

CHAPTER XVI.

THE ENEMIES OF GRASSES AND CLOVERS.

Mice and Shrews.—These small animals often damage meadows by eating some of the stems and larger roots of grasses and clovers, especially the thickened portions stored with starch near the surface of the ground. They could be trapped if too troublesome, or caught by cats and dogs, but it has been shown that they are not an unmixed evil, as they build nests of old stems and leaves, which, when deserted, are the favorite abodes of bumble bees; and these should be encouraged, because they help fertilize the flowers of red clover, and thus increase the yield of seeds, which are very valuable.

Moles.—In permanent pastures or meadows where the land is dry and sandy, moles sometimes become very troublesome, raising large numbers of unsightly mounds, which are a great annoyance to the mowers. No doubt the moles eat some worms, large numbers of white grubs and other insects, some of which feed on the roots of grasses and clovers, but we know from experiments that moles will eat vegetation in considerable quantities. We should rather run the risk of dispensing with the services of the moles, but the writer is sorry to say that he thinks this kind of game is not often easily caught. Where fields are plowed, and a rotation of crops is followed, moles are seldom troublesome.

Pocket Gophers.—With these diggers the writer has had no experience, but from all accounts, they will often do a good deal of damage. Their burrows are a great nuisance, to say nothing of the grass and clover which they devour or tread under foot.

Woodchucks.—These large rodents are often very troublesome to the farmer who owns dry, sandy, or gravelly land. They

dig long holes, raise piles of dirt, devour and tramp down large patches of meadow. They can usually be caught quite easily in steel traps; they can be shot if one has the patience to watch for them. Where the ground is not too high and dry and a good supply of water handy, by taking advantage of a wet time when the soil is full of moisture, they can often be drowned out and made to come to the surface, where they make sport for the dog. To help make the job a success, before beginning, draw several barrels of water and pour them in quick succession down the hole, which is in the highest place.

Insects.—The rest of this chapter is prepared for this volume by my colleague, Prof. A. J. Cook.

It is generally supposed, even by those best informed and most interested, that our forage plants, including clovers and grasses, are comparatively free from the devastation of insect pests. While our fruits, vegetables and grains are known to be tunneled or devoured at the root, girdled or fed upon at stem and foliage, and blasted in the fruit, the same is not generally supposed to be as true of the plants which give value to our pastures and meadows. While Harris and Fitch give account of many insects which prey upon nearly all others of our cultivated plants, very few are mentioned that attack our grasses and clovers, even by these great scientists and wonderful observers. Mr. J. Stanton Gould, in his *Forage Crops*, knows only four insects which attack the clovers, while at that time over seventy were known to attack the apple. This is not because such enemies do not exist, but rather because the plants fed upon are so abundant that even great damage is either not noticed or else is supposed to be due to drought or other climatic disturbance, or forsooth to the "running out" of the crop. The very nature of our grasses and clovers conceals insect ravages, and thus the harm must become very patent or it will generally be all unobserved.

At present over seventy different species of insects are known

to attack the clover, and nearly or quite as many draw their sustenance from our grasses. It is not probable that all this increase is due to more close study and observation. Insects are constantly leaving our wild plants, either from choice or necessity, and adopting our cultivated plants as a more acceptable diet. We are constantly introducing species from the old world, some of which are of recent importation, and may well cause solicitude because of the serious damage they do. Both of these causes, change of food, habits and importation will continue to increase these pests, so that constant study and experiment will be necessary to ward off the threatening danger.

Insects Injurious to Clover.—In the report of the New York Agricultural Society for 1881–82, p. 190, Prof. J. A. Lintner gives a list of insects which infest clover in Europe. There are 71 species. Nearly every genus represented by these foreign species is included in our insect fauna. The list is of much interest to us, the more so as the noxious insects of Europe are constantly being introduced into America. The following is the list:

