umber brown to dark sooty brown, with ash gray and cream yellow markings. In the middle of its body on each side of the back are four obtuse, conical humps, placed on the fourth and three following rings, the two middle ones being larger. These dorsal humps project horizontally outward, rendering the back flattish and imparting to it a serrated appearance along each side. Beneath upon each side are humps which are more obtuse, resembling retracted prolegs, each of these ventral humps frequently having a sooty black cloud upon its anterior side. Upon the last segment are two conical tubercles, their tips often black and yielding a short bristle. Upon the outer base of these tubercles is a small oval spot or short streak of a cream yellow color; and posteriorly along each side of the back is a row of small, cream yellow dots, one on each segment, the last dot being quite near the hind end of the small oval spot. On the back of the fourth and following rings are similar dots placed near each other, upon the anterior bases of the dorsal humps. And along the middle of the back is a row of ash gray marks having the form of an inverted letter V, their hind ends terminating at the cream-colored dots; the two anterior of these marks, occupying the top of the fifth and sixth rings, being more expanded, irregular and cloud-like. Each of the four prolegs has an ash gray or pale reddish stripe upon its outer face. The stripe upon the anterior pair of prolegs is prolonged obliquely upward and forward, into an irregular triangular spot of a bright cream yellow color. And upon the two segments next forward of this are similar spots, but successively smaller, the anterior one being usually a mere cluster of small spots and dots irregularly connected together. Beneath, along the middle is an ash gray line, faintly margined on each side with darker sooty brown, this line not being prolonged upon the breast nor reaching the tip. On each side of the neck immediately below the breathing pores is a slender, irregular whitish line. The head has the same color with the body and is frequently mottled more or less with ash gray.

After the young worms have changed their skins and taken on the markings above described, they become much altered in their habits. They now eat the whole of the leaf instead of nibbling small holes through it. And one of the first things we observe respecting its feeding, is, that whilst it is a common habit of the leaf-eating caterpillars and other larvæ to take only the more tender parts of the

leaf and pass by the coarse woody midvein and the coarser veins which branch from it, although the leaves of the lilac are so firm and leathery in their texture, this measure-worm consumes the entire leaf, including the midvein and its branches, leaving only a stump of the green leaf-stem.

We notice it as another singular habit of this worm, that, whilst most other worms endeavor to hide themselves from view, and do their work as much as possible where their operations are concealed and least liable to attract observation, this worm selects the most exposed situation it can find and places itself where it will be conspicuously in view. The whole company of these worms move away from their first location and take up their residence together, upon one of the most projecting branches of the lilac bush. Here, feeding in the night time and remaining at rest during the day, they begin at the outer end of the limb and wholly strip it of its leaves, advancing farther and farther along from night to night. But instead of remaining to repose during the day where they have last been feeding, and where the foliage would aid in secreting them from view, they crawl back to that part of the branch which has been entirely denuded of its leaves, and where they will be most openly exposed, and there suspend themselves, clinging with their hind feet to the stumpy leaf-stalks and the small twigs, and hanging perpendicularly with their heads downward. And they now present a very singular and interesting instance of that imitation of other objects which is so common among the creatures of this class.

This faculty of mimicking other things, with which so many insects are endowed, is certainly one of the most curious and wonderful phenomena in nature; this habit which they have, some in their larva, others in their perfect state, to place themselves in such situations and form themselves into such shapes as to appear like some other object in nature, to which they in reality have no relationship, no affinity whatever, and an object, frequently, which no one of their race has ever seen and cannot therefore be supposed to know that any such object has ever existed. The design of this counterfeiting of other objects undoubtedly is to protect them from being noticed and destroyed by their greatest enemies, the birds. This is evident from the fact that the object which is imitated is always something to which birds will have a repugnance or to which they will be wholly indifferent. Among the multitude of things which are mimicked we never meet with a berry, a seed-pod or any other object which will be attractive to a bird. And it is truly one of the most beautiful arrange

ments of nature, whereby creatures which have no means of defense, usually no power to spring or fly or other resort whereby to escape from their enemies, are able to take on such an appearance as will cause them to be overlooked and passed by unharmed. But for this they would soon be exterminated.

It is most frequently some of the common parts or appendages of shrubs and trees which are imitated. Different kinds of small insects are accustomed to station themselves in the axils at the base of the leaf-stalks, where they appear like the buds growing at these points. The larvæ of the different lappet-moths so closely resemble the bark of the trees on which they respectively feed, as to be quite invisible when they are at rest. Many of the measure-worms have a habit which most persons have noticed. Fixing themselves to a limb by their hind pair of feet, they hold their bodies outward therefrom, straight and stiff, remaining motionless in this position for many hours, their slender cylindrical form and dull colors giving them a most perfect resemblance to a dead twig branching from the limb. Without adverting to other instances of this mimicry we return to this lilac measure-worm, and remark that in its young state, when suspended from the under side of a leaf with the middle of its body bent into a semi-circle, it is *sui generis* in its appearance, looking like no other object in nature with which I am acquainted, and the cluster not in the least resembling an assemblage of worms. But when it is grown to a larger size and the whole family is hanging suspended from the twigs of a leafless limb, they present a counterfeit which is so perfect and striking that it is at once recognized. They then have the exact aspect of the brown aments or unopened staminate flowers of the alder, the poplar and other analogous trees which put forth their flowers in early spring when the limbs are destitute of leaves. Whoever is familiar with the appearance of these pendant tassels as they occur upon the alders growing along our streams of water will at a first glance be struck with the close resemblance of these lilac worms to them. The similitude will be noticed in all their details; their size, their form, their position, their brown color, the projecting teeth along the sides of their backs appearing as the ends of the opening scales of the aments, and to crown all, the three bright yellow spots upon each side of the worms are a perfect counterfeit of some of the yellow anthers of the flowers beginning to protrude from between the scales. And we further observe that a portion of the aments of the alder grow in pairs, and in a company of these worms hanging from the twigs and leaf-stalks, here and there two will be

seen suspended from the end of the same stalk or from the opposite sides of a twig. In thus imitating these tassels of the immature flowers of the alder so perfectly in such a number of particulars, what a remarkable display of instinct does this worm present!

If the bush in which they are suspended be jarred or they are otherwise alarmed they draw themselves upward, bending their bodies into angular shapes.

The worms continue to feed six or eight weeks, coming to their full size about the middle of September. They then descend from the bush and crawl under fallen leaves or other rubbish, and there spin around themselves a network of threads with open meshes, to the outer surface of which, small pebbles, loose lumps of dirt and fragments of leaves are fastened; and in this slight cocoon it takes on its pupa form.

The pupa is closely invested by the cocoon, which is oval, half an inch long and 0.20 thick. The pupa is chestnut red, its rings densely and confluently punctured, all the posterior ones having a broad smooth hind border. The wing-sheaths are minutely wrinkled and rugose from short, irregular, strongly impressed lines, those around the border being more even, parallel and at right angles to the edge. The tip terminates in two slender black thorn-like spines, which are hooked at their ends.

The insect lies dormant, inclosed in its cocoon during nine months of the year. It begins to come abroad in its perfect form upon the last days of June, new individuals continuing to hatch and come forth until the middle of July. Upon the same night on which they issue from their cocoons the sexes pair, and the female deposits her eggs upon the following day. They are probably laid in a cluster, glued upon the under side of a leaf of the lilac. Seventy-five eggs were counted that had been deposited by one female.

The eggs are smooth and glossy, of a short, cylindrical form, with rounded ends. They are 0.025 long and two-thirds as thick. They vary remarkably in their color, being at first pale bluish or yellowish green and changing in a day or two to pale reddish. This color gradually deepens to coral red, bright and shining. They then grow darker, and just before hatching are deep liver brown. They hatch two weeks after they are laid. The evacuated shells are white and translucent.

The MOTH or miller varies in width across its extended wings from 1.25 to 1.35, the larger specimens being females. The *head* is more than twice as broad as long, the large, protuberant eyes occupying each side and constituting more than half its total width. It is covered with rusty, yellowish scales. The palpi or feelers project out

from the flattened front and are held apart. They are straight and strongly compressed, with loose scales at the base, those of the second joint being smoothly appressed to its surface; third joint distinct but small, little longer than thick, cylindric-conic, its apex bluntly rounded. The spiral trunk is more than half the length of the antennæ. The antennæ are more than half the length of the body, and of a wood brown color. In the males they are pectinated, having two rows of longish branches which are directed downward and are curved, their tips approaching each other and ending in a fine short bristle. These branches are minutely ciliated and gradually diminish in length, the ten last joints being merely toothed like a saw, each tooth tipped with a fine bristle. In the female these organs are simple, thread-like, more slender toward their tips, with two rows of fine bristles along the under side. The *thorax* is broad oval, but little longer than thick, and is clothed with scales, and along each side with hairs of a rusty yellowish color. The *abdomen* is cylindric, reaching the inner angle of the wings in the dried specimen, longer when alive. It is pale brown, often with a dark brown band on the hind edge of each segment. It is narrowed at its tip and ends in a circular fringe of brown hairs inside of which, in the males, are two valves which are clothed with white scales. The *wings* are somewhat broad, measuring in a male 0.58 by 0.32 and the hind pair 0.50 by 0.34; they are scalloped on their hind edge with six rounded sinuses in each, those of the hind pair being more deep. They have a silky gloss and are grayish yellow or fawn colored, commonly freckled more or less with short transverse brown lines. The fore wings have the outer or costal edge straight with the ends gently curved, and the hind edge somewhat oblique and forming an obtusely rounded angle near the middle, the outer third of its length being straight or sometimes slightly concave. The costal margin is gray, tinged with green when alive, this color being much wider from the middle nearly to the tip, and much freckled with short transverse blackish lines. Forward of the middle a straight nut brown band crosses the wing obliquely, the outer end of which is faint and bent forward. Crossing the wing beyond its middle are two blackish lines, nearly parallel with the brown band and with each other, about four times their width apart, the hind one often a little bent outside of its middle, making the intervening space wider at this point, and then approaching the forward line and uniting with it on the costa. The space between these lines dark rusty yellow, appearing to the eye a broad dark colored band crossing the wing and continuous with a similar band on the hind wings. A cloud of sky blue scales bordering this band on the hind side of its inner end. A black spot on the inner angle, and a dark rusty yellow spot on the hind edge slightly inside of the tip. The hind wings have a broad rusty yellow band across their middle, continuous with that of the fore wings, but the blackish line on its anterior edge is faint or wholly disappears, whilst that on its hind edge is slightly thicker and more distinct than on the fore wings, and is bordered on its hind side by sky blue scales, which are more sparse toward the outer side of the wing, or wholly vanish. To these scales succeeds a second rusty yellow band, which becomes darker toward its hind edge. This band widens from its inner end to the middle, and from thence continues broad to its outer end; but frequently its outer half is faint, being tinged with lilac red, which color occupies the remaining portion of the wing, back of this band, except a large patch of rusty yellow on the hind edge at its outer end; and two or three lunules of rusty yellow surmount the notches which are next inside of this patch, the inner lunule being much more broad and conspicuous; and following it is a black lunule surmounting the inner notch of the series. The fringe is short and gray intermixed with scales of sky blue, with a brown line across its middle and another at its base. The underside is bright orange, the costal margin of the fore wings gray. Both pairs are crossed in the middle by a

single very distinct nut brown line, which, upon the fore wings, is a little thicker and slightly flexuous and is bordered on its hind side with lilac gray, which color sometimes shows a faint slender brown line along its hind edge, parallel with the preceding one. Back of the line across their middle the hind wings and the inner part of the fore wings are lilac grayish with the hind border orange. The *legs* are rather short, the thighs varying in color from orange to pale violet yellowish; the shanks and feet are gray-green in the live insect, fading to gray in the dried specimens, freckled sparsely with black atoms, their exterior side being blackish. The hind shanks are longer and much thicker than the thighs, and have two pairs of long stout spurs. The feet are distinctly five-jointed, the joints cylindric and successively shorter and diminishing in thickness.

The colors and markings of some specimens vary from the description above given. The fore wings sometimes have all their surface back of the band darker, of a reddish lilac color, thus corresponding with the hind wings. In the female specimen before me the blackish lines crossing the wings are widened to double their thickness in the males and are of a paler or brown color with their edges indistinct. The female figured by Herrich Schœffer appears to have had the second line on the fore wings wholly effaced.

This is a rare insect and it is probably impossible for it to become so multiplied as to occasion any material injury. Should there be a few clusters of its larvæ upon the lilacs in a particular neighborhood, notwithstanding the manner in which they disguise themselves, some bird would discover their real character, and they thereupon would all be speedily found and destroyed. I placed a cluster of eggs which were beginning to hatch, in contact with a leaf of a lilac bush. The infant worms thereupon were watched day after day for about a week, when they all abruptly disappeared. Some bird had undoubtedly discovered and destroyed them. I regretted the loss but little, thinking that as some fifty worms in the flock of the previous summer had matured and buried themselves in my grounds, one or more broods from them would in all probability soon appear upon some of the lilac bushes in the yard. But I was disappointed. They nowhere showed themselves. The birds had probably learned the disguise which they assumed; this disguise thereupon ceased to be a safeguard, and the whole progeny from the previous year's flock of worms was destroyed it is most likely when but a few days old.

These facts indicate by what a very precarious tenure it is that this species holds itself in existence. Wherever a few families of its young show themselves, they are discovered by the birds and are immediately exterminated. Thus it seems to be only in a locality here and there, where the birds from not seeing any of these worms for some years, have forgotten the mask which they put on, that a flock of them is able to elude their inveterate foes and grow up to maturity. And thus a season will sometimes arrive when a vigilant collector

will obtain a few specimens of this moth, and it will then vanish and he will meet with it no more.

JOHNSON'S PRIOCYCLA, *P. Johnsonaria*, new species.

It has been remarked above that the insect treated upon is the type of a distinct genus, of which genus it is the only member as yet known. Whilst I am engaged in preparing the foregoing account, there comes to me, through the open door of my study, attracted by the light of the lamp, a moth whose scalloped wings and other characters at once show it to be intimately related to the one under consideration, a second species pertaining to the same genus. It was upon the 28th of June that this specimen presented itself to me, the same date on which the moth of the preceding species began to come forth from the pupæ in my cages. Anxious to obtain other specimens of this variety, I, on several of the following evenings, went with a lighted lamp to different parts of the grounds around my residence, but without any success.

I dedicate this interesting discovery to the memory of the late Secretary of our State Agricultural Society, Hon. B. P. Johnson, whose efficient aid, rendered on numerous occasions, has much assisted me in these investigations of our noxious insects.

This species may be briefly defined as follows: Yellowish brown; fore wings with a subcentral black dot and crossed obliquely by two distant blackish lines; hind wings with a faint brown band and a blackish line; under side pale lemon yellow, posteriorly grayish brown, with numerous brown freckles and a blackish band and line crossing both wings. Width of the male 1.35.

The *head* is tarnished gray, and is flattened in front. The palpi are blackish along their under side; their third joint small, twice as long as thick, almost cylindric, slightly diminishing in thickness toward the tip, which is obtusely pointed. The antennæ are more than half the length of the body and pectinated in the male, the stalk being gray and its branches pale brown and identical in their details with those of the preceding species, the last ten or twelve joints being destitute of branches and merely toothed along their under side. The *thorax* is tarnished gray. The *abdomen* is yellowish brown, unicolor with the wings, with a row of dusky brown spots along each side. Beneath it is gray, freckled with pale brown spots and dots. Its tip is on a line with the inner angles of the hind wings. The *wings* are moderately broad, the fore pair measuring 0.63 by 0.32, and the hind pair 0.51 by 0.37. The fore wings have their costal edge straight, with but a slight short curve at each end; the hind edge oblique and convexly rounded, with the outer third of its length straight, this edge being slightly scalloped, with shallow sinuses and short broad lobes, which are rounded and not at all angular. They are of an umber brown color, the basal two-thirds of their length tinged with dull yellow; the costal margin dark grayish,

freckled with black. Forward of the middle a very distinct blackish brown line extends obliquely across these wings, which is gently curved, and near its outer end is abruptly bent forward at a right angle, and is slightly thicker at this end. Beyond the middle is a similar line, parallel with the first, and near its outer end slightly waved and perceptibly thickened, this line separating the yellowish brown anterior from the darker brown posterior part of the wing. Between these two lines, outside of the center of the wing, is an oval transverse black dot, formed of elevated scales. A faint dusky streak extends from a little inside of this dot to the inner margin, nearly parallel with the bluish brown lines. Beyond the posterior line the dark ground color is freckled with a few black atoms. Half way between this line and the hind edge is a small blackish spot near the inner margin, and a blackish transverse streak toward the outer margin, the hind edge of which is darker and more distinctly defined. Back of this streak a coffee brown cloud, having a silky grayish reflection, occupies the tip of the wing. The hind wings have their hind edge strongly rounded, forming almost a half circle, and deeply scalloped, both the projecting lobes and the intervening incisions being rounded. Their ground color is the same with that of the fore wings, but their fore part is less tinged with yellowish, and is sprinkled with a few black atoms. Forward of their middle they are crossed by a straight faint dusky brown band, which is continuous with the dusky streak inside of the black dot of the fore wings. Parallel with this band and crossing the wings a little beyond their middle is a very distinct blackish brown line, nearly straight, and in line with the blackish spot near the inner angle of the fore wings, all the space back of this line being a shade darker and without spots or clouds. The fringe is short, toward the tips of the fore wings very short, and is concolor with the wings, on the under side showing a darker brown line at its base. On the under side both pairs of the wings are alike in their colors and marks, the basal part being dull pale lemon yellow, and the hind part darker, dull pale brown, the two colors separated by a slender gently waved blackish brown band which is placed slightly back of the middle, and is curved and parallel with the hind margin, and forward of this is a broader brown band with its edges indefinite, crossing the wings straight and oblique on the upper, curved on the lower pair, its outer end not attaining the costal edge, its inner end on the hind wings much narrowed, the subcentral black dot of the fore wings appearing as a short black streak upon the hind edge of this band, and a black crescent also on its hind edge in the middle of the hind wings. Both pairs are much freckled with brown and blackish dots and short transverse lines. The fore wings have their inner border broadly stained with brownish gray, and also show a blackish transverse cloud forward of their tips and a smaller one on their inner angles. The *legs* are gray with a tinge of tarnished yellow, and are freckled with numerous brown dots. The tips of the anterior shanks are black, and the hind shanks are a third longer and beyond their middle a third thicker than the thighs.

White Butterfly, *Pieris oleracea*, Harris. (Lepidoptera. Papilionidæ.)

Eating holes in the leaves of the cabbage, turnip and radish, a nearly cylindrical pale green worm having a darker streak along the middle of its back, and growing to over an inch in length, its pupa naked, angular, white or pale, suspended by a thread around its middle, under a board or similarly dry situation and producing a white unspotted butterfly about two inches wide.

