

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

---

Faculty Publications: Department of  
Entomology

Entomology, Department of

---

October 1891

## Report of the Entomologist

Lawrence Bruner

*University of Nebraska-Lincoln*

Follow this and additional works at: <https://digitalcommons.unl.edu/entomologyfacpub>



Part of the [Entomology Commons](#)

---

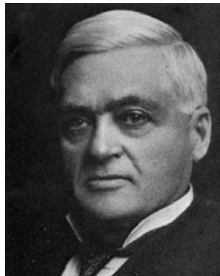
Bruner, Lawrence, "Report of the Entomologist" (1891). *Faculty Publications: Department of Entomology*. 150.

<https://digitalcommons.unl.edu/entomologyfacpub/150>

This Article is brought to you for free and open access by the Entomology, Department of at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Faculty Publications: Department of Entomology by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Published in  
*Annual Report.*  
*Nebraska State Board of Agriculture*  
*for the Year 1891.*  
Prepared by Robert W. Furnas.  
Lincoln, NE, 1892.

"L. Bruner, Entomologist for the Board" was Lawrence Bruner, Professor at the University of Nebraska, who established the Department of Entomology and Ornithology in 1895. Bruner is considered the "father" of Nebraska entomology.



Lawrence Bruner, 1856-1937.

## REPORT OF THE ENTOMOLOGIST.

BY L. BRUNER, ENTOMOLOGIST FOR THE BOARD.

In accordance with custom I present herewith a report as acting entomologist to the State Board of Agriculture. In former reports attention was paid to various insects detrimental to the agricultural interests of the state—sometimes one thing and at other times other things were considered. For the present paper I have concluded to give a review of the subject of the insect enemies of corn. In doing this it is my intention to follow the plan adopted in Bulletin No. 14 of the Experiment Station, where I treated the insects injurious to young trees growing upon tree claims.

Since the corn crop is the most important of all our productions at present in the state of Nebraska, it should be the aim of every farmer or raiser of this staple to study all the features connected with the cultivation of this cereal. Along with the methods of cultivation and marketing of his crop the producer should pay some attention to the insect and other enemies of corn. Especially is this necessary with reference to the insect enemies. In my last report I gave a list of the various insect enemies of the sugar beet, and it was there stated that at least calculation there were as many as 64 distinct species of insects that had been observed to feed upon that plant. In like manner, a little trouble on the part of entomologists of the country has revealed the fact that Indian corn is attacked by 100 or more distinct kinds of these enemies.

While there have not been that number of insect enemies to this one crop actually found here in Nebraska, most of them are known to occur here; and it is also a well established fact that many of these are exceedingly troublesome. Some of them have been mentioned from time to time in former reports, as well as in the agricultural papers of the state; but of many of the others nothing has been said.

While estimates have set the actual injury done to all crops at the high figure of from 15 to 50 per cent of the entire crops affected, I will not claim more than an average based on the lowest figure, viz., 15 per cent. One-seventh of Nebraska's corn crop is then annually destroyed by insect enemies. Some years this amount is even doubled, which means a great many dollars to the state's income, even at the usual low prices received for the crop. When much of this injury can be prevented why not try to save some of this loss?

## LIST OF CORN INSECTS.

## HYMENOPTERA.

*Solenopsis fugax* Latr. (Small Yellow Ant.)

*Solenopsis molesta* Say.

*Lasius brunneus alienus* Latr. (Small Brown Ant.)

## LEPIDOPTERA.

- Arctia arge* Drury. (The Arge Tiger Moth.)  
*Leucarcia acræa* Drury. (The Salt Marsh Moth.)  
*Spilosoma virginica* Fab. (The Yellow Bear.)  
*Empretia stimulea* Clemens. (Saddle-back Caterpillar.)  
*Hyperchiria io* Fab. (The Io Moth.)  
*Apatela obliterata* Sm. & Abb. (The Smeared Dagger.)  
*Agrotis c-nigrum* Linn. (The Spotted Cut-worm.)  
*Agrotis subgothica* Haw. (The Dingy Cut-worm.)  
*Agrotis herilis* Grote. (Western Striped Cut-worm.)  
*Agrotis clandestina* Harr. (W-marked Cut-worm.)  
*Agrotis messoria* Harr. (Dark-sided Cut-worm.)  
*Agrotis tessellata* Harr. (Striped or Corn Cut-worm.)  
*Agrotis ypsilon* Rott. (Greasy or Black Cut-worm.)  
*Agrotis saucia* Hubn. (Variegated Cut-worm.)  
*Agrotis tricoxa* Lint. (Dingy Cut-worm.)  
*Agrotis morrisoniana* Riley. (Clay-backed Cut-worm.)  
*Hadena devastatrix* Boisd. (The Glassy Cut-worm.)  
*Hadena arctica* Boisd. (The Yellow-headed Cut-worm.)  
*Laphygma frugiperda* Guen. (The Fall Army Worm.)  
*Nephelodes violans* Guen. (The Bronze-colored Cut-worm.)  
*Gortyna nitela* Guen. (The Stalk Borer.)  
*Achatedes zææ* Haw. (The Spindle Worm.)  
*Heliothia unipuncta* Haw. (The Army Worm.)  
*Heliothis armigera* Hubn. (The Corn Worm.)  
*Asopia farinalis* Linn. (Meal Snout Moth.)  
*Pempelia lignosella* Zeller. (The Smaller Corn-stalk Borer.)  
*Crambus zeelus* Fernald. (The Root Web Worm.)  
*Crambus exsiccatu* Zeller.  
*Crambus fuscicostellus*.  
*Pseudanophora arcabella* Clem. (Burrowing Web Worm.)  
*Cænogenes mortipenella* Grt. (Burrowing Web Worm.)  
*Eurycreon rantis* Guen. (Garden Web Worm.)  
*Diatraea saccharalis* Fab. (The Corn-stalk Borer.)  
*Lophoderus triferana* Walk. (The Red-banded Leaf-roller.)  
*Dichelia sulphureana* Clemens. (The Sulphur Leaf-roller.)  
*Sitotroga cerealella* Oliv. (The Angoumis Grain Moth.)  
*Tinea granella* Linn. (The Grain Moth.)  
*Tinea zææ* Fitch. (The Indian Meal Moth.)

## DIPTERA.

- Sciaria* sp.? (The Black-headed Grass Maggot.)  
*Anthomyia zææ* Riley. (The Seed Corn Maggot.)  
*Diastata* sp.? (The Corn-leaf Miner.)  
*Mesograpta polita* Say. (Corn-feeding Syrphus-fly.)  
*Chætopsis ænea* Wied.

## COLEOPTERA.

- Omophron libiatum* Fab. (No common name.)  
*Megilla maculata* De Geer. (The Common Lady Bug.)  
*Silvanus surinamensis* Linn.  
*Silvanus cassiæ* Reich.  
*Silvanus advena* Walzl.  
*Typhæa fumata* Linn.  
*Ips fasciatus* Oliv.  
*Tenebrioides dubia* Mels.  
*Tenebrioides mauritanica* Linn.  
*Agriotes mancus* Say.  
*Melanotus communis* Gyll.  
*Melanotus cribulosus* Lec.  
*Sitodrepa panicea* Linn.  
*Aphodius tutulentus* Hald.  
*Macrodactylus subspinosus* Fab. (The Rose Chafer.)  
*Lachnosterna*—several species (The White Grubs.)  
*Euphoria inda* Linn. (The Indian Cetonia.)  
*Prionus imbricornis* Fab. (The Tile-horned Prionus.)  
*Diabrotica longicornis* Say. (The Corn-root Worm.)  
*Diabrotica 12-punctata* Oliv. (The 12-spotted Squash-beetle.)  
*Systema blanda* Mels. (The Pale-colored Flea-beetle.)  
*Chætocnema pulicaria* Melsh. (The Brassy Flea-beetle.)  
*Tenebrio obscurus* Fab.  
*Tenebrio molitor* Linn.  
*Epicauta vittata* Fab. (The Striped Blister-beetle.)  
*Epicauta cineria* Forst. (The Gray Blister-beetle.)  
*Epicauta pennsylvanica* De G. (The Black Blister-beetle.)  
*Epicærus imbricatus* Say. (The Imbricated Snout-beetle.)  
*Sphenophorus pertinax* Oliv.  
*Sphenophorus ochreus* Lec.  
*Sphenophorus placidus* Say.  
*Sphenophorus robustus* Horn.  
*Sphenophorus cariosus* Oliv.  
*Sphenophorus sculptilis* Uhler.  
*Sphenophorus parvulus* Gyll.  
*Sphenophorus scoparius* Horn.  
*Calandra oryzeæ* Linn. (The Rice Weevil.)  
*Calandra granaria* Linn. (The Grain Weevil.)

## HEMIPTERA.

- Blissus leucopterus* Say. (Chinch-bug.)  
*Jassus inimicus* Say.  
*Cicadula nigrifrons* Forbes.  
*Cicadula quadrilineatus* Forbes.  
*Macropsis nobilis* (?).  
*Aphis maidis* Fitch. (Corn-plant Louse.)

*Chaitophorus flavus* Forbes.

*Rhopalosiphum dianthi* (Schr.)—In greenhouse.

*Aphis maidis-radici* Forbes. (The Corn-root Louse.)

#### ORTHOPTERA.

*Anabrus simplex* Hald. (Western Cricket.)

*Orchelimum vulgare* Harr.

*Scudderia pistilata* Brunner.

*Melanoplus femur-rubrum* De G. (Red-legged Locust.)

*Melanoplus atlantis* Riley. (Lesser Locust.)

*Melanoplus spretus* Thos. (Rocky Mountain Locust.)

*Melanoplus differentialis* Thos.

*Melanoplus bivittatus* Say.

*Schistocerca americana* Drury.

A number of other locusts.

#### MYRIAPODA.

*Iulus impressus* Say. (Thousand-legged Worm.)

---

In order that many of the above named insects can be recognized they are treated separately in the following pages, where the principal ones are figured, and the life-histories of all given more or less fully along with some of the remedies that have been found to succeed against them. As this is but a preliminary report upon the insect enemies of maize, or Indian corn, each species will be but briefly treated. It is hoped that matters in general will permit of my treating the subject more fully some time in the future, when I can also mention the enemies of other grains and grasses. With this end in view, I would therefore ask each of our farmers and other interested parties to report to me from time to time the occurrence of all such insect enemies that come to their notice.

#### HYMENOPTERA.

THE SMALL YELLOW ANT. (*Solenopsis fugax* Latr.)

It is not the usual case with the representatives of this family to be vegetable feeders to such an extent, at least, as to become what might be termed injurious. Still, this small yellow ant is often guilty of injury to corn by attacking and feeding on the kernels of seed corn at about the time of sprouting and for some time thereafter, thereby stunting the growth of the plant. This source of injury need not, however, be considered of sufficient importance to warrant special efforts being put forth towards the destruction of this insect.

SOLENOPSIS MOLESTA Say.

A second species of ant has sometimes been known to injure corn by attacking and gnawing the leaves of younger plants. This injury, like that of the preceding species, is seldom of sufficient importance to require attention on the part of the farmer.

THE SMALL BROWN ANT. (*Lasius brunneus*, var. *alienus* Latr.)

This ant is not directly injurious to the corn crop, but, in an indirect way, can be said to be very much so. It is the constant companion of the Corn-root Louse mentioned further on in this report, and by its care of that insect becomes a party to the injury. It has the habit of gathering and storing the eggs of this louse in the fall of the year; and then, in the following spring, of placing them where the heat of the sun hatches them. After the eggs are hatched the young lice are carefully cared for by the ants and placed upon the roots of corn and other plants where they are guarded to some extent from their enemies. The ant is not a vegetarian in its food-habits, but lives upon certain small insects and such other animal matter as it finds. It is also very fond of the "honey dew" which the plant-louse secretes. Hence the affection exhibited by it for the louse.

For a remedy see under head of Corn-root Louse.

There may be other species of ants that are directly or indirectly injurious to this plant, but, if so, they have not yet come to my notice. There may also be other kinds of hymenopterous insects that attack the plant in one or the other stages of its growth.

## LEPIDOPTERA.

THE ARGE TIGER MOTH. (*Arctia arge* Drury.)

One of the common corn enemies here in the state is the larva or caterpillar of the above named insect. Like the two following species, its larvæ or young are hairy caterpillars, and can be recognized from the following description, which is taken from Harris: "The caterpillar measures about one and a half inches in length, is of a dark greenish-gray color, but appears almost black from the black spots with which it is thickly covered; there are three longitudinal stripes of flesh-white on the back, and a row of kidney-shaped spots of same color on each side of the body. The warts are dark gray, and each one produces a thin cluster of spreading hairs." The moth is described about as follows: "Its general tint is a light-flesh color, fading to nankin; the fore wings are marked with streaks and small triangular spots of black; the hind wings are generally deeper colored than the fore wings and have from five to seven or eight black spots of different sizes upon them; there are two black spots on the collar, and three on the thorax; the abdomen is of the color of the hind wings, with a longitudinal row of black dots on the top, another on each side, and two rows of larger size beneath."

This insect has frequently been quite destructive to young corn in the southern states, besides being quite common over the greater portion of the Mississippi valley.

THE SALT MARSH MOTH. (*Leucarctia acræa* Drury.)

The second of these hairy caterpillars that frequently does some injury to corn is the one that bears the above name. This caterpillar is considerably larger than the preceding, and can be recognized from the following description: "The full grown caterpillar measures one inch and three-quarters or more in length. It is clothed with long hairs, which are sometimes black and sometimes brown on the back and fore part of the body, and of a light brown color on the sides. The hairs, like those of other *Arctians*, grow in spreading clusters from warts, which

are of a yellowish color in this species. The body, when stripped of the hairs, is yellow, shaded at the sides with black, and there is a blackish line extending along the top of the back. The breathing holes are white, and very distinct, even through the hairs."

The parent insects are rather large white moths, with the hind wings and the sides of the abdomen rust red. They have both pairs of wings dotted with black; and the body is also mottled with the same color.

The insect will never, in all probability, do sufficient harm in this state to amount to injury.

#### THE YELLOW BEAR MOTH. (*Spilosoma virginica* Fab.)

A third of these hairy caterpillars is the larva of the white moth known as the Yellow Bear Moth—yellow bear because of the color of the caterpillar. This is the common white, yellow, or light brown caterpillar of weed patches, gardens, and fields. There are two broods of the worms annually, and those of the first often do some injury to young plants of corn. Although so common an insect, it seldom does sufficient injury to warrant our taking decided action towards fighting it. Should it be thought best to do so, this and the two preceding species can readily be hand picked in most instances. If very numerous the Paris green and London purple sprays will effectually destroy them.

#### THE SADDLE-BACK CATERPILLAR. (*Empretia stimulea* Clemens.)

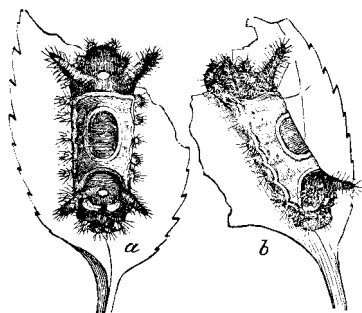


FIG. 1.—*Empretia stimulea*; caterpillar, side and dorsal views. [After Riley.]

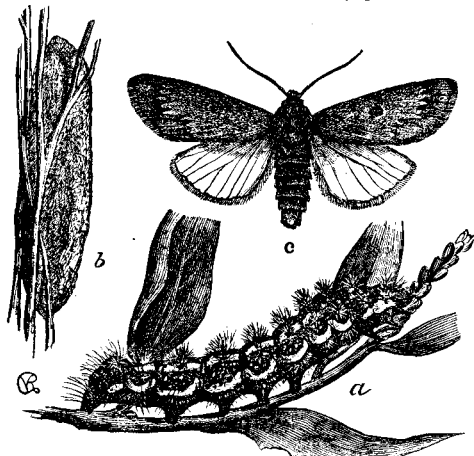
Among the numerous other insects that feed upon the Indian corn is the one shown in the accompanying figure. While it is not to be considered a dangerous pest to this crop, it is included from the fact of its having been found feeding here at different times. The description of the caterpillar and moth are copied from Packard's Guide to the Study of Insects: "The larva is thick and elliptical, the body being rounded above, but flattened beneath, and a little fuller towards the head. There is a pair of densely spinulated tubercles on each side of the segments, the subdorsal pair on the me-

tathoracic ring, and a pair on the seventh abdominal ring, being two-thirds as long as the body is wide. There are three pairs of small but well developed thoracic legs, while there are none on the abdominal segments. The body is reddish, with the upper side green between the two largest pairs of spines, centered with a broad elliptical reddish spot, edged with white, as is the green portion along the side of the body. The moth is rarely found by collectors, and is of a rich deep velvety brown, with a reddish tinge. There is a dark streak along the basal half of the median vein, on which is situated a golden spot, while there are two twin golden spots near the apex of the wing. It expands an inch and a half."



THE IO MOTH. (*Hyperchiria io* Fab.)

The caterpillar which is shown in the cut herewith presented is the young of one of the silk worms that frequently feed upon such low plants as clover, corn, etc. The insect is seldom numerous enough to be injurious, hence need not require much attention here. As a tree enemy it is more to be dreaded. The moth is quite an attractive one and can be recognized by the following short description: A reddish or yellowish brown moth with feathered antennæ or feelers, which has a wing expanse of from two and one-half to three inches. The hind wings are provided with large eye-like spots and the front ones with several wavy or undulating lines across them parallel to the outer border. Hand picking will be found a sufficient remedy for this insect, in most instances at least.

FIG. 2.—*Hyperchiria io*; larva. [After Riley.]THE SMEARED DAGGER MOTH. (*Apateia obliuata* Sm & Abb.)FIG. 3.—The Smeared Dagger Moth (*Acronycta obliuata*): a, mature larva; b, cocoon; c, moth—natural size. [After Riley.]

The larva of the insect which bears the above name is a hairy caterpillar also, but has these hairs or bristles arranged in clusters emanating from a series of tubercles or wart-like elevations. In length it measures about an inch and one-quarter to an inch and one-half; in color it is a deep velvety black, brightly ornamented with red and yellow. Upon each segment there is a transverse row of tubercles. From each of these tubercles there arises a tuft of short, stiff hairs, those on the upper part of the body being red, while below they are yellowish. The light markings in the illustration are

bright yellow in the living insect, while the spiracles, or breathing pores are white. There are also a few whitish dots scattered over the body. When full grown the larva draws together a few leaves or other loose material in which it constructs for itself a rough cocoon. In this cocoon it transforms to a dark brown chrysalis. There are two broods annually. One of them appears in June and July, and the other in September and October.

The moth that is parent to these larvæ is a very plain looking insect, of the same size and general appearance as the accompanying figure. Its front wings are gray, with a row of small black dots along the hind border. There is also a broken zigzag line of the same color across the wing beyond the middle, which, in some specimens, is quite dim. In addition to these markings, the middle area of the wing is provided with dark gray spots. The hind legs are white.

#### REMEDIES.

This is one of our injurious insects that is usually kept in check by insect parasites; and, therefore, it seldom becomes necessary for us to pay further attention to it. It is more of a garden than a field pest. It also feeds upon some of our weeds.

CUT-WORMS. (*Agrotis*, *Mamestra*, and *Hadena*.)

It is needless for me to tell the farmers of Nebraska that cut-worms are among our most dreaded insect pests, for everybody who has tried to raise corn, or garden crops of any description, for several years in succession, has had experiences of his own concerning their powers of destruction.

These cut-worms are moderately large, fleshy worms tapering gently towards both ends. When full grown they average from one and one-fourth to one and one-half inches in length, are dull yellowish-white or gray, sometimes inclining to greenish, and clouded and striped or variously marked with dull black or smoky brown; sometimes, though rarely, with deep black and pure white. One of these worms (*Agrotis clandestina*) is figured herewith (Fig. 4), the illustration showing it as curled, a position taken by them when disturbed. This species is about an average in size—some species being larger and others smaller than this.



FIG. 4.—The W-marked Cut-worm (*Agrotis clandestina*); larva. [After Riley.]

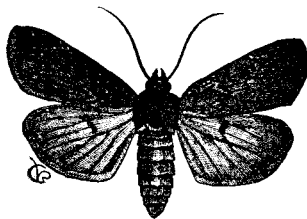


FIG. 5.—*Agrotis clandestina*; moth. [After Riley.]

The name "cut-worm" embraces the numerous species of caterpillars that have the habit of concealing themselves during day-time, either beneath some object lying on the ground, or by directly burying themselves just below the surface, and coming forth after night to feed upon various kinds of vegetation. Many of them confine their attacks to garden products and other low succulent plants, but others are known to climb up the trunks of trees, grape vines, and a variety of the taller kinds of vegetation belonging to garden, vineyard, and orchard, where they cause great havoc by eating the buds and tender leaves in early spring. Cut-worms are the young of a certain group of "Owlet" moths, which are also nocturnal in their habits. Both the larvæ and mature insects are, as a rule, inconspicuous in color, being usually dull gray, brown, or black, or have these colors combined.

There are upward of three hundred distinct species of cut-worms found within the limits of the United States; and perhaps fully one-third that number occur within our state. Of these the following species have been ascertained to work on corn:

- THE SPOTTED CUT-WORM. (*Agrotis c-nigrum* Linn.)  
 THE DINGY CUT-WORM. (*Agrotis subgothica* Haw.)  
 THE WESTERN STRIPED CUT-WORM. (*Agrotis herilis* Grt.)  
 THE W-MARKED CUT-WORM. (*Agrotis clandestina* Harr.)  
 THE DARK-SIDED CUT-WORM. (*Agrotis messoria* Harr.)  
 THE STRIPED OR CORN CUT-WORM. (*Agrotis tessellata* Harr.)  
 THE GREASY OR BLACK CUT-WORM. (*Agrotis ypsilon* Rott.)  
 THE VARIEGATED CUT-WORM. (*Agrotis saucia* Hubn.)  
 THE CLAY-BACKED CUT-WORM. (*Agrotis morrisoniana* Riley.)  
 THE DINGY CUT-WORM No. 2. (*Agrotis tricola* Lint.)  
 THE GLASSY CUT-WORM. (*Hadena devastatrix* Boisd.)  
 THE YELLOW-HEADED CUT-WORM. (*Hadena arctica* Boisd.)  
 HADENA STIPATA, MORT.  
 THE BRONZE-COLORED CUT-WORM. (*Nephelodes violans* Guen.)



FIG. 6.—*Nephelodes violans*; caterpillar. [After Lintner.]

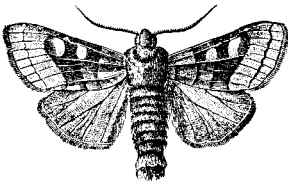


FIG. 7.—*Nephelodes violans*; moth. [After Lintner.]

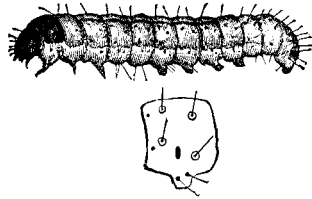


FIG. 8.—*Hadena devastatrix*; larva. [After Riley.]

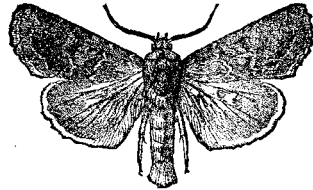


FIG. 9.—*Hadena devastatrix*; moth. [After Riley.]