Sitones flavescens.....	Morsham.	Apion craccæ.....	
Sitones lineatus.....	Linn.	Coccinella impuncta.....	
Phytonomus nigrorostris.....	Fabr.	Hylesinus trifolii.....	Müll.
P. meles var. trifolii.....	Herbst.	Labidostomis longimana.....	Linn.
Tychius polylineatus.....	Germ.	Lycæna Amyntas.....	Schiffm.
Tychius pisirostris.....	Fabr.	Lycæna Alexis.....	Treits.
Ceutorhynchus lineatus.....	Payk.	Lycæna Ægon.....	Schiffm.
Apion seniculum.....	Kirby.	Lycæna Cyllarus.....	Fabr.
Apion virens.....	Herbst.	Lycæna Dolus.....	Hüb. n.
Apion flavipes.....	Fabr.	Lycæna Adonis.....	Hüb. n.
Apion fagi.....	Linn.	Lycæna Argus.....	Hüb. n.
Apion assimile.....	Kirby.	Melitæa Athalia.....	Esp.
Apion trifolii.....	Linn.	Melitæa Cinxia.....	
Apion gracilipes.....	Dietrich.	Colias Hyale.....	Linn.
Apion varipes.....	Germ.	Leucophasis sinapis.....	Linn.
Apion apricans.....	Germ.	Zygaena Minos.....	Hüb. n.

<i>Zygæna meliloti</i>	<i>Ochs.</i>	<i>Euclidia glyphica</i>	<i>Hüb.</i>
<i>Zygæna lonicerae</i>	<i>Hüb.</i>	<i>Euclidia mi</i>	<i>Hüb.</i>
<i>Zygæna trifolii</i>	<i>Esp.</i>	<i>Herminia crinalis</i>	<i>Treits.</i>
<i>Zygæna filipendulae</i>	<i>Hüb.</i>	<i>Boarmia selenaria</i>	<i>Hüb.</i>
<i>Zygæna peucedani</i>	<i>Esp.</i>	<i>Fidonia clathrata</i>	<i>Linn.</i>
<i>Zygæna scabiosae</i>	<i>Hüb.</i>	<i>Ortholitha bipunctaria</i>	<i>S. V.</i>
<i>Zygæna Achilleae</i>	<i>Hüb.</i>	<i>Ortholitha palumbaria</i>	<i>Hüb.</i>
<i>Zygæna angelicae</i>	<i>Ochs.</i>	<i>Ypsolophus deflectivellus</i>	<i>H. S.</i>
<i>Orgyia fascelina</i>	<i>Hüb.</i>	<i>Phoxopteryx badiana</i>	<i>S. V.</i>
<i>Gastropacha rubi</i>	<i>Hüb.</i>	<i>Gelechia taeniolella</i>	<i>Treits.</i>
<i>Gastropacha trifolii</i>	<i>Hüb.</i>	<i>Gelechia anthyllidella</i>	<i>Hüb.</i>
<i>Callimorpha hera</i>	<i>Linn.</i>	<i>Lithocolletis Bremiella</i>	<i>Frey.</i>
<i>Lasiocampa trifolii</i>	<i>Linn.</i>	<i>Lithocolletis insignitiella</i>	<i>Zell.</i>
<i>Orthosia litura</i>	<i>Hüb.</i>	<i>Coleophora deauratella</i>	<i>Lienig.</i>
<i>Orthosia gracilis</i>	<i>Hüb.</i>	<i>Acipitilus pentadactylus</i>	<i>Linn.</i>
<i>Plusia gamma</i>	<i>Hüb.</i>	<i>Agromyza trifolii</i>	<i>Kaltenb.</i>
<i>Mamestra pisi</i>	<i>Hüb.</i>	<i>Agromyza nigripes</i>	
<i>Mamestra chenopodii</i>	<i>Hüb.</i>	<i>Lopus roseus</i>	<i>Fall.</i>
<i>Mamestra suasa</i>	<i>Esp.</i>	<i>Aphis pisi</i>	<i>Kaltenb.</i>
<i>Agrotis comes</i>	<i>Hüb.</i>	<i>Epilachna globosa</i>	
<i>Episema graminis</i>	<i>Linn.</i>	<i>Goniostena sexpunctata</i>	
<i>Acontia solaris</i>	<i>Hüb.</i>		

In the same volume, p. 192, Prof. Lintner gives the following list of insects attacking the clover in the United States, nearly all of which are widely distributed:

LEPIDOPTERA.