One of the most interesting of our garden insects is the White Butterfly as it is currently named, which in July and August is daily

seen flying about the garden. It pertains to a group which has been termed the *Brassicaceæ* or Cabbage Butterflies, from the fondness which those of their larvæ whose habits have been observed, nearly all manifest, for feeding upon the different plants which pertain to the genus *Brassica*, the cabbage, cauliflower, kale, and turnip, though they readily nourish themselves also upon any of the other species of the natural order *Cruciferæ*, the mustard, radish, horse-radish, nasturtion, water-cress, etc., to which order of plants most of the species appear to be confined. They are also termed the Garden-white Butterflies, from the places they frequent and their being so uniformly of a white color. This group is quite extensive, the species being distributed over most parts of the world. They are especially numerous in the tropical countries of the eastern hemisphere, whilst here upon the American continent their numbers are very few. This White Butterfly is our only native species in the central and northern sections of New York, its geographical range being known to extend west to Lake Superior and north to Labrador and the sixty-fifth degree of latitude. Originally subsisting upon some one or more of our wild plants of the order *Cruciferæ*, it has now become accustomed to lay under contribution for its support our cultivated plants of this order, particularly the cabbage and the turnip; and these plants being grown so extensively in all our gardens furnish it an abundant supply of nourishment, whereby its numbers are now greatly increased. I think I am safe in saying that within the sphere of my own observation these butterflies of late years are ten fold more numerous than they were forty years ago. Complaints of their injuries are getting to be frequent, and they are threatening to become a formidable evil.

The White Butterfly comes out of the pupa shell in which it reposes through the winter, and begins to be seen along road sides and in the meadows on the first coming on of warm weather. Pupæ which I had kept in a stove warmed room through the winter, gave out the butterflies on the twenty-seventh day of April, and it is only ten or twelve days later than this that they come out when they are in the outdoor atmosphere. Several years I have noted them as being first seen on the eighth and other years on the ninth day of May. One year only have I seen them abroad earlier than this, on the sixth day of the month. It is along road sides and in the meadows that they mostly occur at the commencement of the season.

The sexes pair and the female commences laying her eggs immediately on issuing from the pupa state. At this early period in the season there are no garden plants sufficiently grown for it to resort

to them; and it being a native insect of our country we know its natural food must be some one or more of our indigenous plants, on which it wholly subsisted before the cabbage and our other cultivated vegetables were introduced upon this continent. I find it is nourished upon the water-cress or yellow rocket, the *Barbarea vulgaris*, much more extensively than upon any other plant, wild or cultivated. Our botanists have usually regarded this as a native plant of this country; but as it is also a European plant some have supposed it was probably originally introduced here from abroad. It occurs in such abundance in our moist lowland meadows and also in dry gravelly upland soils that it has every appearance of being a native plant. And this insect feeding upon it in such numbers as it does, is a further indication that it is an indigenous plant. It, more than any other member of the vegetable kingdom, appears to be the natural food-plant of this butterfly.

This plant starts into growth so early in the spring that its radical leaves become sufficiently expanded to meet the wants of this butterfly when it first makes its appearance. And it is principally upon this plant that the first generation of each year is reared. It, however, is no doubt able to sustain itself upon several other wild plants of the order Cruciferæ. And later in the season, when the cabbages, turnips and radishes in our gardens are sufficiently grown to be adapted to its wants, it begins to bestow its eggs upon them. It sometimes invades the cabbage when the plants are only six or eight inches high with but five or six leaves put forth upon them.

When engaged in depositing its eggs it flies very slowly just above the tops of the plants, alighting upon a leaf here and there; and so intent is it upon the work in which it is engaged that it will sometimes come quite near a person, without manifesting any fear, or quickening its flight to move away.

Alighting, it stands upon the edge of the leaf, and bending its body downward it touches the tip to the under surface of the leaf, planting an egg thereon, placing it from an eighth to a quarter of an inch inward from the edge of the leaf. From one to three eggs, placed slightly apart from each other, are thus glued to the underside of the leaf, when it again takes wing and searches out another leaf such as it desires.

The eggs are nearly one-twentieth of an inch in length and twice as long as thick. They are shaped like a sugar-loaf, being cylindrical, with the base cut off transversely and the opposite end gradually tapered to about a third of the thickness and then abruptly and

bluntly rounded. They are beautifully sculptured, being ribbed lengthwise and closely and very minutely striated transversely. The number of the ribs or elevated ridges is fifteen. The eggs are of a very pale greenish white color and the ribs clearer white. They are slightly glued to the underside of the leaf by a gummy substance which is soluble in water, whereby they would probably be washed off the leaf by the rains, were they not placed on the underside where the wet will not reach them.

The eggs which are laid in May hatch in about ten days, and later in the season, when the weather becomes warmer, they probably hatch in a shorter time. Some authors state that the worms of this genus, in hatching, burst open the egg shell. This is not so, at least of this species. The worm begins to feed when it is inside of the shell. When it first wakens to life it commences opening and closing its jaws. These, being in contact with the inner surface of the shell, scratch upon and erode it, its ribbed uneven surface aiding to expedite this operation. At length a small opening is hereby made in the shell. The edges of this opening are then eaten away, more and more, until a hole is made, sufficiently large for the worm to crawl out. And after making its exit, the worm continues to nibble at this opening, until it has eaten the whole of the shell.

When it first issues from the shell it is a minute cylindrical worm of a glossy, watery-white color, thinly clothed with fine shortish hairs. It clings to the leaf with the thick fleshy legs at the hind part of its body, throwing its head suddenly and spitefully from side to side when anything molests it. The first worms coming out as they do in May, are liable to encounter some frosty nights and cold chilly days, during which they remain clinging to the leaf, torpid and motionless, awaiting the return of a more genial atmosphere to warm them again into activity.

The infant worm, having consumed the egg-shell, begins to feed upon the green leaf, and immediately thereupon its body begins to acquire a green color. It eats small round holes through the leaf when it is young, larger and less regular ones as it advances in size and approaches maturity. It feeds mostly by night and remains at rest during the day, frequently standing in the groove made by the midvein on the upper side of the cabbage and turnip leaves, with its head downward, toward the base of the leaf. But if there is a fold in the margin or any other covert where it will be more hid from view, it conceals itself therein. It resorts to the same place upon the leaf day after day, spinning and fastening to the surface an exceedingly fine

web of silken threads to give it a more secure foothold. It moves about but little, crawling very slowly, with its mouth to the surface on which it is crawling, placing there a silken thread to aid it in clinging. It seldom quits the leaf on which it is placed, if this is of sufficient size to fully feed it.

This worm grows to nearly or quite an inch and quarter in length and 0.15 in thickness. It is slightly thickest in its middle and more tapered toward its hind than its fore end. It is divided by transverse constrictions into thirteen segments including the head, the two last segments being less distinctly separated. It is of a pale green color, similar to that of the leaves of the cabbage and swedish turnip, and along the middle of the back is a darker line. The whole upper part of the body above the breathing pores is dusted over with minute black atoms, the coarser ones of which are arranged in transverse rows, and the surface is clothed with numerous fine, short white hairs. Its head is of a flattened globular form, of the same width as the neck and is held vertically. It is of the same pale green color as the body, with little, if any, glossiness, and is thinly covered with fine white hairs. Low down on each side is a row of four black dots, and the six or seven minute teeth with which each of the jaws are furnished, are also black.

When it has done feeding it remains at rest upon the leaf about twenty-four hours. It then crawls away from the plant and wanders about until it finds a suitable situation in which to repose during its pupa state, the underside of fence-rails, of stones in a wall, of limbs of trees, or some similar spot where it will be dry and sheltered from the rain. They appear to be particularly careful to place themselves where no wet will reach them. Thus I have once met with a number that on leaving the garden had crawled under the portico of the contiguous dwelling, and had there placed themselves along the lower edges of the clapboards to remain through the winter where persons were passing quite close to them every hour of the day.

The very curious operations of these cabbage butterflies in passing from the larva to the pupa state, the spining of a loop or girdle of silk threads around their bodies to hold them in a particular position, and the drawing of their bodies out from the old skin in such an artistic manner as to have the girt remain around them, were long ago stated so accurately by the philosopher Reaumur, that I am able to add but little to the account he has given. Observers will frequetly be disappointed of the opportunities they expect for examining these phenomena, as they take place more frequently by night than by day.

Having found such a situation as it requires the larva determines in what position it will place itself to remain during its pupa state, for there is much diversity in our white butterfly in this respect, it being sometimes suspended upon the underside of a horizontal or an inclined surface, and at other times against the side of a vertical surface; and it is held in a variety of positions, horizontal, oblique, or almost perpendicularly upward or downward, usually with its back but sometimes with its right or its left side downward.

Having selected the spot it will occupy and the position in which it will suspend itself, it requires a loop to be made around its body to hold it in this position. To give its feet the secure foothold they will require while this loop is constructing it first spreads a slight carpeting of silk threads upon the surface on which it is to stand, forming also at its lower end a thick mass or little hillock of these threads. It then fastens the hooks of its hind feet securely into this mass of threads, and clinging to the carpeted surface with its middle legs, its body is so very soft and flexible that it is able to bend and turn its head backward touching either side or the top of the back at a point one-third of the distance from the hind to the fore end. And with its head thus turned backward it fastens to the surface at one side of its body a thread of silk which it spins from its mouth. It then carries its head up over its back and down upon the opposite side of the body, where the mouth fastens the other end of the thread, thus forming a loop around its body holding it to the surface on which it is standing. This single thread, however, is exceeding fine and possessed of but little strength. The worm therefore carries its mouth back again by the same route, to the opposite side, thus spinning a second thread, with its end fastened at the same point where the first one was commenced. And it thus continues to move its mouth from one side to the other, until it has formed a skein of threads of sufficient size and strength to securely sustain the weight of its body. Reaumur states the number of threads in the loop to be about fifty. But in our American species there is no uniformity in this loop, it being in some instances not a fourth the size that it is in others. If the larva gains some secluded corner where it will experience no molestation, it does not trouble itself to spin but a few threads to form this loop.

The most laborious part of this work, and that which occupies the principal part of the time that this loop is being constructed, is the fastening of the ends of the threads to the surface on each side of the worm. As the tension upon the threads is almost directly upward

it has a strong tendency to tear them from their attachment, and the worm shows particular care in fastening the ends securely, applying its mouth to the surface at numerous points to glue the thread thereto, whereby a dense web comes to be formed upon the surface around each end of the loop. The worm, moreover, moves its body from side to side with each thread that is spun. When a thread is about being fastened upon the right side, to give the mouth the requisite room for attaching it to the surface, the body is crowded to the left, as far as the threads already spun will admit, thus putting these threads on the stretch, whereby the worm will ascertain if it is fastening them sufficiently secure.

Having completed its skein of threads the larva straightens itself, and it is then noticed that about two-thirds of its length is forward of the skein. It now becomes quiet and motionless, but its body gradually contracts in length, whereby at the end of an hour or two its anterior part is found to be but half as long as it previouly was, the skein now girting it around its middle. It has also undergone a sensible change in its form, that portion which is forward of the girt being thicker and cylindrical whilst that which is back of it is gently tapered.

The larva remains in this position, with its hind feet fastened into the little hillock of silk threads at the end of its body and the loop around its middle, from twenty to thirty hours. Then, with some writhings and contortions a cleft is opened in the skin on the upper side of its neck, which crack soon extends along the middle of the head and the fore part of the back, forming an orifice of sufficient size to allow the body to pass out through it, and when the head is also disengaged it rests upon the old skin of the larva. The pupa now by contracting and elongating itself rapidly crowds the skin backward crumpling it together underneath its body, until only the conical hind part remains upon the pupa. Being securely held by the loop of silk which is now around it, the pupa readily withdraws the tapering hind end of its body from the remainder of the larva skin, and the tip of its body being furnished underside with a number of minute hooks, it pushes these backward beyond the shriveled remains of the larva skin, and fastens them into the little wad of silk threads to which the larva skin is also attached by the minute hooks of the hind feet. This larva skin being now a crumpled mass of membrane and hairs, discommodes the pupa by being crowded as it is under and around the hind end of its body. In order to remove it therefore, the end of its body being bent into a curve at this time

and fastened at its tip, it moves this part of its body around and around, in a rotary manner as it were, thus crowding against the pellet of old skin, dislodging it from its former place, and gradually breaking it off from its connection with the little bundle of silk threads. It continues this motion some little space of time to accomplish this purpose, over a half minute I should judge it to have been, in the instance which I witnessed. At length the crumpled mass, having become rolled into a little wad no larger than a kernel of allspice, becomes entirely detached and falls to the ground.

As yet the pupa retains the shape of the larva, being thickest anteriorly and gradually tapered to the tip, without any angular projections upon the back, only the horn at the anterior end and the wing sheaths having their pupa development. But the protuberance upon the back of the thorax case soon begins to appear, and shortly after this a slight angular projection becomes perceptible upon each side of the middle of the back. These gradually become more prominent, and in a short time the whole surface becomes molded into its normal pupa form.

The chrysalis or pupa of this as of many other butterflies has such a singular form that persons not versed in entomological science will deem its back to be its under side. It is what is technically termed a naked, suspended, angular pupa; that is, it is not inclosed in a cocoon or other covering; it hangs suspended in a loop, and its surface presents angular processes and projecting points. Along its under side it is smooth and nearly straight from end to end, but its back is much bulged and uneven, with angular ridges and projections. It is of a white or yellowish white color, frequently with stains of brown on some parts of the surface, and with numerous black dots of different sizes, the most of which are placed symmetrically.

The PUPA is about 0.70 long, 0.15 wide and 0.24 high. It is divided into twelve segments, the sutures between most of them being quite conspicuous. The first segment or head case is prolonged forward into a prominent conical point which is curved gently upward and is bluntly rounded at its tip. Near its base on the upper side are two small projecting points which are usually black. From each of these an elevated line extends obliquely backward and inward to the anterior end of a prominent keel-like ridge along the middle of the occiput which is the anterior end of the prominent dorsal ridge, and is of a black color. The second segment or thorax case is elevated in the middle of the back into a very prominent stongly compressed nose-like ridge, which is rounded at the summit and descends backward in a straight or nearly straight line, a slight notch usually occuring toward its end, made by the suture between this and the third segment. The third segment is short, the ridge upon its middle is black, and it frequently shows four dots in a transverse row on its anterior part, the outer dots being longer. The fourth segment is equally or more short than

its predecessor and is recognized by some slight transverse lines or wrinkles upon its surface and by the loop of silk which passes across its middle. It frequently has six or eight black dots placed symmetrically and in positions similar to those upon the following segments. The fifth or first abdominal segment has a slight elevated line upon its middle which in some instances wholly disappears. Upon each side of the back this segment is elevated into a prominent ridge, beginning upon the anterior margin and gradually ascending to the hind margin, with a broad shallow notch in its middle and frequently a brown spot upon its anterior ends. The sixth segment upon each side continues the elevated ridge of the preceding segment, at its anterior corners jutting abruptly upward and forming a prominent angular point, which inclines outward, overhanging and protecting the wing sheaths, the inner edges of which overlie the base of these ridges on their outer sides. The angular apex of each ridge is frequently stained with brown or black. From this point the ridge descends backward in a straight line, ending at the hind edge of the following segment, and a raised line is continued from thence along each side of the back to the tip. Along its middle the sixth segment has a slightly raised line, which on the following segments becomes more elevated, forming an acute angular line along the middle of the back, and on the last segment dividing into two straight diverging forks which extend to the tip, their ends there uniting with the ends of the lateral dorsal lines. On the back of these segments are usually twelve black dots, placed symmetrically, one on each side of the center of each segment; two others further out and back, one before the other; a fourth one still farther out and upon a transverse line with the first; a fifth obliquely forward and outward from the last, and the sixth one larger than the others, on the anterior corner of each segment. On the under side these segments frequently show a row of small blackish spots along the middle, the spots being often faint and more or less obliterated, and on each side three longitudinal rows of black dots, the second row being formed of a large and a small dot upon each segment. The veins of the wing sheaths are also finely dotted, with a series of larger dots alternating with the tips of the veins.

The pupa remains quiet and motionless, with the tip of its body fastened in the little mass of silken threads and the loop passing around it and holding it suspended in a horizontal or oblique position, for a period of eight to twelve days in summer, and seven months in the winter, it entering this state the beginning of October and continuing in it till the following May. The ridge along the forepart of the back of the pupa then cracks apart and the inclosed butterfly withdraws itself from its pupa case, and stands beside it for a few hours for the several parts of its body to dry and acquire their requisite solidity and strength, when it flies away in search of its mate. Thus, while the winter brood is over half a year in completing its transformations, the summer broods reach maturity in from four to six weeks, the period appearing to vary as the weather is more or less warm and dry.

The BUTTERFLY varies from 0.60 to 0.70 in length and from 1.80 to 2.15 in width across its spread wings. Its body is black and clothed with hairs or in some places with scales. The *head* is thickly covered with shortish hairs, which are black and

white above, white on the underside, and on the face white with two vertical rows of black. Palpi straight and held projecting obliquely forward and upward, covered with white scales, the last joint black with its sides white. Eyes in the live insect greenish white with rows of movable blackish dots, the central one being coal black; in preserved specimens brown or brownish gray. Spiral trunk equaling the antennæ in length. Antennæ black above, white beneath, and alternated with these colors along the sides, the knobs at their ends compressed and widening outward, with the tips bluntly rounded and pale tawny yellowish. The *thorax* is black and clothed with soft hairs of a leaden white color. Breast covered with white hairs. The *abdomen* is black on the back, at base with hairs similar to the thorax. On the sides and beneath covered with appressed white scales. The *legs* are pale brown, the thighs black, more or less covered with white scales and on the underside with white hairs. The *wings* are milk white above and beneath, and without spots. They are dusted with black scales at their base, sometimes very slightly or not at all on the hind pair, but commonly more broadly, these scales extending along the outer margin frequently nearly a third of its length and in rare instances the entire length. The tips sometimes show similar black scales along the veins. On the under side the hind wings always have a stain of ochre yellow at the base of their outer margin. The fringes are short and white.

The under side of the hind wings are subject to some variations in color which it is important to notice. Instead of being white they are of a pale sulphur or cream color, the tips of the fore wings also participating in this hue. Boisduval regarded these as a distinct species, which he named *Pieris cruciferarum*, a name indicating them to be connected with the cruciferous family of plants. Another variety has the veins here broadly marked with dusky or blackish. It was from specimens with the wings thus striped that Dr. Harris drew up his description of the species. Still other specimens occur with the under side of these wings pale yellow, as in *cruciferarum*, and with the veins dusky as in the preceding variety; and these have been treated as a distinct species by Mr. Kirby, under the name *Pontia casta*, the chaste or unspotted Pontia. These varieties occur associated together, and that they are mere varieties and not distinct species I am assured, from having met with them paired with each other.

Dr. Harris, in Agassis' Lake Superior, says: "Specimens of the females have been seen, though rarely, with one or two dusky spots on the upper side of the fore wings." I have never met with a specimen showing these spots, and from the indefinite manner in which Dr. H. speaks it is evident he was unacquainted with examples of this kind. Specimens have been presented for my inspection as being this variety, having a faint dusky spot slightly beyond the center of the fore wings and a similar duskiness on their tips, and also a dusky spot on the margin of the hind wings. I have recently obtained

specimens marked identically in this manner, and others having a second spot on the fore wings, more faint and small, placed inside of the sub-central one, which I know to be males and females of *P. Rapæ*. And we should expect hybrids of this species and *oleracea* would be marked in this faint manner. But it will be truly remarkable if genuine specimens of *oleracea* vary to present faint spots placed as they are either in *Rapæ* or *Protodice*.