As my time and space are limited I shall not try to describe these different kinds separately, nor can I figure all of them now. The remarks—which are herewith presented—will, therefore, be general.

## REMEDIES.

It is rather a difficult matter to name any single, or even two or three, remedies that will apply to all cut-worm depredations. Before the various species had been separately studied, it was, and even now is, supposed by many that what is true of one is also true of all species of cut-worms. The different kinds appear at different seasons, and work in different ways, hence must be fought in various ways.

In the garden many of the worms can be taken by supplying artificial hiding places for them in the form of blocks, chips, or boards, which can be examined each morning and the worms crushed. Digging about hills of corn, stalks of cabbage, and tomatoes, and other plants showing recent disturbance, will usually result in the finding of the culprit. Cones of tar-paper set about plants will act as safeguards against their attacks, provided the paper projects an inch above ground.

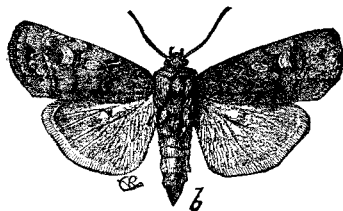


FIG. 10.—Dark-sided Cut-Worm (*Agrotis messoria*); moth. [After Riley.]

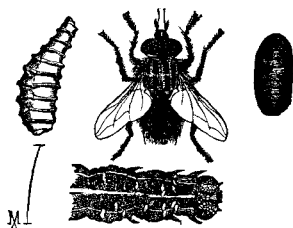


FIG. 11.—Army Worm Tachina fly; larva, pupa, imago, and front end of Army Worm showing eggs. [After Riley.]

Salt is also said to be repulsive to the worms. This latter mode of fighting injurious insects is not to be too highly recommended, since salt is also more or less detrimental to the growth of many kinds of vegetation.

The very best remedy that has thus far been suggested and tried against cut-worms is the use of poisoned grasses, cabbage leaves, or clover. This is done by taking these substances and tying them into loose bunches, and then sprinkling them with a solution of Paris green, or London purple, say a tablespoonful to a bucket of water. Then in the evening scatter these poisoned baits over the field between the rows of beets, cabbage, etc. The worms will be attracted to them, eat and die. These baits should be renewed several times, at intervals of two to four days, according to the state of the weather and the abundance of the worms.



FIG. 12.—Tachina or Flesh Fly.

All of these cut-worms are attacked by several kinds of parasites, both hymenopterous and dipterous. They are also devoured by a number of predaceous beetles, while birds of many kinds are especially fond of them. One of these dipterous parasites is shown in Fig. 11, and another at Fig. 12.

#### THE FALL ARMY WORM. (*Laphygma frugiperda* Guen.)

Very closely related to the cut-worms, and resembling them much in general appearance and habits, is an insect that has received the popular name of Grass Worm or Fall Army Worm. This insect is shown in Fig. 13, where the mature insect is figured. This insect is frequently very numerous, and is accordingly

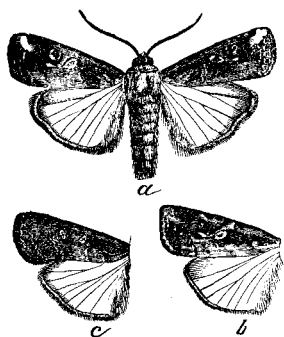


FIG. 13.—*Laphygma frugiperda*; moth, showing variations. [After Riley.]

very destructive. Although called the Grass Worm, it is by no means confined to grasses as its diet. Corn and other crops are just as eagerly attacked and devoured by it.

Since this is such an important insect, and as I have not treated of it before in any of my reports to the Society, I will give a quite full description of it here. The following characterizations of the insect are copied from Prof. S. A. Forbes's account of the insect in the fourteenth report of the entomologist of Illinois.

*Moth.*—"Front wings narrow, apex broadly rounded. General color brownish-gray, varied with bluish-white, dusky and fulvous. A bluish-white patch at the apex of the wing, usually containing a few black points. Subterminal line arcuate, of the same color, continuous, with this patch in front, sometimes obsolete at the terminal angle of the wing, but sometimes complete. Before the subterminal line, and within the apical patch, is a dark blotch upon the middle of the wing, which sometimes contains one or two triangular black points. Transverse anterior and transverse posterior lines sometimes obsolete, when present double, zigzag. Base of wing slightly paler, with a longitudinal black blotch in the middle. Orbicular spot obliquely oval, pale testaceous, with an oblique mark of same color immediately without. Reniform spot obscure, distinguished in front and behind by small whitish blotches, the posterior linear, often shaped like the letter 'e,' the anterior variable. Upon the costal margin, a series of whitish dashes, four of them between the reniform spot and the apex, and as many more, obsolete, between that and the base. Terminal line pale, subterminal space dark, divided into quadrate blotches by the nervures. Fringe paler gray, the scales tipped with black between the nervures. Under surface smoky but paler anteriorly and terminally, and fulvous along the costa. Posterior wings translucent, nearly white in some lights, roseate in others, dusky on anterior margin and on anterior half of outer margin. Head, thorax, and abdomen, nearly uniform gray; thorax with a V-shaped black mark in front."

*Caterpillar or larva.*—"The larvæ are dark, the general effect being that of a nearly black insect with a broad buff band below the stigmata, and a narrow yellow subdorsal line. The dorsum is black or a very dark brown with a yellow median line, and irregular white lineations along the border of the dorsal space. The subdorsal band is also black, slightly mottled along the lower margin, bordered above by a yellow line which is itself bordered above and below by a shade of deeper black. The stigmatal band is drab, mottled with pale brown; the stigmata black, partly within the substigmatal band and partly within the subdorsal band. In one specimen, the dorsum is pale chocolate brown with scarcely a trace of the median line. The heads in all are jet black except on the sides, behind the eyes, where they are somewhat mottled with whitish. The Y-shaped mark upon the front is white and deeply impressed. The cervical shield is black, with the median line and subdorsal yellow lines continued upon it. Upon the caudal shield the median line widens to a more or less triangular blotch. The labrum is brown, the basal joint of the antennæ is wholly white, the second joint white with a black

ring at the base, and the third joint brown. The venter is greenish brown beneath the buff lateral band, becoming nearly yellow towards the bases of the prolegs. Each of the latter has a glossy black patch upon its outer surface. Between these jugs the surface is a brownish green. The whole ventral area is finely mottled with yellow."

From notes accumulated by different authors it would appear that there are at least two broods northward and three southward in the United States. The first brood northward often attacks the young corn, and by eating the leaves and burrowing into the heart of the plants kills them. Later in the summer the leaves and the tender ears are damaged.

#### REMEDIES.

As it is in the case of other cut-worms and the true Army Worm, so it is with reference to the present species. They are all usually held in check by their natural enemies, certain dipterous and hymenopterous parasites. Sometimes, however, these from some cause or other fail to do their work, and the moth gains the ascendancy. When such is the case artificial means must be resorted to if we would protect our crops from their ravages. In writing on this feature of the subject, Professor Forbes has the following to say:

"The female moths, when searching for a proper place of deposit for their eggs, are evidently attracted to the ground upon which the larvæ do their damage, by the presence of an abundance of green food for the latter, a fact which immediately suggests early plowing of ground intended for winter wheat, as a preventive measure. Doubtless, except for the allurements of growing vegetation, the eggs of the imago would be planted elsewhere, or so widely scattered as to effect no appreciable damage.

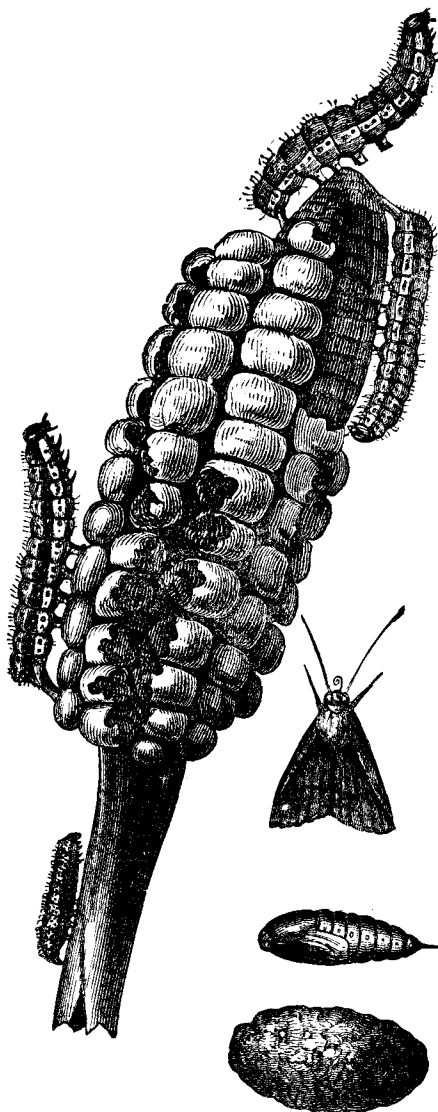
"Certainly in that region where the grass worm prevailed last year it would be prudent to plow early after oats when it is intended to plant wheat.

"If, however, this precaution has been neglected and hordes of the larvæ appear in the wheat fields, it will doubtless prove difficult to arrest their ravages. No opportunities for experiment have as yet offered, notice of the appearance of the larvæ in the wheat having been received too late to permit trial of remedial measures; but it may be worth while to suggest heavy rolling as a measure likely to be practicable and efficient in some instances. This has occasionally been found useful for the destruction of the true Army Worm. One farmer in Mason county, who noticed that the grass worms were extending their ravages rapidly from the central area in which he first noticed them, believed that he had destroyed the brood and prevented further injury by plowing under the infested area and rolling it heavily immediately thereafter. If a disposition to migration, like that of the Army Worm, is apparent, the march of the host may be arrested by measures which have been found more or less efficient in the case of the last named insect; that is, a furrow may be plowed across the line of their march, when the worms collecting therein may be destroyed by dragging a log along the furrow. If their appearance is easily detected while they are quite small, it might not be unprofitable to destroy them with Paris green or other form of insect poison, but in most instances it will doubtless be less expensive to resow the ground than to attempt the somewhat doubtful remedies here proposed."

It will be seen from the foregoing remarks that the insect is more of an enemy to the small grain than to corn. Still its omnivorous food-habits make it also a

very important species in the list of enemies of this last named cereal. If it is destroyed when working as a grass worm or wheat worm there will be little need to fight it as a corn enemy.

**THE CORN WORM, BOLL WORM, TOMATO WORM, ETC. (*Heliothis armigera*.)**



A very common as well as a very injurious corn insect in the state of Nebraska is the one bearing the above names in different portions of the country. And queer, too, it is, when we take into consideration the widely different nature of the food plants upon which the insect works. Nor are these its only food plants. It is also known to work upon a large variety of others, differing greatly one from the other, both as to nature and taste. Peas, beans, pumpkins, squashes, peppers, heads of hemp, leaves of tobacco, of lucerne, etc., also boring into the stems of the tomato, gladiolus, and geraniums. It also works on the Jamestown weed (*Datura stramonium*) and the different ground-cherries (*Physalis*), as well as upon the seed-bolls of the morning glories. It will be seen from these references that, with but few exceptions, the worm, for it is the larva only that does the damage, is essentially a fruit and seed eater—almost invariably attacking the part bearing the seed, or else the pulpy stem in the absence of these. Aside from these it is not, however, too dainty a feeder to refuse the leaves of tobacco, geraniums, and any other plant available in their stead.

Here in Nebraska the worm is essentially a corn insect, and it is as such that we have to deal with it. Every farmer who has raised corn has seen the worm, and knows how it works upon the tender new corn by entering at the "silk end" of the ear and living upon the kernels—sometimes almost entirely denuding the cob. Figure 14 shows the insect in its larval, pupal, and perfect

FIG. 14.—The Corn worm (*Heliothis armigera*); ear of corn showing larvæ and work; at right, pupa and moth. [After Riley.]

stages, and Fig. 15 the egg, larva, pupa, and imago with spread wings. In Fig. 16 it is shown as a tomato worm.

The parent moth, while classed with the Noctuidæ, or nocturnal species, along with the cut-worms, is partly diurnal in its habits. On hazy days, and especially during late summer, it can be seen flying about and feeding upon the blossoms of clover, golden rod, etc.

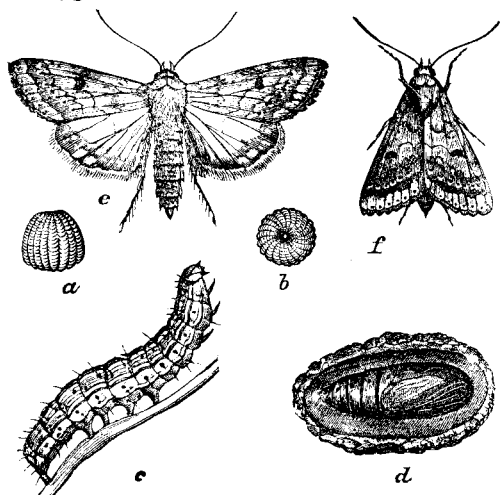


FIG. 15.—The Corn Worm (*Heliothis armigera*): *a*, *b*, enlarged view of the egg; *c*, full grown larva; *d*, pupa, in case; *e*, and *f*, moth—natural size. [After Riley.]

fall, long after the first frosts here in Nebraska, hundreds of the moths are to be seen about the lights in our cities. Whether or not any of these hibernate I cannot say.

As before stated, the larva is quite a general feeder. In addition to the food habits already mentioned, it gives me pleasure to be able to announce that the larva is also inclined to cannibalism, and sometimes attacks others of its kind, which it not only kills but entirely devours.

#### REMEDIES.

The Corn-Worm, like other injurious species, can and should be carefully battled against whenever the opportunity presents. A single moth lays on an average about 500 eggs, and from the secluded nature of the larvæ, has but few natural enemies. Hence, every moth killed in spring before egg-laying begins means the saving of a considerable later loss.

As remedies that have been tried with success, the following are suggested: hand picking, attracting by odor and drowning, and attracting by light. The first applies to the larvæ; the others to the moths.

*Hand picking.*—Where the larvæ infest gardens, the gathering of them by hand and afterwards destroying is quite feasible. Even in corn fields of moderate extent, this method of warfare is of sufficient benefit to pay for the time thus spent. Its presence in the ears is known by the eaten and blackened silk, mingled with excreta. To capture the worms here, the husk can be opened at the top and the depredator killed.

There are from two to three broods annually here in Nebraska, the early spring larvæ feeding scattered about upon such different food plants as present themselves, and maturing in time to be ready for the first appearance of the tender ears of corn. The second brood is the one to be dreaded. After the corn has ripened and these larvæ of the second brood have pupated, there is sometimes a third brood; i. e., some of these, and perhaps all, for aught I know, issue and seek the various plants above mentioned, and provide for a wintering set of pupæ. Very late in the



*Attracting by odors and drowning.*—During certain times of the year, when the moths are issuing from pupæ, and before they have laid their eggs, these insects can be attracted to baits and destroyed. For this purpose a mixture of molasses

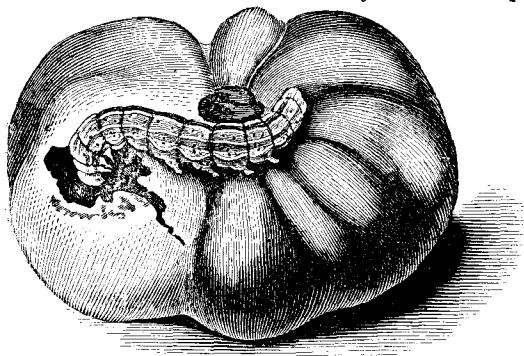


FIG. 16.—The Corn Worm (*H. crumigera*) as a tomato worm.  
[After Riley.]

and molasses, previously prepared in the proportion of four parts of the former to one of the latter. These plates were set on small stakes or poles driven into the ground in the cotton field, one to about three acres, and reaching a little above the cotton plant, with a six-inch-square board to receive the plate. These arrangements were made in the evening soon after the flies (moths) had made their appearance. The next morning we found from eighteen to thirty-five moths in each plate. The experiment was continued for five or six days, distributing the plates over the entire field, each day's success increasing [? decreasing] until the numbers were reduced to two or three moths to each plate, when it was abandoned as being no longer worthy of the trouble. The crop that year was very little injured.

*Attracted by light.*—The habit among a large number of nocturnal insects of coming to bright lights has frequently been taken advantage of for the purpose of destroying certain of the injurious species. This has been done in connection with the one under present consideration. While I do not approve of the general use of this as a remedy against nocturnal insect pests, it might be resorted to in extreme cases. Just as many of the useful or beneficial species are also attracted by lights, and many of them are certain to be destroyed along with the injurious ones. The best means of applying this remedy is shown in Fig. 17. If this plan is adopted, many of the beneficial species will be enabled to crawl out of the water and escape, while the moths cannot. A very little kerosene oil should be added to the water to prove most beneficial in results. This will also add greatly to the number of friends destroyed.

and vinegar, set out in the fields in shallow dishes, will attract and destroy them. This method will also attract and destroy many other species. The following quotation from the Patent Office Report (Agriculture) for the year 1885, page 285, gives some light upon this subject:

"We procured eighteen common-sized dinner plates, into each of which we put half a gill of vin-

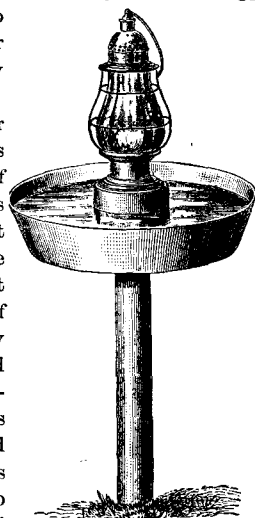


FIG. 17.—Lamp arranged for catching moths. [After Lintner.]

Prof. J. A. Lintner, in commenting upon the destruction of the first brood of this moth, has the following remarks to offer,\* which will also apply to other injurious species:

"To illustrate the great importance of destroying the insects which would produce the first brood of a many-brooded species, and the ease with which subsequent multiplication may at this time be prevented, we present the following calculation, showing the results which would follow the above experiments conducted for a single night, upon the supposition that each female of five successive broods would have deposited its full quota of eggs, and that each egg would have produced a moth. It is scarcely necessary to add that not even a near approach to such an entire exemption from loss in four distinct stages of insect life can ever occur in nature.

"The average number of moths to the plate as given above (referring to the same quotation from the Patent Office Report embodied here) being twenty-six, the entire number captured during the night would have been four hundred and sixty-eight. Assuming one-half of these to have been females, and each to contain five hundred eggs, the caterpillars of the first brood would number one hundred and seventeen thousand. By the same method of calculation, we have for the second brood twenty-nine and a quarter millions of caterpillars; and continuing the computation until we reach the fifth and last brood, we have the amazing number of 457,031,250,000,000 caterpillars, or exceeding four hundred and fifty-seven trillions.

"To present this computation in a more convenient and comprehensive form: Under the above conditions and by the same progressive increase, a Corn Moth emerging from its pupa in May would be represented by a progeny of nearly two trillions of caterpillars in its last annual brood in November, a number fourteen hundred times greater than that of the entire human population (as estimated) of the globe."

In this computation Mr. Lintner has carried his figures on to the fifth generation or brood, and not made allowance for loss of life by accident, disease, or predaceous foes. Our third brood is the last one we can count on for this state. Of course these figures only show possible results, and are not intended to represent actual facts. At any rate the increase of insect life is sufficiently rapid to warrant the expenditure of prompt and summary measures in dealing with them.

#### THE STALK BORER. (*Gortyna nitela* Guen.)

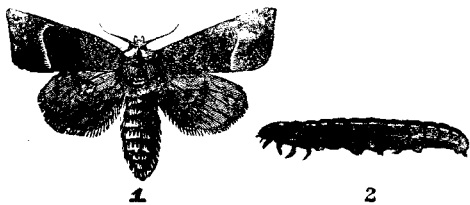


FIG. 18.—*Gortyna nitela*: 1, moth; 2, larva. [After Riley.] of course the injury inflicted is the death of stalk or ear. Lintner, in speaking of this insect, says, "More frequently it falls under our notice as a borer in the pith of plants cultivated in our

The insect which is figured herewith (Fig. 18), while not at all numerous, has occasionally been known to do considerable injury to growing corn both in the field and in gardens. It works both in the stalks and in the cob. When working either way

\*First Annual Report of the State Entomologist of New York, 1882, p. 126.

gardens, as in the stems of asters, dahlias, lilies, spinach, etc." He might have gone on and mentioned various weeds growing along roadsides and along the edges of fields.

The moth, which is parent to this boring larva, measures about one and one-half inches in wing expanse. Its wings are of a wood-brown color, sprinkled with yellowish dots. The only conspicuous ornamentation is a yellowish-white line at the outer third of the front wings, bent at nearly a right angle, near the front margin; between this line and the outer border the wing is paler.

"The caterpillar, shown at 2, measures over an inch long when fully grown. It is purplish-brown above, with three white lines on the back, of which the central one is continuous, and the other two interrupted from the fourth to the seventh segments inclusive. The first two segments have a white stripe on their sides, and above the third and fourth fleshy legs (prolegs) there is another white stripe. The head and a caraneous plate on top of the first and last segments are shining yellow, bordered on the sides with black. In its walking, which is quite rapid, the caterpillar arches its back somewhat like the *Geometridæ* (measuring worms), as it does not use its first pair of prolegs."

#### REMEDIES.

The remedies that can be employed against this insect must vary more or less according to the plant which it infests. When it attacks weeds such as the ambrosias, cocklebur, chenopodiums, polygonums, etc., and shows no inclination towards forsaking them for potatoes, tomatoes, and other garden plants, the insect does not require being molested by us; but when it does leave them for cultivated plants its presence is quickly seen by the wilted stems, and it should be sought out and destroyed. The stems of the plant containing the larvæ should be collected and burned.

The moth is claimed to live over winter and to lay its eggs early in June of the following summer. These eggs are supposed to be laid upon the stems of the plant in which the larvæ afterwards bore. Often a single stem will not contain sufficient food for a larva when it leaves its first stem and enters a fresh one. When working in small grain many stems are required for the feeding of a single larva to maturity.

#### THE SPINDLE WORM. (*Achatodes zææ* Harr.)

An insect that is found throughout the Atlantic, middle, and northern states, and one that has at times been very injurious to corn in the New England states, is known to entomologists by the above name. Harris, in writing of this insect, uses the following language:

"This insect receives its common name from its destroying the spindle of the Indian corn; but its ravages generally begin while the corn-stalk is young, and before the spindle rises much above the tuft of leaves in which it is embosomed. The mischief is discovered by the withering of the leaves, and, when these are taken hold of, they may often be drawn out with the included spindle. On examining the corn, a small hole may be seen in the side of the leafy stalk, near the ground, penetrating into the soft center of the stalk, which, when cut open, will be found to be perforated, both upwards and downwards, by a slender worm-like caterpillar, whose excrementitious castings surround the orifice of the hole. This caterpillar grows to the length of an inch, or more, and to the thickness of a

goose-quill. It is smooth, and apparently naked, yellowish, with the head, the top of the first and of the last rings black, and with a double row, across each of the other rings, of small, smooth, slightly elevated, shining black dots. With a magnifying glass a few short hairs can be seen on its body, arising singly from the black dots." This caterpillar also attacks other plants than Indian corn. It has been found to bore into the stems of the dahlia, elder, etc. The parent moth is described by that author as having "The fore wings rust-red, mottled with gray, almost in bands, uniting with the ordinary spots, which are also gray and indistinct; there is an irregular tawny spot near the tip, and on the veins there are a few black dots. The hind wings are yellowish-gray, with a central dusky spot, behind which are two faint dusky bands. The head and thorax are rust-red, with an elevated tawny tuft on each. The abdomen is pale brown, with a row of tawny tufts on the back. The wings expand nearly one inch and a half."