<i>Callidryas Cuvale</i>	<i>Linn.</i>	<i>Arctia Achaia</i>	<i>Gr.-Rob.</i>
<i>Colias Cæsonia</i>	<i>Stoll.</i>	<i>Pyrrharctia Isabella</i>	<i>Sm.-Abb.</i>
<i>Colias Eurytheme</i>	<i>Boisd.</i>	<i>Hyperchiria Io</i>	<i>Sm.-Abb.</i>
<i>Colias Philodice</i>	<i>Godt.</i>	<i>Agrotis saucia</i>	<i>Hüb.</i>
<i>Terias Nicippe</i>	<i>Cram.</i>	<i>Mamestra trifolii</i>	<i>Esp.</i>
<i>Terias Lisa</i>	<i>Boisd-Lec.</i>	<i>Mamestra renigera</i>	<i>Steph.</i>
<i>Terias Delia</i>	<i>Cram.</i>	<i>Mamestra (Ceramica) picta</i>	<i>Harr.</i>
<i>Melitæa Editha</i>	<i>Boisd.</i>	<i>Leucania unipuncta</i>	<i>Haw.</i>
<i>Chrysophanus Americana</i>	<i>D'Urb.</i>	<i>Prodenia commelinæ</i>	<i>Sm.-Abb.</i>
<i>Lycæna Comyntas</i>	<i>Godt.</i>	<i>Drasteria erectea</i>	<i>Cram.</i>
<i>Eudamus Pylades</i>	<i>Seudd.</i>	<i>Hypena scabra</i>	<i>Fabr.</i>
<i>Hyphantria textor</i>	<i>Harr.</i>	<i>Aspilates dissimilaria</i>	<i>Hüb.</i>
<i>Arctia Phalerata</i>	<i>Harr.</i>	<i>Asopia costalis</i>	<i>Fabr.</i>

LEPIDOPTERA—CONTINUED.

<i>Asopia olinalis</i> <i>Guen.</i>	<i>Tortrix incertana</i> <i>Clem.</i>
<i>Asopia farinalis</i> <i>Linn.</i>	<i>Anaphora agrotipennella</i> <i>Clem.</i>
<i>Tetralopa</i> N. sp.....	<i>Gelechia roseosuffusella</i> <i>Clem.</i>
<i>Phoxopterus angulifasciana</i> <i>Zell.</i>	

COLEOPTERA.

<i>Hylastes trifolii</i> <i>Müller.</i>
(Larva in roots)
<i>Lenguria Mozardi</i> <i>Fabr.</i>
(Larva in stem.)
<i>Graphorrhinus vadosus</i> <i>Say.</i>
(Imago on leaves.)

DIPTERA.

<i>Cecidomyia leguminicola</i> <i>Lintn.</i>
(Larva on seeds.)
<i>Cecidomyia trifolii</i> <i>Loew.</i>
(Larva on leaves.)
<i>Oscinis trifolii</i> <i>Burgess.</i>
(Larva on stem.)

ORTHOPTERA.—(ALL ON LEAVES.)

<i>Caloptenus femur-rubrum</i> <i>De Geer.</i>	<i>Caloptenus bivittatus</i> <i>Say.</i>
<i>Caloptenus spretus</i> <i>Thomas.</i>	<i>Caloptenus atlanis</i> <i>Riley.</i>
<i>Caloptenus differentialis</i> <i>Thomas.</i>	

HOMOPTERA.

<i>Pemphigus lepidii</i> <i>Riley, M. S.</i>	<i>Thrips</i> sp..... <i>Welsh.</i>
(On roots.)	(On blossoms.)

The following additional species are added on page 206:

LEPIDOPTERA.

Nephelodes violans, Guenée, *Riley*, 1st Report, N. Y. St. Ent., 1882. p. 103.

Plusia brassicæ, *Riley*, Id Gen. Ind. Suppl. Mo. Repts., p. 78.

Heliothis armiger, *Hüb.*, Barret Ent. Month Mag, XIV., p. 151.

Enpithecia interruptofasciata, *Pack.*, Coquillet, *Papilio* I., p. 57.

Ephestia interpunctella (*Hüb.*) *Clemens*, Proc. A. N. S. Ph. 1860, p. 206.

Dichelia sulfureana. (*Clem.*) Comstock Report Comm. Agr. 1880, p. 255.

Amphisa discopunctana, (*Clem.*) Comstock Report Comm. Agr. 1880, p. 258.

Platynota flavedana, (*Clem.*) Comstock Report Comm. Agr. 1880, p. 257.

Sericoris instrutana, (*Clem.*) Comstock Report Comm. Agr. 1880, p. 258.

Grapholitha interstinctana, (*Clem.*) Comstock Report Comm. Agr. 1880, p. 254.

COLEOPTERA.