This is currently termed the White Butterfly, which name distinguishes it with sufficient clearness from all the other butterflies of the region in which it abounds. It was first scientifically named and described by Dr. Harris, in the New England Farmer, 1829, vol. 7, p. 402, *Pontia oleracea* or the pot-herb Pontia being the designation he bestowed upon it; and under this name he noticed it more or less fully in his subsequent publications; his discourse before the Mass. Horticult. Soc., 1832, p. 7; his report to the Legislature on the Insects of Mass. injurious to vegetation, 1841, p. 213; his paper on Lepidoptera, in Agassis Lake Superior, 1850, p. 386, where a figure of it is also given; his Treatise on the Insects of New England, 1852, p. 233, and Flint's edition of this treatise, 1862, p. 269. Boisduval inserts it under the name *Pieris oleracea*, in his Species General des Lepidopteres, 1836, vol. 1, p. 518, and on the next page describes *Pieris cruciferarum* as a distinct species, as we have noticed above. Mr. Kirby in his Fauna of North America, published 1837, p. 288, alludes to *Pontia oleracea* by name in connection with his supposed species *Pontia casta*.

It will be noticed that these authors disagree as to the generic name of this butterfly. Whilst Dr. Harris and Mr. Kirby term it a *Pontia* Boisduval calls it a *Pieris*. The question thus arises, which of these names are we to adopt as being the correct name for our insect? This is a difficult point to determine, as will appear from a brief notice of the manner in which these names were introduced into the science and the posture in which this subject stands.

These white butterflies pertain to a section of the old genus *Papilio*, which Linnæus fancifully designated *Danai Candidi* or the White Greeks. The Bavarian naturalist, Schrank, in the second volume of his Fauna, which was published in 1802, elevated this section to the rank of a distinct genus, to which he gave the name *Pieris*. Fabricius, at his death, left a manuscript revision of the order Lepidoptera, which it is to be regretted has never been published. A short abstract of the genera proposed in this manuscript was given by Illiger, in his Entomological Magazine, in the year 1807, the *Danai Candidi*

of Linnæus being divided into two genera, namely, *Pontia* containing the white and *Colias* the yellow butterflies. Naturalists have since been greatly at variance as to whether *Pieris* or *Pontia* should be the name of the genus containing these white butterflies; and since they have more recently come to be further divided into smaller genera, the utmost confusion has arisen, as to the groups to which these names have been applied. Thus Stephens, Curtis and other British authors have given the name *Pieris* to what are termed the black-veined whites and *Pontia* to the garden whites. Boisduval, following French precedents, unites these and other genera of the British writers into an extensive genus containing 170 species bearing the name *Pieris*, whilst some half dozen species from countries bordering upon the Indian Ocean constitute his genus *Pontia*. Ochsenheimer, a leading German authority, includes these garden whites in quite an extensive genus to which he gives the name *Pontia*, thus differing diametrically from the French authors in the insects to which this name is to be applied. We thus have in this as in a number of other instances, some even of the most common and best known insects, presented to us under two or three different generic names, by our best authorities in the British, the French and the German schools. Under such embarrassing circumstances how are we to determine which name should be employed? In many of these cases our rules for regulating these names are not so fully agreed upon and established as to make our way clear. Upon one point, however, there is a general concurrence, to wit, that the name which is first proposed and published for a species or genus must be adopted, and all names which are subsequently given to the same species or genus must be rejected as spurious and mere synonyms. This rule is our only release from the embarrassment of the present case. The name *Pieris* having been proposed anterior to that of *Pontia*, it is entitled to be retained. Originally both the white and yellow butterflies were included under this name. But entomologists have all concurred in giving the name *Colias* to the latter, as proposed by Fabricius. The white butterflies, moreover, were the typical species of the original group. Thus the name *Pieris* rightfully belongs to them. And it would obviously be unfair to Schrank to supersede the name he presented, by one which was subsequently proposed. We thus find the name *Pieris* presenting stronger claims for being retained than the name *Pontia*. And authors are now coming to concur pretty generally in adopting this name.

Cabbage Worm, or Turnip Butterfly, *Pieris Rapæ*, Linn. (Lepidoptera. Papilionidæ.)

Eating the leaves of the cabbage and turnip, and often gnawing into the compact heads of the former; a cylindrical green worm with a pale yellow line along the middle of its back and a row of yellow dots along each side, growing to over an inch in length; its pupa, naked, angular, gray, freckled with black dots, held in a loop on the under side of rails, boards, etc., and producing a white butterfly about two inches wide, its wings with black spots.

Since the preceding account of our native white butterfly, *Pieris oleracea*, was written, a closely similar but much more destructive cabbage butterfly has invaded our State, and has suddenly become so excessively multiplied and numerous, that it is no exaggeration to say it is now threatening to annihilate the cabbage crop. A new insect enemy of such importance has, of course, received my particular attention, and the present volume of Transactions having been delayed in its issue, I am enabled herewith to present, from the observations I have made, a history of this insect and its transformations, which will be found more full and exact than any account which has before appeared, correcting some errors of previous observers, and containing several new and interesting facts in the habits and economy of this important accession to the insect fauna of our country.

During the fore part of the year 1870, our white butterfly made its appearance in the usual manner. One or more of them might be seen almost every day flying about our gardens and yards. On the second day of August four white butterflies were hovering about and alighting around me in my garden, when one of them was noticed with much surprise as having a round black spot near the middle of its fore wings. Conjecturing it to be the spotted variety of our white butterfly, and anxious to secure the specimen, I hastened to obtain a net for its capture; but on being approached, to my great regret it flew wildly away. Next day, however, two similar specimens were noticed and captured, and on examination were discovered to be the European *Pieris Rapæ*. And on the following days these spotted butterflies occurred more and more common, whilst our white butterfly immediately vanished, not one of them being seen either in the gardens or the meadows. And this foreigner became more and more abundant till the close of the season, doing immense injury to the cabbage crop in all our gardens, greatly surpassing every other insect depredator upon this vegetable which we have previously known in our country. Around the city of New York and in New Jersey it began to attract public notice about the middle of July

two or three weeks earlier than its appearance through the eastern and northern sections of the State.

This insect is a native of the eastern continent, and from time immemorial has been well known in all the countries of Europe, as being in its larva state a cabbage worm of all others the most obnoxious, it is so prone to attack the inner leaves of this vegetable, eating its way into the heads and secreting itself therein. Duponchel informs us that in consequence of this habit of penetrating into the interior of the plants on which it feeds, it in France is named the *Ver du cœur*, *i. e.* the Heart-worm. The butterflies are very common everywhere, in the gardens and meadows, beginning to appear the last days of April and continuing till the end of the season.

It was brought to this country in some vessel which discharged its cargo at Quebec. Mr. Riley, in his second report on the Noxious Insects of Missouri, p. 108, suggests it was probably introduced into this country in its egg state, upon a batch of refuse cabbage leaves which were thrown from some vessel, where, after hatching, the young larva managed to find suitable food close by. But the insect does not remain in its egg state the length of time required for such a voyage. The eggs, however, hatching on shipboard, the worms from them would readily sustain themselves on the leaves, and on reaching port where fresh vegetables could be obtained, the few wilted and decaying cabbages remaining would be thrown away, with some of these worms lurking among their leaves, whereby their race was probably started upon our continent.

It was in the year 1859 that this butterfly was first taken in Quebec, and Mr. J. G. Bowles, in a paper in the Canadian Naturalist for August, 1864, estimates that it had not then extended more than forty miles from Quebec in different directions. In 1866 it was captured in the northern parts of Vermont and New Hampshire, and in 1868 they had reached Lake Winnepesaugee, in the center of the latter State. Last year they were reported as having been taken at Bangor and other places in Maine, and also in New Jersey. The present year (1870), probably favored by the protracted drouth, they have suddenly overspread a large portion of the middle and western States, and have everywhere become so multiplied as to nearly ruin the cabbage crop in most of the gardens.

The eggs are placed indifferently anywhere upon the under side of the leaves, and sometimes one may be seen on the leaf stalk, on the edge of the leaf, or on its upper surface. They are but slightly attached to the leaf, separating therefrom if gently pressed against.

They are so very small that the eye does not notice them unless the attention is turned toward them. They are then readily perceived, being much paler than the leaf of the cabbage or the Swedish turnip. To the eye they appear like little pale yellow grains projecting out from the surface of the leaf, more high than thick. A seed of Timothy grass laid upon the leaf beside one of these eggs is found to be three or four times larger than the egg. They are white when newly laid and acquire a yellow tinge afterward.

When examined with a magnifying glass, they are found to be cylindrical and shaped like a sugar loaf, with the end which is glued to the leaf cut squarely off and the opposite end tapered to a point with a small portion of the apex cut squarly off. Their surface is glossy and beautifully sculptured, being fluted or ribbed lengthwise, with intervening grooves, and transversely it is closely and evenly striated with exceedingly fine impressed lines. One of these eggs, of which I carefully count the number of the ribs, has twelve only. The length is 0.045, and it is about four times as long as thick.

The eggs hatch in about a week after they are laid, the inclosed worm eating an opening through the shell of sufficient size to enable it to crawl out therefrom. The evacuated egg shell is whitish and translucent, the elevated ribs appearing as slender opaque white lines. A worm which I watched as it came out of the shell measured 0.065 in length. It was glossy and pale, tinged slightly with yellowish. Its body was slightly tapered from before backward, its sutures marked by transverse constricted lines, the intervening segments being roundly elevated. The head was a little thicker than the body and clothed with fine black hairs, the body having finer whitish hairs.

The first act of the worm is to eat the shell of the egg from which it has been hatched. It first gnaws an opening on one side from the top nearly to the base, and then very slowly nibbles the sides of this opening, and the base of the shell, until it is so cleanly consumed that no indications of the spot where it was placed remain. In the instance observed, the worm was occupied five hours in eating its shell. When this is accomplished it remains at rest for a few hours.

Its second act is to weave a mat or carpet to give it a more secure foothold upon the leaf. Applying its mouth to the surface of the leaf and moving it from side to side, it spins therefrom a thread of silk of most extreme fineness, which it fastens to the surface, crossing it in every direction, until it forms a thin film, which to the eye appears like a small glossy spot, very visible in a particular reflection

of the light, looking as though the leaf had there been lightly touched with varnish. If nothing occurs to drive it therefrom, this spot becomes its residence for a few days. And wherever it takes up its abode subsequently, it constructs a similar mat, into the threads of which it can catch the minute hooks of its feet, to render its standing more secure than it is upon the naked surface of the leaves.

It next begins to feed upon the leaf, some six or twelve hours after it has finished eating the egg shell. At some point slightly outside of the edge of the mat on which it is standing, it eats a round hole, the size of a small pin head, into which it gradually sinks its head, deeper and deeper, until it passes through the parenchyma of the leaf to the skin of its upper surface. As yet it is so small that the eye only perceives it to be a minute cylindrical pale yellow worm, usually lying straight and motionless on the leaf. But as it feeds on the green pulp of the leaf, its body acquires a green color and slowly increases in size, growing about one-thirtieth of an inch in length daily.

Foreign authors state that in getting its growth this cabbage worm molts or casts its skin "several times." I can say with perfect confidence, it is only three times that it molts. When it first comes from the shell it is extremely soft and its skin admits of much distention before it constricts the worm to such a degree that it requires to throw it off. It is not till it has grown to double its first size and is 0.12 to 0.15 long that it casts off its skin the first time. It then feeds and grows till it has again doubled its size and is 0.25 to 0.30 long, when it molts a second time. It again doubles its size and becomes about 0.50 long, when it makes its third molt; and the skin which it then acquires it retains till it reaches maturity, throwing it off only when changing into its pupa form. This is the uniform course of these worms, as I have observed in a number of instances. The only aberrations I have noticed in these moltings are, that one of them is sometimes deferred till the worm is much larger; yet this does not appear to affect the other moltings of the same worm, for these occur as usual. Thus, in one instance the second molting did not take place until the worm was 0.38 long; yet the third occurred when it was 0.53. In another instance the second molting took place when the worm was 0.30 long, yet the third was deferred until it was 0.64.

When the worm is about to change its skin it ceases to feed and crawls to a part of the leaf where it will not be liable to be disturbed, commonly placing itself on the upper side of the leaf, frequently in a

groove formed by one of the larger veins, but quite often on the even surface of the leaf. Having selected the spot it will occupy, it spins and weaves a carpet of threads on which to stand securely, it being of the utmost importance to have its hind feet firmly fastened. It stations itself on this carpet, standing with its head downward toward the base of the leaf. It remains in this position twelve or sometimes twenty-four hours, awaiting its change, sometimes bending its body slightly for a short time and then straightening itself again, raising its head for a moment and then lowering it, or giving a sudden shrug or jerk of its body, especially if anything intrudes upon it.

The worm at this time presents some alterations in its form and appearance. The most conspicuous of these changes is in the neck or second segment, which is stretched out to double its ordinary length, its anterior part being smooth and shining and strongly narrowing to the base of the head. This smooth glossiness of the neck is a character by which we always know when one of these worms is about to molt. On each side of the neck are six small black dots, four of them placed in a curved row which extends obliquely downward and forward, and the other two are back of these. The head is translucent and colorless, with a green cloudiness at its base. On the throat is a smooth protuberance as long as wide, its end rounded and feebly translucent.

After standing nearly motionless for several hours some slight distortions and writhings of the worm begin to be perceptible. The fore part of the body at times becomes distended and cylindrical and the hind part is less thick and tapering; anon the fore part becomes shrunken and the middle is distended; these phenomena being evidently produced by the movements of the worm pent up within the skin, contracting and elongating itself, and pressing now against one part and then against another. At length, as if it had become impatient with this long dalliance and delay, a more vigorous and determined pressure upon the anterior end is evident; slight tremors and twitchings of the fibers upon the top and side of the neck are seen, and soon the skin all around the suture at the base of the head parts asunder, the head is pushed forward and with a gentle wriggling the large new head is crowded out from the open end of the skin, with the old head, which is now an empty shell, adhering to and covering its mouth like a muzzle. And continuing to wriggle and squirm and elongate itself, the three first rings and their feet are slipped out from the old skin, which is crowded back, constricting the remainder of the body, the liberated anterior portion being bulged

out broader than the confined part, and very soft and bright green. The hooks of the hind feet being securely fastened in the threads of the carpet on which the worm stands, it now with its liberated anterior feet draws itself slowly and gently forward, with some slight writhings, thus freeing more of the body from the old skin. And now at the tip of the body a portion of the skin is seen to be evaenated, the end of the body being slipped forward out of it, and only the gray membrane remains there. This membrane is so thin and soft that it sinks down flat upon the leaf, as the end of the body is drawn out of it farther and farther by the worm continuing to crawl forward. In two minutes from the time the skin is first rent open around the neck, the body becomes wholly released from it. The skull of the old head, however, still remains upon the mouth of the worm, clinging thereto with much tenacity. To loosen and detach it the worm repeatedly rubs and presses it against an elevated vein of the leaf or any other projection it finds, persevering in its efforts until it at length succeeds, two minutes more being usually spent in releasing the mouth from this encumbrance.

It then rests, standing on the leaf with the skull of the old head in front of it, and the cast skin behind it. The latter is about half the length of its body, and is a flattened gray film, notched at its hind end, rounded in front and turned upward along each side. The worm remains at rest commonly about an hour. It then steps forward to the old skull and crowding against it with its head rolls it off from the leaf. It next turns around and walking back to the cast skin commences eating it, wholly consuming it in about five minutes. After this it again rests an hour or more. It then wanders away and goes to feeding on the leaves.

These cabbage worms have a different aspect when they are approaching maturity from that which they present during the earlier stages of their life. When young their skin is glossy and shining, and they are then more slender and their form cylindrical. This glossiness entirely disappears later in life, and the surface has a peculiar, somewhat velvety appearance, and the body becomes relatively thicker, with a more robust look, and perceptibly tapers from the middle toward each end.

When fully matured, these worms are quite uniformly an inch and one-tenth in length; but specimens one-tenth of an inch longer are sometimes met with. They are usually one-tenth of an inch shorter, or more, when they are at rest than when crawling.

Their color is pale grass green, varying in the depth of its shade in different specimens, but always darker green than the pale leaves of the cabbage and turnip. They are commonly, but not always paler beneath. And they are particularly distinguished by a pale yellow line on the back, and a row of small yellow spots along each side.

When examined with a magnifying glass, the surface of these worms is found to be everywhere bearded with fine short whitish hairs, those upon the back shorter, and in the young worms black and interspersed with small stiff bristles. These hairs arise from numerous minute black elevated points, with which the surface is everywhere studded, the larger points being arranged in transverse rows, a row upon each of the elevated ridges into which the segments are divided by impressed, slender, transverse lines. In addition to these black points, a few pale dots or minute warts are more or less perceptible, one appearing on each side of the middle of the back, on the second elevated ridge of each segment, another lower down on each side, upon the fifth ridge, and some others below these. But on each of the three first rings these pale dots are arranged in a single transverse row, on the first elevated ridge, three dots on each side, placed equidistant from each other. Along the middle of the back is a pale yellow line, which is sometimes very faint, or visible only on the anterior rings. Low down on each side is a row of dots of a brighter yellow color than the line on the back, one on each segment, placed a little back of the breathing pore, and usually more or less united with the yellow ring around the breathing pore. The breathing pores are small, broad oval, dull white, inclosed in a black ring, which is bordered with yellow, this border being more broad on the fore side and sometimes wanting on the hind side. The head is spheroidal, and as broad as the neck, green and clothed with hairs. The legs and prolegs have the same green color as the body.

The most curious feat performed by this insect is the fabricating of a little girt or loop in such a manner that it will be around the body of the pupa to hold it suspended in an inclined or horizontal position. It devolves upon the larva to make this girt and place it around its own body in such a manner that when its skin is thrown off to enable the pupa to appear, the girt will not be displaced but will encircle the pupa in the required manner, as the latter is destitute of any mouth, feet or other members to enable it to make this girt or to adjust it in the proper position around its body. The process to be gone through with is quite similar to that of suspending the arm in a sling fastened around the neck and then drawing the coat sleeve from off the arm without drawing the sling off with it.

When the worm has become full fed it remains at rest some twenty-four hours. It then wanders about until it finds a suitable place in which to repose during its pupa state, the under side of a rail, a board lying partly elevated from the ground, or other situation where wet will not penetrate to it. And placing itself in the spot it intends to occupy, it again rests for some hours,

It then prepares to construct the girt for holding the pupa. For doing this work it requires to have a secure foothold, for it must not make a misstep and fall as it sometimes does when it is wandering around. It accordingly proceeds to cover the spot it has selected with a carpet of silken threads. It appears to be the constant habit of these worms to place such a carpet wherever they tarry for a day or more, although I do not see this fact noticed by any writer. And being now grown to a larger size, with a more arduous labor to perform, a more densely woven and substantial fabric is constructed than on previous occasions. The worm finishes this work by spinning upon the lower part of the mat a little round wad or hillock of threads, which is frequently of a conical form and pointed at its apex.

The worm is industriously occupied one or two hours in constructing this carpet and the little wad at its lower end. As soon as this work is finished it turns around with its head upward, and straightening itself on the mat, it moves the tip end of its body around, until it finds the little elevated wad. This it grasps between the hind pair of its feet, securely fastening their hooks into it. And with the feet along the middle of its body it also clings to the mat. It thus stands perfectly secure from falling, with the feet at the fore part of its body disengaged.

Without any pause in its work it now proceeds to spin the girt around its body. This curious operation it will be difficult to describe so clearly as to make it easily comprehended by the reader. The worm has no sooner fastened its hind pairs of feet to the mat of threads it has spun and straightened itself, than it begins to bend the fore part of its body around, bringing its head backward to near the middle of one side or the other. Put thus upon the stretch, the anterior half of the body becomes lengthened and more slender than the hind part, and so very pliant and flexible that the worm is able to double it together in every direction.