#### REMEDY.

The same author states further, that "In order to check the ravages of these insects they must be destroyed while in the caterpillar state. As soon as our corn fields begin to show, by the withering of the leaves, the usual signs that the enemy is at work in the stalks, the spindle worms should be sought for and killed; for if allowed to remain undisturbed until they turn to moths, they will make their escape, and we shall not be able to prevent them from laying their eggs for another brood of these pestilent insects."

#### THE ARMY WORM. (*Leucania unipuncta* Haw.)

The name "Army Worm" has been indiscriminately applied in this country to several species of widely separated insects that at times have appeared in great numbers, and moved apparently with a single impulse as of an army. Among

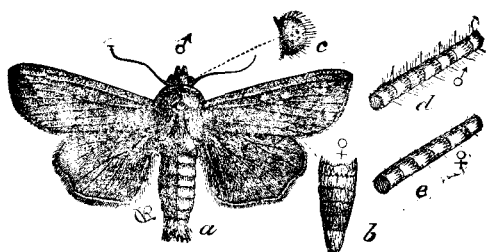


FIG. 19.—The Army Worm (*Leucania unipuncta*): a, male moth; b, abdomen of female; c, eye; d, antennal joints of male; e, do. of female, enlarged. [After Riley.]

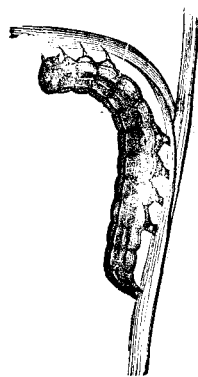


FIG. 20.—Army Worm, the full grown larva. [After Riley.]

these can be mentioned the Cotton Worm (*Aletia xyntina* Say), which devastates the cotton crop of the southern states; the Grass Worm (*Laphygma frugiperda* Sm. & Abb., also a southern insect; the Tent Caterpillar (*Clisiocampa sylvatica* Harr.); the Fall Web Worm (*Hyphantria textor* Harr.); and one or two others.



FIG. 21.—Army Worm; the pupa. [After Riley.]

Here in Nebraska the larva of a species of saw fly is sometimes “dubbed” with the name of Army Worm; one of the *Myriapods* also is called by that name. There is perhaps an excuse for this “many-foot” receiving the name, because it frequently appears in veritable armies upon low ground. Unlike the true Army Worm (*Leucania unipuncta*), of which this article treats, this “thousand-leg” does no particular damage to growing vegetation. It is an underground feeder, and only comes to the surface during excessively wet weather, and when mating.

The Army Worm is almost cosmopolitan in its distribution, but nowhere except in the United States does it appear to be a pest. Here, too, its ravages are confined chiefly to the middle and northern portions east of the Rocky mountains. In Nebraska it was first observed by me in injurious numbers during the summer of 1888, and then only over a limited area in our extreme northwestern counties. Of course it may have been present in hurtful numbers prior to this, and its ravages not have come to my notice. This is hardly probable, however, since I have been carefully watching the coming and going of insect pests within the state for upward of fifteen years.

This insect can readily be recognized by a comparison with the above figures. The moth is reddish-brown, more or less thickly sprinkled with minute black specks over the front wings; and it also has a small white spot near the center of each, from which it takes its specific name. The larva or “worm” is striped with light clay and brown, which colors vary somewhat in different individuals.

#### REMEDIES AND NATURAL ENEMIES.

Chief among the remedies adopted for keeping in check the increase of this pest is the burning of old grass, stubble, and other like receptacles for the eggs and hibernating larvæ. Perhaps this accounts for the absence of the pest from our frontier settlements in this and other western states for the past twenty years and more, the customary fall and early spring prairie fires having destroyed such eggs and larvæ as would otherwise have entered upon the spring and summer campaigns.

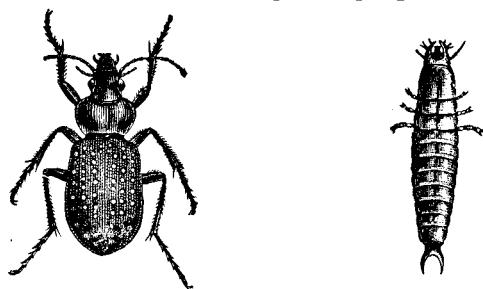


FIG. 22.—*Calosoma calidum*; a, the beetle; b, the larva. [After Riley.]

This is a preventative before the pest has “materialized.” The burning should be postponed until spring has well advanced, to be of most benefit. During late years, the increase of area cultivated, and the prevention of starting fires on the prairies, especially in the “cattle district” of the northwest, has perhaps been the direct cause for the presence of this insect in injurious numbers.

Now that it is with us, and liable to remain, we must be ready to meet it face to face. Ditching, rolling, plowing, etc., are remedies that can be used advantageously. Ditching and fencing can be resorted to in preventing the worms from passing from one field to another. Fence boards set on edge and saturated with kerosene will effectually check an advancing column, after which they can be destroyed by crushing. Ditching, with the opposite side of the ditch from the advancing



FIG. 23.—*Cicindela 6-guttata*.  
[After Riley.]

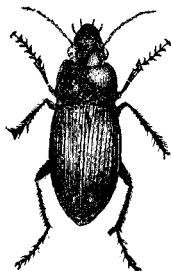


FIG. 24.—*Harpalus caliginosus*.  
[After Riley.]

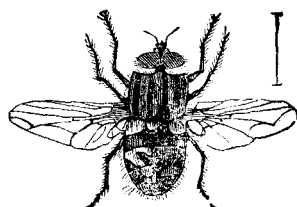


FIG. 25.—*Ecorista leucanix*.  
[After Walsh.]

host "dug under," will "corral" the worms for the time being, when they can be destroyed by crushing, or by covering with hay or straw and setting fire to it. Poisoning with London purple and Paris green has also been resorted to with good results; but as long as other and less dangerous methods do not fail, it is advisable not to resort to these. Grass or grain that has been sprayed with these poisons should never be fed to stock, as there is danger of poisoning animals so fed.

During ordinary years, this, as well as most all other injurious insects, is kept in check by its natural enemies; but occasionally, from various causes, these of themselves are not sufficient to do the work. Among the enemies of the Army Worm are to be mentioned the insectivorous birds, poultry, reptiles, and when hard pressed for food they even devour one another. Quite a number of the predaceous beetles and their larvæ destroy hundreds of the worms. Three of these beetles are figured here. Fig. 23 represents *Cicindela 6-guttata*; Fig. 24 is *Harpalus caliginosus* Fabr.; and Fig. 22, *a* and *b*, are larva and imago of the Fiery Calosoma, *Calosoma calidum*. There are also a large number of true parasites that work upon this insect in one or the other of its stages. One of these (*Ecorista leucanix*), a Tachina fly, is figured at Fig. 25. Besides the several species of two-winged flies that are parasitic upon *Leucania unipuncta*, there are certain Ichneumonids and other parasitic Hymenoptera that attack the worms by laying their eggs within their hosts' bodies, where their young eat away their vitals.

#### THE MEAL SNOUT MOTH. (*Asopia farinalis* Linn.)

This insect is mentioned among corn enemies on the strength of its attacking stored grain and the meal made of corn. The moth is a member of the Deltoids or Pyralidæ family—a name given to the group on account of the shape of these insects when at rest. The meal moth has the front pair of wings light brown, "crossed by two curved white lines, and with a dark chocolate-brown spot on the base and tip of each." These moths are often seen upon ceilings of rooms and out-buildings, and can easily be destroyed at such times.

THE SMALLER CORN-STALK BORER. (*Pempelia lignosella* Zeller.)

In figure 26 is shown the various stages of the above named insect, together with its work. While a southern species, it is mentioned in this paper, because it may at some future time be introduced into the state. For a full description of the insect in its different stages, and also for its habits and life-history, the reader is referred to the report of the United States entomologist printed in the Annual Report of the Department of Agriculture for the years 1881 and 1882, pp. 142-145.

THE ROOT WEB WORM. (*Crambus zeelus* Fernald.)

The corn plant is often injured here in Nebraska, as well as in several other states, by the above named insect. As the name implies, this pest works chiefly below ground, where it feeds upon the roots of its food plants. The figure (Fig. 29) will give the reader an

idea of its mode of attack. In writing about this particular insect, Prof. S. A. Forbes, state entomologist of Illinois, uses the following language:

"Upon digging into the affected hills, the caterpillars were found just beneath the surface, sometimes as many as five or six in a hill, each in a retreat formed by loosely webbing together a mass of dirt irregularly cylindrical in shape, one and one-half to two inches long and about one-half an inch in diameter. The worm was found in a silk-lined tube within this mass (the tube not always perfectly constructed), which in some cases opened at the surface, its presence being indicated by a circular opening about the size of a wheat straw, in the earth next a stalk of corn.

"The first attack upon the plant was made by gnawing the outer surface beneath the ground and above the roots. Occasionally the stalk was completely severed, as by a cut-worm, but usually not, the larvæ showing rather a disposition to work upwards, eating a superficial furrow or burrowing lengthwise along the center of the stem. \* \* \* The foliage was also frequently eaten, the lower leaf first and then the upper ones, the larva evidently leaving its burrow for this purpose. The tips of the leaves were eaten off, or irregular elongate holes were eaten through them—probably at night, as I have never seen the larva abroad by day. Where the corn was largest, webbed masses of dirt were frequently found which contained no larvæ, a fact which I at first inclined to suppose indicated that the insect inhabiting them had transformed, especially as the larvæ found were

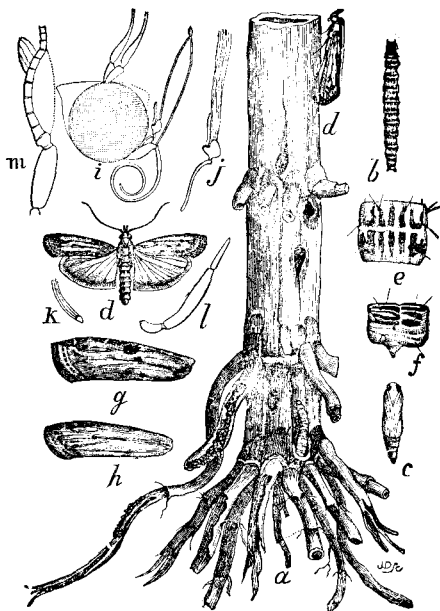


FIG. 26.—*Pempelia lignosella*: a, stalk showing work of larva; b, larva; c, pupa; d, moth with wings expanded and at rest—natural size. [After Riley.]

quite uniform in size and apparently full grown. I failed to find a single pupa, however; and as our breeding experiments did not yield the insect for more than a month, it seems more likely that these empty webs had been abandoned by worms which had gone in search of young stalks."

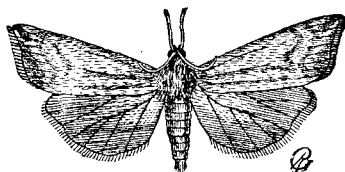


FIG. 27.—*Crambus zeellus*; moth. [After Forbes.]

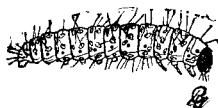


FIG. 28.—*Crambus zeellus*; larva, slightly magnified. [After Forbes.]

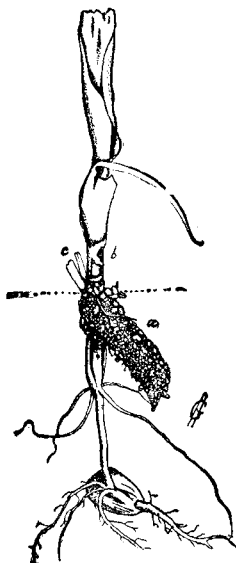


FIG. 29.—Corn injured by *Crambus zeellus*; a, tubular nest in earth. [After Forbes.]

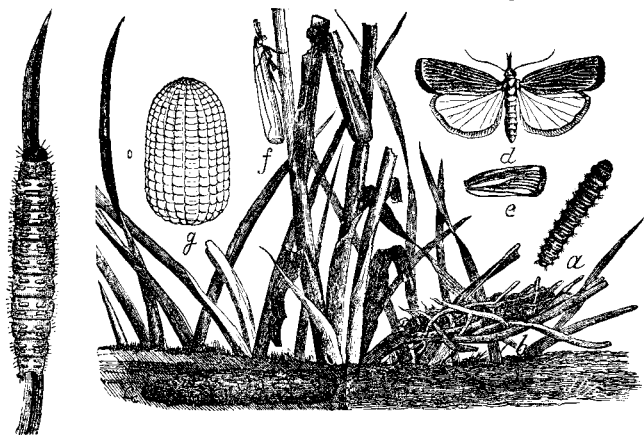


FIG. 30.—*Crambus vulgivagellus*: a, larva; b, web of same; c, cocoon; d, moth, wings expanded; f, same, wings closed; g, egg—greatly enlarged. [After Riley.] Larva more highly magnified at left. [After Lintner.]

The larva (Fig. 28) is pale reddish-brown in color, has a nearly black head, dusky yellow neck, and is covered by extraordinarily large piliferous tubercles, each of



which bears an unusually long black hair. These "tubercles" are not elevated, but consist of smooth shining areas, of a firmer consistency and a darker tint than the adjacent surface. The moth which is parent to these web worms is a small leaden-colored insect that does not quite measure an inch in wing expanse.

#### REMEDIES.

In speaking of remedies against this insect Professor Forbes expresses the opinion that "The injuries inflicted occur so early as to permit replanting in most seasons in case they should prove to be of serious import; and this species is consequently to be classed with the cut-worms so far as the effect of its injuries to corn are concerned."

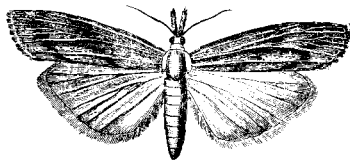


FIG. 31.—*Crambus exsiccatus*; moth. [After Lintner.]

Two other species of *Crambus* have also been taken in corn fields.

**CRAMBUS EXSICCATUS.** The moth shown in Fig. 31.

**CRAMBUS FUSCICOSTELLUS.**

The larva and other stages of still another species, *C. vulgivagellus*, is figured at No. 30. These latter have very similar habits to those of the *C. zeelus* described above, hence need not be treated separately. Most of these insects are normally enemies of grasses rather than of corn, but also attack that plant at intervals—especially when that crop is planted upon sod.

**THE LARGER CORN-STALK BORER.** (*Diatraea saccharalis* Fabr.)

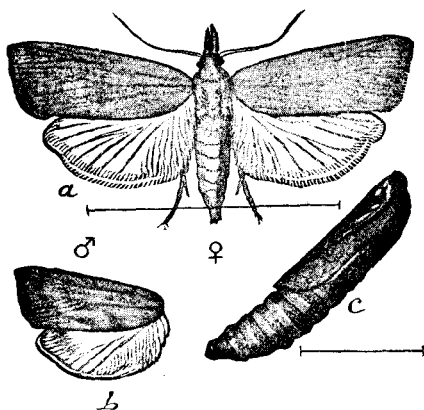


FIG. 32.—*Diatraea saccharalis*: a, moth; c, pupa; [Insect Life.]

"Boring into the stalks of corn near the ground, a white larva, most often with dark spots, measuring when full grown about one inch in length, transforming to a slender brown pupa within the stalk, which eventually gives forth a light brown moth, with a wing expanse of an inch and a quarter."—Comstock.

This insect, although formerly a southern species and a sugar cane pest, has of late years transferred its attention to corn, and is now rapidly working its way northward. Some idea of this insect's appearance can be had from the accompanying figures (Nos. 32, 33, 34), which are taken from an article in *Insect Life* by L.

O. Howard, devoted to the life-history of the insect.—*Insect Life*, Vol. IV, No. 3, pp. 95-103.

#### REMEDIES.

In treating of this feature of the subject, Mr. Howard has the following to say: "With the more careful and thorough methods of cultivation in the north this insect will have no chance for its life. It will reach its maximum in localities like parts of



FIG. 33.—*Diatraea saccharalis*; work of larva.  
[Insect Life.]

localities), and even when dragged off and collected they are not burned. Where, however, the old stalks are systematically removed from the field and burned after

South Carolina, where corn is simply stripped for fodder in early August and the bare stalks with the ear attached stand until after the cotton is picked, ginned, and shipped, and where, even after the ears are harvested, the stalks are seldom harvested. In Virginia, however, the conditions are nearly as favorable for the continuous development of the insect. Where it is not intended to follow corn with winter grain the corn is cut in October, and the butts stand in the ground until the following spring, affording the larvæ safe places of hibernation. Even in plowing for another crop of corn in the spring many of the old stalks are not destroyed but remain standing through the winter. Under these conditions there is no check whatsoever to the increase of the pest. Where winter grain follows corn the stalks are not thoroughly dragged off (they never seem to be systematically pulled as in some parts of Maryland and other

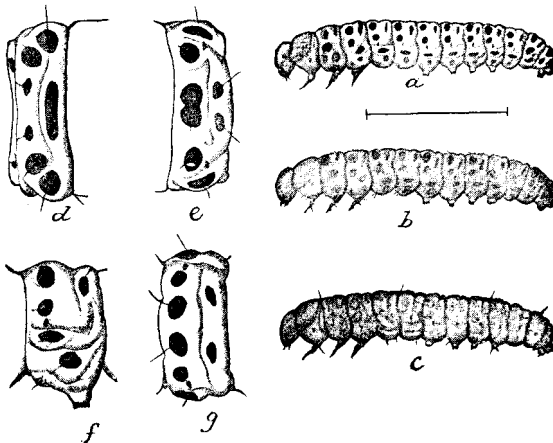


FIG. 34.—*Diatraea saccharalis*; larval variations—enlarged. [Insect Life.]

harvest or during winter, or where a constant rotation of crops is practiced, the corn-stalk borer will never become a serious pest."

The insect is two brooded as far north as Virginia and Maryland, and three brooded in the Gulf states.

THE CORN-FODDER MOTH. (*Helia æmula* —.)

During the past five or six years, in Mississippi, the above named moth has been more or less injurious to corn fodder in the stack. The larva is briefly described as being "over an inch long, of a uniform brown color, without hair, almost translucent, has full complement of feet for crawling rapidly, and does not roll the dry leaves nor make a web till the chrysalid is formed." This insect belongs, along with several of the above named species, in the lepidopterous family, *Pyralidæ*.

THE GARDEN WEB WORM. (*Eurycreon rantalis* Guen.)

One of our corn insects is shown in Fig. 35. It is known by the name of the Garden Web Worm, from the fact that it spins a web while feeding; and "Garden," because it is a garden frequenter rather than a field inhabitant. Systematically, it belongs to the family of moths which bear the name of *Pyralidæ*, the members of which are all more or less injurious. It has been quite thoroughly treated in Professor Riley's annual report to the Commissioner of Agriculture for the year 1885, pp. 265-270. I will therefore quote quite largely from that source.

In referring to the distribution of this insect that author writes as follows: "*Eurycreon rantalis* is quite a widespread species, occurring all over the United States. It has been captured in South America, and the original description of the species was from a specimen from Montevideo. It is also a very variable species, and has been variously described under the names of *crinisalis*, by Walker; of *communis* by Grote, and of *occidentalis*, by Packard."

DESCRIPTIVE.

"The moth (Fig. 35, *f*) has an average expanse of 18mm. The general color is either orange or reddish yellow, inclining to buff, or more commonly a lighter or darker shade of gray, having, in certain lights, either a copperish or greenish reflection very similar to that on the well known Cotton Worm Moth (*Aletia xylinæ*).

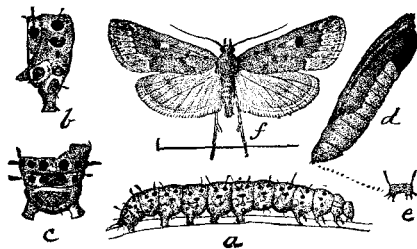


FIG. 35.—Garden Web-worm (*Eurycreon rantalis*):  
a, larva; d, pupa; f, moth—all slightly enlarged.  
[After Riley.]

The characteristic markings, as shown in the figure, are the darker reniform and orbicular spots, with a paler shade between them; two irregular transverse pale lines, generally relieved by darker shade, most intense posteriorly on the anterior line and basally or interiorly on the posterior line. The terminal space may be either paler or darker than the ground color. The markings are very variable, however, dark specimens (*rantalis*) having them all well defined, paler specimens (*communis*) less so, while in others (*crinisalis*) the anterior line and inner portion of posterior line may be lacking."

"The larva \* \* \* is also somewhat variable in color, being either pale or dark-yellow, or even greenish-yellow. It is marked with rather distinct jet-black piliferous spots, as illustrated in the figure. The piliferous spots are also more or less distinctly relieved by a pale border.

"The pupa is of the normal brown color and characterized by the tip of the body having two prominences, each furnished with three stout, short spines."

Although this insect is known to extend over a remarkably large area, its injuries have thus far been confined to the region between the Missouri river and the Rocky mountains; nor has it been observed here to any great extent—at least, north of the Platte river. This area is, however, quite liable to be increased with the general cultivation of the soil in the beet belt.

#### FOOD PLANTS.

Like many of our more injurious insect pests, the "Garden Web Worm" is quite a general feeder. It is especially one that will need our watchful care if we hope to keep it within bounds, for it is one of the very few species that is a genuine weed-feeder. In fact, it is more partial to some of the weeds than it is to cultivated plants. Professor Riley speaks of the food habits of this insect as follows in the report already referred to: "There is no question but that the preferred food of this species is the foliage of plants of the genus *Amarantus*, called in different parts of the country Amaranth, Pig-weed and Careless weed. This was very noticeable in our observations in 1873, and its next preference seemed to be Purslane. Professor Snow also mentions Lamb's Quarter (also called "Pig-weed" *Chenopodium*) as a favorite food plant. Prof. C. E. Bessey, writing from Lincoln, Nebraska, August 11, mentioned an unusual abundance of these larvæ upon *Amarantus retroflexus* and *A. blitoides*. Another correspondent mentions finding them the present year (1885) upon the common Cocklebur (*Xanthium strumarium*), but this was probably due to their excessive abundance and want of proper food. This, also, is probably the case with the common Burdock (*Lappa*), which is mentioned by another correspondent. Professor Popenoe mentions, among the weeds injured, *Amarantus alba*, *Chenopodium album*, *Ambrosia trifida*, *Apocynum cannabinum*, and *Grindelia squarrosa*. He also mentions the fact that they injured a bed of scarlet verbenas."

The following are the cultivated plants that it has been observed to feed upon: Corn, cotton, cabbage, cucumber, castor beans, melon, squash, pea, beans, red clover, alsike, alfalfa, pumpkin, sweet potato, Irish potato, egg plant, tomato, orchard grass, timothy, meadow oat grass, millet, flax, tobacco, sugar cane, lettuce, onions, and beets, besides others. Thus it will be seen that the insect is a more general feeder than might be at first supposed. In fact it appears to be able to feed on almost anything.

#### HABITS AND NATURAL HISTORY.

Under this heading Professor Riley, whom I have already quoted largely, says: "The full natural history of the species has not yet been made out. The eggs have not yet been described, the method of hibernation is not positively known, and the number of annual generations has not been carefully determined."