- Lachnosterna serricornis*, *Le Conte.*, Webster Am. Nat., XVI., p. 746.
Colaspis brunnea, *Fab.*, Webster Am. Nat., XVI., p. 746.
Diabrotica longicornis, (*Say*) Forbes' 12th Rept. Ins. Ill., pp. 21, 23.
Diabrotica 12-punctata, (*Oliv.*) Forbes' 12th Rept. Ins. Ill., p. 104.
Tenebrio Molitor, *Fitch*, Fitch Trans. N. Y. St. Ag. Soc., XIII., p. 376.
Macrobasis unicolor, (*Kirby*) Webster Am. Nat., XVI., p. 746.
Epicærus imbricatus, (*Say*) Webster Am. Nat., p. 746.
Sitones lineellus, (*Gyllenhal*) European authors.
Sitones flavescens, (*Marsh*) European authors, (Kalt et al.).
Phytonomus punctatus, (*Fab.*) Riley Am. Nat. XV., p. 750.

HEMIPTERA.

- Poecilopsus lineatus*, (*Fab.*) Lintner 1st Rep., N. Y. St. Ent., p. 277.
Limothrips tritici, (*Fitch*) Lintner 1st and 2d Repts. Ins. N. Y., p. 304.

NEUROPTERA.

- Smynturus hortensis*, (*Fitch*) Fitch 6th-9th Repts. Ins. N. Y., p. 189.
Smynturus arvalis, (*Fitch*) Fitch 6th-9th Repts. Ins. N. Y., p. 191.

The following species are mentioned by Prof. S. A. Forbes in Entomological Report of Illinois, Vol. 14, pp. 72-74:

LEPIDOPTERA.

<i>Cymatophora crepuscularia</i> ,..... <i>Tr.</i>	<i>Tortrix pallorana</i> <i>Robb.</i>
<i>Hæmatopis grataria</i> <i>Fab.</i>	<i>Hypena scabra</i> <i>Fabr.</i>
<i>Cacæcia rosaceana</i> <i>Harr.</i>	

HOMOPTERA.

- Coccus trifolii*.....*Forbes.*

ACARINA—MITES.

- Bryobia pratensis*.....*Garman.* | *Bryobia pallida*.....*Garman.*

To these I would add two other coccids which I have observed on clover.

- Pulvinaria innumerabilis*.....*Rath.* | *Lecanium tiliaë*.....*Fitch.*

Strecker in his catalogue of N. A. Mac. Lipidoptera gives *Meganastoma cæsonia*, Stroll as feeding on clover. While in Rep. Comm. Ag. 1863, p. 573, and in 1865, p. 40, *Epicæ fallax* is mentioned as a clover enemy.

It is more than probable that others of the butterflies, especially of the genera *Colias*, *Melitæa* and *Lycæna*, will be found upon further investigation to feed upon our clover; while it is not at all probable that the fourteen species of beetles named in the list comprises all the enemies of the clover belonging to that order. There is but little doubt that the list will be doubled. Of the Orthoptera (Locusts) but five are named, and they all of the genus *Caloptenus*. It is quite certain that all of our many species of that genus, and nearly all others, may be justly included in the list. Only one unnamed species of Thrips is mentioned. The past season I have found three species, one black, one light yellow, and one bright red, all to be very abundant on the clover blossoms, yet I could not see that they were greatly injurious.

Many of the insects named in the above list feed more generally on other plants. *Mamestra picta* prefers the cabbage, *Heliothis armiger* feeds on the corn and cotton, *Leucania unipuncta*—the army worm—on oats and the grasses, so that for the most part they are not serious enemies to our most valuable forage plant. One of the insects named in the list, *Asopia costalis*, feeds on the dry clover, either in the stack or mow, where it often does very great injury.

As our space will not permit a detailed description of all of the above only those whose mischief is so considerable as to create concern for the future of one of our most valued farm crops will be described. These work on the roots, foliage, and seed, and will be described in that order.

Hylastes trifolii, Clover-root Borer.

Order Coleoptera. Family Scolytidæ.

Müller, Mem. Soc. Dep. Mt. Tonnerre I., pp. 47-64, 1807.

Schmitt, Stett Ent. Zeit. V., pp. 389-397, 1844.

Lintner, Ann. Rep. N. Y. St. Agr. Soc., 1879, pp. 41-42, Ill.

Lintner, Rep. N. Y. Ag. Soc., 1882, p. 193, Ill.