And now turning its head backward to one side, it applies its mouth to the surface on which it is standing, near the anterior pair of thick fleshy prolegs, sometimes in a line with these legs, sometimes a little back of them. It there fastens the end of a thread of silk which it spins from its mouth. It now requires to turn over, in order to carry this thread over its back and fasten it on the opposite side of its body. It accomplishes this in a very peculiar and truly remarkable manner. Releasing its anterior feet from their hold and keeping its body doubled together, it is able to carry its head and the double part of its body up over its back and down upon the opposite side, all this time keep-

ing the crown of the head and top of the neck inward, face to face with the body, whilst the mouth, the breast and anterior legs face outward. It here fastens the other end of the thread, applying its mouth to the surface at several different points to render the attachment secure, a minute or more being occupied in turning from one side to the other and fastening the thread. It then turns back again, spinning a second thread in contact with the first, and fastening its end at the same point where the first thread was commenced.

It does not spin this thread from the forward extremity of its head. Its mouth is turned downward toward its breast, so far that the threads which have been spun pass across the throat and shoulders of the worm when it is turning over, the neck as well as the middle of the body being inclosed in the girt, whereby both the head and the posterior half of the worm are upon the hind side of the girt, and the remainder of the body, doubled into a half circle, is upon the fore side.

In this manner the worm carries its mouth from one side of the body to the other, each time adding another thread to the girt, until it has formed a skein of threads of sufficient strength to hold its body securely suspended. A much stronger girt is probably formed to hold the pupa through the winter than to sustain it only a week or two in the summer. Reaumur supposes there are about fifty threads in the girt, he having observed thirty-eight spun, and about a dozen had been spun before he began the count. In one instance which I observed, the worm placed but twenty-one threads in its girt, and was occupied twenty minutes in spinning and fastening this number. In another instance thirty threads were spun, the worm being engaged thirty-five minutes in the work. And both these girts were for winter pupæ. These facts render it evident that the number of threads in the girts is extremely variable.

When the girt is finished the worm requires to withdraw its head and neck from it. This is quite a nice operation; for if it should draw its head directly forward out of the loop, it would incur a risk of separating and drawing apart the threads in the bundle, and would probably break asunder some of the threads thus separated. To avoid any such casualty the worm first retracts its head into its neck as far as it can, and then bends it inward, crowding it against and under the side of the body, farther and farther, until the girt slips off from it. This curious expedient will be better understood by the reader from a familiar illustration. If he holds the fore finger of one hand straight and hooks the fore finger of the other hand around it, to free

the straight finger, he can draw it directly out from the hook, or he can bend it together, farther and farther, until it slips out. It is in a manner analogous to this latter that the worm slips its head and neck out from the girt without any risk of breaking the threads or parting them asunder.

Immediately upon the release of its head it usually bends and brings its mouth to one end of the girt, placing numerous short threads there, to fasten it more securely. It then strengthens the other end in the same manner. And now having nothing more to do, it straightens and composes itself to rest. Its body lies quite loose in the girt. But it now contracts and soon becomes so thickened as to fill the girt. Retaining the same form, color and marks that it has previously had, except that it is one-fourth of an inch shorter, it remains at rest in the loop, sometimes only eighteen or twenty but usually thirty hours before changing to its pupa form.

Why does this insect take such care to construct this loop and subject itself to the arduous labor which its fabrication requires? It is not at all essential that the pupa should be suspended in this manner. Quite a number of pupæ that were gathered in autumn from the under side of the railing of my garden fence, were dropped promiscuously into a cup, in which they laid neglected, in doors, through the winter, the cup being occasionally inspected and shaken, rolling its contents about from side to side. And now, at the end of four months, nine butterflies have come from these pupæ within the past two days, and I judge half of them will hatch. If they had been carefully detached and gently laid upon some dry, soft bedding, with their backs downward, without being further disturbed, I make no doubt they would all have lived and completed their transformations. It thus appears that the loop has no further design than to hold the pupa securely in a dry, clean, airy situation.

When the change to the pupa form approaches, the body becomes thicker anteriorly and its color fades to dull yellowish green. The breathing pores appear as small black dots, each inclosed in an elliptic dull yellow spot; and slightly above them a new mark, a dull white line becomes quite distinct, extending from a little forward of the loop backward nearly to the tip. Dull pale purplish stains appear upon the skin, this color sometimes forming a wavy streak on each side of the back of the second and third rings. The second ring becomes still more distended by the pressure from within, stretching it to double the length of the rings next it on each side. The suture between the head and the first ring is ever and anon put upon the

stretch, and in its upper part a slender silvery line is at times visible; and subsequently the skin here parts asunder and the glossy green surface of the pupa becomes perceptible in this cleft, which opens when the parts are put upon the stretch and closes when the pressure beneath relaxes.

And now all forward of the loop becomes strongly pressed upon from within and is much distorted and its color changed to very dark purplish, dingy and livid. This steady, strong pressure from within continues ten or fifteen minutes. At length the skin on top of the second ring suddenly parts asunder its whole length and the glossy surface of the pupa is crowded strongly upward in this elliptic opening. At the same time the top of the head opens apart; and at this moment there is a strong constriction forming a narrow belt around the neck; but with the outward pressure before and behind it, this first ring now parts asunder, and the whole anterior part of the pupa rises out of the opened larva skin, which slips downward from off this fore end of the pupa, the edge of the old skin at this moment extending from the back a little forward of the loop, diagonally forward and downward upon each side. The skin is next to be slipped backward out of the loop. This is accomplished by the pupa contracting and elongating its body a few times and simultaneously wriggling itself from side to side. These motions crowd the very thin film of skin rapidly backward, out from the loop and onward toward the tip. Back of the loop the pupa bulges out as it is released, little by little, from the constriction of the larva skin, and this abrupt enlargement pushes against and aids to crowd the skin backward, step by step, each time the pupa elongates itself. It is principally by a vermicular motion, a succession of contractions and elongations, that the abdomen of the pupa appears to crawl out from the larva skin, the process resembling an earth worm (*Lumbricus*) crawling out from its hole in the ground. The skin as it is crowded back becomes wrinkled into little plaits and folds. It is pushed back farther and farther, until it finally forms a crumpled soft gray mass of thin membrane and hairs around the tip of the body.

The last act of this metamorphosis is very curious. The pupa is held only by the loop around its middle and the tip of its body imbedded in the crumpled larva skin which remains fastened to the little hillock of threads by the hooks which belonged to the hind feet. The pupa now, by contracting, draws the end of its body out of the crumpled mass of skin, and is therenpon held in place by the loop alone. Its body ends in a pair of soft pincers, and it is wonderful to

observe how dexterously as soon as these pincers are drawn out from the mass of old skin they pass back over this mass, and then bending inward vigorously push the mass forward and briskly feel around its farther side, till they find the little hillock of threads and instantly grasp it firmly. But the crumpled mass of skin and hairs crowds against and discommodes the hind part of the body. And how can the pupa relieve itself from this discomfort, having no mouth, no feet, wherewith to dislodge the mass and move it aside? The expedient to which it resorts is most singular and admirable. Immediately as the curved tip fastens to the little hillock of silken threads a brisk circular motion of the body commences, like that of a pestle carried around and around in a mortar; not a semi-circular motion, as some authors have stated. Hereby the old skin is pressed against at every turn and is gradually broken from its attachments and finally drops to the ground.

The change now described takes place with great rapidity. Reaumur terms it the affair of a moment. From the opening of the skin on the back of the neck till the detachment and fall of the crumpled mass of old skin, it has been five minutes, in two instances in which I have noticed the time.

It will be observed by those who are versed in what has been published on this subject, that my recital of the manner in which the pupa releases the hind part of its body, from the larva skin is quite different from that of Reaumur, our principal authority on this subject hitherto. The observations of this distinguished philosopher and naturalist are so accurate and he describes them with such clearness that they have justly been universally confided in. And probably no one since his day has investigated this metamorphosis of the turnip butterfly, from deeming his history of it to comprise all the facts and to be perfectly authentic.

According to Reaumur's account, when the larva skin has been pushed back so far as to cover only about one-third of the length of the pupa, the insect ceases to shorten and lengthen itself, it being more convenient for it to directly withdraw the extremity of the pupa, and then push it back along the outside of the empty larva skin till it reaches the little cone or hillock of silk threads, into which it fixes the minute hooks at the extremity of the tail. We have already seen it is the habit of the larva when molting to draw the hind part of its body out of the old skin, in much the same manner that is stated of the pupa, accomplishing this by means of its three anterior pairs of feet. But the pupa having no feet or other external

members, I know not how it can draw the end of its body out of the larva skin, except by shortening it, although Reaumur says it has ceased to shorten and lengthen itself. And several considerations seem to render it wholly impossible for the pupa to release the end of its body in the manner stated. Hanging as it does closely girt about by a loop around its middle, its body cannot be moved forward a third of its length without breaking the loop. The loop it should be observed is more or less imbedded in and glued to the surface, whereby the releasing of the hind end from the larva skin in the manner stated must be effected wholly by the half of the body back of the loop. This half of the body is three-eighths of an inch long, with two-thirds of this length covered by the larva skin with its tip fastened to the little hillock of silk threads; being thus situated I know not how it can draw itself out of the larva skin except this half of the body shortens itself to one-third of its length, and this it is obviously incapable of doing. But it is unnecessary to pursue this subject further. Suffice it to say that with Reaumur's statement in my thoughts and my attention fixed upon what was taking place, I have distinctly seen the vermicular motion continue, the body contracting and lengthening alternately and crowding the larva skin backward, further and further, until all the segments of the body except the last were released. And how Reaumur came to fall into the error it thus appears he has done is unaccountable to me.

The pupæ are three-quarters of an inch long, and about one-fourth as thick. They are quite rough and uneven anteriorly, with projecting ridges and angular points on the back, and the head prolonged into a tapering horn. In their color they are variable as the chameleon, the same pupa sometimes changing to a wholly different color in twenty-four hours. Is their color influenced by that of the surface on which they are placed? A worm which I confined in a stone jar, which was dark-brown inside, girt itself to this surface, and changed to one of the darkest colored pupæ I have seen. They are frequently green, or bluish-green when they have newly entered the pupa state, but this color fades after a time. Others are flesh-colored. Others are brown, often of a pale umber tint. Their most common color is gray, usually pale or ash gray, and they are freckled with numerous black dots. When the time is near for them to give out the butterfly the wing-sheaths become bright yellow, and show also the black spots of the wings, whereby we are able to ascertain the sex of the butterfly some weeks previous to its birth.

These pupæ vary somewhat in their size, but are commonly 0.75 long, 0.20 broad, and 0.20 high. They are divided into thirteen segments, by transverse sutures which are for the most part quite distinct. On the back, which is downward as the pupa reposes suspended in its loop, the first suture crosses the anterior part of the elevated nose-like protuberance, frequently making a slight notch therein. The second segment or prothorax case is large and strongly elevated in the middle, forming the nose-like prominence just mentioned. Often a slight notch in the hind part of this prominence shows the suture between this segment and the third, which is short, and the suture between it and the still shorter fourth segment is quite faint. But this fourth segment is readily recognized by the loop which passes across its middle. The fifth or first abdominal segment is quite distinct and equals both the preceding segments in its length; and on each side it is elevated into a compressed keel-like edge, the anterior part of which projects up in an obtuse angular point. The sixth segment is still more elevated on each side, the edge jutting up into a sharp point or angle. The following segments are plainly marked by conspicuous sutures. They on the back are roof-shaped, with an elevated line along the middle, and another, less prominent, along each side. On the under side these segments are rounded, forming a half cone.

Its colors are too variable and evanescent to admit of an exact description. When it has newly entered the pupa state it is frequently bright green, with a bright yellow line along the middle of the back and a white line on each side, and some black marks and numerous dots. Of these colors the last only remains, the others fading away, and the pupa usually becomes dull gray, marked with black as follows: A stripe on each side of the conical horn in front; a spot on the apex of the nose-like prominence; a spot on the angular points on each side of the fifth and sixth segments; numerous small dots symmetrically placed, the more conspicuous ones being a row along the middle of the back, placed one at the anterior edge of each abdominal segment; a lateral row of smaller ones, placed on the anterior angles of the same segments; four small ones in a transverse row across the middle of the sixth segment, and six in a similar row on the seventh segment; numerous fine dots on the veins of the wing-sheaths, and a row of larger ones alternating with the tips of the veins.

In summer this insect remains in its pupa state sometimes only a week. Therefore, as it continues about a week in the egg, and the larva completes its growth in a fortnight, and then reposes two or three days suspended in its loop, these cabbage worms can grow up to their perfect form in one month from the time the eggs are laid. The duration of this chrysalis state, however, is extremely variable. This is the more remarkable, as the larva is so constant in completing its growth in fourteen days. Joseph L'Admiral, long ago, published the dates when five of these cabbage worms took on their pupa form, and when these pupæ gave out the butterflies. I have completed similar observations in four instances, having several others still in hand to become completed the coming season. These observed instances, combined, form an interesting table, showing how very irregular is the duration of the chrysalis state in this species, no other insect within my knowledge being thus erratic. Each

of my observations began in August, those of L'Admiral, in July and September.

Table Showing the Duration of the Pupa State at Different Dates.

Pupa state began.		Butterfly came out.		Pupa state lasted.
July	8	July	19	11 days.
"	20	August	5	16 "
August	19	"	26	7 "
"	21	December	8	109 "
"	22	September	2	11 "
"	29	"	7	9 "
September	4	"	23	19 "
"	5	May	28	265 "
"	16	April	1	197 "

Its change from the pupa to the perfect state is in no respect different from that of the white butterfly, narrated on a preceding page.

From the other white cabbage butterflies this species is distinguished by having the fore wings blackish at their tips and with a round black spot in the middle slightly beyond the center, the females having a smaller second spot between this one and the inner edge; and both sexes having a small black spot on the outer edge of the hind wings a little beyond the middle; its size also, measured from tip to tip of the opened wings, being two inches, but frequently varying to a quarter of an inch smaller or larger than this, the larger ones being females.

The head is coated over with straight white and black hairs of different lengths, the black ones less numerous on the under side. The eyes are large, protuberant and hemispherical; in the living specimen grayish green, with four rows of movable black spots, the central spot being of a deeper or coal black color; in the dead specimen dull brown and without spots. The antennæ are 0.40 long, and composed of thirty joints, which are shorter at each end than in the middle. They are slender and thread-like, with the tips enlarged into a knob of an elongated egg-shaped form with the larger end outward. Their colors are prettily arranged in new and unrubbed specimens, the outer and under sides being white; on the upper side a continuous black line; on the inner side a row of long oval dark brown spots, one on each joint extending from its base nearly to the tip; these spots separated from the black line above by a slender white line, which is widened toward the apex of each joint, and there sends downward a transverse band connecting this white line with the white under side. The knob is flattened or spoon-shaped and black on the concave inner side, white on the lower edge and outer side; the upper part of this side being sprinkled with black scales which sometimes form bands of this color; the tips pale yellow. The thorax is black and clothed with soft hairs of a white or bluish white color. The abdomen is black and covered with white appressed scales, less dense

upon the back; its under side white and coated with white scales. The legs are covered with white scales, and the under side of the thighs with white hairs; and there is frequently a black stripe on the thighs and one or two slender black lines on the shanks and feet. The wings are white and at their bases dusted more or less with black scales. The fore wings frequently have black scales sprinkled along their outer or costal border its whole length. At their tips is a large triangular grayish black spot, which is longer on the outer than on the hind side, and on its inner side straightish, frequently with a concavity toward its inner end. In the female this spot is larger, but effaced on its inner end, whereby it has more of a squarish than a triangular form. Slightly beyond the center of these wings is a large black dot or round spot; and between this and the inner edge, in the female, is a second spot, which is usually smaller and less regular in its form, with its edges more indefinite. And in this sex is frequently a faint gray streak on the inner border of these wings, extending from opposite the inner spot forward toward the base. The hind wings in both sexes have a black spot on the outer margin a little back of the middle, which is smaller than those on the upper wings, and its edges indefinite. On the under side, the fore wings are white and sprinkled with black scales at the base and along the outer border sometimes to the middle. Along the inner side of the rib vein toward the base is a broad stain of yellow, more distinct in the females. The tips are pale yellow; and in both sexes here are two black spots, corresponding with those on the upper side in the female, but commonly smaller. The hind wings are pale yellow, and dusted over with small black scales, which are more numerous toward the base; the outer edge is brighter yellow near the base; and no vestiges of the black spot of the upper side are here visible in either sex.

These butterflies are liable to vary greatly in their markings, the spots being larger or smaller, coal black or pale, sometimes quite small and dim, and sometimes one and another of them totally disappearing. In the south-eastern part of Europe, a small variety occurs in which all the spots are wanting except that on the upper side of the fore wings. This has been treated by Hubner as a distinct species, under the name *P. Ergane*.

Another variety, also small in size and coming out earlier than the others appear, having the bases of the wings black, the tips of the fore pair slightly, if at all, blackish, the second spot on these wings double or composed of two small dots, and the under side of the hind wings very densely dusted over with black scales, was long regarded as a distinct species, named *P. Metra* by Stephens. Among some late pupæ, kept in a warm room the present winter, one has given me a butterfly of this variety.

Westwood says: "Some females have the upper side dirty pale buff." I have not met with any in this country thus colored. Curtis states that he has a male "which has all the wings of a bright yellow color." I possess two specimens of this kind, both as deep yellow, and nearly the same tint as our common yellow butterfly, *Colias Philodice*. These both came from larvæ which, when nearly grown, had been placed in boxes with some leaves on which to feed and were

afterward forgotten, and completed their transformations thus closely inclosed. It would hence appear that seclusion from the light tends to produce this yellow variety.

This species is very common in all the countries of Europe, from Lapland to the Mediterranean. Boisduval states that it also inhabits Barbary, Egypt, Siberia, Asia Minor and Cashmere.

In a collection received from the late M. S. Culbertson, D. D., Missionary of the Presbyterian Board at Shanghai, China, are a dozen specimens which present such slight and unessential differences that I cannot deem them anything else than a local variety of this species. In the males the spot at tip of the fore wings is larger, extending the same distance on the hind side of the wing that it does on the costal side, and is darker colored from being less dusted with scales, and these scales are sky blue instead of white, and are most numerous along the costal side of the spot. The second spot on the under side has opposite it on the upper side a few black scales forming a faint cloud in most of the examples. On their under side the fore wings are more broadly stained with sulphur yellow on their outer base, this stain being faintly prolonged along the costa to the yellow spot at the tip; and upon the inner side of this yellow stain is a faint brown or smoky streak, formed by a cluster of black scales in the hind part of the discoidal cell toward its outer side; this streak being distinct and quite obvious to the eye in each of these examples, yet in none of my American or European specimens do I perceive any traces of it. The tips of the fore wings beneath, and the surface of the hind wings are pale ochre and brighter yellow than in our insects, and the hind wings are less dusted with black scales, these scales being most dense in the inner half of the discoidal cell, whilst the outer part of this cell and all the hind half of the wing is nearly or quite destitute of them. In the female the black spot on the tip of the fore wings is larger, more broad and more nearly square than in our insects.

This new insect, on this side of the Atlantic, is currently termed the cabbage worm. In Europe, everywhere in company with it is another very similar but larger species, which is called the cabbage butterfly, its scientific name also being *Pieris Brassicæ;* and this smaller species is distinguished by the names small white butterfly, small white garden butterfly, small white cabbage butterfly, and in conformity with its scientific name it is also termed the turnip butterfly. This last we regard as its most appropriate name, its larva being equally common on the leaves of the turnip and ruta-baga as on those of the cabbage; though as they do but little injury to the tur-

nip crop their presence upon it is noticed much less than on the cabbage.