The insect is evidently a many-brooded species, since indications point to at least three or four sets of the moths during the spring, summer, and fall. The larva is

a web-maker, and always spins as it goes and constructs a sort of retreat in which it remains during the day-time at rest. It is described by Professor Popenoe in the second quarterly report for 1880 of the Kansas State Board of Agriculture. He says: "The following points in its history are the partial result of my study of the insect. Although I made careful search for the egg, I failed to discover it *in situ*, but it is without doubt deposited on the lower side of the leaf, or low down among the bases of a cluster of leaves, as newly hatched larvæ are found in both these situations, from which they soon wander to other parts of the plant. As soon as it (the larva) begins to move about it begins to spin the web, and this is

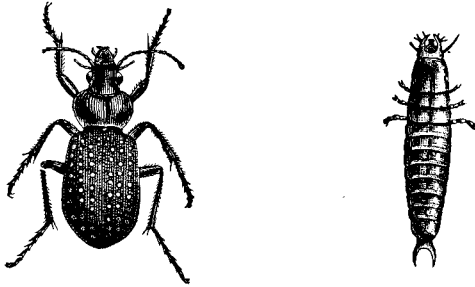


FIG. 36.—*Ca'ono-na ca'idum*: a, the beetle; b, the larva. [After Riley.]

increased in extent as the movements of the larva are extended. It is very active in all stages of growth as a larva, and springs aside quickly when touched, sometimes throwing itself into a coil, but more often running rapidly away. At least in early life the larva, when thrown off a leaf, will hang by a thread of silk. In case a single leaf is of sufficient size, as in the sweet potato, the well-grown larva is generally found on the upper side in a shelter formed by drawing partly together the edges of the leaf by the silk of its web. In this shelter it is usually found at

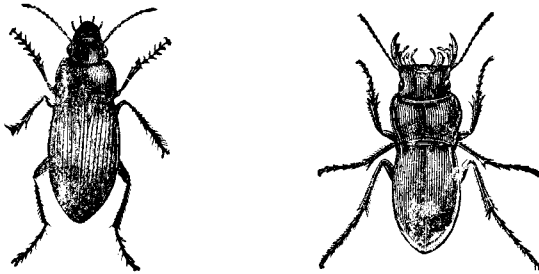


FIG. 37.—*Harpalus caliginosus*. [After Riley.]

FIG. 38.—*Pasimachus elongatus*. [After Riley.]

rest during the day, hanging by its feet, back downward, to the lower surface of the web. In other plants several leaves may be drawn together for a place of concealment. If, indeed, the larvæ are not partially gregarious, they are at least not disturbed with proximity to each other, as several may be found at times in a common web, although I believe this is exceptional. As they are forced to move to new parts of the plant for fresh food their webs are extended until finally the entire

plant is covered. The young devour only the surface and substance of the leaf on the side where they are, leaving the veins and the opposite epidermis untouched, producing a "skeleton" leaf. As they grow older, however, they devour all portions of the leaf, and often eat also the petioles and tender stems. Opportunity has not been given to determine the exact length of the larval life of this insect, but judging from observations made, this cannot greatly exceed a week. Parties living in the region where the insect was present in great numbers give ten days as the length of time in which the chief destruction was accomplished."

Although I have never paid personal attention to this insect, it is learned from the records of others that, when full grown, the larva spins for itself a delicate silken cocoon among the debris on the ground at the base of its food plant, and transforms to the pupa or chrysalis stage. It remains in this last from one to two weeks.

#### NATURAL ENEMIES.

Like all other injurious insects, this one is quite certain to have its insect enemies, both parasitic and predaceous. Some of the ground-beetles, like those illustrated in Figs. 36, 37, and 38, feed upon the larvæ, while a *Tachina* fly has been bred from them in Kansas by Professor Popenoe.

#### THE SULPHUR LEAF-ROLLER. (*Dichelia sulphureana* Clemens.)

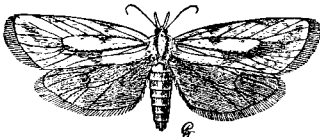


FIG 39. *Dichelia sulphureana*; moth.  
[After Forbes.]

The little insect which is figured herewith (Fig 39) is parent to one of the leaf-rolling or leaf-folding larvæ that occasionally attacks young corn. While it may never become sufficiently injurious as a corn pest to make it worth our time to fight it as such, there is no harm in becoming acquainted with its appearance and mode of life. Aside from its attacks upon this plant, it is known as a clover insect.

In speaking of this insect, Prof. S. A. Forbes says (14th Ills. Rept., p. 19) "This species has been repeatedly bred by us from corn during the present year [1884], the larvæ being found in May and June folding the young leaves of the plant from side to side and feeding within the cylindrical case thus formed."

The larva or caterpillar is, when full grown, a trifle more than one-half inch in length, of a greenish-yellow, more or less translucent, color. The head and cervical shield is variable, ranging from honey-yellow to yellowish-brown. In shape it is fusiform, that is, tapering gently towards both ends. The moth is, generally speaking, brownish-yellow above, with the front wings marked by two V-shaped brown bands (the apex of the angle to the rear), so placed that when the wings are closed these markings form an X.

#### THE RED-BANDED LEAF-ROLLER. (*Laphoderus triferanus* Walk.)

A second of these leaf-rollers has been found to feed upon corn in Illinois. This is the insect which bears the above name. Professor Forbes also mentions this insect in the same report, where he says: "The presence of this larva, and that of the sulphur leaf-roller just treated, is indicated in corn fields by the folding lengthwise or rolling of the leaves in May and June. If these leaves be opened a green wriggling larva will be found enclosed in a web within.

"The moth hatching from these folded leaves in June, if *Laphoderus triferanus*, may be recognized as an insignificant species, about a half inch across the spreading. The fore wings are reddish-brown, except on the terminal fourth, which is gray speckled with black, as is also the basal half of the posterior edge of the same wings."

Like the preceding species, this insect enjoys a wide range and is quite a general feeder, thereby rendering it a dangerous enemy to corn, should it incline to select this as its special food plant. It has been collected from Maine and New York to Illinois and Texas; and has been found feeding on the cranberry, elm, soft maple, oak, apple, rose, beans, *Gnaphalium polycephalum*, clover, strawberry, and corn." This multiplicity of food plants and wide range render it a rather difficult insect to handle. Should it become destructive it might be destroyed by the use of the arsenite sprays, such as London purple and Paris green.

#### THE BURROWING WEB WORM. (*Pseudanaphora arcaneella* Clem.)

This species, again, has been studied by Professor Forbes, of Illinois, who published an account of the result of that study in the 16th report of the entomologist of that state (pp. 98-100, Pl. VI, Figs. 2, 3, 5).

He writes of this insect as follows: "This larva constructs a silk-lined burrow in the earth, commonly terminating in a little chamber, and opening above in a webbed mass of earth or rubbish, into which its silken lining is extended. This web worm is commonest in meadows, but most easily detected in cultivated lands the first year after grass. We have taken it from both corn and wheat following sod, and from gardens, hedge rows, and the like.

This web worm is described as "a slender caterpillar from one and one-eighth to to one and one-fourth inches in length. General color, a soft dusky-gray, with a peculiar silky look, darkening forward to the head and first thoracic segment, which are shining black. Distinguished especially by large, irregular, shining white or dusky areas on the thorax. The imago or parent insect is "a thick-bodied, heavily-tufted, and wooly-looking moth of rather dark brownish-gray color, with distinct purple gloss, when fresh, on all the wings, the fore wings with lighter median shades, and indistinct spot and fine transverse lineations."

#### BURROWING WEB WORM. (*Cænogenes mortipenella* Grt.)

In company with the preceding species, and scarcely separable from it in the larval stage, was a second burrowing web worm with similar life-history. These transformed to "a light-bodied, narrow-winged, pale brown moth, the hind wings dusky, and the fore wings speckled, spotted, and minutely barred with dark brown or black. Wing expanse varying from 25mm. in the smallest male to 34mm. in the largest female."

#### THE ANGOUMOIS GRAIN MOTH (*Sitotroga cerealella* Oliv.)

"A very important insect in the south to-day is the so-called Angoumois Grain Moth. It abounds in the Southern corn fields and granaries to an alarming extent; but as we go north its numbers lessen and its injuries decrease. It is difficult to give its native home with certainty, but the probabilities are that it was originally a south European insect. It has been known in this country since 1728, and was probably introduced by the early settlers of Virginia and the Carolinas. No insect is more easily carried from one country to another, as it will breed for years with-

out intermission in a bottle of grain kept as a sample, or will remain unsuspected in kernels in parcels of seed."

Professor Riley, in his report as United States entomologist for the year 1884, has devoted considerable space to this insect's injuries, habits, and history in this

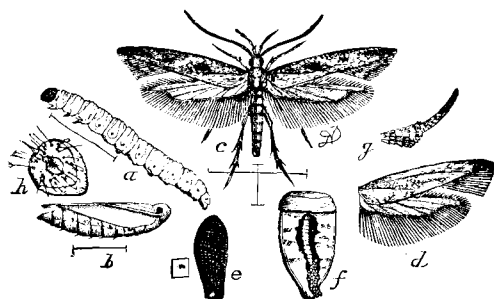


FIG. 40.—*Sitotroga cerealella*: a, larva; b, pupa; c, moth; f, mode of attack. [After Riley.]

country; and in treating it here that paper will be largely quoted. He writes of its natural history and habits as follows:

"The old statement concerning the eggs is: 'The female moth lays a cluster of from twenty to thirty eggs upon a single grain, in lines or little oblong masses in the longitudinal channel.' Our own experiments on the moth in confinement show that the eggs are preferably laid (in ears of corn) under the membrane which adheres to the basal portion of the seed, and although the membrane adheres very closely the moth manages to insert her ovipositor under it. They are also deposited in both the longitudinal and transverse grooves between the grains. Som-times there is only a single egg, though usually they occur in batches of as many as twenty-five. The eggs are delicate, flat, and oval, and are pale red in color, with prismatic reflections (Fig. 40, e).

"The young larvæ are very active and crawl rapidly about, sustaining themselves by silken threads. They soon find tender places and bore into the kernels, leaving almost imperceptible openings. With wheat it is stated that a single grain has never more than one occupant, but with corn two or more are usually found. The larva is smooth and white, with a brownish head and prothoracic plate (Fig. 40, a.) With the smaller grains, it has been inferred, from the fact that the quantity of excrement in the grain seems less with the full grown larvæ than with the younger ones, that the larvæ eat their own excrement once or twice. At full growth the larva cuts a circular hole in the cortex of the seed for the exit of the future moth, without, however, displacing the stopper thus formed. It then spins a delicate cocoon

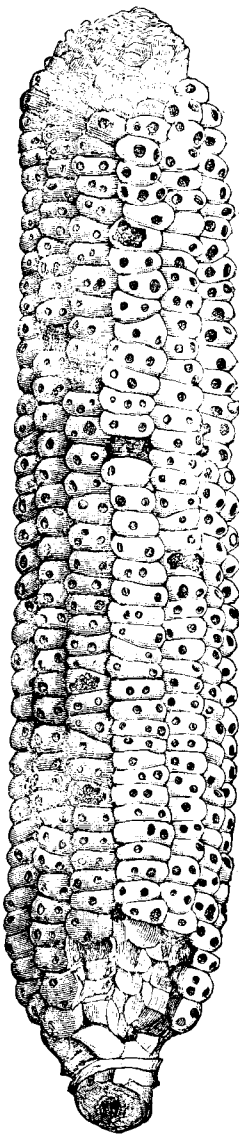


FIG. 41.—Ear of corn showing injury of *Sitotroga cerealella*. [After Riley.]



within the grain, in which it transforms to pupa (Fig. 40, *b*). The moth issues through the previously prepared hole, and is of a very light grayish-brown color, more or less spotted with black, and with an expanse of wing of about half an inch. Ears of corn frequently have every kernel affected by one or more larvæ, and present the appearance of our figure (41) after the moths have issued."

This and several other insects that injure stored or cribbed corn are rather difficult to handle on account of the open nature of the cribs that are used for this purpose. A number of remedies have been suggested and tried with more or less complete success; but as most of these entail a considerable outlay of labor and money, they can hardly be termed a success. The insect is known to be killed by a temperature of 167 degrees Fahrenheit if continued for a period of fifty minutes. It has also been destroyed by the use of bisulphide of carbon fumes. This latter can only be used in tight buildings and must be kept away from lights of all kinds, since it is very explosive. It, the insect, is also attacked by a small hymenopterous parasite, which latter might be aided in some way to kill it off.

#### THE GRAIN MOTH. (*Tinea granella* Linn.)

Although this insect is principally a wheat pest it has also been known to feed on shelled corn when stored for any length of time. When such is the case the outside of the kernels are attacked and fastened together with webs of silk. The insect has been described by a number of different American writers, most of whom have given an account of its habits and mode of life. Briefly, this grain insect can be described as follows:

The moth, which is about one-third of an inch in length when its wings are folded, is creamy white, with six brown spots on the costa of each front wing and with a long brown fringe at their ends. It is commonly found about old granaries during summer, and at such times should be killed.

#### REMEDIES.

While not the easiest among insects to get rid of, the grain moth is not as difficult an enemy to control as is the preceding. Usually granaries are sufficiently tight to permit the use of some such a remedy as the bisulphide of carbon alluded to above. When this is the case it will be quite an easy matter to pour some of the liquid into a vessel and place in the bin containing the infested grain. Now cover this with some heavy sheet or blanket so as to retain all the fumes and allow them to penetrate the entire contents of the bin. Be very careful not to bring a lighted lamp, lantern, cigar, pipe, or any other fire in contact with the fumes, for they are very inflammable. Neither should this be used in places where any animal or person will be confined with it for any length of time, for it is quite as destructive to higher animals as it is to insects. After the fumes have penetrated the whole contents of the bin or granary for a considerable time, open and let it air. No poisonous effects are left behind, and grain thus treated does not appear to be materially injured for planting.

#### THE INDIAN MEAL MOTH. (*Tinea zea* Fitch.)

A third species of this group of small moths occasionally is found to feed upon stored corn; but more commonly attacks corn meal. Professor Riley has the following to say concerning this insect to a correspondent (American Entomologist, III, p. 229):

"The pale worms, with rows of minute spots of a more dusky color, each giving rise to a hair, and with a brownish-yellow head and cervical shield, are the larvæ of *Ephesia zœæ*. This is a little moth which Fitch called the Indian meal moth, and of which he gave a figure in his second report as state entomologist of New York (1857). It is characterized by the basal third of the wings being of a pale cream color, while the outer two-thirds are of a more obscure reddish gray. This worm is almost omnivorous and feeds with equal relish on all sorts of dried animal and vegetable substances, being, however, particularly fond of grains and fruits."

It is the common worm of dried fruits in stores.

## DIPTERA.

As a rule corn is pretty free from attacks and injury by members of this order of insects. But few of the two-winged flies have thus far been caught in the act of injuring the crop. The following named five are all that have come to my notice.

THE CORN-FEEDING SYRPHUS FLY. (*Mesograpta polita* Say.)

THE SEED CORN MAGGOT. (*Anthomyia zœæ* Riley.)

THE CORN-LEAF MINER. (*Diastata* sp.)

THE BLACK-HEADED GRASS MAGGOT. (*Sciaria* sp.)

CHÆTOPSIS ÆNEA Wied.

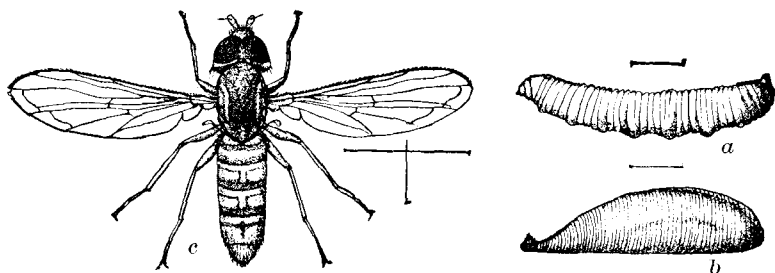


FIG. 42.—*Mesograpta polita*: a, maggot; b, pupa case; c, imago—all enlarged.  
[Insect Life.]

The first named is figured herewith (Fig. 42). It belongs to a family the members of which are nominally insect feeders, being more especially plant-lice destroyers. This one, however, has been taken in the very act of feeding upon the leaves of corn in various parts of the country by a number of different observers. Its injuries are not very great, and but little fear of its becoming a pest is apprehended by entomologists.

The other species named are also only occasionally found in numbers, and then but little injury is done by them.

## COLEOPTERA.

The order Coleoptera, comprising the beetles, contains by far the largest number of species that attack this crop in one or the other of its stages of growth, and afterwards while stored or after it has been made into meal. The first one on the list is the

## OMOPHRON LABIATUM Fabr.,

which has no common or popular name. It is a member of the large family of ground-beetles, and differs from most of its allies which are carnivorous by being injurious to corn. It is said to be very injurious to grains of growing corn in its larval stage at the south.

THE COMMON LADY BUG. (*Megilla maculata* De G.)

FIG. 43.—*Megilla maculata*. [After Riley.]

Another beetle that has departed from the path of virtue common to members of the family of which it is a representative is the one named above. As nearly everybody knows, the lady bugs, or lady-birds as they are quite often called, are feeders on plant lice, larvæ, soft-bodied insects, and eggs of other insects. This one, contrary to its rightful nature, attacks and eats both the blades and the soft kernels of growing corn. The insect is shown in the accompanying figure, No. 43.

It also eats plant lice, and by so doing more than repays its injuries wrought.

## SILVANUS SURINAMENSIS Linn.

A very common insect that occurs in stored grain of various kinds is that known by the above name. It is a small brown beetle about one-eighth of an inch in length, and is characterized by having its thorax toothed along the sides, while the top is provided with grooves and intervening ridges. Both the mature insect and its larvæ feed upon the grain. This insect also attacks a large number of other substances. It is especially troublesome to dried fruits, seeds, grains, tobacco, and other similar substances. There are also two additional species of the genus which have been known to feed upon corn. They are

## SILVANUS CASSIÆ Reich., and

## SILVANUS ADVENA Waltl.

Both of these have similar habits with the *surinamensis*, hence need not be described separately. All three of them can be destroyed by the use of bisulphide of carbon in the manner described for several other stored grain pests.

## TYPHŒA FUMATA Linn.

This is another small beetle that has been found on several occasions to attack Indian corn. It works upon the grain as do the preceding species, but works upon it while in the stack, where it has been taken in company with the *Silvanus advena*. No remedy is given in this case, for the reason that none is known.

## IPS FASCIATUS Oliv.

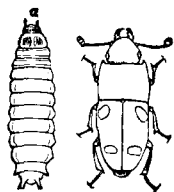


FIG. 44.—*Ips fasciatus*: imago and larva. [After Packard.]

This beetle, which is shown in the accompanying figure, has been known to do considerable injury to sweet corn in Minnesota. It has also been observed here in Nebraska on different occasions to enter the tips of growing ears—especially such as had been previously attacked by the Corn-Ear worm. As the insect usually feeds upon decaying vegetable matter in preference to that which is perfect we need not fear much injury from it, only as the beetle might incidentally follow the work of some other species.

The beetle is shining black with four yellowish spots upon

the wing covers. It is quite variable, both in the size and shape of these markings as well as in stature, but will average nearly one-fourth of an inch in length.

**TENEBRIOIDES MAURITANICA** Linn.

A reference to Fig. 45 will give the reader some idea of the general appearance of the members of a small group of insects that frequently infest granaries, where they feed upon stored grain to some extent at least.

These insects can be described briefly as "oblong, somewhat depressed or flattened beetles, of a black or reddish-black color," which are usually found under the bark of dead trees. The one figured is of an average size. While feeding to some extent upon grain and grain products, most of the species are carnivorous in their habits. Evidently these species found in granaries, corn cribs, and even on ears of corn while on the stalks, and on the ground in fields; also live to some extent upon the larvæ of other insects.

**TENEBRIOIDES DUBIA** Mels.

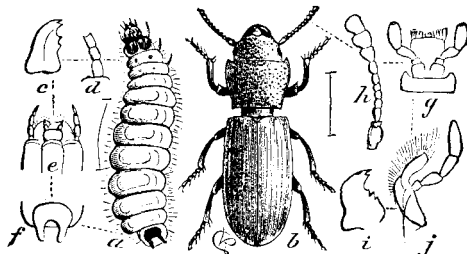


FIG. 45.—*Tenebrio corticalis*: a, larva; b, beetle. [After Riley.]

**WIRE-WORMS.**

The insects which bear the above name are very prominent among the farm pests belonging to this class of animal life. Professor Comstock, one of our best authorities on the subject of insect depredations, has the following to say of this group of insects:

"Wire-worms occur in all parts of our country; there is hardly a cultivated plant that they do not infest; and working as they do beneath the surface of the ground, they are extremely difficult to reach and destroy. Not only do they infest a great variety of plants, but they are very liable to attack them at the most susceptible period of their growth, before they have attained sufficient size and strength to withstand the attacks; and often seed is destroyed before it has germinated. Thus fields of corn or other grain are ruined at the outset."

Professor Comstock in another place writes of these insects: "In our studies of the life-history of wire-worms an interesting point was determined, which is of some practical importance, and will therefore be mentioned here. Wire-worms live for several years in the worm or larval state. When the worms are grown they change to pupæ. This takes place in the species that commonly infests field crops during the summer. The pupa state lasts only a short time, the insect assuming the adult form in the latter part of the summer. But, strange to say, although the adult state is reached at this time, the insect remains in the cell in the ground in which it has undergone its transformation till the following spring,

nearly an entire year. With most insects only a very short time is required, after the change from the pupa to the adult state, to allow the body to harden, and the insect to become fitted for active life. But in this case the quiescent period after the adult form is reached is not only of long duration, but appears to be necessary to the life of the insect; for in every case where the soil in the breeding cages was disturbed after the insects had transformed, the beetles perished in the soil. The only way in which we have been able to rear active adults has been to leave the soil in the breeding cages undisturbed from midsummer till the following spring.

"This experience clearly indicates that by fall plowing we can destroy the beetles in the soil, and thus prevent their maturing and depositing eggs the following spring."

These wire-worms are quite common in Nebraska, as well as in other portions of the country. They are the young of the insects popularly known as "click-beetles," "snapping-beetles," and "skip-jacks," so common everywhere.

These wire-worms are rather hard, smooth, cylindrical larvæ of a light brownish-yellow or straw-yellow color. They live, as a rule, in the ground, where they feed upon the roots of various plants. In the case of corn, they sometimes bore into the root, or they eat away the small fibrous rootlets, and in that manner cause the plant to shrivel up and die. Wire-worms are said to be rather long-lived, some of them remaining in that stage for several years, as stated above.

#### AGRIOTES MANCUS Say.

Our commonest species in corn fields is the one known to entomologists by the above name. The beetle is a small, short, thick beetle, measuring about three-tenths of an inch in length and is of a dark brown color, covered with dirty yellowish gray hairs, which are arranged in rows upon the wing covers.

#### AGRIOTES PUBESCENS Melsh.

#### DRASTERIUS DORSALIS Say,

is another species of "click-beetle" that is very common in corn fields. This latter insect is of about the same size as the preceding and is of a testaceous color, marked along the middle of the thorax and across the wing covers with black.