Riley, Ann. Rep. Comm. Agr. 1878, pp. 248-250, Ill.

Riley, Am. Entomol., Vol. III., p. 180, 1880, Ill.

Saunders, Ont. En. Rep., Vol. XII., p. 43, 1881, Ill.

This insect has long been known as a not very common insect of Germany in Europe. Müller, as shown by the name, regarded it as an enemy of the clover, while Schmitt thought that it attacked such plants as were already enfeebled, and was not a serious injury. In 1878 the beetle attacked this valuable plant in northwestern New York, and the fact that it injured very seriously the clover of that region proves that Müller was correct and Schmitt wrong.

Prof. Riley investigated the habits of the insect, which he found very destructive to the clover in Yates, Ontario and Seneca counties. He described it under the name *Hylesinus trifolii*, or Clover-root Borer, and pointed out the fact that it is much like one of our common bark beetles, *Hylesinus opaculus* Lec., which is often found just under the bark of ash and elm trees. While much like the elm bark beetle, it is not only a different species, but is placed in a different genus,—*Hylastes* by Leconte and Horn, and by European Coleopterists.



FIG. 138.

The insect is well represented in Fig. 138, *a* showing the affected plant, *b* the grub or larva, *c* the pupa, and *d* the beetle or imago. The eggs are whitish oval, the larva white, with yellow head. The length of larva is 3 m m (.12 of an inch) in

The family to which it belongs, Scolytidæ, is represented by numerous species, usually called bark beetles, as they tunnel and sculpture various evergreen and deciduous trees just beneath the bark. It is often stated that they attack enfeebled trees, yet I have often found them industrious and thriving on trees which were in full strength and vigor.

The insect is well represented in Fig. 138, *a* showing the affected plant, *b* the grub or larva, *c* the pupa, and *d* the beetle or imago. The eggs are whitish oval, the larva white, with yellow head.

length. The pupa is ⁽²⁾22 m m long and has two spinous projections on the top of the head, and two smaller anal projections. The imago is black, with brown punctured elytra. It is 2 m m (.08 of an inch) long.

The beetle hibernates, usually as an imago, but also as a pupa or larva. Mating occurs in early spring, when the female bores into the crown of the plant and deposits five or six eggs. When these hatch the larva feeds at first in the opening formed by the imago for her eggs, but soon works downward forming tunnels lengthwise of the main roots, which entirely destroys the plant.

In September many pupæ will be found in the upper part of the galleries.

Although as yet this beetle has not been found doing damages in the United States outside a limited area in New York, it is too much to hope that this will continue to be true. Surely such enterprise as would carry the insect from Europe to America can hardly be expected to permit it to remain stationary on this continent. The fact that it has no parasites, as yet discovered, to weaken its efforts or reduce its numbers, not only accounts for its exceeding numbers in this country as compared with Europe, but also gives prophecy of wide extension and serious ravages in the future.

It is difficult to suggest satisfactory remedies for insects which are so numerous and scattered as are these beetles. It is probable, in fact the experience in New York already confirms the suggestion, that they will not be equally destructive every year; that while they may ruin whole fields one season the very next year they may be quite rare and far less injurious. The only remedy thus far suggested is to plow the clover under when the insects are discovered to be at work, and not grow clover for a time. This green manuring would certainly be very excellent for the land. Yet it is to be feared that the insects would take to other herbage, possibly other leguminous plants, rather than

perish. This supposition seems more probable in that this species has varied so far in its habits from those of its near congeners, which are all bark or wood eaters so far as I know. It is quite probable that summer plowing, followed by thorough harrowing, might destroy the insects at work in the clover. If such were the case it certainly would be a wise proceeding.

Prof. I. P. Roberts says: "In Central New York, of late years, we mow the seeded land but once and pasture in the fall the abundant second growth. Since 1878 the clover-root beetle has worked upon the clover to such an extent that it invariably fails the second year. This has caused us to change from a five to a four year rotation, viz.: hay, corn, oats and wheat."

Languria Mozardi, Fabr., Clover-stem Borer.

Order Coleoptera: Family Erotylidae.

Latreille, Gen. Crust. et Ins. III., p. 66, 1807.

Say, Am. Entomology, III., 1828, III.

Lamarck, An. sans vert., deux. edit. IV., p. 486, 1835.

Melsheimer, Cat. Coleop. U. S., p. 47, 1853.