It received its scientific name from Linnæus, first in his Fauna of Sweden, published in 1746, where, and in his subsequent works, he termed it *Papilio* (*Danai Candidi*) *Rapæ*, the last or specific name being the old Latin and also the botanical name of the turnip. And by this name only it has been known to naturalists from that day to this, it having escaped from becoming overloaded with synonyms as are so many of the common European insects. Although a multitude of writers have noticed it, it is a pleasure to see its several varieties have been mistaken and proposed as species only in two or three instances.

A prominent trait of this insect, is its quiet peaceful disposition. The larvæ avoid any intrusion upon each other, and upon other insects. Each one appears to feel it has a right to the leaf on which it finds itself placed, and is reluctant to forsake it and go to another leaf, as if fearful it might thereby be encroaching on the domain of another. Whoever has fed these worms, in cages, will have noticed that when fresh leaves are supplied to them, they do not begin to feed on them until the leaf they have been eating is consumed, or has become so stale and dried that it is no longer edible. The young worms are particularly timorous in this respect. When a small piece containing a young worm is cut out from a leaf, it soon becomes so dry and hard that the worm is unable to eat it, yet it appears to feel it has no right to any other leaf than that. This dried fragment, with the worm standing upon it, being placed upon a fresh leaf, the worm, pressed with hunger, after awhile crawls hesitatingly to the edge, and reaching off begins to feed upon the fresh leaf. But if any slight jar or other motion occurs, it instantly draws back, as if it felt guilty of pilfering a dinner which belonged to another, and it stealthily glides to the middle of the dry fragment, seemingly to make it appear that it has not been intruding outside of its own domain.

If an aphis is located on the under side of a leaf on which a worm is feeding, the latter avoids encroaching upon, or in any way molesting it, leaving untouched a portion of the leaf a half inch or more in extent around the aphis.

When a worm is jostled or otherwise annoyed by another worm, an aphis, fly or insect wandering about upon the leaf, it jerks its head violently from side to side, which usually has the effect of turning the intruder away. But if this resort fails, the worm stoically submits, and without further resistance allows the other to crowd against

it, or mount over its back. It never attempts to bite another insect or larva, however much it is molested by it.

Another trait of this cabbage worm which merits to be particularly noticed, is its strong vitality, its remarkable hardiness and tenacity of life. Several facts already stated show that both the larvæ and the pupæ survive such disasters and mistreatment as would be deemed fatal to them. And I may further add to what has been related, that water does not appear to drown these worms, and freezing does not appear to kill them. Upon a chilly day, in the middle of November, meeting with a half grown worm which appeared to be so torpid with cold that it was unable to crawl, I placed it in a concavity in a cabbage leaf which was lying upon the ground, proposing to observe it further. A cold rain coming on, filled with water the hollow in the leaf, in which this worm was lying, and the following night this water froze to ice. Going to it the next morning, and finding the worm imbedded inside the solid ice, I placed it upon a dry leaf in the sunshine, where the ice gradually melted, and the worm becoming dry was found to be alive. Bringing it in doors, its neck was found to be swollen, showing that it was preparing to cast off its old skin, and would therefore remain quiescent until this was accomplished. It, however, turned its head around whenever it was touched, and the next night it changed its skin, thus showing that it survived an immersion of eight or ten hours in water of icy coldness, and a freezing inside of a cake of ice.

Being thus strongly tenacious of life, those offensive and poisonous substances which are repulsive and fatal to many larvæ, will have little if any effect upon these worms.

Most fortunately, nature has provided many natural enemies to these cabbage butterflies, whereby in their native haunts they are constantly preyed upon and restrained from becoming unduly numerous. But having newly arrived on our continent, they find they are here released from their most inveterate destroyers, and are therefore able to multiply without check or hindrance. Sooner or later, however, these foreign destroyers will follow them to our shores, or some of our American predaceous insects will learn to assail and prey upon them, whereby they will cease to be tho formidable evil which they now are.

The birds, by European writers, are ranked as most important destroyers of the larvæ of this and the larger cabbage butterfly. Mr. Haworth states that "small birds destroy incredible numbers of them as food, and should be encourged. I once observed a titmouse (*Parus*

major) take five or six large ones to its nest in a very few minutes. In inclosed gardens, sea-gulls, with their wings cut, are of infinite service. I had one eight years, that lived entirely all the while upon the insects, slugs and worms which he found in the garden. Poultry, of any sort, will soon clear a piece of ground."

But the most efficient enemies of these butterflies are their internal parasites. These are mostly very small ichneumon flies, resembling winged ants. The most common of these parasites is the *Microgaster glomeratus*. This minute fly punctures the skin of the cabbage worm in thirty to sixty places, inserting an egg in each puncture, from which a maggot hatches, which feeds internally upon the worm, weakening it to such an extent that it dies immediately after these maggots have got their growth and issued from it.

Another important parasite is the *Pteromalus puparum*, which, on finding a pupa which has newly entered this state, places upon its surface her whole stock of eggs, to the number of two or three hundred. And the exceedingly minute maggots which hatch from these eggs, eat into the pupa, and there complete their growth and transformations in about a fortnight, the tiny flies then coming out in a swarm, hovering and dancing around the dead pupa until the sexes have paired, when the females fly away to find new pupæ on which to place their eggs.

Another ichneumon fly is much larger, and distributes its eggs one to each pupa. Still, another exceedingly minute fly is reared in the eggs of these butterflies.

As yet, I have met with no internal parasites infesting these larvæ or pupæ in this country. Mr. Provansher, of Quebec, however, has obtained a two-winged fly from one of the pupæ, which resembles one of our common flesh flies.

Other predaceous insects and arachnidans slay and feed upon these cabbage worms, and some of these slaughter such numbers that they are nearly as efficient destroyers as are their parasitic enemies. On the first of September, upon a plant which had nine leaves, the largest ones being five or six inches broad, I counted seventy-one eggs. As the plant could not sustain one-third of this number of worms, I let these eggs remain undisturbed, to observe their subsequent history. Five days afterward, there were on this plant twenty infant worms, and only thirteen eggs. Thus thirty-eight eggs, more than half of the previous number, had disappeared. On the under side of the leaves, in several places, small holes, two or three contiguous to each other, were eaten into the pulp of the leaf, showing that young

worms a day or two old had been feeding in these places. The query therefore arose, what had destroyed these worms? On coming to inspect the leaves more particularly the agent in this destruction was quite evident. Small spiders were observed inhabiting the under side of the leaves, four to eight in number upon the larger lower leaves, some of them standing openly exposed upon the leaf, others nestled under a slight web. They had apparently been attracted to this situation to feed upon these worms, and one of them was seen a few days afterward in the act of eating a small worm which it had killed. By slaughtering such numbers of these worms immediately after they hatch from the eggs and before they have eaten the cabbage leaves so as to occasion any damage to them, they render us an important service.

As seen upon the cabbage leaves these spiders are one-tenth of an inch in length. They are of a waxy white color, smooth and glossy, with two black parallel lines along the middle of the fore body, the lines united at their hind end. The abdomen or hind body is globular and usually of a yellowish tinge, with a broad stripe of opake milk-white along the middle of the back and a narrower one on each side. They have eight small black glass-like eyes in front, placed in two rows. The four middle ones are placed at the angles of a square and the two outer ones on each side are united together. They will thus pertain to the genus *Theridion*. This species does not appear to have been described either by Prof. Hentz or Baron Walcknaer. I meet with it so common upon the under side of cabbage leaves that, although it may hereafter be found equally common in other situations, it may appropriately be termed the cabbage spider, *Theridion Brassicæ*. It grows to nearly double the size above stated, and then varies somewhat from the markings it presents when young, as noticed in the following description.

The Cabbage Spider, *Theridion Brassicæ*, grows to 0.18 in length, and is of a waxy white color, with two black parallel lines along the middle of its fore body, ending anteriorly near the eyes, and confluent at their hind ends. The abdomen is globular, and in young specimens shows a stripe of opake milk-white upon the middle of the back and one upon each side; that upon the back being broad anteriorly and tapering to a point at its hind end, its anterior half having a waxy white line along the middle, and a transverse line of the same color crossing the stripe and slightly separating its forward end from the remainder, this stripe being also three-lobed on each side, the middle lobe longest; the lateral stripes also having similar but smaller lobes on their upper side, the ends of which project into the sinuses between the lobes of the dorsal stripe. In adult specimens the whole upper side is opake milk-white, which color on the sides is broken into minute dots. The under side is waxy white, with a black dot on each side of the tip, and a third one on the base.

The legs are long and slender, the first pair being longest and the second pair next the third being slightly shorter than the fourth pair. They are ornamented with a a black band on the tips of all the shanks except the third pair.

The female incloses her eggs in a globular ball of a white color, two-tenths of an inch in diameter.

The UNDERLEAF SPIDER, *Theridion hypophyllum*. Another spider, a pretty little species, occurs on the under side of the same leaves with the preceding, and is about half as numerous. It probably feeds upon the young cabbage worms, but I have no positive evidence that it does so. Though it is no larger than the preceding species, it is much more conspicuous from its bright colors. Its forebody and thighs are bright cherry red, its globular abdomen is black and shining, and four punctures or impressed points are seen upon the forepart of its back, at the angles of a square, whereof the hind side is longest. Its legs are black or blackish, and more short and thick than in the foregoing species. The chelicers of the male are large and black.

This is a common species, and inhabits the under side of the leaves of forest trees, as well as those of garden vegetables. I have also met with it repeatedly on the surface of the snow in forests, on mild days in winter. On the leaves of trees, I have noticed it feeding on plant lice.

This lovely little spider I have sometimes thought might perhaps be a variety of the *Theridion roscidum* of Prof. Hentz. It, however, is quite constant in its colors, and I have never met with a specimen having spots on the abdomen, as is called for by the description of that species.

These cabbage worms are also destroyed by some of the rapacious bugs of the order Hemiptera, insects which are commonly recognized by the flattened form of their bodies, and the disgusting bed-bug odor which they emit. Though most of these bugs subsist upon the juices of vegetables, several of the species, with their sharp needle-like beaks, pierce the larvæ of other insects, and suck out the fluid contents of their bodies. Some of these predaceous bugs become residents of the cabbage patch, upon discovering the ample supply of food which is there presented them. One of them, in its larva, its pupa or its perfect state, may occasionally be seen standing on the edge of a cabbage leaf, with a worm hanging downward from its beak, dead, flaccid and doubled together. It is occupied about six hours in sucking the fluids of one of these large worms, and this meal usually suffices it for forty-eight hours, after which another worm becomes its victim.

The important question remains to be considered; how can we most successfully combat this new enemy and rescue our cabbage crop from the destruction which appears to be impending over it? And the thought which first occurs in connection with this inquiry is, that having received this evil from Europe we can from thence be informed of its best remedies, aware that during the centuries of experience they have there had with this enemy every measure for its destruction which promises to be of value will no doubt have been fully tested, and those which are most efficacious will have been conclusively ascertained.

And we find that about the only measure recommended by European writers is, searching out, capturing and destroying the insect in all the different stages of its growth. Kollar says: "The best way to destroy them is picking off and killing the caterpillars, as well as the pupæ, the latter being found attached to adjacent trees, hedges and walls." Duponchel, in his Iconograph of Caterpillars, vol. 1, p. 50, says the most efficacious measure for destroying them will be for the gardeners to employ their idle children in capturing for the slaughter all the white butterflies which are flying around their cabbages, as these are mostly females seeking places to lay their eggs; and slaying one female before she begins to lay, we destroy one entire generation of caterpillars, composed perhaps of a hundred to a hundred and fifty individuals. He also recommends searching for and destroying the eggs and the pupæ.

Setting children to capturing all the butterflies that come around the plat of cabbages, stimulating them to increased diligence by a trifling reward for a certain number caught, I regard as the most effectual mode of keeping the crop free from this enemy. They should be furnished with a net, a bag made of musquito netting or some similar fabric, about three feet long and eighteen inches diameter, its mouth sewed to a hoop of stout wire with the ends securely fastened to a handle some four feet long. With such a net the butterflies will be readily caught, as they are commonly slow in their flight.

Many of the pupæ may be entrapped by placing pieces of boards between the rows of cabbages, elevated two or three inches above the ground, to the under side of which numbers will resort to pass this stage of their lives. A half dozen boxes open at the bottom and top, used for protecting hills of cucumbers from the striped yellow beetle, having been left lying upon their sides three yards distant from a row of ruta-bagas, were found with fifteen pupæ in them, showing that

the insect resorts to the nearest covert it can find, in which to pass its pupa state.

To search the cabbage leaves over and with scissors cut asunder every worm that can be found, repeating this search so often as is required, is a task so formidable, that many persons, instead thereof, have dusted their plants with some powder or sprinkled them with some solution, hoping hereby to destroy at least a portion of the worms or banish them from the plants. But, I am informed by several persons, that of the many substances of which they have thus made trial, not one has appeared to possess any efficacy. I notice, however, that my esteemed friend, Mr. Riley, states that "white hellebore will kill the worms if sprinkled on to them." From the experiments I had made with this substance on several different larvæ, I had supposed it would have no effect upon these cabbage worms. Whilst it is certain and immediate death to the larvæ of different species of the saw-flies (*Tenthredinidæ*), the larvæ of the Lepidoptera appear to be unaffected by it. Even when the latter are forced to eat it largely with their food, though its acridity produces purgation and violent inflammation of the intestines, they always recover from this severe illness. Mr. Riley's statement, however, being so positive, has induced me to make a trial of this substance upon these worms. Hellebore, which had a few weeks before killed every currant worm where it had been applied, and was thus known to be a good article, was dusted upon a cabbage worm till it was so coated therewith as to wholly hide its green color, except on the under side of its body. And I could not discover that the worm was in the least affected thereby. Crawling between the leaves in its cage, it in about three days had rubbed off all this powder, being no more discommoded by it, apparently, than if it had been road dust. As this and other poisonous substances have no effect on these worms, it seems hopeless that any remedy can be found, which, dusted upon the cabbages, will destroy them without destroying the cabbages also. And we are thus left to capturing the butterflies, and searching out their eggs, their larvæ and pupæ, and destroying them one by one, as our only resort for saving our cabbage crops from the ravages of this insect.

FOURTEENTH REPORT

ON THE NOXIOUS, BENEFICIAL AND OTHER INSECTS OF THE STATE OF NEW YORK.

By Asa Fitch, M. D., Entomologist of the Society.

Scollop Shell, *Scotosia undulata*, Linn. (Lepidoptera. Geometridæ.)

The last of July, two or more leaves of the cherry fastened evenly together around their edges, and between them a pale, black-dotted measure worm, its back dull greenish with four white lines, and on each side a dark green stripe; its pupa under leaves on the ground through the winter, and in June producing a moth, with wings all occupied with alternate blackish and whitish wavy lines.

A delicate moth, an inch and a half in width, and known to English collectors as the scollop shell, from its resemblance to the ribbed shell thus named, is marked in a peculiar manner, the whole surface of both pairs of its wings being occupied with numerous wavy and zigzag lines alternately of a pale gray and a brown or blackish color, whereby it is easily recognized and remembered. It is said to be met with in woods, sparingly, but almost everywhere through the northern countries of Europe, and occurs abundantly in particular localities of limited extent. Upon this continent I have several times met with it in my own neighborhood, and it has been repeatedly found in Canada and Nova Scotia, and as far north as Hudson's Bay.

This moth has been well known in Europe for such a long period it is remarkable that none of the naturalists there appear to have discovered the measure worm from which it is produced, nor the vegetation on which this worm feeds. Though the old authors, a century ago, mentioned the sallow, *Salix caprea*, as being the tree upon which it is reared, our modern lepidopterologists make no allusion to this topic; whence it is evident the worm and its food is unknown to them.

On the first days of August, last year, I noticed that a young cherry tree growing in my yard had the two last leaves on the end of several of the branches and shoots curiously fastened together, face

to face, their edges evenly meeting all around; the outer sides of the leaves being also convex, thus making a cavity between them and giving them the resemblance to the two valves of a clam shell; and their inner surface, which had been the upper side of the leaves, and also their parenchyma, had been extensively eaten by worms residing in the cavity between the leaves, there being but one worm in some of these cavities and in others two or three, and sometimes as many as five or six. The leaves at the end of the limbs and twigs are nearly or quite alike in their size and form, and the worm, by spinning from its mouth a fine silk thread and fastening it first to the edge of one leaf and then to the edge of the other, by making each successive thread as tight as it is able when fastening its end, manages to gradually draw two leaves together, with their upper sides facing each other; and when they are brought into contact, the worm, standing upon the edge of the two leaves, and carrying its head from side to side, fastens the thread it is spinning successively to the border of one leaf and the other as it steps backward, traveling around and around upon the outer edge of the leaves a multitude of times. This work is done, no doubt, by night, when no bird or other enemy is abroad to espy it when it is thus conspicuously exposed; and it is probably employed at this work for several successive nights, adding to the threads until a thin, paper-like tissue is formed over the united edges, thus wholly excluding any parasite or other insect enemy from entering its habitation. The threads of this tissue are placed lengthwise of the leaf and diagonally, none of them appearing to be transverse.

The worm lives in security between the leaves, feeding upon their pulp, until it is wholly consumed, except a slender border around the outer edge of both leaves—the skin of the under side of the leaves and the network of veins remaining and continuing to constitute a secure wall to the house in which the worm lives. The two leaves do not furnish the amount of sustenance it requires to bring it to maturity, and when their pulp is consumed a third leaf is similarly drawed down and tied over one or the other of the two first, and then a fourth, till finally six leaves are usually tied together, though only a part of the last ones are eaten, portions of them remaining green. The first leaves die and become brown as other leaves overlay them, and with each additional leaf the nest becomes more convex and globular, till finally it forms an uneven ball or a short bag. On tearing these leaves apart one or more worms and a quantity of black grains, their feces, are found in the cavity inside.

These worms are slender cylindrical, and grow to nearly or quite three-fourths of an inch in length. The surface of their bodies is smooth and without any raised points or ridges. Like other measure worms they have only five pairs of feet, one pair at the tip and another pair a little forward of these, being thick prolegs, and three pairs of slender true legs upon the breast. Some short fine erect hairs are scattered over the surface, arising from black dots. Along the middle of the back is a pale livid greenish stripe, bordered on each side by a rather thick whitish line, outside of which is a paler lurid greenish stripe of similar width to that on the middle of the back and having in it two black dots upon each segment, and on its outer edge a whitish line similar to that on its inner edge. Outside of this whitish line, along each side of the back, is a very dark green stripe, of the same width with the paler green ones inside of it, and having along its outer edge a yellowish white line. Below this line the sides are pale greenish yellow, with a slender yellowish white stripe upon an elevated ridge of the skin, there being on each segment two black dots above this stripe, the anterior dot being the breathing pore, which, more highly magnified, is seen to be a minute yellow dot inclosed in a black ring. There is also a black dot in this stripe and two below it, these last being usually margined with a yellowish white ring. Directly below the hind one of the dots last mentioned is another black dot placed in a slender broken faint yellowish white stripe. And forward of this dot is another, and below this still another, on the under side of the body. On the hind end of the back is a semicircular black spot; and there is a large black dot on the base of each of the hindmost legs. These thick prolegs are glossy, and of a pale yellowish and watery color.

These measure worms completed their growth on different days early in August, and then descended to the ground, crawling under dead fallen leaves and other rubbish, where they spun a few fine threads like cobweb upon the ground over and around them. They here cast their skins and appeared in their pupa form, usually having the small slender two-parted hook at the end of their bodies fastened into some of the cobweb threads. The pupa is glossy and of a bright chestnut brown color, its surface minutely wrinkled and with the abdominal segments coarsely punctured. It is 0.40 long and 0.12 thick. In this pupa state the insect remains through the winter.