#### MELANOTUS COMMUNIS Gyll.

The insect which is figured herewith (Fig. 46, *a*, the larva, *b*, the beetle) is even more common than either of the preceding; but instead of working so much in corn fields is more of a grass insect. The line between the larva and beetle indicates the length of the latter, which is usually of a dull brown color. This is one of the few insects of the family that is attracted by lights at night, and often enter houses.

#### MELANOTUS CRIBULOSUS Lee.

Still another of these wire-worm insects that has been taken in corn fields.

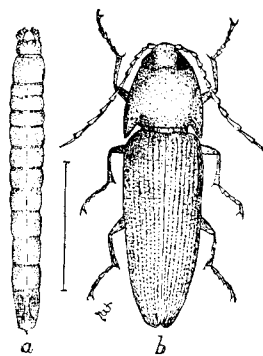


FIG 46.—The common Snapping-beetle (*Melanotus communis*): *a*, larva; *b*, beetle. [Original.]

## REMEDIES.

As remarked above, fall plowing will be beneficial by destroying the immature beetles in their cells. Another method which will undoubtedly prove of some value in checking the ravages of these insects, is trapping the beetles in spring before they have deposited their eggs. This has been successfully accomplished in New York state by Professor Comstock, from whose writings I have already quoted considerably.

"The results of our efforts to trap wire-worms were very different from what we had expected. A few were taken in traps baited with sweetened dough, not enough, however, to be of much practical importance. But to our surprise, large numbers of click-beetles were taken. This at once opened a new line of investigation. If it is possible to trap and destroy the beetles before they have laid their eggs, we have at our command a much more effectual method of preventing the ravages of wire-worms than by destroying the larvæ after they are partially grown. \* \* \* Of the substances used as baits, clover attracted by far the larger number of beetles. It should be noted in this connection that a neighboring field, separated from the corn field only by a lane, is a clover-meadow. The average distance of our traps from the meadow was less than ten rods. It is a matter to be questioned whether the beetles spread from the clover field, or whether the proximity of this field lessened the number in the corn field on account of the greater attractions of the clover. The clover baits were small bunches, about one-quarter pound weight, of freshly cut clover."

That this method of trapping is feasible, can be judged from the fact that Professor Comstock took over 500 of the beetles in a single night in twenty-four traps—tin pie and cake dishes placed in the field above ground.

## SITODREPA PANICEA Linn.

This is another of the small reddish-brown beetles that often attacks stored grain. It measures about one-eighth of an inch in length, and its larva is a bare, thick, "grub-worm" like affair. It also is a somewhat general feeder—being found sometimes as a museum pest. It can be destroyed by the use of bisulphide of carbon as directed for several other species of similar habits.

## APHODIUS LUTULENTUS Hald.

Given in this connection on the strength of its having been taken in Missouri while feeding upon grains of corn contained in cow-dung. Not to be considered injurious.

THE ROSE CHAFER (*Macrodactylus subspinosus* Fabr.)

The insect which bears the above name has become one of our most generally distributed injurious insects of the country. Like many of the others, it is also a very general feeder. As a corn insect, it works only in the mature stage.

This species has been treated very fully by Prof. C. V. Riley in the April number of *Insect Life* (Vol. II., pp. 295-302, 1890); also by Prof. J. B. Smith, in a special bulletin issued from the New Jersey Agricultural Experiment Station. The following account of the insect is taken mostly from the article by Prof. Riley:

## NATURAL HISTORY.

The natural history of this insect can be briefly stated as follows: "According to Harris, the female beetle lays her eggs, to the number of about thirty, about the middle of July, at a depth of from one to two inches beneath the surface of the ground. He does not state the favorite place for oviposition, but in our experience

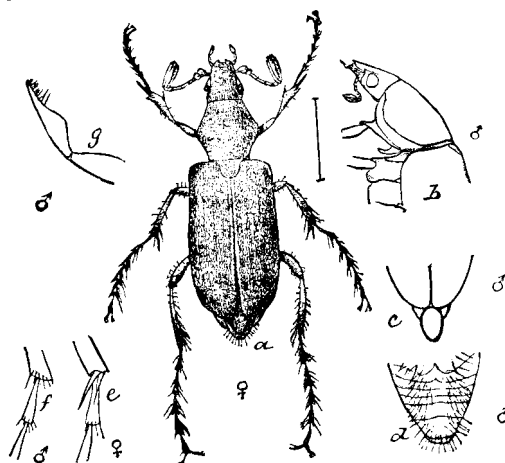


FIG. 47.—The Rose Beetle (*Macrodactylus subspinosus*): a, female beetle; b, c, d, e, f, and g, outline figures showing character of the sexes, etc.—all enlarged. [After Riley.]

the larvæ are especially abundant in low, open meadow land or in cultivated fields; particularly where the soil is light and sandy. Harris states that the eggs hatch in about twenty days, and, while the period will vary with the temperature, the larva is found fully grown during the

autumn months. With the approach of cold weather it works deeper into the ground, but in the spring will frequently be found near the surface or under stones and other similar objects, where it forms a sort of cell in which to pupate. In confinement the pupa state has lasted from

two to four weeks. The perfect beetle issues in the New England states about the second week of June, while in the latitude of Washington it is seen about two weeks earlier. It appears suddenly in great numbers, as has often been observed and commented upon, but this is in conformity with the habits of other Lamellicorn beetles, *e. g.*, our common May-beetles (*Lachnopterna*), and this habit is still more marked in certain species of *Hoplia* and *Serica*. It remains active a little over a month, and then soon disappears. The species produces, therefore, but one annual generation, the time of the appearing of the beetle in greatest abundance being coincident with the flowering of the grape vine."

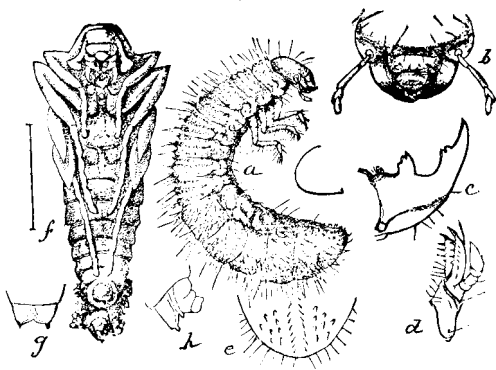


FIG. 48.—The Rose Beetle (*Macrodactylus subspinosus*): a, full grown larva, side view; b, head of larva, front view; c, left mandible of jaw of larva from below; d, pupa, below—all magnified. [After Riley.]

## DISTRIBUTION.

This beetle occurs from the New England states westward to the eastern foothills of the Rocky mountains, and is found from the Indian territory northward to

the British Possessions. Its greatest numbers, however, are to be found near the Atlantic coast in Maryland, Delaware, and New Jersey, where horticulture and farming have been carried on for many more years than farther to the westward. It is also spreading to some extent into new regions.

#### ENEMIES AND REMEDIES.

Unless they appear in too great numbers the beetles can be destroyed to some extent by the use of London purple and Paris green. They can also be gathered by beating the plants upon which they have congregated over an inverted umbrella and afterwards destroyed. The larvæ are more difficult to reach, but over small areas can be destroyed by drenching the surface with the kerosene emulsion and allowing it to soak in. Both the imago and the larva are eagerly devoured by a number of birds, and domestic fowls are remarkably expert in the art of getting away with the beetles. Reptiles and some of the smaller mammals are also very fond of them; while many a one is killed by Carabid beetles.

"MAY-BEETLES." (*Lachnosterna*.)

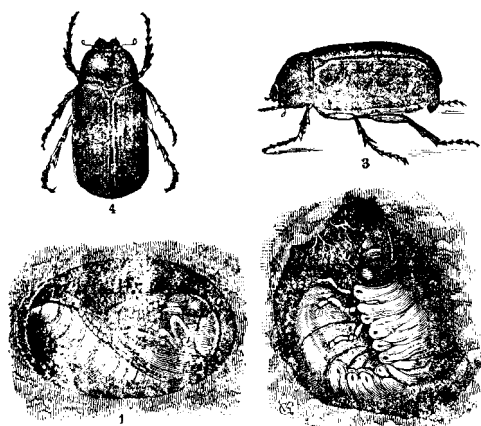


FIG. 49.—The Common May-beetle (*Lachnosterna fusca*): 1, the pupa; 2, the larva or white grub in its ground cell; 3 and 4, the beetle, side and dorsal views. [After Riley.]

The common May-beetles, *Lachnosterna fusca*, and allies, are among the most troublesome of all insect pests with which the agriculturist has to deal. Here in the west these large and voracious insects are equally as numerous upon the prairies as they are in the vicinity of timber. In fact, they appear to be even more plentiful about new farms than old ones, because the tree-growth on the newly cultivated grounds is so scant that a moderate number of the beetles will very quickly entirely strip off the leaves, while they would make but very little show if working on the foliage

of trees of moderate or large size. All of these May-beetles are nocturnal in their habits and feed while we are asleep; and during day-time lie hidden away in the ground, where they burrow during early morning, only to come forth again the following evening to continue their destruction among our fruit, shade, and forest trees.

One of these beetles (*Lachnosterna fusca*) is represented in Fig. 49, where the pupa, mature larva or grub, and the imago are all shown natural size.

These different species of May and June beetles are usually about the size of the one shown in the accompanying figure, though some are larger and others smaller. They are mahogany-brown or yellowish-brown in color, and either smooth or slightly roughened; and some of them have a covering of short hairs, among which are several longitudinal rows of longer ones upon the elytra, while a few are more



or less pruinose—i. e., covered with a bluish-white powdery-like substance similar to that covering ripe or nearly ripe plums.

So common and destructive are these insects (*fusca* and allied forms) throughout the country that, next to the Colorado Potato-beetle, Chinch-bug, Codling-moth, Rocky Mountain Locust, and a few others of our most injurious insects, they have received more attention than most of our insect pests. Their work as corn enemies is done chiefly in the grub state, although much injury is also committed by the beetles themselves to young corn.

#### LIFE-HISTORY.

The life-history of this beetle has been given in the following summary by Professor Riley (First Report Insects of Missouri, p. 157): "Soon after pairing, the female beetle creeps into the earth, especially wherever the soil is loose and rough, and after depositing her eggs, to the number of forty or fifty, dies. These hatch

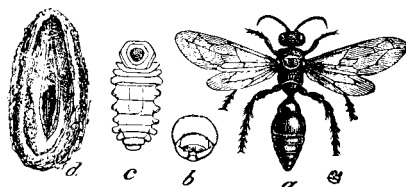


FIG. 50.—White Grub Parasite: a, imago; b, head of larva; c, larva; d, cocoon. [After Riley.]

in the course of a month, and the grubs, growing slowly, do not attain full size until late summer of the second year, when they construct an ovoid chamber, lined with a gelatinous fluid, change into the pupa (see Fig. 49,1), and soon after into beetles. These last are first white, and all the parts soft, as in the pupa, and they frequently remain in the earth for weeks at a time, until thoroughly hardened, and then on some favorable night in May they rise in swarms and fill the air. It is very probable that under favorable conditions some of the grubs become pupæ, and even beetles, the fall subsequent to their second spring; but growing torpid on approach of winter, remain in this state in the earth, and do not quit it any sooner than those transformed in the spring. On this hypothesis, their being occasionally turned up in the fresh beetle state at fall plowing becomes intelligible."

From this summary then we are led to believe that the grub or larval state lasts more than a year—a long time when we take into consideration the comparatively short life of the beetle, the actual life of which, after it has once left the ground, is but a few days—not more than two weeks, and oftener less.

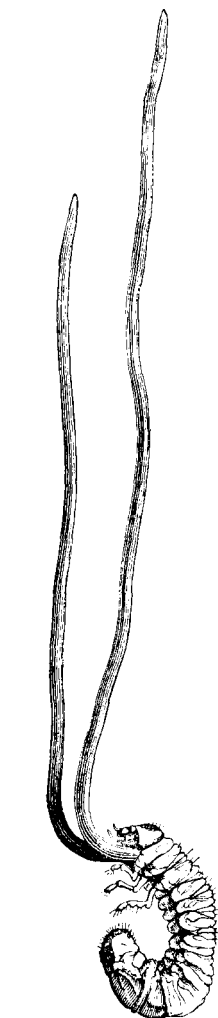


FIG. 51.—White Grub Fungus. [After Riley.]

## REMEDIES.

On account of their underground life the larvæ or grubs of the May-beetles are very difficult to reach and destroy. They are not without their natural enemies, both vertebrate and invertebrate, and the majority of them are thus destroyed between the time of hatching from the eggs and issuing as beetles. A large number of our birds are especially fond of the fat grubs, and can be seen industriously following the plow as it turns them up with the fresh loose soil. All kinds of domestic fowls eat them greedily, while hogs industriously search for them by rooting over the ground where they occur in abundance. Mice, shrews, moles, ground squirrels, and skunks are also remarkably fond of both the grubs and beetles. Among their insect enemies the wasp known as *Tiphia inornata* Say is the greatest. This insect is shown in its several stages in Fig. 50. The larva of this black or bluish-black wasp attacks and destroys the grubs, after which it spins a pale brown elongated silken cocoon of the kind so frequently dug up when working the ground, and transforms to the pupa state, and later to the perfect fly. During the spring of 1889, here in the city of Lincoln, these May-beetles were attracted to the electric lights by thousands, as were also two large black ground beetles, *Calosoma ceterneum* and *C. lugubre*, in moderate numbers. These latter beetles would pounce upon a May-beetle as it lay floundering upon the walk under the lights, as a cat would upon a mouse, and very quickly kill and partly devour it.

The grubs are also frequently attacked and destroyed by a peculiar whitish fungus. This fungus issues near the head of the grubs and occasionally attains a length of three or four inches, when it has near the appearance of the accompanying illustration (Fig. 51).

Many of the beetles can be destroyed by jarring the trees over sheets and gathering them as they fall, after which they can be drowned in boiling water or thrown into the fire and burnt. Other methods can be devised by those who have the insects to fight—circumstances, of course, directing these forays against the enemy.

THE INDIAN CETONIA. (*Euphoria inda* Linn.)

FIG. 52.—The Indian Cetonina (*Euphoria inda*).

This beetle which is figured herewith (Fig. 52) is a very common insect in all parts of the country to the eastward of the great plains. It is one of our earliest spring visitors, and may often be seen flying about in sheltered localities before the snow has entirely disappeared from the more open places. It is very frequently seen here in Nebraska during early April, as it skims over the surface a foot or two above the earth, producing a buzzing noise very similar to that made by a bumble bee. When flying this and other members of the sub-family, instead of lifting the elytra the wings are merely thrust out at the sides.

All of the Cetonini are lovers of flowers, and also of the sweet juices of plants of various kinds. This beetle is therefore quite injurious to different kinds of ripe fruits upon which it gathers in large numbers, often entirely devouring apples, peaches, and pears. It is also a corn insect here in the west, feeding upon the ends of the ears while still soft. I have also taken many of the beetles upon the trunks of apple and other fruit trees, where they had gathered about "bleeding"

wounds produced by wind-breaks or pruning. Just what the larval habits of this beetle are I do not know, but I have taken the beetle on several occasions from ant's nests in company with *Eu. hirtipes*, which latter I have never taken anywhere else.

#### REMEDY.

The beetle should be gathered and destroyed at all times and places; for, should its larval habits be such as to permit of its increase in great numbers, it can become a dangerous pest.

#### THE TILE-HORNED PRIONUS. (*Prionus imbricornis* Fabr.)

A large long-horn boring larva, like the one figured herewith, has been reported as working in the roots of Indian corn. That the insect may be recognized and guarded against I present herewith an account of the Broad-necked Prionus, a

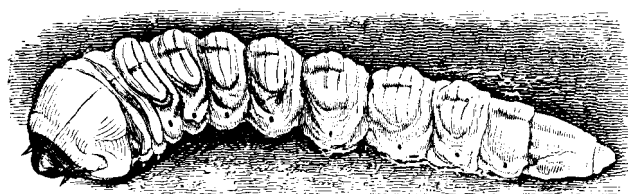


FIG. 53.—The Broad-necked Prionus (*Prionus laticollis*); larva. [After Riley.]

closely allied species, with similar habits. It is shown in the larval, pupal, and imago stages in Figs. 53, 54, and 55, respectively, all natural size. In color the larva is yellowish-white, with its small horny head reddish-brown. The pupa is also light colored, while the beetle is dark mahogany-brown, inclining to black in some specimens.

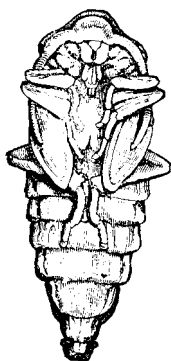


FIG. 54.—The Broad-necked Prionus; pupa. [After Riley.]

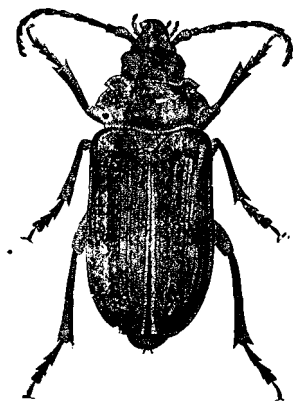


FIG. 55.—The Broad-necked Prionus; beetle, female. [After Riley.]

The larvæ of this and allied species bore in the roots of the plants which they injure; and it is supposed that they are three years attaining their growth. These borers, although so very large, often work upon roots smaller than their own diameter, and in consequence are often plowed up in breaking prairie.

## REMEDIES.

These underground borers are the most difficult of all our insect enemies to fight, and must be dealt with singly; in other words, each larva must be searched for and destroyed. Happily for us the insects are not very numerous, and hence rarely become a pest. Their presence can quite readily be detected by the sudden death of the plants which have been attacked. It also destroys young apple trees, osage orange, and other seedlings growing in rows, which it follows and takes one after the other.

THE CORN-ROOT WORM. (*Diabrotica longicornis* Say.)

An insect that promises to become a pest in the near future in this and adjoining states, if it continues to increase as rapidly during the succeeding two or three years as it has in those past, is what is known as the Long-horned Diabrotica (*Diabrotica longicornis* Say), Fig. 56. This beetle is quite closely related to the common striped Squash-beetle (*D. vittata*), that works upon the squash, cucumber, and melon vines, the perfect insect feeding upon the leaves and young fruit, and the larva boring into the roots and vines.

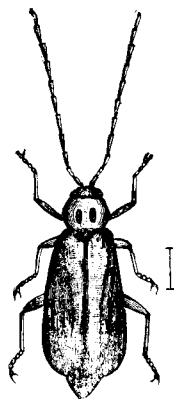


FIG. 56.—The Corn-Root Worm (*Diabrotica longicornis*)—enlarged. [Original.]



FIG. 57.—*Diabrotica longicornis*; larva—greatly enlarged. [After Forbes.]

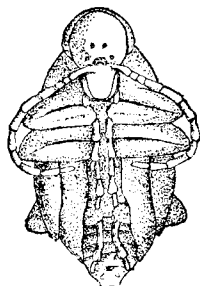


FIG. 58.—*Diabrotica longicornis*; pupa—enlarged [After Forbes.]

There is but a single brood of this *Diabrotica* annually in this latitude. The eggs are laid during the latter part of September and first half of October about the roots of corn, where they remain during winter, and hatch the following spring in time to attack the young corn when it has attained a few inches in height. It continues feeding in the larval stage through June and July, by boring into the roots and stalk just at or near the surface, and, when numerous, renders the stalk weak, so as to be easily blown down by wind storms. The larvæ are fully matured by the last of July or early in August, when they transform to the pupa, and in a few days to the imago or beetle stage.

## DESCRIPTION.

*Larva*.—The larvæ (Fig. 57), which alone do the damage, when full grown, measure about one-half of an inch in length, are whitish, slender, of nearly equal diameter throughout, and remind one not a little of some kinds of maggots or fly larvæ. They are not very active, and for the most part either bore directly into the heart of the plant, or else work among the small lateral roots. The pupa, which is also whitish, but shorter than the full grown larva, is inactive, and remains among the soil about the roots until it transforms to the imago. The larval and pupal stages of the present species are very similar to these of the next, which is figured in all its stages of growth.

*Imago*.—The parent of this worm is a rather slender, pale-greenish, oblong beetle, about one-sixth of an inch in length. Its eyes are black; the antennæ or feelers, are about equal to the body in length, also greenish. The thorax is subquadrate, slightly narrowest in front, with two impressed spots placed behind its middle. The elytra, or horny wings, are irregularly punctured, and have their suture and outer margin somewhat embrowned.

The beetles are to be found upon various flowers during the fall months. The present fall (1888) they were especially numerous upon the blossoms of the various compositæ, and last year in Illinois they were very numerous upon the blossoms of buckwheat during the month of August. Late in the fall, after having laid their eggs, they also occur upon the stalks of corn, where they creep down among the leaves for shelter.

## REMEDY.

This insect has thus far been found working only on corn, hence the remedy that at once suggests itself is the simple rotation of crops, where that can be followed.

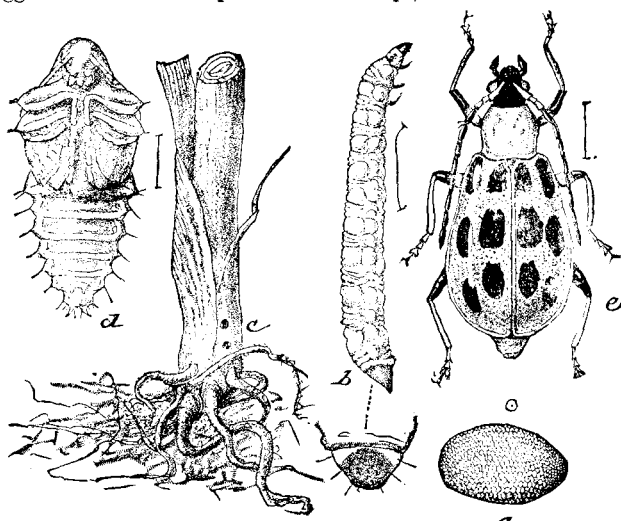


FIG. 59.—The 12-spotted Diabrotica. [Insect Life.]

As the eggs are laid in the fall, the insect is necessarily restricted the following year in its larval stage to fields occupied by corn the year before. Should other

crops from those upon which the larvæ feed occupy these fields, they (the larvæ) would naturally perish of starvation.

THE TWELVE-SPOTTED SQUASH BEETLE. (*Diabrotica 12-punctata* Oliv.)

This common insect, which all will at once recognize by reference to the accompanying illustration (Fig. 59) of the beetle, has of late years come to be known as a dangerous corn pest. It works in a similar manner with the long-horned species above described; but, being a much more general feeder, with a wider distribution, may become a still more dangerous enemy than is that insect. The 12-spotted beetle is also known to be double-brooded, while *longicornis* is only single-brooded, which renders the insect at once capable of becoming a more formidable pest to handle. This is true of it on account of its being able to lay its eggs about the young corn in spring by aid of its hibernating as a perfect insect, while its ally can only trust to the future care of its offspring by placing its eggs about the maturing corn stalks of the year. Two dipterous parasites have been bred from this insect—one from the larva and pupa, and the other from the beetle. The species has been carefully studied and written up by Professor C. V. Riley (Insect Life, IV, pp. 104-108), and by Prof. H. Garman (Psyche, Febr. and Mch., 1891.)

THE PALE-COLORED FLEA-BEETLE. (*Systema blanda* Mels.)

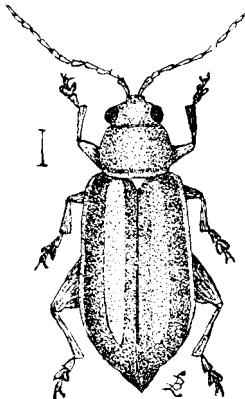


FIG. 60.—The Pale Flea-beetle (*Systema blanda*). [Original.]