Le Conte, Proc. Acad. Nat. Sci. Phil. VII., p. 161, 1854.

Oliver, Entomol. V. p. 464, III.

Crotch, Trans. Am. Ent. Soc. IV. p. 350, 1873.

Le Baron, 4th Ann. Rept. Ins. III. p. 181, 1874.

Comstock, Ann. Rept. Comm. Ag. 1879, p. 199, III. 1880.

Saunders, Ont. En. Rep. Vol. XII. p. 44, 1881, III.

Lintner, Ann. Rep. N. Y. Ag. Soc., 1882, p. 196, III.

The clover-stem borer, though not very common, is widely distributed throughout the country. It is found in Michigan, Canada, New York, and south to Washington and west to Kansas. Indeed it is mentioned as far south as Louisiana. Prof. J. H. Comstock was the first to discover and describe its full life history. Though not as yet known to be a serious pest, from its wide distribution we may suggest that it does more harm than is suspected, as a great many plants in a clover field could be destroyed and yet not be missed. Even though not as yet alarmingly injurious we cannot tell when it may become so. In its

distribution the seeds of mischief are wide scattered, no knowing when they may germinate.

Fig. 139 shows the eggs, larva, pupa and imago of the insect as well as the natural size of eggs and the larva—the latter as it appears in the hollowed stem of the clover. The eggs are yellow, curved,



FIG. 139.

and 1.7 m m (about 1-16 of an inch) long. The larvæ like wire worms, and many other grubs, are slim, with the three pair of jointed legs well developed, and a pair of anal pro-legs. When full grown the yellow larva is 8 m m (a little more than .3 of an inch) long. Like the pupa it has two plainly marked anal spines. The pupa is also yellow and slender, and 6 m m long. I find Say's description of the imago, as usual, very exact: "It is slender, cylindrical; the dark red antennæ gradually form a club of five joints. The palpi are thread-like; the mandibles bifid at tip; the maxillæ have horny teeth. The thorax is yellowish-red, smooth and unspotted. The elytra are bluish-black, with a green tinge, marked with deeply impressed punctures, arranged in regular series, but without impressed striæ. The thighs are pale rufous at base; the tibiæ have a slight rufous tinge; the tarsi are dotted with dense hairs beneath the three basal joints, the 3d being bilobate." The venter has the three posterior joints black. The length of the beetle is about 7 m m ($\frac{1}{4}$ of an inch).

The female lays the eggs in June, piercing the stem with her jaws, and pushing her eggs clear in to the pith, often, says Prof. Comstock, to a depth of 6 m m. The larvæ feed upon the pith downward, forming a burrow 15 c m (6 inches) long. This greatly injures if it does not kill the plant outright. The pupa is formed at the bottom of the burrow in August, and shortly

after the fully developed beetles begin to appear. They are seen to emerge from the hollowed stems from August to October. There is only one brood a year. Like many of our noxious beetles, the imago hibernates and waits for the vigorous plants of genial June before dropping her precious burden of eggs.

If this pest promises to do any serious harm we have only to cut the clover early in July, when we shall save the crop, and probably destroy the insects. This would give chance for a second crop of hay or fine pasture or crop of seed from the same plants. It is a welcome fact that Prof. Comstock found two parasites working on these beetles, in such abundance that we understand why the latter are no more numerous and destructive. One a Chalcid and the other an Ichneumon fly.

Phytonomus punctatus, Fabr., Clover Leaf Beetle.

Order Coleoptera. Family Curculionidae.

Le Conte, Rhyncophora, p. 124, 1853.

Riley, Am. Naturalist, Vol. XV., p. 912, Nov., 1881, III.

Riley, Rep. Comm. Ag. 1881-82, p. 171, III.

Kilman, 15th Rep. Ont. En. Soc., 1884, p. 32.

This, like many of our most destructive insects, is an imported species. It is a common insect in Germany, and has probably been in this country for years, as Dr. LeConte received it from Canada in 1853, when he described it as *Phy. opimus*. As it does not exist in collections of American Coleopterists, it is possible that the insect described by Dr. LeConte by mistake was reported as Canadian, it really being itself foreign. In 1881 a serious invasion of Western New York, Yates county, was experienced, when Dr. Riley, of the Agricultural Department, investigated and gave a detailed description of the species, including its work and habits. It is worthy of remark that *Phytonomus nigrirostris*, also imported, exists in the United States, and doubtless works as a larva on the clover, as it is known to do in Europe. I have taken this species in considerable numbers along on our Western Michigan lake shore.