In Europe these moths are stated to make their appearance the last of June, and this is the time I met with them in former years. But for six years past my specimens have all been captured nearly a month later, on the 20th of July, or within two days of that date; and seven moths reared in cages all came out upon the 18th of July and the three following days.

The moths measure 1.35 to 1.50 across their extended wings. They are ash-gray, varied with blackish markings and bands on the abdomen. The wings are all occupied from their bases to the extremity with numerous transverse lines or stripes, which are alternately ash-gray and blackish, fading to brown in specimens long preserved. These lines are wavy and frequently zigzag in places, forming right angles at each bend. On the fore wings, the number of blackish lines is usually sixteen. In some specimens these lines are quite uniform from the base to the hind

edge; but, usually, a paler trace crosses the wings slightly beyond their middle. This is caused, commonly, by two of the black lines uniting, more or less, and forming a chain-like row of marks or a series of black rings, or sometimes merely black dots, these being most distinct toward the inner edge. In other instances this pale streak is produced by two or three of the ash-gray lines taking on a white color, or by one of the blackish lines becoming very much broken and effaced. Outside of the center of the fore wings, a black dot is usually perceptible to the eye. In one specimen before me, a short, brown, transverse streak on the middle of the costal edge is quite conspicuous, followed by a second similar streak at one-third the distance from this to the tip. The hind border of the wings is frequently tarnished brown or butternut color, traversed by a wavy white line. The basal fourth of the hind wings is gray, sprinkled more or less with blackish atoms not arranged in transverse lines. These wings are toothed on their hind edge.

This moth was named *Phalæna* (*Geometra*) *undulata*, by Linnæus, first in the tenth edition of his System of Nature, published in 1758, where he characterizes it as having bristle-like antennæ and all the wings above with transverse wavy blackish streaks, and living upon the *Salix caprea*. The specific name *undulata*, it scarcely needs to be mentioned, has allusion to the wavy or undulated streaks upon the wings. Being so distinctly marked, it has escaped from being mistaken and described under different names.

The generic name *Scotosia*, formed from a Greek word implying mist or gloominess, was first proposed by Mr. Stephens for three species of British moths, whilst he regarded this species as constituting another genus. M. Guenee, however, deems the differences between these insects so slight and unessential, that he unites them with still other species under one genus, in which arrangement other authors have since concurred.

These moths are probably nowhere so numerous as to cause any sensible injury to the cherry trees. But their larvæ tying the leaves together in such an artistic manner will attract notice wherever this phenomenon occurs, and will excite a desire for information respecting the insect which has this curious habit.

RASPBERRY BEETLE and WORM, *Byturus unicolor*, Say. (Coleoptera. Dermestidæ.)

Adhering to the gathered fruit of the red raspberry, a very small soft tarnished white worm, passing its pupa state under rubbish on the ground, and coming forth the latter part of May, an oval, pale dull yellow beetle, 0.15 long, densely clothed with short fine gray hairs.

Throughout our country there occurs on the fruit of the red raspberry a small white worm, which commonly remains adhering to the berry when it is gathered, lying usually on the inner side of the

cup or cavity in the berry. Hereby the fruit is rendered unfit for the table or for preserving, until it has been looked over with the utmost care, and the berries closely examined one by one, each berry on which one of these worms is found being either thrown away or the worm removed from it. This picking over of the berries to cleanse them from these worms is a most irksome task, in which many hours of valuable time are every year spent in most of the households in our country. And notwithstanding this scrutiny, some of the worms no doubt remain, and are unconsciously eaten with the berries, it being impossible for the most piercing sight to detect them in every instance, especially those which are young and minute.

When examined with a magnifying glass, these worms are found to be plump and cylindrical, slightly tapered at each end, and nearly one-fourth of an inch in length when fully grown. They are white, each segment having on the back a broad, pale, tawny yellow band occupying more than half its surface, and being also furnished with a few short, erect, whitish hairs. The mouth is darker tawny yellow. On the breast are three pairs of legs, but none on the body back of these, except at the tip, which is prolonged into a single proleg of a short conic form, and blunt at its end; and on the apex of the last segment, above the base of the proleg, are two minute projecting points, appearing like two deep red dots.

When the worm is fully grown, it drops to the ground, probably with the fall of the berry in most instances, and secreting itself under any dead leaves or other rubbish which it there finds, it forms a cell in the dirt, in which it changes to a hairy pupa of a pale dull yellowish color, and in this situation remains at rest through the winter, and till the middle of May or a little later, when it changes to its perfect form, and is then a small beetle about twice as long as thick, varying in its length from 0.12 to 0.15.

This beetle is of an oval form, its opposite sides almost straight and parallel, quite convex above and flat on the under side. It is throughout of a pale dull yellowish color, sometimes tinged with chestnut brown, or reddish, and is covered above and beneath with exceedingly fine short grayish hairs, which are appressed to the surface and arise from fine close punctures, on the wing covers these hairs being finer and less visible. The head is small, roundish, flattened upon the face, and held vertically, sunk into the thorax to the eyes, which are rather large, black, round, and very convex and protuberant. The upper lip is transverse, its edge with a slight, broad, shallow notch or concavity. The antennæ are short, not reaching the base of the thorax when turned backward. They are thread-like, with their tips enlarged into a little knob the shape of an egg reversed. They are composed of eleven joints, which though distinct are compactly united. The basal joint is largest and gradually widens toward its apex. The two next joints are short and thicker than those

which follow, which gradually but very slightly decrease in thickness to the three last, which are enlarged into the knob, and are more broad than long, the last joint being hemispheric and with the convex side outward. The thorax is more wide than long, scarcely wider across its base than its apex, convex above, and on each side abruptly depressed into a thin outer edge, which is much widened at the base, the basal angles being rectangular. The scutel is small, square, and rounded on its hind side. The wing covers are scarcely broader than the thorax, and have slightly elevated slender lines running lengthwise. The legs are of medium size, the hind pair longest, the thighs thick and stout and slightly narrowed at each end, the shanks gradually thicker toward their tips. The feet are more slender, their soles with dense fine hairs. They are five-jointed, the middle joints very small, the fourth joint minute and concealed between the lobes of the third joint; the last joint longest, equaling all the preceding joints in length, with a pair of small hooks at its end which are strongly curved and furnished with a prominent tooth at their base.

LETTUCE EARTH-LOUSE, *Rhizobius Lactucæ*, new species. (Homoptera. Aphidæ.)

On the roots of lettuce, often in great numbers; very small oval, white and pale-yellow lice, with dusky legs and antennæ, their bodies dusted over with a white powder.

The roots of the lettuce in our gardens are much infested by small white wingless lice, which begin to appear upon them early in the season, and multiply and become extremely numerous toward its close. When the lettuce is becoming too advanced to be longer useful for the table, and is beginning to shoot up to seed, upon uprooting it to clear the ground it occupies for other uses, the lumps of earth which break from around its rootlets will frequently be observed to be profusely pervaded with what appears to the eye to be a white moldiness. But on examining this white substance with a magnifying glass, it is found to be a white flocculent matter — a dry mealy powder — interspersed with short white down-like threads. And upon the slender rootlets of the lettuce will here and there be seen a small white louse, with its body dusted over with the same white powder, showing that the moldy appearance of the earth, which was first noticed, has been produced by these lice crawling through it and rubbing off a portion of the mealy coating of their bodies.

And when one of these plants is uprooted, on breaking off pieces of the ball of earth adhering to the roots and rootlets, cavities will be come to which are filled and crowded with a swarm of these lice, of all sizes, from the newly born infants to the full grown adult females, promiscuously heaped together in a confused mass, their bodies dusted over with the white mealy powder above mentioned, and the hind ends of many of them, and the backs also in some, coated with short flocculent fibres, giving them an appearance of being dressed with minute

feathers. They are intolerant of the light, and when the cavity in which they are inclosed is opened, exposing them to the glare of day, they slowly crawl into the cracks and crevices in the ball of earth, one after another, and in a short time all disappear. Here and there among a cluster of these lice is seen a little white, woolly, rough, oval mass. This is a dead louse covered with pruinose and other refuse matter. In the cavities among the lice also occur drops of a fluid resembling clear limpid water, globular, of different sizes, the surface of the globules dusted over with the same white pruinose powder, which keeps them from uniting together when they chance to come in contact; this fluid probably being the honey dew secreted by the lice.

As these small underground lice are destitute of wings, they would be inferred to pertain to some of the Apterous tribes of insects. But, when they are closely examined, they are found to be so very similar to the plant lice, as to show the family *Aphidæ* to be their true place. In this family they constitute a distinct group or sub-family, to which M. Amyot has given the name *Geophthiri*, or earth-lice, (Annales Soc. Ent. de France, 2d Series, v. 485.) They differ from the plant lice in their underground residence, in their never acquiring wings, though it is of late stated that in rare instances some of them have been found with wings, in being destitute of honey-tubes, and in being always viviparous and never produced from eggs. They were formerly regarded as constituting a single species, which was named *Aphis radicum*. But, on coming to be examined more closely, it is quite evident that they are of several species. A number of these species have been named and described, constituting several distinct genera. They are met with not only on the roots of different plants, but also in the ground beneath stones, and in the nests of ants. And ants are always found associated with them. The little brown or dusky ant, *Formica nigra*, Linn., common in gardens, occurs in the cavities containing these lettuce lice, and in the earth around them. And these earth-lice are nursed and guarded by the ants, the same as are the plant lice. Upon raising a stone and finding several of these white earth-lice under it, the collector, after securing one of them, on looking to obtain a second specimen, finds they have all disappeared, having been taken away by the ants into their holes in the ground. And, as stated by Kirby and Spence, they are no doubt carried by the ants and distributed upon the roots of different plants.

This species upon the roots of the lettuce appears to pertain to the genus *Rhizobius*, of Burmeister, in which the antennæ have but five

or six joints, the last joint being longer than those preceding it, and blunt at its apex.

The *young lice*, measuring bnt 0.02 in length, are very pale yellow, glossy and watery, with the legs and antennæ whitish. They are nearly thrice as long as hroad, somewhat flattened, their opposite sides parallel in some, in others slightly widening backward and ronnded at the tip. The transverse sntures are faintly perceptible. The eyes appear as minnte black dots, one on each side of the anterior end. The antennæ are thread like, and only one-fonrth the length of the body. When highly magnified, they appear to be four-jointed, the joints twice as long as thick, the first joint cylindrical, the two following ones thicker toward their tips, and the last one slightly longer than the others, and thickest toward its base. The feet are but one-jointed, half as long as the shanks, and end in a pair of hooks.

The *mature lice* are 0.08 long, their width less than half their length, some being much more broad than others. They are oval, and of a dull white color, with the legs antennæ and beak dusky, sometimes pale smoky with their bases nearly white, and in other specimens much darker and even blackish their entire length, with the end of the body also slightly dusky. The beak is appressed to the breast, appearing like a short dnsky mark upon the skin, its tip scarcely reaching the base of the second pair of legs. The antennæ are shorter and more slender than the fore legs, thread-like and five-jointed, the joints cylindric. The two basal joints are slightly thicker than the following ones, and their length double their thickness. The third joint is variable in its length, in the mature females being almost double the length of the second, and but little shorter than the last joint, whilst in the narrower younger lice it is little, if at all, longer than the second. The fourth joint is the shortest of all, being bnt little longer than thick. The last joint is longest, and is bluntly ronnded at its end. The sutures of the body are marked by slender impressed transverse lines. The feet show but one distinct joint, which is cylindrical, and four times as long as thick in the hind pair, shorter in the middle and anterior pair, with two hooks at the end.

The lettuce is such a thrifty, vigorons plant, that it does not appear to be perceptibly injured, however much its roots are thronged by these earth lice. Other vegetation which is more delicate and feeble has not a like immunity. Dr. Harris relates that upon pulling up China asters which appeared to be perishing from no visible cause, he found hundreds of these little white lice clustered upon the roots. Mr. Newcomb, of Pittstown, N. Y., informed me a few years since that little white lice gathered upon his verbenas, in some instances in such numbers as to completely cover the roots, causing the plants to droop and wither and turn yellowish, and when felt of they seemed loosened and not set firmly in the ground. He found tobacco-water to be an effectual remedy for these insects. By watering the earth around the plants freely with this decoction, he was able to promptly arrest the evil, and none of his plants died, as they inevitably would have done had they been neglected.

In addition to the ants, there occurred among these earth-lice

numerous small white maggots, pointed at one end and blunt at the opposite end; and, also many pupæ of these maggots, the hard, outer cases of these pupæ being 0.15 long, and of a pale, dull yellowish color, one or both ends being darker, and of a brown or reddish brown hue, their head end being abruptly tapered and prolonged into a short projecting point, with its end cut off transversely, and their opposite end bluntly and unevenly rounded, and usually showing two small projecting points, frequently with two large blackish dots above them.

From some of these pupæ I obtained a small yellow fly, which I have frequently noticed alighted in the garden. It is closely related to the *Chlorops lineata*, Fab., and *C. tæniopus*, Meig., having the antennæ inserted upon a slight prominence of the forehead, three broad black stripes upon the thorax, and the fore feet black. I name this fly the Garden Chlorops, and a short description will suffice to characterize it and show that it is different from the species above named.

The Garden Chlorops, *C. hortensis*, is 0.10 in length, and, to the end of its closed wings, 0.15. It is glabrous and of a pale bright yellow color. On the thorax are three black stripes, which are slightly broader toward their anterior ends. The middle stripe is continued forward upon the head to the frontal prominence, narrowing to a point at its anterior end, and it extends backward only to the suture at the base of the scutel. On each side of the breast is a black dot, and forward of it a short black line, which narrows to a very acute point at its anterior end. The abdomen is black, with a narrow yellow border at its tip; it is flattened and broad egg-shaped, its length and width closely like that of the thorax. The face is white, and the last joint of the antennæ black. The fore feet are black their entire length.

Wood Tick, *Ixodes Americanus*, Linn. (Aptera. Acaridæ.)

Common in the forests in unsettled sections of the country, and fastening itself upon man and animals; a flattened, obovate, chestnut red tick, having a white spot on the end of its scutel, and a whitish ring on its knees.

The most common tick of our country, called the wood tick from its inhabiting the woodlands, and not occurring in cleared and cultivated grounds, though formerly abundant throughout the northern and middle States, has now become nearly or quite extinct. The Swedish naturalist Kalm, in passing through the east part of our State one hundred and twenty years ago, when crossing from the Hudson river to Lake Champlain, speaks of the discomfort he experienced from the wood ticks with which the forests there abounded. At this day, along the route he pursued, not one of these insects can probably be found. Residing in that vicinity, I have never met with this wood tick except in a single instance. Forty

years ago one was found in a decaying log in the forest. But specimens received from correspondents at the west and south show it to be still common in the new and sparsely settled sections of our country.

Its becoming thus extinct with the settlement of the country and the clearing off of its forests, is the more remarkable, since in other parts of the world ticks which are very similiar to this abound in old countries where all the tillable land is under cultivation, and even in thickly populated cities. I am informed by Mrs. Culbertson, late of the Presbyterian mission in China, that these insects are very common in that country. She states, that in the city of Shanghae, they are constantly fastening upon the dogs, sinking their heads into the skin of the dog and sucking his blood until they become enormously distended, appearing like a large sized bean adhering to the skin, of a shining bluish color. It is between the dog's toes that they are most prone to fasten themselves, where only the end of their bodies can be seen; and frequently the crevices between the toes are filled with as many ticks as they can hold, others becoming also attached upon the body at different points, distressing the dog greatly, and from pain and loss of blood he languishes and becomes puny, weak and emaciated, dull and spiritless, and dies if he is not relieved from his tormentors. It is the common custom, whenever it is discovered that a dog is much infested, to have a servant take him and by hand pick off every tick upon him.

In those sections of the country which were settled little over a century ago, tradition still speaks of the annoyances which our American wood ticks were, particularly when, in the heat of summer, the woods were traversed for gathering berries. And the account which M. Kalm gave of the habits of this insect to Baron De Geer, the correctness of which is also confirmed by Rev. I. Acrelius, who had been a resident of this country for several years, shows what a pest it was at that period, both to man and beast. He states that these ticks were found in the woods, the whole summer through, occurring there on the bushes and the plants growing among the bushes, but more particularly on the fallen dry leaves of the preceding year, with which the ground is covered; they are there so abundant that if one sits down on the earth or on the trunk of some fallen tree, his clothes and even his body soon gets covered with them; for though of a slow pace, they immediately climb upon his clothing, seeking some naked place on the body, on which they instantly fasten themselves by introducing their trunk into the skin. Those who go into the

woods barefooted soon get their feet and legs thronged with them. They fasten themselves not only on man but also on animals, such as horses and horned cattle, which they frequently kill by fixing themselves in such very great numbers on their bodies, from which they suck the blood. They never inhabit the meadows or cultivated fields, or cleared lands, but always live where trees are growing. They pierce the skin in such a subtile manner that the person attacked does not at first notice their puncture, and only perceives it when they have penetrated so far that half their body is found sunk into the flesh; it is then that he feels at first a strong itching, and afterward a very severe pain at the place of the puncture, where a hard swelling occurs, the size of a pea or larger. It is then very difficult to get rid of the tick, for in endeavoring to draw it out it breaks asunder rather than to let go its hold, so that the head and trunk remain in the sore, soon producing an inflammation, followed by a suppuration, whereby the sore is frequently made deep and dangerous, and is accompanied with a most intolerable itching. It is, therefore, by cutting the flesh all around it that we must try to withdraw the tick entire from the spot where it is lodged. Or it is well to make use of a small pair of tweezers to draw it out, as M. Kalm states he had done with success. But the tick clings so strongly that in this operation one often tears out also a portion of the skin. M. Kalm states that he had seen horses which had the under side of their bodies and other parts so covered with these ticks, that the point of a knife could scarcely be introduced between them, and from being continually sucked by these cursed parasites deeply sunk into their flesh, the animals become so enfeebled, and are tormented so grievously that they eventually succumb and die in great misery.

Various authors have spoken of these ticks, and there has been some confusion respecting them, several distinct species of this country and South America having probably been included under the name *Americanus*. But the brief characters given by Linnæus, derived from the specimens obtained in this country by Kalm, make it sufficiently clear to what species this name rightfully pertains. He defines the *Americanus* as being obovate, reddish, with the scutel and knees whitish. It is very evidently the common wood tick of this country to which this description points.

The wood tick in its natural state, and not at all distended with blood, is flat as the common bed bug, to which it has a resemblance. It is almost circular, being little longer than wide, and is scarcely wider forward of the middle, or egg-shaped, with the pointed end backward, the form technically termed obovate. Specimens are

variable in size, the largest measuring nearly or quite 0.20 in length. It is of a chestnut red, or sometimes yellowish color, with the abdomen commonly blackish. The thorax is glossy, closely punctured, with two impressed longitudinal lines, which are nearly parallel, with their forward ends more deeply impressed. A large white spot on the scutel is variable in its size. The abdomen is not glossy. It has a sub-marginal impressed line, and on its hind part two or three faint, longitudinal impressed lines are usually perceptible. The knees, and commonly the other joints of the legs are marked exteriorly with a small white crescent or a slender ring.

The ticks of our country which are most similar to this merit to be noticed in connection with it.