This small, pale-colored flea-beetle, which is shown in the accompanying illustration (Fig. 60), has a rather wide range over the United States. It is found in the New England states, and thence westward to the Dakotas, from which latter point it is exceedingly common southward and westward to California and Arizona.

It is very variable in its color as well as in its sculpturing, some specimens being almost black, while others are nearly yellowish-white, the color of the vittæ or stripes of the elytra. The insect also varies greatly in the amount and manner of its punctuation, from specimens in which this is deep and coarse to others that are almost smooth and glossy.

Its mode of attack is very similar to that of several others of our smaller flea-beetles, *i. e.*, it gnaws the leaves of the plants upon which it feeds full of holes upon either the upper or lower side. This is done in the beet by the insect eating away the outer parenchyma of the leaf, not reaching quite through, and thereby leaving the plant with a blister-like appearance, similar to those affected by some of the diseases known as Leaf-spot or Leaf-blight.

Reports state that this flea-beetle has frequently been quite destructive to growing corn, whole fields of this crop having been stripped of the leaves and leaving the bared stems standing.

OTHER FOOD PLANTS.

Unlike many of its allies the Pale-colored Flea-beetle is quite promiscuous in its food habits. It has been known to include in its bill of fare many of our weeds, such as the *Amarantus*, *Chenopodium*, *Purslane*, etc., while among cultivated ones the beet, white clover, corn, and strawberry have been recorded.

## REMEDIES.

Under the head of remedies against this flea-beetle can be mentioned the kerosene emulsion, and the arsenical sprays. The former has been tried by several of our correspondents with apparently good results. One of them at least wrote that the kerosene emulsion worked perfectly, and that none of the beetles were to be seen the next day. If the emulsion did not kill them it at least drove them away, which is nearly as good. If the insects continue to appear and to attack the plants after the application of the emulsion, and it is not intended to use the tops for stock food, the arsenical spray will be effectual in their removal. No parasites were observed to attack this beetle, nor was it found among the insects contained in the stomachs of birds which have been examined here at the station to ascertain their food habits. This does not, however, prove that it is not eaten by the feathered tribe.

THE BRASSY FLEA-BEETLE. (*Chætocnema pulicaria* Mels.)

So named from the general bronzy or brassy color of entire surface, a small, slightly oblong, oval flea-beetle that measures about one-sixteenth of an inch in length. It has been observed on several occasions to do considerable injury to corn in Illinois by riddling the leaves with holes. This beetle occurs from Pennsylvania to Colorado and southward.

THE EUROPEAN MEAL WORM. (*Tenebrio molitor* Linn.)

The ordinary meal worm is too well known to require a lengthy description here. Every housekeeper has seen both the parent beetle and its larvæ. Packard states of this insect in his Guide to the Study of Insects: "*Tenebrio molitor* Linn., the meal worm, is found in all its stages about corn and rye meal; it is sometimes swallowed with food. \* \* \* The larva is about an inch long, cylindrical, smooth, and glossy, with the terminal segment semicircular, slightly serrated on the edges, and terminated in a single point." These

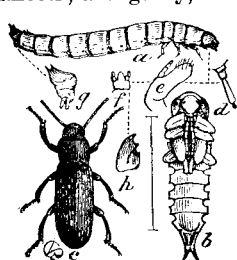


FIG. 61.—*Tenebrio obscurus*: a, larva; b, pupa; c, beetle, natural size. [After Riley.]

beetles also gather in large numbers in granaries and corn cribs, where they feed upon the stored grain; especially are they to be found in these places if they are not rain-tight and the grain becomes wet and rots.

The beetles have become thoroughly "domesticated" and are seldom found away from the habitations or storehouses of man. They are nocturnal and move about after nightfall, when they can often be seen flying and creeping about the walls of buildings which they enter whenever an opportunity is presented. In houses they soon seek out the pantry and attack all kinds of flour and meal.

THE AMERICAN MEAL WORM. (*Tenebrio obscurus* Fabr.)

Very similar to the above is a second species of meal worm. This latter, a native of America, is darker colored than the European insect and of the same size. Our insect is less numerous also than the foreigner, but its habits are the same. It is shown herewith (Fig. 61) in its different stages of development.

## REMEDIES.

Meal worms are very retiring in their nature, and feed and breed only in dark retreats where they are seldom disturbed. To prevent their increase about mills and such other places where their food occurs these should be kept well lighted and cleaned. No heaps of rubbish should be left to lie about under which the beetles and larvæ could gather, while flour and meal bins should be made tight and kept closed during night-time when the insects are moving about.

BLISTER-BEETLES. (*Epicauta*, etc.)

Quite prominent among the insects that destroy the beet here in the west are several species of moderately large soft-bodied beetles that are popularly known as blister-beetles. Two of these insects are shown in Figs. 62 and 63. As a rule they are quite partial in their food habits to the various kinds of plants belonging to

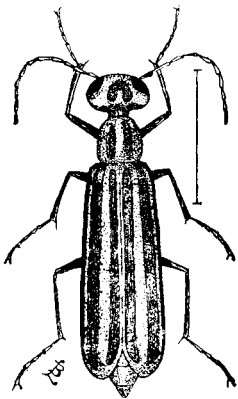


FIG. 62.—The Striped Blister-beetle (*Epicauta vittata*). [Original.]

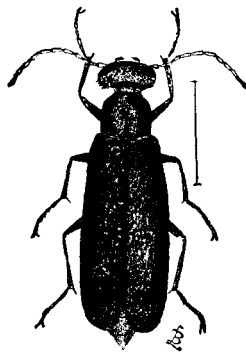


FIG. 63.—The Black Blister-beetle (*Epicauta pennsylvanica*). [Original.]

the pulse family (*Leguminosæ*). Nevertheless a number of them have the habit of forsaking them for a large variety of other plants, and especially do they appear to relish garden plants.

Like other insects that occur over a rather wide scope of country, and that must necessarily be subjected to great variations of climate, altitude, and abundance or lack of the proper food supply during their period of development, these insects vary greatly in size as well as in color among the different individuals of the same species, some of them being fully double the size of others.

As a rule, these blister-beetles are gregarious in their habits, and feed in company—sometimes by the thousands. When they gather upon any particular plant or plants they are not long in finishing such portions of it as they can devour. Juicy plants are special favorites of theirs at times, while at other times these are passed by and they seem to prefer just the opposite qualities in their food plants—just as they are in their comings and goings, so they are in the selection of what they subsist upon as mature insects. They come and go mysteriously, sometimes only as a few stragglers, but more frequently in large swarms. One year they pre-



fer one food plant, and another year another; so that they will include most of our common plants in their bill of fare inside of a dozen years.

While these insects are both interesting and somewhat of a mystery to us as beetles, they are much more so in their preparatory stages. In treating our common gray species (*Epicauta cinerea*) as a tree defoliator, some space was devoted to the discussion of its early life-history along with that of other species. Since we will always be more or less troubled with these insects as beet, corn, and other crop pests, I will repeat what I wrote there.\*

"These blister-beetles are among our most interesting forms of insect life, both as regards their life-histories and their economic importance; and it is quite difficult for us to decide whether their existence is really more of a benefit than a detriment to us, or *vice versa*. They appear during the months of June and July, and are both diurnal and nocturnal in their habits. Prof. C. V. Riley, who has been our most energetic American entomologist in working out the life-histories of these insects of economic importance, published an account of the life-histories of the present and the two other species of the same genus on pages 297 to 302 of the First Report of the United States Entomological Commission. In that work he shows how the eggs are laid, hatch, and the young larvæ, which at first are very active, search for locust or grasshopper eggs upon which they feed. The life-history of these little triangulins, as they are called, is an interesting one as portrayed by that author, but not more so than are the succeeding stages through which the same insect must pass before it can issue into the world as a full-grown blister-beetle. Were it not for the lack of space, I would quote the author's paper entire. Those who would like to read the account for information can do so by referring to the above named report. In writing a report upon some work that I did for the United States Entomological Commission during the summers of 1880-1 in the northwest, the following language was used:†

"Until quite recently, the larval habits of our various blister-beetles were but little understood. Since the researches of the commission, however, the preparatory stages of many insects, which had hitherto been shrouded in mystery, have been ascertained for the first time. Among these were those of quite a number of the *Meloidæ*. It has been ascertained that they feed upon the eggs of locusts, and especially those of *C. spretus* (the Migratory Locust). This, then, accounts for the great numbers of these insects that are found in all the leading locust areas of the west and northwest, especially in the latter district. Riley has shown in the report for 1878 and 1879‡ the peculiar and interesting feature possessed by the young of some of these insects of protracting development one, two, or even more, years, thereby supplying a new means for the continuation of a species that is dependent upon uncertainties for its continuation among the living.

"I have noticed a great number of species of these insects both in Montana and Colorado. In Montana they were mostly partial to the *Leguminosæ*—*Lupinus*, *Astragalus*, etc.—some of which, in certain localities, were covered with these beetles, and denuded of their foliage, thus furnishing an example of an insect that in its preparatory stages is parasitic on another, and that, after maturing, lives upon a

\* Bulletin No. 14 of the Agricultural Experiment Station of Nebraska, pp. 112-114.

† Report United States Entomological Commission, Vol. III, p. 41. [1883.]

‡ Report United States Entomological Commission, Vol. II, p. 260; also, American Entomologist, Vol. III, p. 196.

plant not eaten by the insect on which it was a parasite. In this way, then, the parasitic beetle is not only insured of perpetuating its kind through its capability of lying dormant in its imperfect stages for an indefinite time if the necessary amount of food is absent, but also through its choice of food, in its perfect state, since it lives upon that which the locust discards.' "

Thus far three of these blister-beetles have been known to attack corn. These are:

THE STRIPED BLISTER-BEETLE. (*Epicauta vittata* Fabr.)

THE GRAY BLISTER-BEETLE. (*Epicauta cinerea* Forst.)

THE BLACK BLISTER-BEETLE. (*Epicauta pennsylvanica* De G.)

#### REMEDIES.

Considering the usefulness of these insects in their larval stage, and their erratic nature as beetles, it is a question in my mind whether or not it would be a wise thing for us to be too hasty in their destruction. Even should they appear in great numbers and direct their attention to our crops, would it not be the wisest plan rather to drive them away than to kill them? They are very prolific breeders, it is true, and a very few of the beetles will furnish enough eggs for a vast army of the beneficial larvæ. If we have just had a "grasshopper year," or there is a probability of having one, my advice would be to spare as many of the beetles as possible, at least until after the majority of their eggs had been deposited. The numbers of these beetles is regulated by the amount of food available for the larvæ and not that of the mature insects. Neither birds nor domestic fowls relish them; nor is it a safe plan for persons with soft or delicate hands to gather and crush the beetles between their fingers, for, like the "Spanish Fly," these insects are also "blister" makers when handled. If it becomes absolutely necessary that some remedy be applied in order to save vegetation from destruction, and the insects cannot be driven away by repeatedly beating them off, they can be readily collected in pans or other receptacles containing a little kerosene or hot water. The plants can also be sprayed with either London purple or Paris green in the proportion of four ounces to a barrel of water.

THE IMBRICATED SNOUT-BEETLE. (*Epicerus imbricatus* Say.)

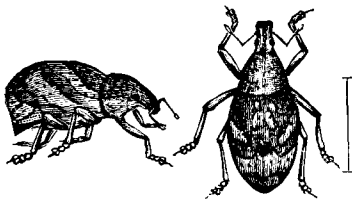


FIG. 64.—Imbricated Snout-beetle (*Epicerus imbricatus*); dorsal and side views. [After Riley.]

The accompanying figure (Fig. 64) represents one of the weevils or snout-beetles that sometimes attacks various fruit trees, the twigs, fruit, and leaves of which it gnaws. Here in Nebraska this beetle is quite common; and at times, in certain localities, has been known to do considerable injury to these trees, as well as to a variety of other plants. Among those plants upon which it feeds, the following have been

mentioned by different writers: apple, cherry, gooseberry, onion, radishes, cabbage, beans, watermelons, muskmelons, cucumbers, squashes, beets, and potatoes. Here in Nebraska the species has on several occasions been taken in corn fields, feeding upon the young corn, when but a few inches in height. At West Point, Cuming

county, it was unusually abundant in a corn field immediately adjoining the town on the northeast, about the year 1876 or 1877, when a considerable part of the field was denuded by it.

When numerous, an application of Paris green or London purple will effectually check them, if used as for the Colorado potato-beetle.

Up to the present time its life-history is not known, nor has it been very regular in its arrival at all points within its range each year. It is one of the few of our insect enemies that comes and goes by starts—sometimes appearing in great numbers several years in succession, and then again being almost entirely absent for one or more years—a regular bohemian, as it were.

#### CORN BILL-BUGS.

"The snout-beetles of the genus *Sphenophorus* (popularly known to some extent as "bill-bugs") are gradually rising to prominence as injurious insects, corn especially suffering from them a serious and often fatal injury, which has long been known, although but little understood; and as the life-histories and habits of the various species are apparently very similar, others than those now known to injure agricultural products will probably be added to the list of noxious species."—(Forbes, in 16th Ills. Rept.)

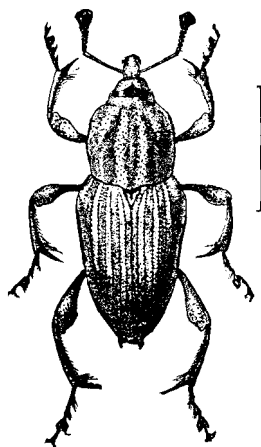


FIG. 65.—*Sphenophorus ochreus*. [Insect Life.]



FIG. 66.—*Sphenophorus ochreus*; larva. [Insect Life.]

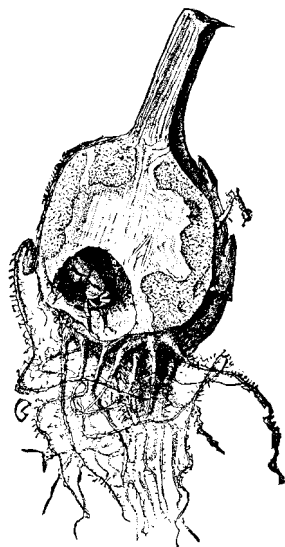


FIG. 67.—Root of *Scirpus*, showing work of *Sphenophorus ochreus*. [Insect Life.]

Both the beetles and their larvæ at times attack corn. The former work upon the plants above the ground, while the latter attack the roots and bore into the pith of the lower portions of the plant.

Professor Forbes (*loc. cit.*) writes of the injuries of these "bill-bugs" as follows: "As larvæ these species live and feed, as far as known, in the roots of grass-like plants, less commonly boring also the lower part of the stem. Grasses with bulb-

ous roots, like timothy and the club rush, are probably their more normal breeding plants. In timothy meadows the hollowing out of the root bulb frequently kills the plant—if not outright, then the following year. The larger club rush seems to endure better the attack of the clay-colored bill-bug, as several successive bulbs of a series are often found excavated, each having given origin to its plant notwithstanding the injury.

"The adults of all the species feed in substantially the same manner, as far as observed, and inflict a similar injury on the plants they infest. Standing with the head downward and the feet embracing the lower part of the stalk, they slowly sink the beak into the plant, using the jaws to make the necessary perforation. At intervals the head is slowly and regularly rolled from side to side as if to pry apart the several tissues, and when the soft interior substance of the plant is penetrated, a pause is made to enable the insect to devour the part thus brought within reach of its jaws. By moving forward and backward and twisting to the right and left, the beetle will often hollow out a cavity beneath the surface much larger than the superficial injury would indicate. *Ochreus*—Figs. 65, 66, and 67—(and possibly other species also) elongates the original slit by pulling the head strongly backward with the compressed beak inserted, thus using the latter to split the stem as a boy uses his knife to split a stick. In this way a slit an inch long may be made in the stalk of corn or head of cane beneath which the softer parts will be completely eaten out. Our imprisoned beetles, confined with rapidly growing corn left the lower part of the stalk, as it hardened, and fed at the tip of the plant, or searching out the forming ears, penetrated the husk and gouged out the substance of the soft cob. The intestines of these beetles were well filled with the solid tissue of the plant, but I saw no evidence that they sucked the sap, although it is not, perhaps, impossible."

Up to the present time at least eight species of these bugs have been ascertained to attack Indian corn.

THE SCULPTURED CORN SPHENOPHORUS. (*Sphenophorus sculptilis* Uhler.)

This beetle has been known to do considerable injury to young corn in some parts of Nebraska. Unlike the "Imbricated" species, it only occurs upon low ground near wet places; as, for example, in the vicinity of ponds, lakes, and marshes, where there is more or less vegetation of rank growth. Its larvæ are supposed to breed in such localities in company with other species of the genus; but just what their special food plant or plants are in these locations has not yet been satisfactorily ascertained. One of the larvæ of an allied species is shown in the accompanying illustration, Fig. 66. The mode of that insect's attack is also shown in Fig. 67. Since several allied species have been definitely ascertained to breed in the stems or stalks of corn near the root, it is not at all improbable that this insect may also frequently breed there. The injury caused by this weevil has usually been credited entirely to the mature beetles which work just at or immediately beneath the surface of the ground by puncturing the tender shoots with their bill or snout. When we take into consideration the fact that most if not all of the species of weevils with the egg-laying habits, of which we are acquainted, use the beak for boring a hole for the reception of the eggs, these punctures in corn may also serve such a purpose to some extent at least. These punctures are also known to be made while the insects feed.

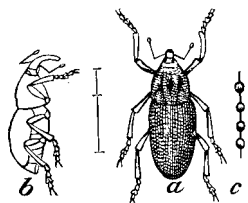


FIG. 68.—Sculptured Corn Sphenophorus (*Sphenophorus sculptilis*. [After Riley.]

The accompanying figure (Fig. 68) is a good representation of this beetle, and will serve as a guide for the identification of several of the allied species that are also known to inhabit the state. The species has been repeatedly described by such authors as Walsh, Riley, Packard, Glover, Comstock, Lintner, and others, and hence will receive but a cursory notice here. It is dull black, sometimes covered with a grayish matter adhering to its upper surface. The thorax and wing-covers are sculptured as shown in the figure, which is some-

what enlarged—the line between the two showing actual size, and that on the right showing plan of the sculpturing of the wing-covers.

In some parts of the United States this insect has been exceedingly common, causing a great deal of injury to the corn crop. Its usual method of attack is to puncture the tender shoot just at or below the surface of the ground; but when numerous, and as many as from five to twelve specimens attack a single hill, the entire plant is said to be eaten to the root. Especially is this said to be the case when the corn is but a few days old. Later the puncturing is the typical mode of attack. The injury by the beetle sometimes continues far into the month of June.

Other species of the genus *Sphenophorus* breed in the stems of the cocklebur and ambrosia, as well as in those of some of the sunflowers.

#### REMEDIES.

As a remedy against this curculio or snout-beetle it has been suggested that where the attack is limited to small areas the application of a handful of sand saturated with kerosene around each of the hills will effectually rid the field of them, rains carrying the oil down into the soil and killing the beetles. If not, then a careful hand picking will be necessary. As a rule these attacks upon corn are made at such times when their natural habitats on low grounds are overflowed or inundated during wet springs.

Should the eggs be discovered in the punctures in the stalks these latter should be pulled up and carried from the field and destroyed. Likewise, if it is ascertained that the insect actually does breed in the stems, the roots should be destroyed in fall by burning in order to kill the pupæ and hibernating beetles. As yet the species is not a confirmed corn insect, but we cannot tell how soon it will become such—finding, as it will, that this crop is annually at hand for it to work upon. Then, too, the longer it works upon this plant the more partial will it become to it as a food plant. Like all other insects that adopt a new food plant, and more especially if it be one of the cultivated plants, this beetle is liable to change its habits to conform with the surroundings belonging to corn fields, instead of those belonging to low, wet places. Should that be the case then we will certainly have a troublesome pest in the Sculptured Snout-beetle. Let us therefore do all we can to keep its numbers within proper limits.

#### THE OCHRE-COLORED SPHENOPHORUS. (*Sphenophorus ochreus* Lec.)

This rather large species is figured herewith (Fig. 65), while its larva and manner of attack are shown in Figs. 66 and 67 respectively. The species has recently shown a tendency of leaving its customary food plant, one of the club rushes, for

Indian corn in portions of Illinois and Indiana. Especially has it worked upon corn growing on low ground adjacent to swamps.

SPHENOPHORUS PERTINAX Oliv.

SPHENOPHORUS PLACIDUS Say.

SPHENOPHORUS ROBUSTUS Horn.

SPHENOPHORUS CARIOSUS Oliv.

SPHENOPHORUS SCOPARIUS Horn.

SPHENOPHORUS PARVULUS Gyll.

THE GRAIN WEEVIL. (*Calandra granaria* Linn.)

This is the true grain weevil, concerning which so much has been written, both in this and European countries. It is a blackish snout-beetle very similar in form to the different species of "bill-bugs" mentioned above, but much smaller—being about one-fifth of an inch in length. In this country the insect is less common than in Europe, and occurs chiefly in old granaries and corn cribs, where it feeds upon the stored grain. It attacks both corn and wheat, as well as some of the other grains. The mature beetles, as well as the larvæ, feed upon the grain. As a remedy, the use of bisulphide of carbon, as directed under several others of the species that attack stored grain, will be found very efficient.

THE RICE WEEVIL. (*Calandra oryzae* Linn.)

The insect which bears the name of "Rice Weevil," is naturally an enemy of that grain, but also attacks corn and wheat. It is distinguishable from the *granaria* in having two large red spots on each elytron or wing cover.

#### HEMIPTERA.

CHINCH-BUG. (*Blissus leucopterus* Say. Figs. 69-70.)

The Chinch-bug, which has become one of our most destructive insect pests in the United States, was first noticed in the state of North Carolina, where, like all of our other injurious insects, it acquired its taste for cultivated crops, and began its attack upon these plants in preference to those growing wild, and upon which it had probably fed from times very remote. These new food plants being always at hand during the season when the bug lays its eggs and the young are growing and occurring in vastly greater quantity, of course gave the insect advantages for rapid increase. The loose soil about the roots of these cultivated plants, too, more nearly met the requirements necessary for the work of the young than was to be found upon uncultivated grounds.

The Chinch-bug was first scientifically described by Mr. Thomas Say, in the year 1831, from a single specimen captured in eastern Virginia. He called it *Lygæus leucopterus*. Soon after this, and within a few years, its range in injurious numbers began to widen, it having made its appearance in grain fields in different localities west of the Alleghany mountains.

From the year 1839 forward, its spread in the middle and western states has been quite regularly noted, until now it is known to occur very nearly from ocean

to ocean. It is more of a southern insect than a northern one, although it is often met with north of our boundary line in Canadian territory. While it has been seen and is now known to be a regular resident along our northern border, its depredations have thus far been confined chiefly south of the forty-fifth degree of latitude. In speaking of the geographical distribution of this insect, Mr. Howard says:\* "East of the Rocky mountains the Chinch-bug seems to be indigenous, north and

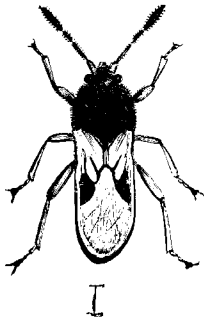


FIG. 69.—Chinch-bug, (*Blissus leucopterus*); imago. [After Riley.]