Dr. Riley records this insect as very destructive in New York in 1881, and again in 1882. Mr. A. H. Kilman, of Ontario, reports this same weevil at Ridgeway, in that province. He says they were wafted across the lake by a strong August wind. He says that Eastern New York was desolated by the insect in 1883, but that the insect in that year proceeded no further west than Rochester. August 10, 1884, they were so abundant in Buffalo that they could be gathered by the quart, and thousands were crushed by persons walking on the pavement.

As entomologists know, these weevils are armor proof against water, we can easily see how this destructive insect can be easily and quickly distributed along the shores of the northern lakes, and thus soon become a widely known and greatly dreaded pest.

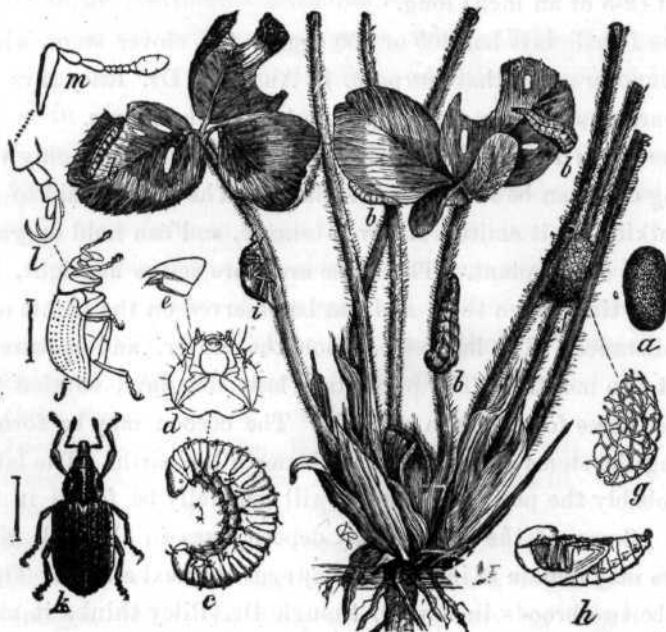


FIG. 140.

Fig. 140 gives a good idea of the insect and its work; *a*, egg; *b b b b*, larvæ; *c*, recently hatched larva; *d*, head of larva; *e*,

jaws; *f*, cocoon; *g*, meshes of cocoon; *h*, pupa; *i*, weevil natural size; *j*, side view; *k*, dorsal view; *l*, tarsus and claws of beetle; *m*, antenna.

The eggs are oblong, oval, yellow, 1 m m (1-25 of an inch) long. The larva is yellowish at first, but becomes greenish-yellow with age. There is a pale rose colored dorsal line. The body is rough, length 14 m m (.65 inch). The pupa is well shown in figure and is greenish with yellow markings. It pupates in an oval yellow cocoon of coarse threads.

The imago is dark brown; sides of thorax and elytra dull yellow, with a central yellow line on the thorax. There are rows of black raised points along the inner half of the elytra, with similar dashes of muddy yellow towards the tips. The beetle is 1 c m (2-5 of an inch) long.

The female lays her 200 or 300 eggs in the clover stem, which she punctures for that purpose, in August. Dr. Riley says the eggs are pushed into crevices at the base of the plants.

The larva usually drops when approached, so that only very young ones can be found on the plants. The anus is said to aid in walking, as it emits a sticky substance, and can hold or grasp the stem of the plant. The larvæ are more active at night, but are very timid even then, and can be observed on the plants only at a distance. The larvæ feed upon the clover, and mature in about two months. The pupa state lasts ten days, so that the beetles come forth late in autumn. The cocoon may be formed among the stems of clover or just beneath the earth. The latter is probably the position where it will generally be found in the field. Some of the weevils may deposit eggs in the fall, while others may remain as imagos and lay eggs the next season. There may be two broods in a year, though Dr. Riley thinks it more likely that there is but one, and that variation in size and time of appearance is caused by retarded or accelerated development; while the larva does no inconsiderable damage, far the most is

done by the mature beetle. The weevils are voracious eaters, consuming every part of the plant above the earth, and like most weevils feeding by night and hiding by day in crevices in the earth or among the stems of the plants. Like the larvæ they are very timid, and fall at the slightest jar of the plants. It feeds on all kinds of clover, red, white, and alsike. The beetles in July and August often do very serious damage, completing the work of destruction so well begun by the larvæ at an earlier date.