One of these, differing in being widest back of the middle and thus having an ovate form, and more largely covered with white, this color having a tallow-like appearance, of which I have received specimens from Virginia and from the Indian territory west of Arkansas, may be named and characterized as follows:

FIVE-LINED TICK, *Ixodes 5-striatus*. Ovate, rust-colored; thorax and scutel tallow white with irregular rust-colored spots and punctures; abdomen with punctures and five impressed longitudinal lines, the outer one on each side being sub-marginal; legs paler, their joints white. Length 0.20.

Another species, which was received in company with the preceding, from Rev. William S. Robertson, Tullahassie, Indian territory, I dedicate to its discoverer. It presents the following characters:

ROBERTSON'S TICK, *Ixodes Robertsonii*. Oval, punctured, rust-colored, above marbled with tallow white on the head, thorax and abdomen, with rust-colored punctures; abdomen with a sub-marginal impressed line, between which and the edge are deeply impressed, equi-distant, transverse lines with white interstices; joints of the legs white. Length 0.16.

TORTURING TICK, *Ixodes cruciarius*, new species. (Aptera. Acaridæ.)

An oval lead-colored tick, with chestnut-brown head and legs, which sinks its head into the skin of man and animals, gorging itself with blood; its wound intolerably painful and dangerous.

Dr. Gideon Turner, of White Creek, N. Y., has presented me with a specimen of a tick with which is connected a history of much interrest. I regret that a full written statement of this case, which I had been somewhat encouraged to expect, has never come to hand. A memorandum which I made from a verbal statement which was given to me, is to the following purport:

It was on a morning in July, 1868, that a daughter of Dr. Turner was awakened from her sleep by a most excruciating pain in one of her limbs. She immediately discovered that this torment was caused by an insect which, during her sleep, had almost buried itself in the

skin, and had so filled itself with blood that it was distended to the size and shape of a bean. Of course no time was lost before removing this thirsty little blood hound. Notwithstanding this, the pain continued extremely severe, indicating the wound to have been poisoned by venom from the insect. To neutralize this poison, it was freely bathed with diluted aqua ammonia. She went to the school she was teaching and entered upon the day's exercises, but finding she was becoming more unwell, she was constrained to dismiss her school and return home. The surface around the wound became vesicated, as if from a plaster of cantharides, the whole limb became swollen, some slight convulsions occurred, and, for a time, her condition seemed rather critical. The medication, however, which was promptly resorted to, appeared salutary; the next day she was evidently better, and thereafter speedily recovered.

The following is the description of the above insect, drawn up from the specimen as it appeared when it was placed in my hands some time afterward.

Dimensions, 0.40 long, 0.25 wide, 0.10 high. Color of the body, gray, tinged with blue; anteriorly white, of a tallow-like appearance, here and there with a blackish dot or irregular blotch, six of these dots being in a transverse row on the neck. Head and legs chestnut brown. It is of an oval form, with a gentle contraction forward of the middle and narrower forward of this contraction than it is behind it, the ends bluntly rounded, flattened upon the back and also beneath; the back anteriorly sloping gently downward toward the head. The surface very finely and closely striated transversely. The head (in strictness termed the buckler or shield) is coriaceous and glossy, longer than wide, rounded, its sides back of the middle rectilinear for a short distance, and its anterior end cut off transversely. Its surface is punctured, the punctures minute and shallow, more dense on each side, where are two impressed lines which at their anterior ends approach each other. The beak is short, about a third of the length of the head. The back anteriorly is occupied by large irregular ridges and intervening hollows, which are mostly transverse or oblique. The middle and hind parts present three parallel, wide and deep longitudinal grooves, the middle one less broad, extending farther back, and ending anteriorly in a line with the contraction. Crossing the two interspaces between the longitudinal lines near their middle, is a transverse groove which is less deeply impressed. On the under side two large grooves begin at the throat, and, diverging from each other, extend the whole length, and between them posteriorly is a medial groove which reaches backward beyond the ends of the lateral ones.

Eleven years before this case occurred, in September, 1857, my young daughter found a small tick upon her arm, with its head sunk into the skin, and causing an intolerable pain, much more severe than the sting of a bee or a wasp. She had, just before, picked up a basket of chips under the wood-shed, where this had probably got upon her clothes. As it was instantly removed, the pain gradually subsided, a redness remaining at this point the next day.

The description of this tick, which I drew up at that time, is as follows: Length, 0.10. Of a lurid dove color or leaden-blue, with an impressed furrow on each side of the back, the furrow slightly interrupted near its forward end; and, posteriorly, a similar furrow along the middle, extending a little farther back than the lateral ones, its anterior end more slender, and terminating about opposite to the middle of the lateral ones. Beneath, similar, but the lateral furrows almost in contact at their anterior ends, and diverging backward; and the middle furrow short, being merely a deep, oblong, oval indentation. The head, or clypeus, is crustaceous and shining, diamond shaped, with the posterior and lateral angles rounded and the fore end transversely truncated. It is finely punctured, with two impressed lines reaching almost its entire length, with a shorter line on each side between these and the outer edge. The head is of a pale chestnut color, as are also the beak and legs. These last are shortish, thread-like and equal in length, each composed of six short joints, about twice as long as thick.

Although this tick is so diminutive, and quite unlike the one first noticed in size and appearance, being thin as paper, whilst that is so plump and round that its thickness equals the total length of this, they coincide so exactly in color and sculpture that I doubt not they both pertain to the same species. The two impressed lines on each side of the head and the three furrows upon the back appear to be characters whereby, in connection with its leaden color, this species can be easily identified, whether in its ordinary gaunt state or obese from distention with blood. Though specimens in my collection show there are other species having three furrows upon the back, the furrows differ from those of this species, the middle one in particular being much longer here than appears usual for it to be.

Two descriptions of this tick have now been presented to the reader, one being of its appearance in its ordinary state, when newly captured, the other of its appearance when distended with blood and several months dead and dried. To render this account more complete, I will next present a description taken from a living specimen filled with blood, though not so fully distended as the specimen already described.

One of these ticks occurred firmly fastened upon the skin of a mink (*Putorius vison.*) On removing the skin a bright red inflamed spot, a quarter of an inch in diameter, was exposed on the inner side of the skin at the point where this tick was fastened; and on the whitish fascia of the muscle covered by this portion of the skin was a similar inflamed spot, indicating the excessive irritation and pain the animal had been suffering from this parasite.

The specimen measures 0.38 by 0.23, and is regular oval, with bluntly rounded ends. It is flattened and glossy, of a white color tinged with leaden blue, the head, mouth and legs being dark brown and shining. On the back are three dilated, impressed lines or grooves, which are uneven, the lateral ones being narrowed by a

contraction toward their anterior ends. The middle groove commences farther back than the lateral ones, and its anterior portion is shallow. Posteriorly it is prolonged beyond the ends of the lateral ones. Beneath are two longitudinal grooves, and between their hind ends is an elliptic impression, in depth and width similar to the grooves. One and another of these grooves becomes small and slight, and again becomes deep and wide at the will of the animal when it is living; and in the lateral ones, on the back, a series of punctures, five in number, are at times quite conspicuous. And I notice the middle groove on the back at times becomes for a moment or two greatly increased in its depth and width, the lateral grooves simultaneously being almost obliterated. Over the whole surface are very close minute transverse striæ. The coriaceous chestnut-brown head has numerous punctures evenly scattered over its surface, and four impressed longitudinal lines, the two middle ones diverging backward. The two lines on each side incline to unite at their ends, thus inclosing an elliptic space.

It is slow in its motions, and though heavy and unwieldy, from being gorged with blood, it readily crawls up the side of a glass bottle.

It may be noticed that the blue tinge of the body in this species fades, and at length totally vanishes in specimens which are long preserved. The small specimen described above, which was first taken, is now changed to a dull white color. The specimen distended with blood is also dull white with some dark colored blotches and dots here and there. The specimen taken upon a mink has now become badly "greased," a casuality well known to collectors, rendering one and another of their specimens worthless, and for which there is no remedy that I am aware. Thus affected, this specimen, the body of which was originally bluish white, is now dark chestnut throughout, this being at first the color of the head and legs only.

Is the bite of these ticks venomous? Do they poison the wounds they make? This was a question on which there was some discussion and difference of opinion among persons in the vicinity of Miss Turner, some of those most intelligent on subjects of this kind being of the opinion that the bite of these insects was merely a simple wound. But the excruciating torment which it produces, we think, is a sufficient proof that the wound is poisoned. If it were a simple wound like that made by a sliver of wood, removing the irritating substance would immediately alleviate the pain. But, here, the pain continued intolerable for hours after the insect had been removed. Moreover, the fact is well known that some of these ticks are extremely venomous. One of the most noted of these is the Persian tick, *Argas Persicus*, locally termed the Malleh, and known to travelers as the Venomous bug of Miana, the species being most common and dangerous in that city in northern Persia. As showing the habits of these insects more fully, and the symptoms produced by their bite,

we extract what follows from the account of the Miana bug, given by M. Kotzebue, in his Travels in Persia, in 1817, as cited by Walckenaer and Gervais in their Natural History of Apterous Insects, although some of the statements have a savor of the proverbial exaggerations of travelers. The European bug, with which he compares that of Miana, we suppose to be the common bed-bug.

This dangerous insect, called the Miana bug, is a little larger than the European bug, and is blackish gray, sprinkled on the back with a multitude of red points. It conceals itself in the walls of dwellings, frequenting in preference those that are old. In these the bugs are found in great abundance, and their prick is most dangerous. They never show themselves in the day-time, and are also afraid of light, though the glare of lamps and candles does not always put them to flight. They have infested Miana from time immemorial, and scatter themselves out into its suburbs, where they are a little less dangerous. During winter they remain motionless in the holes of the walls, and, like all venomous animals, it is in the greatest heat of the summer that their poison has the most activity. What is most marvelous of these bugs is that they do not attack the native inhabitants, or, at least, the puncture which they make in them has no more grave results than that of the bugs of Europe; but, in return, they make a cruel war upon strangers who have the misfortune to pass a night at Miana, often causing their death in less than twenty-four hours. Of this I have heard two instances related.

The English residents at Tabreez unitedly declare that they at Miana lost one of their servants who was attacked by these terrible insects. He soon after felt a violent heat all over his body, fell into a kind of delirium, and finally expired in terrible convulsions.

From others I have received information, equally credible, about Colonel Baron Wrede, who some years ago was sent as Russian ambassador to Persia. It was quite late in the season when he passed Miana, and thinking there was then nothing to fear from the bug, he rested there over night, but with the precaution of having a candle lighted in his room. He experienced no evil, but a Cossack in his retinue, the next morning had a black spot on his foot, took to talking wildly, and at length fell into a paroxysm of frenzy. The inhabitants advised a remedy they used in such cases. This was to skin an ox and envelope the foot in the warm hide. Recourse was had to this expedient, but it was of no service, and the poor Cossack died in woful agony. We are assured that this measure is commonly successful, but it is also necessary that the diseased person remains forty

days without taking any food or drink but sugar water and honey. As already stated, the natives of Miana take these bugs into their hands without any danger. How fortunate it is that these formidable insects do not nestle in the clothing, for they would soon be carried all over Persia.

Tooth-ache Mite, *Ixodes? Odontalgiæ*, new species. Apteta Acaridæ.

A minute brown mite with pale margin and legs, the penultimate joint of the latter longest, the end of its body transversely truncated and strongly notched in the middle. Found on the root of a newly extracted tooth.

In addition to the ticks and mites which infest the skin of man and animals externally, are others which are internal, occurring in different parts of the interior of the body. One of the most common and best known of these is the itch-mite, *Sarcoptes Scabiei*, which abounds in the pustules of the human itch. Other mites occur in ulcers, and like the itch-mite may communicate the same ulcers to other persons. An interesting case in proof of this is reported in Cooper's Microscopic Journal, 1842, vol. ii, p. 65. A negro sailor was received into the Seaman's Hospital Ship, affected with large ulcers on the soles of his feet, of a peculiar character. He appeared to have received this malady from wearing a pair of shoes a day or two, which he had had from another negro whose feet were similarly diseased. In these ulcers a mite occurred, a figure of which is given, which shows it to be a species quite different from the itch-mite. This sailor had come direct from the East Indies, from a locality where no such malady as this was known. The other negro was from Sierre Leone, where, it is stated, a sort of itch is prevalent, which ulcerates and is very difficult to cure. It is added that in some water from the Sinoe river, on the coast of Africa, a whole mite and broken fragments of others were found, similar in every respect to the one from these ulcers.

It is reported that in one of the quarters of Paris at a former period persons were frequently affected with mites under the eyelids, which a woman there became considerably noted for removing with a silver needle. Another species, named the dysentery-mite, from its abounding in the evacuations of dysentery patients, is stated to occur in all parts of the alimentary canal. And even in the brain these insects have been met with, both on its surface and deep in its interior. Hermann reports that in the *post-mortem* examination of a soldier who died in the military hospital of Strasburg from a fracture of the skull, on separating the two hemispheres of the brain and taking out the pia-

mater, a mite was seen running upon the corpus callosum near the pineal gland. He also states that M. Lauth, professor of anatomy, showed him a little insect he had found near the base of the brain, on the surface of the pituitary gland, in a deceased maniac in the hospital, which everybody took to be a crab-louse, but which Hermann knew to be a species of mite closely resembling in size and color the *Acarus cellaris*, which he frequently met with in the moist earth in a corner of his cellar.

There can be little doubt that in many cases these mites are present in one part and another of the body, and that under certain circumstances they occasion lesions and diseases, of which the most competent members of the medical profession are unable to conjecture the cause. I here present an interesting instance of this kind:

A young lady applied to Z. Cotton, dentist, now some years located at Cambridge, N. Y., to extract a tooth from which she was suffering much pain. He found the tooth complained of to be perfectly sound and all its surroundings healthy; he therefore felt averse to removing it, and proposed a resort to soothing, external applications, whereby the pain perhaps would after a time pass away. It, however, was occasioning her so much torment, no external applications having given the slightest relief, that she insisted upon having it taken out. He accordingly extracted it. On then inspecting it, he could perceive no traces of caries, ulceration, or other disease which should cause it to have been painful. While thus looking attentively at the tooth, he noticed, by its moving, that there was a minute insect upon the side of the tooth, partly between its roots. This was a discovery indeed. From the place where it was located when it was first seen, Mr. C. is confident it was not situated between the fleshy gum and the tooth, nor could it, in extracting the tooth, have been rubbed from off the gum to be at the point where it was. Evidently it was situated a short distance within the alveolus, insinuated into the suture between the tooth and the wall of its bony cavity. And he thinks, with reason, it was this mite that had caused the pain which the patient had experienced in this tooth.

He inclosed the specimen in a small vial and presented it to me. As the dysentery-mite, *Sarcoptes Dysenteriæ*, occurs in the mouth as well as in the stomach and intestines, I suspected this would perhaps be that insect, or a species very similar to it. But it proves to be quite different. It is so minute, and the specimen is so contracted in drying, that I am unable to draw from it a description that is complete and perfect. The characters which follow, however, are ample

to enable the species to be clearly identified by an observer who has a specimen of it in his hands.

This mite is about 0.015 long. Its body is opake and of a brown color, like the weathered surface of wood, its border all around being pale, as are the legs also. It is nearly square or quadrangular, and as broad as long, or perhaps somewhat broader across its fore part, and slightly shouldered or humped on each side. Its anterior end is rapidly narrowed and prolonged in the middle into a beak, having the feelers appressed to its sides. The feelers are three-jointed, the first joint only being seen when viewed from above. This joint is cylindric, a third longer than thick, and reaches slightly beyond the end of the beak. The second joint is shortest and held perpendicularly downward at right angles with the first and third, which last is longest and more slender, over twice as long as thick, and held horizontally backward. They are all bearded with inclined bristles on their outer sides. At its hind end the body is cut off transversely and is conspicuously notched in the middle, the notch abrupt and somewhat square, more wide than deep, with a convex projection or small lobe in its middle. Close upon each side of this notch are two coarse bristles projecting backward. The eight legs are about equal in length, more than double the length of the body, thread-like, bearded with inclined bristles, which are coarser toward the feet. They are six-jointed, the basal joint more short and thick; the second, third and fourth joints equal, cylindric and thrice as long as thick, the second and third having each a long coarse bristle arising from their middle, and the fourth having some coarse, thorny points at its tip, and one near its middle; the fifth joint a third longer than the preceding joints and slightly tapering; the sixth joint more slender and shorter than the sub-basal joints, and ending in a long conic point, except in the fore legs, which terminate in a triangular pellet.

Earwig-fly, *Merope tuber*, Newman. (Neuroptera. Panorpidæ.)

A singular insect, forming the type of a new genus, and in several of its prominent characters quite dissimilar to the insects to which it appears to be most nearly related, was discovered in our State, at Trenton Falls, by the late Edward Doubleday, in the year 1837. He met with only a single specimen, a female. From this specimen a short description was drawn by E. Newman, and published the following year in the Entomological Magazine, vol. v, page 180. Mr. Newman there named it the *Merope tuber*, the generic term *Merope* being the astronomical name of one of the smaller Pleiades or stars arising to view in the spring of the year; and the specific name *tuber* having allusion to a remarkable appendage of this insect, a small semicircular callus, like an excrescence, growing upon the inner edge of its fore wings near the base. This unique specimen was subsequently examined and its mouth was carefully dissected by Mr. Westwood, who communicated a more full description, with figures of its several parts, to the London Entomological Society, which was published in the Society's Proceedings, vol. v, plate xiv, fig. 2, *a* to *l*.

Of this rare and remarkable insect, I, eighteen years ago, captured

a specimen, which is a female. The past season I have been so fortunate as to meet with it again, the specimen now obtained being a male, showing this sex to be still more of a paradox than is the female. I know not whether any other specimens of this insect have ever been found. It is an object of so much scientific interest that I here present an account of it:

Whoever meets with the male of this insect, his notice will first be attracted to the remarkably long, stout pair of forceps with which it is furnished, giving to its long, narrow body such a close resemblance to an earwig (*Forficula*) that he will think it probably pertains to that family of insects. But on coming to see that its wings are of ordinary structure, filled with fine longitudinal veins; that its feet are five instead of three-jointed; that its head is retracted and almost entirely hid under the thorax, with the face flattened and held backward, the mouth pressing upon the breast, and with the eyes kidney-shaped and the antennæ inserted in the notch on their inner side, his second thought will be that it is a cockroach (*Blatta*) furnished with a forceps, and thus giving it a relationship to the kindred group *Forficula*. It is not till he happens to observe that the four wings, though broad and hyaline, with the first pair smoky, and thus resembling wing covers, are yet alike in size and are destitute of any plaits or folds, that he becomes aware it may pertain to the order NEUROPTERA instead of ORTHOPTERA, where its resemblances to an earwig and a cockroach would place it. Even then, he notices so many points in which the specimen appears more like the insects of the latter than of the former order (the broad costal or outer area of the wings, no spot in this area answering to a stigma, no small eyes, etc.) that he is in doubt whether it may not be an Orthopter with wings not perfectly developed, as is the case with several of the species of this and other orders.