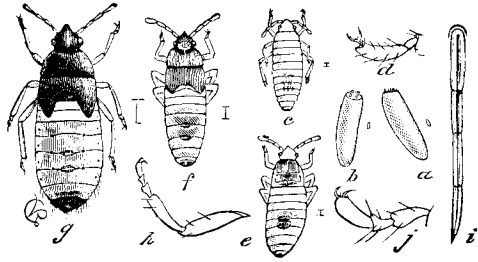


FIG. 70.—Chinch-bug: a, b, eggs; c, larva just hatched; e and f, same more advanced; g, pupa; h, d, and j, legs of bug—all enlarged. [After Riley.]

south, feeding naturally upon various species of wild grasses, and becoming multiplied wherever the cultivation of wheat has reached its original haunts." In the Rocky mountain region, and over the great interior basin, its presence does not appear to have been noted and recorded; but that it occurs on the Pacific slope in the state of California is now a well settled fact. It has been reported from Texas, Mexico, and the Island of Cuba.

#### LIFE-HISTORY AND HABITS.

The Chinch-bug hibernates in the mature or perfect state, tucked away in various nooks and crannies and underneath all sorts of vegetable *debris* as well as other things that offer retreats from the cold and snows of winter. When the warm days of spring appear, such of the bugs as have "pulled through" the long, cold winter, issue from their retreats and begin preparations for the summer's campaign. The mature insects are to be seen flying about during both spring and late fall on bright sunshiny days—in fall to seek shelter and in spring to seek suitable grounds for egg-laying. They also fly during the latter part of July and early August, when preparing for the second brood of young. The mating of the second or last brood sometimes occurs in fall, especially if the weather is pleasant; but usually takes place when the winter quarters are being forsaken. The eggs are then usually laid upon the roots of the plants chosen by the parent bug to be the food of the young, though sometimes upon the stalks of these just above ground. The average number of eggs laid by each female has been estimated at about 500. These are not all deposited at once, but are laid from time to time, during parts of May and June. Hence the reason for finding young of all sizes at the same time. The time required for the full development of the winged insect from the egg as laid is close to sixty days. This being the case, of course those bugs hatched from the first eggs

\* Bulletin No. 17 of the United States Dept. Agri., Div. Ent.

will be the first to mature. When the grain has ripened and no longer affords food for the insects, they must necessarily seek it elsewhere; they must therefore migrate. These movements are made on foot, and by *all*, larvæ, pupa, and imagoes, until they find some plant upon which to feed. This new food plant usually proves to be corn, foxtail, Hungarian, or millet, though frequently various of the grasses, sorghum, or broom-corn are the plants attacked. Even the weeds of fields are occasionally resorted to by them, as I have myself observed in this state, and have been told by others, wild buckwheat being one of these. Upon these grasses and corn the eggs for the second brood are deposited—usually tucked in between the sheath and stalk.

#### FALSE OR BOGUS CHINCH-BUGS.

While this insect is only too common, and occurs generally throughout the regions mentioned, it not unfrequently happens that several other insects are sometimes mistaken for it, and unnecessary alarm caused. The first of these which I will mention is the False Chinch-bug (*Nysius angustatus* Uhl.), which is shown in

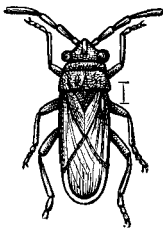


FIG. 71.—False Chinch-bug (*Nysius angustatus*); mature insect, enlarged. [After Riley.]

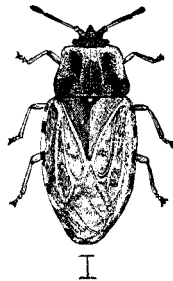


FIG. 72.—*Piesma cinerea*; greatly enlarged. [After Riley.]



FIG. 73.—Negro-bug (*Corimelaena pulicaria*); mature insect, enlarged. [After Riley.]

Fig. 71. Like the true Chinch-bug, it is widely distributed over the country, and sometimes does considerable injury to grape vines, strawberries, potatoes, young apple grafts, and all cruciferous plants. It is exceedingly fond of purslane weed, and also occurs plentifully upon various species of smartweed. This bug also becomes quite numerous during certain years. Another of these false Chinch-bugs, which is also very widely spread, is the Ash-gray Leaf-bug (*Piesma cinerea* Say), which usually occurs upon the foliage of trees. Sometimes in spring it has been known to injure the blossoms of the grape. I have very frequently seen it upon the "tumble weeds" (*Amoranthus*) in numbers sufficiently great to cover them from top to bottom. The Insidious Flower-bug (*Thripheps insidiosus* Say) is another of the bugs frequently mistaken for the "true and only one." This particular insect, however, must be placed among our friends, as it is one of the few insects that destroys the species for which it is sometimes mistaken. A fourth one of these bugs that is a cause of "mistaken identity," is the flea-like Negro-bug (*Corimelaena pulicaria* Germ.), of which Mr. Howard writes as follows:\*

"Its appearance is more different from the Chinch-bug than any of the insects mentioned under this head, and is plainly shown by the figure. It feeds abundantly upon the fruit of the raspberry, and punctures also the stems of the straw-

\*Bulletin U. S. Division Entomology, No. 17, p. 13.



berry, and the blossoms, leaves, and fruit stems of the cherry and quince. It is also injurious to certain garden flowers and to certain weeds. \* \* \* This latter species is well represented in Fig. 73.

#### ENEMIES OF THE CHINCH-BUG.

The chinch-bug appears to be one of the few of our insect pests that is comparatively free from the attacks of insects and other natural enemies. Among the species of predaceous insects known to feed upon insect life, only four of the lady bugs, one neuropterous, a single beetle, and several hemiptera, have been known to destroy it. Among the birds the quail stands at the head; while a few other birds follow closely. A few of the reptiles, as toads, and frogs, also feed upon it, though rather sparingly.

Among the parasitic fungi there are at least two species known to attack the insect now under consideration. One of them is very similar to that which is known to attack the silk worm. It is called the *Micrococcus insectorum*, and infests the alimentary canal. A second of these is the one figured herewith (Fig. 74), where a Chinch-bug is shown as he appears after having succumbed to this fungus—very likely an *Entomophthora*.

Professor Otto Lugger, entomologist and botanist for the Agricultural Experiment Station of Minnesota, in giving his experience with this fungus upon the Chinch-bug, writes as follows: \*

"The warm weather continued, and the first generation of Chinch-bugs became quite numerous and destructive, and the second brood threatened a repetition of last year's disasters. Oats, rye, wheat, and some grasses were utterly destroyed by them, and the young and promising corn formed now a standing invitation to the hungry hordes. To prevent their inroads, all the infested fields and experimental plots were surrounded by a low board fence, six inches high, and snugly fitting to the ground so as to prevent insects from crossing under this fence. The upper edges of the boards were painted from time to time with tar, which prevented the bugs from crossing. The insects were at this time of all sizes and ages. Adults of the first brood, eggs, young hatched bugs, and pupæ of the second brood, were all mixed together, and all were decidedly hungry, as their intense activity and the swarming armies of famishing bugs plainly indicated. To gather in this crop of bugs, round holes about six inches in diameter were drilled in the ground close to the fence, and as one hole became filled with insects it was closed and another one was opened close by, for the reception of more victims. So matters worked to our satisfaction, when an unexpected assistant came to help us, making the structure of more fences unnecessary. The above-mentioned holes were quite deep, and consequently were always wet, a condition of things not at all suitable to starving Chinch-bugs, and they soon became unhealthy and weak, thus presenting the best condition for any disease to claim them as its victims. And such a disease, produced by a fungus, was not slow in making its appearance, as could be seen by the numerous dead bugs. The margins of all the holes, but chiefly those more densely crowded with captives, soon became whitened with dead bugs, enshrouded in white mycelial threads and dust-like spores. In fact, in a few days the upper rims of these holes looked as if recently whitewashed. Nor did the disease

\* Bulletin No. 4, Minnesota Agricultural Experiment Station.

stop there. On the contrary it spread very rapidly to adjoining fields of timothy, Hungarian grass, millet, etc. Even the course followed by it from the holes could be readily recognized for some time by the more or less numerous white spots left in its wake. The fields invaded by the disease afforded, upon closer examination, a truly edifying spectacle to those not interested in the welfare of the Chinch-bugs. They looked quite panic stricken, and moved about in a slow and dazed way, figuratively speaking, as if badly scared. And well they might be! The victims of the disease could be seen everywhere by the thousands. They had been slaughtered in all kinds of positions; but they were usually fastened to the blades and stems of the grass, or to the leaves of young clover. All showed plainly that their last and strong determination in life had been to hold on as long as possible; their legs were firmly planted upon the substances where the bug happened to be; others had only their beaks inserted, and were dangling by them free in the air. But all showed the characteristic white *mycelium* threads issuing from the spores of the disease. The illustration in Fig. 74 shows an enlarged Chinch-bug, with white threads issuing from its body, and numerous other specimens of natural size killed by the fungus. Although almost exclusively attacking Chinch-bugs, the disease was not slow in slaughtering such small flies as found the society of such malodorous companions to their taste. A story with a moral! \* \* \*

"Most, if not all, the Chinch-bugs would have been killed at the experiment station, if the suitable conditions for this disease had lasted a few days longer. But the wet spell, prevailing part of the time the disease was playing such havoc among the bugs, soon passed, and was followed by warm and very dry days, which soon

stopped any further spread of the disease. But by artificially producing such conditions, the disease was kept at work for some time, but only on a very limited scale. Nor could it be spread, because in nature such artificial conditions could neither be produced nor maintained on any extensive scale.

"As many parts of the southern portion of this state were overrun with Chinch-bugs, I thought that a good opportunity and an inviting field was presented to purposely spread a disease—an act not usually considered a very kind one to engage in, and one not to be recommended to physicians. This was exceedingly simple, as all that was necessary was to gather a number of the diseased bugs, put them into tight-fitting tin boxes, and mail them to regions infested by chinch bugs. Arrived at their destination, the contents of the boxes could simply be thrown into any field known to be infested with such bugs. This was done with specimens of the diseased bugs collected at the experiment station, and eighteen differ-

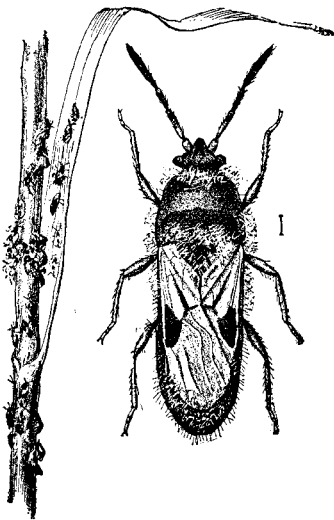


FIG. 74.—Chinch-bug, showing the insect as it appeared when killed by the fungoid disease; enlarged and natural size. [After Lugger.]

ent places in southern Minnesota were thus made centers of distribution for this disease, and, as it seems, with remarkably good results, as the disease has killed off

the bugs to such an extent that careful search in a majority of places failed to produce a single living specimen, whilst the traces of the disease were found everywhere. The disease spread so rapidly that even corn fields growing near wheat fields crowded with Chinch-bugs were entirely protected, and no bugs had entered them in all the places visited by myself."

Professor Snow, of the State University of Kansas, has been very successful in killing off the Chinch-bug by means of these diseases which he succeeds in spreading over the country in infested regions. A number of reports that have been printed in the various agricultural and other journals of the country will show how entirely successful his remedy has proved.

My report made to the United States entomologist upon this insect in October 1887, will perhaps be of some interest here, as in that paper I have given a general outline of this entire subject. It is herewith given in full:

Great and widespread have been the depredations of this repulsive pest, which, next to the Rocky Mountain Locust, is our most injurious species of insect enemy. From its depredations alone throughout the drouth-stricken region of the Mississippi and Missouri valleys, during the present season, millions of dollars' worth of grain have been destroyed, and in several localities actual privation is liable to follow.

The annexed crop reports, culled from various daily and weekly newspapers published throughout this region, will give a slight intimation of the true state of the subject under consideration. Still, each region always draws its own afflictions as mildly as possible, while in speaking of those of a neighboring district they are liable to be somewhat overdrawn or exaggerated.

About the beginning of the second week in July, rumors of Chinch-bug depredations at isolated localities throughout the drouth-stricken area were first circulating through the press. A week later these rumors had become substantiated, and it was definitely known that their distribution and depredations were more widespread and general than was at first supposed; not only in this state, but also in Kansas, Missouri, Iowa, portions of Illinois, Minnesota, and southeastern Dakota. But not until harvest arrived was the full extent of their depredations known.

*Causes of increase.*—When the matter is carefully studied and the causes of the undue increase of this insect are taken into consideration, the wonder is that the injury was not greater and more widespread than it actually has been. The long-continued drouth of last year, with large areas of Chinch-bug depredations, followed by a generally close and severe winter, after which came a warm, dry spring, and hot, scorching summer; all these favored in the greatest degree the most complete development of the bug in all its stages. But a comparatively few of its natural enemies were present, and most of these, too, were species that prefer preying upon other insects to feeding on the unsavory rebel under consideration, when insects of any other kind can be found. These predatory species had a plentiful host in the various species of aphides, leaf-beetles, and such-like other depredators that were also present in great numbers.

One of the most common and perhaps by far the chiefest of reasons for the large numbers of the pests that are always ready to take their place whenever the opportunity offers, is the great carelessness prevalent among farmers in general to "clean up" during late fall and early spring. Especially is this true in portions of Nebraska, Iowa, and Kansas. The bugs winter among rubbish of all kinds, in

meadows, along fences, in brush heaps, among fallen leaves, and among the *debris* collected by hedges, weed patches, and along the outskirts of groves among the underbrush. But there is no use of my going over these points that have been mentioned again and again by all writers upon the subject.

After the bugs have become a pest, the only effectual remedy is wet, cool weather. For some reason or other their constitution is not suited to a superfluity of moisture, nor can they adapt themselves to it. Humidity has the effect of bringing on disease and final dissolution with them, just as it does with various migratory locusts, the only difference being in favor of the locusts. A good, soaking rain, or at most two or three of such, following in the course of several days, generally ends effectually the most threatening Chinch-bug devastation; while on the other hand, a year, or even two, of such weather is sometimes required to entirely obliterate a locust plague.

The question, then, naturally comes up, Can this insect not be materially kept in check by some other and natural means? My answer to this question is, Yes. To a certain degree this is quite possible, and not nearly so difficult a task as one might suppose. A good cleaning up and burning of rubbish of all kinds in late fall, winter, or early spring, will answer the purpose, if the work be general, by reducing the number of hibernating insects. Osage orange and all other very brushy hedges are the most attractive retreats, and at the same time most formidable retreats to master. For my part, I would be in favor of removing these, and replacing them with some other kind not so difficult to keep free from the collecting *debris* carried by winds. Uncultivated prairie lands adjoining fields should also be burned early in spring. The breaking down and burning of corn-stalks in the spring following a Chinch-bug year will also destroy myriads of the insects that have hibernated between the leaves and stalks. At other times, however, the stalks had better be utilized as a fertilizer by plowing under. If covered deeply, this will be a remedy fully as effectual as if burned. Protect the birds, and above all the quails, for they destroy countless numbers of hibernating insects of various kinds that are to be picked up about hedges and such-like resorts frequented by these birds throughout the year. Although belonging to the granivorous birds, the quail is essentially insectivorous, except during inclement weather, when insects are not easily obtained. In my profession as taxidermist, I have dissected many different species of birds in the crops of which were contained injurious insects of various kinds, the Chinch-bug among the others. In no other instance do I remember of the presence of this insect in the crop of a bird in so great numbers as in that of the quail. As a rule, but few birds, mammals, reptiles, or rapacious insects seem to relish any of the odoriferous members of the order Hemiptera or true bugs. In winter, however, this repugnance is partially overcome, and now and then even a Chinch-bug seems a delicate morsel when "meat" is scarce.

Very few insects are known to prey upon the Chinch-bug; while I myself have never observed any of the species which have been credited with the good work thus attacking the enemy. True, I have frequently seen different species of Lady-bugs (*Coccinella*, *Hippodamia*, etc.), and the Lace-wing fly, upon the same corn stalk with the Chinch-bugs. Upon close observation it was also ascertained that the plant was more or less infested with some aphid or plant louse which had attracted these, their natural enemies, before the other bugs arrived. It must not

be inferred from what I say here that I discredit the writings of such authorities as Thomas, Le Baron, and others. Such is far from my intention.

Various remedies, as plowing, rolling, ditching, fencing, and the use of insecticides have been suggested and used with more or less favorable results, both in this and other states; deep plowing immediately after the harvest having succeeded in a few instances by covering the bugs so deeply that they could not creep out. Rolling at a like season has crushed large numbers, while ditching and fencing have succeeded in "bunching" them and for a time checking their onward movement while migrating from small-grain fields to corn fields. At such times the dragging forward and backward of a heavy weight of some sort has been the means of causing great slaughter among their continually increasing ranks. Ditches into which water could be turned have formed complete barriers to their creeping migrations, but not to the after movements of the winged insects as they were about to mate for the second brood.

This insect, like all depredators, has its likes and dislikes, and chooses its food-plants with considerable daintiness of taste.

The small grains are the first on the list, after which follow some of the grasses and corn. Among the grasses, millet, Hungarian, and fox-tail stand at the head, while a few others that usually grow as weeds follow closely. Wild buckwheat is also quite a delicacy with them, and I have noticed several examples where weedy fields were less injured than clean ones, notwithstanding the fact that the one contained equally as many bugs as the other. Several farmers in this state have also mentioned the same fact to me. As a rule, grain in a grassy field has the disadvantage alongside of that growing in a clean one. During the past summer I saw several examples in which the scale was turned. One of these in particular attracted my attention at the time. The crop was corn, growing just across the road from a field of wheat which had been so badly damaged as to render its harvest useless. The ground was covered with wild Hungarian or fox-tail grass, which at the time, August 6th, was dead and perfectly dry for a considerable distance in from the road. Upon examination it was found that our old acquaintance was at work here, attacking the fox-tail in preference to the corn. Referring to my notes made on the ground, I find the following:

"The Chich-bug is still present in considerable numbers in a few corn fields, but absent from others where there are signs of its work. In these a large per cent of the grass (fox-tail) had been entirely killed before the corn was attacked. In no instance has the corn been greatly damaged, the only perceptible injury being in the drying up of a few of the lower leaves."

We had several heavy rains just prior to this, so the partial disappearance of the pest could very likely be attributed to that cause. Since that date but a few scattering specimens of the bugs have been noticed. Hence, I imagine our rains of August and September have been of great benefit in their diminution.

In conclusion, I would state that the only remedy that I know of is in clean farming—burning all rubbish in early spring that has not disappeared during fall and winter; also the protection of our winter birds.

In regions that depend entirely upon irrigation for moisture, or such as are easily flooded, there never need be any loss of crops from the depredations of this insect.

As to future possibilities of injury we can say nothing definite, as weather alone

will decide the matter, a wet year preventing and a dry one favoring their increase in damaging numbers.

#### JASSUS INIMICUS Say.

There are a number of insects that go by the popular name of leaf-hoppers, which derive their nourishment by means of a beak, which they insert into the leaves and stems of various plants, and from which they extract the juices. Several of these have at different times been known to attack Indian corn in sufficient numbers to cause injury to that crop. One of these, the *Jassus inimicus* Say, which is only about one-seventh of an inch in length, was first described in 1831 from specimens collected in Virginia. It is a moderately slender, greenish-yellow insect, dotted and marked by a few black points.

#### CICADULA NIGRIFRONS Forbes.

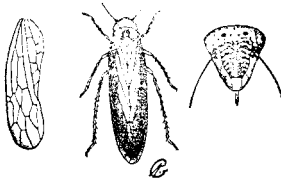


FIG. 75.—*Cicadula nigrifrons*—enlarged. [After Forbes.]

A reference to the accompanying illustration (Fig. 75) will aid the reader of this report to recognize the insect which has received the above name. The insect which it represents is "a moderately slender, yellowish-green species, with four black points at the anterior margin of the vertex. The head is sublunate, obtusely rounded in the middle, its antero-posterior diameter next the eyes being about three-fourths its median diameter. Its color is pale yellow, irregularly mottled with white, with an arc of four irregular black points at its anterior margin, the outer of these just above and within the ocelli. There is a slender impressed median line, black or dark brown, and a depressed spot upon each side appears midway between this and the eye. Total length, .14 inch."—(Forbes, 14th Ills. Rept., p. 67.) Found at Anna, Ill., July 14, very common on young corn.

#### CICADULA NIGRIFRONS Forbes.

A third species of these leaf-hoppers that has at times affected corn is "Similar in general appearance to *Cicadula nigrifrons*, but differs in wing veins and color markings. Head with two round black spots upon either side of the middle of the base, about equidistant from the median impressed line and from the eyes. In front of these a transverse black line extending from eye to eye, but interrupted at the middle of the vertex, followed by a second heavier line sometimes interrupted and sometimes not, the two being nearly joined by a bar at the ends of the first."

As these leaf-hoppers also occur upon small grains and grasses they can be best destroyed by the use of some form of the "hopper dozer," which has proved so successful in capturing and destroying young grasshoppers or locusts.

#### MACROPSIS NOBILIS.

Still another of the leaf-hoppers that is known to attack young corn during the months of June and July, and that has been observed in injurious numbers in Illinois.

#### THE CORN-PLANT LOUSE. (*Aphis maidis* Fitch.)

One of the few species of insects that attacks corn in overwhelming numbers at times is the Corn-plant Louse, which was first described by Dr. Fitch. It is

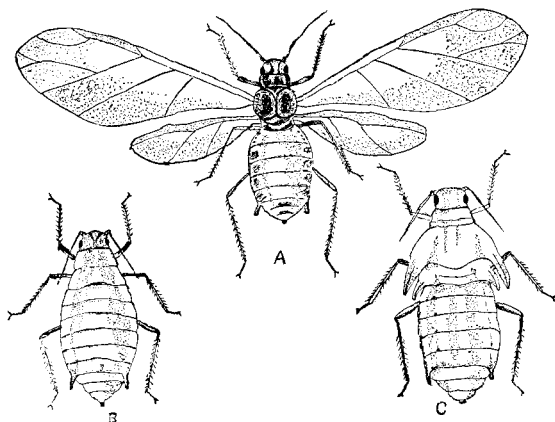


FIG. 75.—*Aphis maidis*: a, winged viviparous female; b, apterous viviparous female; c, pupa. [After Forbes.]

shown in the accompanying illustration (Fig. 76, a, b, c). At a, the winged viviparous female; b, the apterous viviparous female; and at c the pupa of winged viviparous female. It can be distinguished from the Corn-root Louse by the following characteristics:

Form B, of illustration, dull green, the color more or less obscured by a glaucous bloom which is dusted over the entire body; "the head and commonly two bands upon the thorax smooth and black, with spots of the same along the sides of the abdomen and sometimes upon its middle also, the tip of the abdomen drawn out to a black point with two smooth black bands forward of it, the nectaries black and their length about half equaling the distance from their base to the tip, the antennæ black and nearly half as long as the body, the legs black with the shanks whitish except at their tips. They are of a plump oval form, rather broadest back of the middle. Their beak is pale, its tip black; it arises from the lower part of the head and reaches only to the base of the middle legs, between which is a deep groove for its reception when at rest."

Form A.—The winged viviparous females "are black, the abdomen dull lurid green, with black punctures and dots along each side, and three black bands at the tip, and opposite these on the under side a transverse black spot. The nectaries, legs, and antennæ are similar to those of the wingless female."