To ascertain if it pertains to the Neuroptera, he searches through this order for insects having the end of the body equipped as it is here, but he nowhere finds any which are described as corresponding with it in this particular. The only approach to a structure of this kind appears to be in the family PANORPIDÆ, where the males have the tip of the body furnished with a pair of claws or hooks much resembling the jaws of many insects, these hooks having their sharp points directed forward over the end of the back, their size, form, and position being quite unlike the forceps of this insect. And when he reads that "this family PANORPIDÆ is at once distinguished by the front of the head being produced into an elongated slender deflexed

rostrum," "the head vertical, its anterior end prolonged and narrowed in the form of a proboseis;" as the insect in hand has only a short nose or snout, not prolonged into a slender narrow proboseis, and the head not held vertically downward, but horizontally backward, with the mouth pressed upon the breast; he concludes in full confidence that it cannot pertain to this family. And, on comparing it with the other families of this order, he finds no place where it appears to belong. So anomalous is it, that the student in this science will be embarrassed by it in whatever direction he turns. Even Mr. Newman, though he had made the insects of this order his particular study, was unable to decide as to the particular family to which it pertains.

By dissecting its month, Mr. Westwood obtained such details as to show the family *Panorpidæ* to be its true place, notwithstanding it differs so notably from all the other genera of this family as to make its association with them appear quite incongruous. And it is not that it is intimately related to them, but that it is more nearly related to them than to the genera of any other family that makes this family its true place.

The following are the points in which this insect corresponds with the typical genera of this family: 1st. The upper lip is prolonged to an acute point, forming with the other organs of the month a beak or rostrum, which is the essential distinction of this family, although here this beak is short, scarcely longer than thick, whilst there it is long and slender, four times as long as thick. 2d. The upper jaws are longer than wide, and have two sharp teeth at their tips. 3d. The maxillary feelers are thread-like and five-jointed, the joints little longer than thick, the last one oval. 4th. The veins of the wings coincide with those of the genus *Panorpa* more closely than with those of any other insects of this order. 5th. In the female the body gradually tapers to an acute point, which is furnished with two minute threads which are here two-jointed, and in *Panorpa* three-jointed. And 6th, as we now know, in the males the tip of the body is armed, the armature here being a pair of very long stout forceps, whilst there it is a pair of stout sharp hooks.

But the points in which this insect differs from its associates in this family are much more numerous and notable. Allusion has just been made to the great dissimilarity of their beaks, short, and turned backward in the one, in the others long and slender, and hanging down in front like the trunk of an elephant; and of the armature at the end of the body in the males, which is here, a formidable pair of forceps held

horizontally backward, and almost equaling the insect's body in length; there it is merely a pair of small hooks directed upward and curving forward over the end of the back. Other differences, equally important, merit to be noticed. The head, instead of being prominent, and fully exposed as it is in *Panorpa*, *Bittacus* and *Boreus*, is retracted, and almost totally hid under the fore part of the thorax. The eyes, which are protuberant and subglobular in those genera, are here but little elevated above the surface, and are long, narrow, and curved, or kidney-shaped. The three glassy simple eyes, which are so conspicuous in the two first named genera are here wholly wanting. The antennæ, instead of being long and thread-like, or like a fine hair, are shortish and thick. The first segment of the thorax, instead of being a ring or hoop forming a kind of neck to the head, is flattened, forming a semi-circular plate. The body is long, narrow and flattened, not slender and cylindrical. The wings are not shining and glass-like, and are not at all ornamented with spots and bands as they are in the other genera. And the small semi-circular lobe on the inner margin of the fore wings, near the base, is a singular appendage, whereby this species is at once distinguished from all others.

Readers intelligent upon this subject will be aware from what has now been stated, that this insect differs widely from those with which it is associated. In this family PANORPIDÆ, however, each of the groups are very distinct. Though there is a beautiful similarity to the species of each genus, the few genera composing this family are each remarkably different from all the others. They hence form a very heterogeneous assemblage, as will appear from a cursory review of them.

In the genus *Panorpa*, or the scorpion-flies, the body and its members are of ordinary aspect, with nothing peculiar that is perceptible to the eye, except the end of the body in the males, the last joint being very large and egg-shaped, and the two joints preceding it remarkably small, appearing as if atrophied, this structure giving free motion to the tip of the body, enabling it to turn in every direction like the tail of a scorpion.

In *Bittacus*, the body, wings and legs are remarkably long and slender, giving these flies a striking resemblance to the crane-flies or daddy-long-legs of the genus *Tipula* in the order DIPTERA.

Boreus contains very diminutive insects, scarcely one fourth the dimensions of their kindred. They are destitute of wings, and move by feeble skips on the surface of the snow in winter. The genus has only three species, one in Europe, long known, and two, which I have described, in this country

In these three genera the heads are quite similar, being prolonged into a long slender beak or proboscis; and in the males the end of the body is furnished with a pair of stout, sharp-pointed hooks.

The genus *Nemoptera* is remarkable for the singularity of its wings. Although the order NEUROPTERA is defined as having four wings of equal size, we here have a genus of that order in which the hind wings are double the length of the forward pair, and are exceedingly narrow and slender, like blades of grass, and the wings remain spread apart when the fly is at rest.

Finally, the genus *Merope* differs from all the preceding genera in having the head withdrawn under the thorax, the eyes kidney-shaped and several other characters which have already been stated; the fly resembling a cockroach, the males having forceps like an earwig.

These two genera have the head slightly prolonged, and forming a short beak or snout; they have no small simple eyes, and their maxillary feelers are short, not reaching beyond the jaws. They evidently constitute a subfamily separated from the three first genera by the shortness of their beak. Dr. Rambur, who was unacquainted with the last genus, elevates *Nemoptera* to the rank of a family (Neuropteres, page 332), which he characterizes as having the hind wings very long and nearly linear. But it being the distinctive mark of the family PANORPIDÆ that its mouth is prolonged into a beak, the great difference which exists in the length of this beak is the most natural and perspicuous character on which to found a primary division of this family. And thus the two genera, *Nemoptera* and *Merope* will constitute a subfamily, NEMOPTERIDES, having the beak short, little, if at all, longer than thick.

Two or three facts are all we as yet know of the habits of this rare and anomalous insect. It comes abroad in its perfect state from the middle till the end of the month of July. It flies around in the night, and probably secretes itself and remains at rest during the day. It is attracted by a light, and by night flies into the lighted rooms of dwellings through the open windows and doors. It was in a lighted parlor that my specimen of the female was taken, it having entered at an opened window. The male occurred running among the papers on my writing table, having no doubt flown in at the open door and alighted on the table unobserved. From its aspect and motions I confidently supposed it to be a cockroach, until in scanning it its formidable forceps were seen. Thus by its habits also this insect is related to the genus *Nemoptera*, one of the species of which is stated by Olivier to enter houses by night, attracted by the light.

This insect is of a dingy brown color, its abdomen dull pale yellow, and its legs and the forceps of the male yellowish white. Its wings are hyaline but not clear and glassy. They have a tinge of umber brown, the fore pair perceptibly deeper tinged with this color than the hind pair.

The male is larger and his body more robust than the female, measuring 0.40 in length to the end of its tail-like appendages, and to the end of the forceps 0.65. The forceps are joined to the body obliquely on each side of its end, their entire length being 0.32, which is also the length of the body forward of their base. The extended wings of the male are 1.20 from tip to tip. The female is 0.30 long and 0.95 wide across its extended wings. The dimensions of the Doubleday specimen are given as 0.35 in length and 1.05 in width.

The HEAD is almost totally hid beneath the thorax. When viewed on the under side it is more long than wide, its outline is oval, flattened and turned backward horizontally, with the mouth pressed upon the breast and reaching a little beyond the base of the first pair of legs. Its sides are occupied by the eyes, which in the female almost meet together on the vertex or crown of the head, being parted asunder merely by a slender elevated ridge, which has an impressed line along its summit. In the male they are more widely separated, the vertex or space between them being more long than wide and narrowing forward, where it is also grooved along the middle. In both sexes the vertex is black without any glossiness. In front the circular space between the eyes is smooth and shining, black in the male and chestnut brown in the female. The face below the eyes is dull whitish and glossy, the surface slightly uneven from three faint transverse elevations, which are parted asunder by shallow impressed parallel lines. Below this the upper lip is prolonged downward, and viewed in front with a common magnifier, appears like a cone twice as long as thick and gradually tapered to a sharp point. The jaws have on their outer side a dense tuft of yellow hairs, in which their tips are hid from view. The feelers are small, reaching only to the end of the jaws. They are dull whitish, thread-like and five-jointed, the joints little longer than thick, the last one oval. To Mr. Westwood the last joint appeared to be formed of two rings. He found the upper jaws to end in two sharp curved teeth, and inside of these a third obtuse one; the lower jaws two-lobed, their tips conic, and the lower lip nearly square, its anterior angles rounded and fringed with hairs, and furnished with a pair of short, two-jointed feelers. The *eyes* are coal black, their surface finely granular. They are slender, kidney-shaped, four times as long as thick, their lower part narrower than the upper. No simple eyes are perceptible in either sex. The *antennæ* arise in the lower part of the notch of the eyes, and are almost in contact at their base. They are alike in the two sexes, short and thick, about half the length of the body in the female and a little more than a third its length in the male, thickest forward of the middle, and gradually tapering in both directions, toward their tips becoming very slender. They are dark dingy brown in the male, pale brown in the female, the basal joint pale dull yellow. They are composed of thirty joints, which are about as long as thick, and are distinctly separated by contractions between them. The basal joint is thick, its diameter similar to that of the thickest middle joints, and rounded at its summit. The second joint is small, but half as thick as the first. The third joint is slightly longer than thick, and gradually widens from its base to its apex. The following joints increase very gradually in thickness to about the eighth joint, from which to the twelfth they do not perceptibly differ in size, and beyond this they begin to diminish.

The THORAX has its first segment flattened and semi-circular with the sides strongly inclined downward, and in the female so much deflected, that when viewed from above this part appears square and as long as wide, with its opposite sides parallel and its anterior end convex. In its middle is a longitudinal ridge with an impressed line along its summit, and on each side is a raised line extending obliquely ontward and forward, these elevations not reaching the basal edge, and in the female less prominent. The second and third segments are alike in size and form, similar in length to the first, but a third broader. The first and second segments are dark dingy brown, the third dull pale yellow.

The ABDOMEN is smooth and glossy, soft and flesh-like, of a pale dull yellow color. In the *male* its color is more dull and its substance more firm, its width the same as the thorax, its opposite sides parallel, scarcely narrowing toward the tip. In this sex it has eight segments, distinctly marked by an elevated line on their hind margins. The first segment is longest, and is narrowed on each side concavely from its base to its middle, and from thence widens to its hind angles. Its surface is uneven from large smooth elevations and intervening depressions, a large roundish elevation occupying its central and anterior part, and on each side of this a smaller and somewhat triangular one occupying the anterior corners. The second segment is short, less than half the length of the first, and on each side widens from its anterior to its hind angles. The four succeeding segments are larger, equal in size, each about twice the length of the second. The seventh segment is shorter, and the eighth still shorter, the two together being only equal in length to the sixth. The last one is followed by a triangular plate or ninth segment, which is transverse, nearly double the length of the short eighth segment, but not equaling it in width, with its apex rounded; and from under its edge is protruded two narrow triangular appendages, flattened and membranous, about 0.03 long, gradually tapering to a very acute point, and overhanging the angle formed at the inner base of the forceps.

The *forceps* are hard and horny, project horizontally backward, and are regularly curved, each blade in the form of a slightly bent bow. The blades are each composed of two pieces articulated one to the end of the other. The basal piece is double the length, and double the thickness of the apical. It is slightly thicker at its base, where it is articulated to the whole length of one side of the triangular plate, and to the outer end of the hind edge of the eighth segment. It is flattened its whole length, both on its upper and its under side, whereby it is more than twice as broad as thick. The apical piece at its tip is abruptly and strongly compressed, and widened to thrice its preceding thickness, and is concavely notched, this dilated portion having the form of a crescent, placed vertically, with its horns projecting obliquely backward and inward—this last joint of the forceps being thus analogous in its form to the top of the spire of a Turkish mosque, ending in a crescent placed transversely. The surface of these grappling organs is closely bearded with inclined hairs, which are very short and minute on the first, and much longer and coarser on the last joint.

In the *female* the abdomen is simple, narrower than the thorax, flattened, and beyond its middle gradually tapered to an acute point. It is composed of seven segments, one less than in the male, all but the last corresponding in length with those of the male, and the basal one similarly sculptured. The seventh segment is of equal length with those forward of it, and like the sixth is strongly narrowed from its fore to its hind end, where it is transversely cut off, and from its end is protruded a cylindrical tube, as it appears when viewed from above, which is twice as long as thick, and nearly the length of the segment to which it is appended. And from the end of

this tube hangs downward and diverging outward, two small thread-like appendages, which are two-jointed, the joints twice as long as thick.

The LEGS are long and slender, the hind pair slightly longest. They are densely coated with a fine short incumbent beard, and the shanks have a pair of spurs at their tips. The feet are five-jointed, the joints cylindric and successively diminished in length, the last one ending in a pair of small black simple hooks.

The WINGS are laid flat upon the back, one upon another when the insect is running or at rest. They reach much beyond the end of the body, being almost double its length, and in the male cover and hide from view the forceps. The four wings are nearly alike in size, form, texture, and in the number and position of their veins. They are thrice as long as wide, the fore pair being slightly longer and narrower, gradually widening from their bases through two-thirds of their length and rounded at their ends, thus being elongated egg-shaped. They are destitute of any plait or fold, and are pellucid and faintly smoky, the anterior pair perceptibly more so than the hind pair. Along their inner side they are slightly fringed with extremely fine short hairs, which incline backward, and on their outer side are similar hairs incumbent upon the marginal vein. Their disk is occupied by numerous veins running lengthwise of the wing, nearly equidistant from and parallel with each other, some of them forked. They are blackish in the fore wings of the male and pale brown in the hind wings. In the female they are pale brown in the fore wings and dull whitish or colorless in the hind wings. They are connected together by many small and more slender transverse veinlets of a whitish color.

The outer portion, or *costal area*, of the wings is broad and widened toward its middle, thus appearing like the wing of an Orthopterous rather than a Neuropterous insect, and it is destitute of any discolored spot or stigma toward its tip. On its inner side this area is traversed lengthwise by a slender slightly flexuous and nearly colorless vein, which terminates in the marginal vein. Along the outer side of this vein at irregular distances are short oblique veinlets, about twelve in number, connecting this longitudinal vein with the margin. About five of the first of these veinlets are straight and closer together, forming short rhombic cells between them. The succeeding veinlets become more oblique, longer and curved, their middle portion being more longitudinal than their ends, and most of these curved veinlets send off at right angles one or two short straight branches to the next veinlet or to the longitudinal vein, thus dividing all the middle portion of the costal area into extremely irregular cells. In the hind wings these veinlets are fewer, about eight in number, and all nearly straight. Along its inner side this longitudinal vein is connected to the rib vein by from three to six oblique and transverse veinlets placed at irregular distances.

The *rib vein* is slightly thicker and more deeply colored than the other veins. Along its inner side are seven short veinlets connecting it to the next vein, the three first of these being oblique and farther apart, the others transverse.

The several veins which ramify the middle and inner portions of the wing, are all branches of two principal veins, which are given off from the inner side of the rib vein near its base. These two veins are designated the externo-medial and the interno-medial. The former extends along the inner side of the rib vein its whole length, the latter along the inner side of the axillary or anal vein. There is a beautiful correspondence between these two veins, both in their branches and their principal connecting veinlets. Each vein sends off three branches, the first branch being also once forked, thus making five veins ending in the margin of the wing.

The *externo-medial vein* parts from the rib vein above and little more than its diameter distant from the root of the interno-medial. It diverges very gradually

from the rib vein, and after extending the same distance that its root is from the base of the wing it forks, giving off its first branch. This branch, after running a similar distance, divides into two forks, which extend straight onward without any further division to the end of the wing, terminating in the middle of its rounded tip. The main vein extends twice as far before it again divides and sends off its second branch, and at or quite near the same point it makes its first connection with the rib vein, sending a veinlet obliquely backward to it; and this second branch, near its commencement, is connected by a transverse veinlet with the outer fork of the first branch. The main vein, after again extending a similar distance, which is a third or more of its remaining length, gives off its third branch.

Mr. Westwood figures the wings of the left side only, and this externo-medial vein he represents as having four branches in the fore wings and three in the hind ones. But both pairs of wings are liable to vary in the number of these branches. In the male specimen before me this vein has only three branches in each of the wings; in the female specimen the fore wing of the left side and the hind wing of the right side have four branches to this vein.

The *interno-medial vein*, like its fellow, forks three times at equal distances apart, sending out branches from its inner side, which ramify the inner half of the wing. The first branch is given off forward of the corresponding branch of the externo-medial, with which it is connected a short distance from its origin by a transverse veinlet which issues from that branch at half the distance from its base to its fork. This branch continues single two-thirds of its length. It then divides, and its two forks attain the end of the wing next to those of the first branch of the externo-medial. The main vein sends off its second and third branches before it has extended half its length. It reaches the inner margin at about three-fourths the distance from the base to the apex of the fore wings and two-thirds of this distance in the hind ones. Like the outer vein, this also sometimes gives off a fourth branch near its termination.

Occupying the long narrow space between the interno-medial vein and the inner margin of the wing are two veins, answering to what are termed the anal and axillary veins. The first of these corresponds somewhat with the rib-vein, it being, particularly in the hind wings, more thick and darker colored than the other veins in this part of the wing, becoming slender and colorless, however, toward its tip; and the interno-medial vein also connects with it by an oblique veinlet at or near the base of its second branch, and by other veinlets beyond this. The second, or axillary vein is slender, colorless, and scarcely half the length of the preceding. Near its base are two short branches, passing from it obliquely to the margin, and these are connected together by a veinlet which runs from near the end of the first to the base of the second branch.

In the fore wings upon the inner margin, near the base, and at the end of the first or shortest of the two branch veins last mentioned, is a singular appendage, a little semi-circular lobe projecting from the margin, like an excrescence growing upon the side of the marginal vein, the vein being straight and not at all indented by it. This appendage is concave on its upper and convex on its lower side, and is feebly translucent except on its thickened edge. It is black in the male, and pale testaceous in the female specimen before me.

The *veinlets* in the wings are more slender than the veins, whitish, gradually becoming more numerous toward the tips of the wings. There are six or seven veinlets between each of the long parallel veins, and one or two less between the veins ending in the inner margin. They are arranged more or less regularly in five or six rows, crossing the wing in an oblique, or partly in a transverse direction.

REPORTS OF COUNTY SOCIETIES.

ALBANY.

In obedience to the requirement of the statute, ordering a yearly report from the several agricultural societies of the State, I herewith present you a brief abstract of the proceedings of the Albany County Agricultural Society, for the year 1870:

Our annual fair was held at Hurstville, about two miles from the city of Albany, on the 10th, 11th, 12th, 13th and 14th of October.

The week previous was selected for the purpose of holding the fair, but as it set in rainy and unpleasant, it was resolved by a majority of the executive board present at a meeting held on the fair ground, to adjourn for one week.

On the appointed day, the fair opened with a fair prospect of success; but it was then discovered that many exhibitors who had intended to follow up the several fairs taking place about that time, would not be able to attend ours, and then fulfill their previous arrangements.

The manufacturers' department was well represented, excepting the sewing-machines, of which no entries were made by our local agents. The only entry made was by a foreign ageney.

The show of fruit and vegetables, was limited, on account of the adjournment. Most of the articles in this department were perishable, and must necessarily be lost if kept longer than they were prepared for.

The display of cattle was very good, the sheep department fully up to former years, and that of swine and poultry comparing favorably with previous exhibitions.

The show of horses (always good in our county), was not behind former collections. Some two or three stallions, with their get two years old and under, producing a great interest in horse circles, were shown, and formed a very interesting feature in that department.

The premiums being quite large for fast horses, a great number were shown in the different classes, and we were well satisfied that

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