The habits and natural history of this louse have been carefully studied and recorded from time to time in the reports of the state entomologist of Illinois.

#### THE CORN-ROOT LOUSE. (*Aphis maidi-radicis* Forbes.)

This root louse of the corn which is figured herewith (Fig. 77, a, b, c,) has long been confounded with the Corn-plant Louse (*Aphis maidis* Fitch). In the

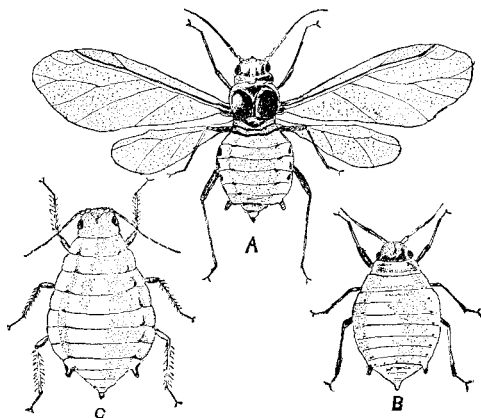


FIG. 77.—*Aphis maidi-radicis*: a, winged viviparous female; b, apterous viviparous female; c, apterous oviparous female. [After Forbes.]

careful studies which the Illinois state entomologist and his assistants have made of these corn-infesting lice, they have failed to connect the two forms. In other words, by carefully working with either form, all efforts to rear from it the other form have thus far failed. This being the case, together with the constancy with which each adheres to the structure of typical specimens of either, Professor Forbes has properly proposed a new name for the present species. A comparison of the figures will at once show the difference between it and the original *maidis*.

The root louse may be known from the following description which is that as written by Forbes, or his assistants, and which will be given in full:

*"Winged viviparous female.*—Head black. Thorax brownish black. Abdomen above with three marginal black spots and numerous small, dark specks over the surface. Antennæ dark with pale at the articulations. Prothorax pale in the middle; meso- and metathorax chiefly brown. Cornicles black with some black at their bases, chiefly inside. Cauda dusky, with several transverse dusky marks before it. Thorax chiefly dark below, with interspaces about bases of limbs brownish. Under side of the abdomen pale green; two transverse dark marks before the cauda. Legs mostly black; tibiæ for basal two-thirds pale. Length of body, 1.8mm.; width of body, .9mm.; antennæ, .7mm.; cornicles, .12mm.; wing, 2mm.

*"Wingless viviparous female.*—Head black above. Prothoracic segment black; the following three body segments each with a transverse dusky mark on their middle. Abdomen pale green, with black marginal spots and with numerous smaller specks over the surface. Antennæ dusky at tip and slightly also at base. Eyes reddish brown. Cornicle black. Cauda dusky; preceded by two transverse black marks. Abdomen beneath with two transverse black marks before the cauda, otherwise nearly uniform pale green below. Rostrum black at base and tip. Coxæ, femora chiefly, tips of tibiæ and the tarsi black. Body widely oval in outline. Antennæ short, about half the length of the body and head; first and second articles equal in length, first largest; third article longest; fourth and fifth subequal and about equal to the thickened proximal part of the sixth. Cornicles short, tapering towards the tip, not swollen, extremities flared. Cauda short and wide. Length of body, 1.4mm.; width of body, .93mm.; antennæ, .57mm.

*"Oviparous female.*—General color dull green; body covered with a glaucous bloom. Above, head dusky, prothorax chiefly dusky, the three succeeding segments each with a median transverse dusky blotch, all the segments behind the prothorax with a marginal and submarginal series of dusky specks on each side. Below, head and prothorax dusky, two dark spots outside the coxa of the middle leg, a dusky line before the coxa of the hind leg, abdominal segments with two series of dusky specks on each side and a pair of dark spots before the cauda. Antennæ, two basal articles, third and fourth at tips, and fifth and sixth chiefly dusky. Eye brownish red. Rostrum dusky. Anterior and middle legs with the coxæ, femora except at bases, tibiæ tips and tarsi except bases dusky. Posterior leg, except the extreme base of the femur, black. Cornicles black. Cauda with black border. Body stout, its greatest width at about the middle. Outline of front seen from above incurved medially. Antennæ with first and second articles equal in length, the first stoutest; third article about equal in length to the fourth and fifth together, the latter nearly equal in length and similar in form; basal



part of sixth article shorter than the distal part, about equal to the fifth in length. Cornicles short, not at all swollen in the middle. The limbs and the cauda have the usual slight pubescence of members of the genus *Aphis*. Length of body, 2.27mm.; width of body, 1.20mm.; antennæ, .80mm.; cornicle, .20mm."

The life-history and habits of the Corn-root Louse are substantially as follows, according to Professor Forbes: "The root louse hibernates as an egg in the earth, and as far as known, only in the nests of ants of a species identified for me by August Forel as *Lasius brunneus*, var. *alienus*. This ant is host and constant companion of the root louse throughout the year. It is equally devoted, however, to the common Grass-root louse (*Schizoneura corni*, by Osborn's determination.) The ant above referred to is the common small brown ant about an eighth of an inch in length, abundant in corn fields in spring, where it burrows among the roots of the corn. Its nests are still more common along the borders of roads and paths through pastures and other grass lands. The formicaries, containing the corn louse eggs, are most frequently to be found in old hills of corn, late in autumn, or in early spring, at a time when the ants are torpid within the earth, and when, consequently, their mining operations do not betray their presence. They should be sought by digging or plowing up the corn stubble in the field, when, if ants be found, a thorough search of the burrows will commonly show the minute, oval, shining black aphid eggs, piled together in larger or smaller quantities, the depth below the surface varying according to the season, and even the time of day. We have found them at a depth of six or seven inches, and again scarcely more than half an inch below the surface. In spring especially, when hatching time draws near, the ants convey the eggs to the upper galleries of their nests during the heat of the day (particularly if the weather be fine), but withdraw them for the night and during cold, wet days.

"The ants themselves pass the winter as adult workers, and as larvæ in various stages, from the minute young to those nearly full grown. The time of hatching of the plant louse eggs varies of course with the season, ranging, according to our observations, from the 10th to 30th of April. The commencement of the hatching season is fairly well indicated by the opening of the radical leaves of the common smartweed or heartweed (*Polygonum persicaria*) in the fields. The greater part of the eggs are commonly hatched a week or ten days before corn planting is fairly under way.

"The plant lice of the first generation, that hatching from the eggs, are wingless, viviparous females—the form commonly known as the stem mother, because from it all the succeeding generations of the season proceed without sexual reproduction, no males appearing, in fact, in any of these generations until the last of the season, when both sexes are evolved and eggs are laid for the winter. This spring generation is readily distinguished by characters of form and color from all that follow. Hatching usually before the corn appears, it is dependent at first in our region almost wholly upon young plants of smartweed (*Polygonum*). The roots of these are laid bare by the burrows of the ants, and upon these roots, within their narrow tunnels, the lice will usually be found thickly clustered. Later, if the field be planted to corn, our common species of pigeon grass (*Setaria*) divides the attention of the lice, offering in fact, for a little time, a more succulent herbage than the rapidly growing smartweed.

"The second generation begins to appear about the 10th of May, and, by the 20th

of that month, may be itself mature. Many of this generation are winged, and others are certainly wingless, as careful breeding experiments upon isolated individuals have proven again and again. Our earliest observation of the winged form of the root louse was dated May 13. This generation may live at first, like the other, upon smartweed and pigeon grass, but is most commonly transferred to corn, either in the same field or by flying to a distance. It is beyond all possible question a fact that the ants burrow the hills of corn industriously in advance of the appearance of these lice, and when they themselves have none in their possession with which to stock their burrows. That they will eagerly seize and convey to their corn-field habitations lice exposed to them, we have repeatedly demonstrated by experiment. They seem, however, to be not wholly dependent upon this louse for food, since in the early spring, before the root lice make their start, the ant often captures small larvæ and various soft bodied insects, which it kills and carries to its nest.

"The third generation may appear from May 15 to 20. It is more generally winged than the second, so far as is indicated by our rather scanty observations.

"The fourth and fifth generations were brought out late in May and early in June in the single experiment which we carried to that length, but the subsequent history of the louse has not been followed through the season in detail. It is only certain that successive broods appear throughout the summer, until fall, breeding continuously upon the roots, and that both winged and wingless viviparous females occur in variable proportions, seemingly determined in part by the condition of the plant upon which they feed, the winged lice being rapidly evolved as the corn plant suffers from the attack. The midsummer generations become, consequently, widely scattered, and the lice may almost disappear in the fields where, earlier in the season, they were excessively abundant. Colonies started in old corn fields which have been planted to some other crop thus abandon them, after living for a time on smartweed, pigeon grass, and the like, and resort to the growing corn; but in midsummer the roots of many other plants become infested—purslane, *Panicum* (tickle grass), pigeon grass, and possibly squash, although our attempts to breed root lice from this last plant on corn were quite unsuccessful.

"Even ragweed will support these lice at least temporarily, as we proved in 1889 by transferring half-grown young of these second generation from smartweed roots to ragweed, where they lived and fed until they acquired wings, five days later. In autumn we have found the last viviparous generation and the oviparous female generation following, on purslane, dock (*Rumex crispus*), fleabane (*Erigeron canadense*), black mustard, sorrel (*Oxalis stricta*), and the common plantain (*Plantago major*), not to mention two other plants not recognized or determined at the time.

"The bisexual generation of root lice makes its appearance in corn fields as early as October 1, and continues there throughout the month, pairing and depositing eggs. Our only observation of the sexes in copula was dated October 21. We have not found the oviparous female anywhere in the earth, except in the burrows of ants, and there, doubtless, the eggs are laid. Certainly they are collected at that season in the chambers of the ants' nests, and carried through the winter there as already described.

"The ants, in the meantime, have continued their development in their small and scattered colonies, the larvæ beginning to pupate by the middle of May and the sexes emerging early in August. Just when and where the eggs are laid by

the fertilized female we have not yet determined; but specimens of this sex have been found in the earth, alive, as late as November, and the continual appearance of the young larvæ in the home nests until the middle of the following summer shows that eggs are laid, apparently, by workers, at frequent intervals through the early part of the season."—(Forbes, 17th Annual Rep. Entomologist of Ills., pp. 64-70.)

This root louse of the corn has been treated somewhat at length on account of its capabilities of becoming the worst corn insect we have. Then, too, its peculiar life-history and underground life render it a more difficult problem to solve by the ordinary observer who has not the time and facilities to do this for himself. In concluding his remarks upon this insect, Professor Forbes gives the following economic suggestions that will prove quite valuable in fighting it:

"In the first place, a long list of observations in the field in the early spring unite in showing that the Corn-root Aphis takes its start only in fields where it occurred the year before, and that such fields are, as a rule, most likely to suffer severely from the attack. The early evolution of a partially winged brood provides however, for so general a dispersal that the expedient of rotation of crops can have only a secondary value.

"Secondly, the fact that the plant louse eggs hatch, as a rule, some days in advance of the growth of corn in the fields (usually a week or more before corn planting), and that in the meantime the lice are dependent on young weeds in the earth, gave the hint for some starvation experiments tried in two successive years. From these we learned that young lice just hatched will perish within five days if deprived of food, whether attended by ants or not. It seems possible, consequently, that their numbers might be greatly diminished in early spring by such a thorough stirring of the soil with disk harrows or other similar apparatus, as would keep down the sprouting herbage in the corn field. Any treatment of the field the preceding summer or fall which should diminish the number of seeds of pigeon grass or smartweed maturing in the corn would diminish likewise the chances of young root lice the following year. I am told that these conditions are agriculturally manageable, and have arranged for field experiments to test these methods.

"A simpler and perhaps more promising expedient is based upon the care of the eggs by the common small brown ant, so frequently referred to. The attention which these eggs receive both in winter and spring makes it seem likely that the care of the ants is essential, and as these insects become torpid early, rarely working beyond November 1, it seems quite likely that late fall plowing of fields infested by them, and their guests, the root lice, to be followed possibly by harrowing, would so break up their homes and scatter their treasures as to make it impossible for the ants to reestablish themselves or to collect the plant-louse eggs again."

*CHAITOPHORUS FLAVUS* Forbes.

This sorghum and broom-corn louse has been taken while working on the roots of Indian corn, at least a louse found here in the state was so determined at the time.

*RHOPALOSIPHUM DIANTHI* (Schr.).

A fourth species of plant louse has been repeatedly taken on corn growing in the University greenhouse here in Lincoln. Do not think it would attack the crop in the field.

## ORTHOPTERA.

It is not my intention to mention here all of the different species of orthopterous insects that attack corn, for were I to do so most all of the different kinds known in the country would have to be included in such a list. The order as a whole is composed of vegetable feeding forms, and most of these feed upon grasses and allied plants in preference to bushes and trees or herbaceous ones. They nearly all attack cultivated crops in preference to wild or uncultivated plants when the former are at hand. In this paper, then, only such species will be mentioned as have been ascertained to injuriously attack that crop.

THE WESTERN CRICKET. (*Anabrus simplex* Hald.)

The insect figured herewith (Fig. 78) is the famous Buffalo Cricket that has so frequently become sufficiently numerous in the great interior basin country to destroy

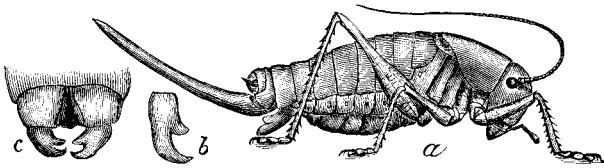


FIG. 78.—*Anabrus simplex*: a, female; b, clasper of male; c, tip of male abdomen. (Entom. Com.)

crops. It has been treated of in the reports of the United States Entomological Commission, and other government publications. As it is confined chiefly to the region lying to the west of the Rocky mountains and east of the coast range, we never need fear its depredations in the Mississippi valley.

THE GLASSY-WINGED GRASSHOPPER. (*Orchelimum vulgare* Harr.)

This insect is included among corn insects on the strength of its using the stalks of this grain sometimes as receptacles for its eggs, and also on account of its frequent attacks upon leaves which it uses as food, eating them full of holes. The insect is one of the smaller katydid-like grasshoppers so common everywhere.

## SCUDDERIA PISTILLATA Brunner.

An insect that is quite common in corn fields here in Nebraska is the one known

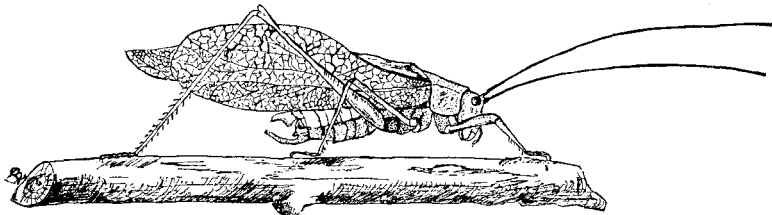


FIG. 79.—*Scudderia pistillata*; male. (Original.)

to entomologists as *Scudderia pistillata*, and which is figured in the accompanying illustration (Fig. 79). It never becomes sufficiently numerous to do material injury

to that crop, but is shown as a representative of the katydid family, several of which at times occur in like situations. Like all of our other species of katydids, this insect is green in color, and resembles the vegetation among which it lurks, feeds, and lives. Its eggs are probably laid within or on corn-stalks, since I have never but once taken the species anywhere save in corn fields.

THE RED-LEGGED LOCUST. (*Melanoplus femur-rubrum* De G.)



FIG. 80.—The Red-legged Locust (*Melanoplus femur-rubrum*); female. [After Riley.]

Of all our North American locusts or grasshoppers this one enjoys the widest range. It is the common species in all parts of the country from the Atlantic to the Pacific, and from the Arctic circle to Central America. Its devastations, while perhaps not as great as those of some others of our destructive species, have been frequent and extensive at times.

THE LESSER MIGRATORY LOCUST. (*Melanoplus atlantis* Riley.)

This locust, which very frequently becomes injurious on account of its excessive increase, is somewhat smaller than the Rocky mountain species. It is also migratory in its habits, but to a much less degree than is *spretus*. In its distribution this insect is much more widely spread than *femur-rubrum*, being common in almost all parts of our country from the Mexican boundary to the fifty-third degree of north latitude, and even beyond in some parts of the country. It is the species which most frequently does the locust injury in the New England states, much of that in our northern states, and some in the extreme northwest. It has also been known to become injurious even in the middle and southern states. In its distribution *atlantis* appears to be more partial to hilly or mountainous country, and especially is this noticeable in reference to its appearance in destructive numbers. It also seems to prefer wooded or mixed country to the open prairie or plains.

As would naturally be expected from its wide distribution, this particular locust presents some variation in its size, color, and to some extent also, its structure. At any rate there appear to be three well-marked forms of the species to be met with within the confines of North America. It does not differ materially in general appearance from the *femur rubrum* which is figured above at 80.

ROCKY MOUNTAIN LOCUST. (*Melanoplus spretus* Thos.)

The Rocky Mountain or Migratory Locust is the insect which is generally re-

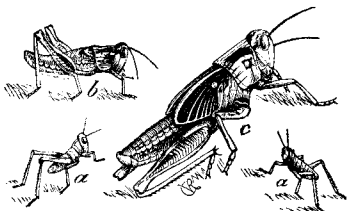


FIG. 81.—R. M. Locust; different stages of growth of young. [After Riley.]

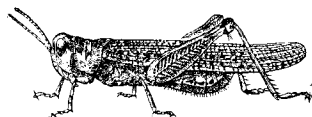


FIG. 82.—Rocky Mountain Locust (*Melanoplus spretus*); male. [After Riley.]

ferred to as the destructive locust of North America, and has caused more injury during the past twenty years than any dozen of the other species combined. It is

this species which we most fear on account of its migratory habits; so marked is this trait that swarms hatching on the Saskatchewan have been traced to the Gulf of Mexico in one season. Its habits have been so frequently described that further mention is unnecessary. It is shown in the accompanying illustrations

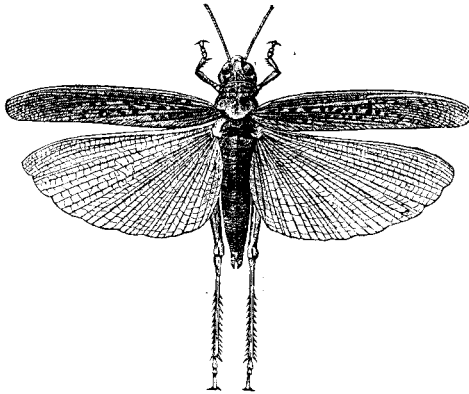


FIG. 83.—R. M. Locust; female. [After Emerson.]

(81, 82, and 83) which show the insect in its various stages of growth with spread wings and closed. The Rocky Mountain Locust has very probably been studied more than any other species of locust known to science; and the numerous remedies that have been suggested and tried at different times and places have proved that it is possible to handle almost any injurious insect enemy if we go at it in the right manner, and continue our attacks after once having begun.

#### THE DIFFERENTIAL LOCUST. (*Melanoplus differentialis* Thos.)

Here in the west we are frequently not a little bothered by a rather large yellowish locust of which the accompanying illustration is a poor representation. This insect occurs along roadsides, the edges of groves, and at other localities where the vegetation is somewhat rank in growth. When more than commonly numerous it attacks and injures both garden and field crops. There are two forms of this differential locust here in the state, viz., the ordinary yellow one, and a black one. This latter form does not differ otherwise from the typical specimens.

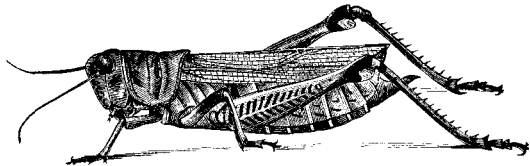


FIG. 84.—The Differential Locust (*Melanoplus differentialis*); female. [After Riley.]

#### THE TWO-LINED LOCUST. (*Melanoplus bivittatus* Say.)

The locust which is shown in Figs. 85 and 86 is too well known to all of the readers of this report to require any special description here. Like the preceding species it is a lover of rank vegetation, and is oftenest found in weed patches or low grounds. When it becomes more than ordinarily numerous these weed patches are forsaken and it enters grain fields and gardens, where occasionally much injury is done to growing crops. Unlike *differentialis*, which is confined to the central portion of the United States, *bivittatus* occurs from the Atlantic to the Pacific, and from the Gulf of Mexico to the Saskatchewan. Its increase in destructive numbers appears, however, to be confined chiefly to the regions lying between the Rocky mountains and the Atlantic. This locust also varies somewhat in color; but can always be recognized by the two light colored lines along the side of thorax

and wing-covers. Fig. 86 represents a male specimen that has been killed by a fungous disease that very frequently destroys great numbers of these insects.

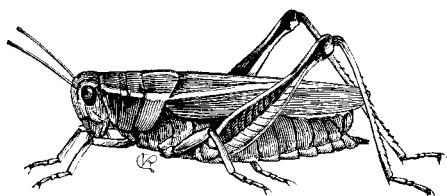


FIG. 85.—*Melanoplus bivittatus*; female. [After Riley.]



FIG. 86.—*M. bivittatus*; male. [After Lugger.]

#### THE AMERICAN LOCUST. (*Shistocerca americana* Drury.)

The locust which is shown herewith in figure 87 is known as the American Locust to entomologists at least, if not to the populace. It is truly a beautiful insect. In addition to its large size and attractive appearance this insect has become familiar to many of us on account of its ravages to crops. It is the species

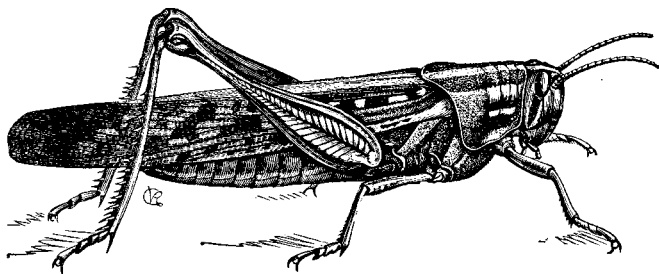


FIG. 87.—*Shistocerca americana*; female. [After Riley.]

which occasionally devastates Yucatan, Central America, and portions of Mexico, and which, on rare occasions, becomes sufficiently numerous along the Gulf coast to do injury to crops. It has also been known in dangerous numbers as far northward as the Ohio river, and occurs sparingly as far north as the northern states.

#### REMEDIES.

These grasshoppers or locusts are usually kept within bounds by their insect enemies, but when the weather has been such as to kill off these parasites the locusts become numerous. When this is the case some artificial measures must be

resorted to if we wish to keep the 'hoppers within bounds and prevent their injury to crops. Such remedies have been numerous, but the ones that have proved the most efficient are plowing under the eggs before they should have had time to hatch, and the capturing of the unfledged locusts by means of hopper dozers. These latter are shallow sheet iron pans in which are put coal tar or kerosene oil and drawn over the ground by horses in such a manner that the hoppers will hop into the pan and be killed by coming in contact with the oil.

#### MYRAPODA.



FIG. 88.—*Julus multistriatus*.

In addition to the large number of hexapodous insects mentioned in the preceding pages, several of the lower articulates also have been known to feed upon Indian corn. Among

these, one of the Myriapods or "thousand legs," has been found feeding upon ears of corn lying on the ground. This insect, or rather "thousand leg," is very similar in appearance to the illustration (Fig. 88), given herewith, and is known to naturalists as *Julus impressus*.