Dr. Riley expresses an opinion, possibly born of hope, that this insect will not spread. I have already shown how it may easily be carried far west, and as we already have seen, it surely is spreading quite rapidly, there is grave reason to fear its general spread in the Northern United States.

As we can not well use Paris green, it is probable that no better thing can be done than to plow under the clover in fields attacked in May, at which time the insects will be in the larva state, and so probably killed by this treatment. If we wait to cut for hay many of the insects would have already pupated, and so would come forth to new mischief the next year.

It is probable that the various predaceous insects will aid to diminish the numbers of this pest, and in time the parasitic insects here as well as in Europe will help to hold it in check.

Cecidomyia trifolii, Leow, Clover-leaf Midge.

Order Diptera. Family Cecidomyiidae.

Loew Verhandl. Zool. Bot., Gesell., XX., 14, p. 142, 1874.

Comstock Ann. Rept. Comm. Ag., 1879, pp. 197-199, III.

Lintner Rept. N. Y. Ag. Soc. 1882, p. 203, III.

Saunders Rept. Ontario En. Soc., Vol. XII., p. 45, 1881, III.

This insect is so nearly like the far more destructive clover leaf midge, yet to be described, that only an expert could distinguish them the one from the other. This species has only been discovered about Washington, and unless it becomes more widely distributed, or worse still, learns the habit of its near

congener, which is doing widespread and most serious harm, it will be of minor economic importance.

As will be noticed it is closely related to the well-known Hessian fly and wheat midge, so destructive to the wheat crop.

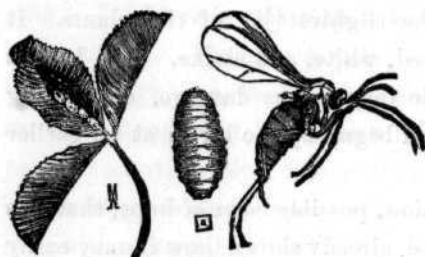


FIG. 141.

Fig. 141 shows the clover leaf concealing the larvæ; one leaf spread open exhibits the cocoons of the insect, the larva and midge or fly. The maggots are folded in the leaflets of the

clover, and are at first white, but later assume an orange hue. When full grown this footless larva is 1.5 mm (.059 of an inch) long. The pupæ are enclosed in white delicate cocoons, fastened between the sides of the folded leaflets. See fig. The color of pupa is pale orange. Eyes dark, folded appendages brown. The fly is brown in color with yellowish hairs on the thorax. The female is 1.6 mm long, the male a little shorter. Except that the fly is a little smaller, and that the female has fourteen instead of sixteen joints to the antennæ, it is almost exactly like the clover seed midge, which will be more fully described and illustrated as its importance demands. The minute eggs, from two to twenty, are laid in the creases of the leaflets either of the red or white clover. In June the larva absorbs the juices of the leaflet, causing it to turn brown and to become slightly thickened, showing the tendency to form galls, which is peculiar to many Cecidomyian maggots. The irritation causes the leaflets to fold, thus forming a safe domicile for the defenceless larvæ. Late in June or early in July the flies come forth.

From the exposed condition of this insect it is very likely to become the prey of parasitic insects, and so never become very numerous. Even in considerable numbers it does no very se-

rious harm, and unless it change its habits will never be a serious pest. We hardly need then to discuss remedies for its ravages.

Oscinis trifolii Burgess. Clover-leaf Oscinis.

Order Diptera. Family Oscinidae.

Burgess, Ann. Rept. Comm. Agrl. 1879, p. 201.

Comstock, Ibid, pp. 200, 201.

Lintner, Rept. N. Y. Ag. Soc. 1882, p. 205.

Fitch described a species of this genus, *O. tibialis*, which attacks the wheat stem. See Fitch's Rept., 1st and 2d, p. 300, and for illustration Pl. 1, Fig. 5th. Dr. Riley describes *Oscinis brassicæ*, which attacks the cabbage, Rept. Comm. Ag. 1884, p. 322, which is fully illustrated Pl. VIII., Fig. 5th, which cut would answer in a general way for the Clover Leaf Oscinis. There are several European species which give our friends over the sea some anxiety.

The clover Oscinis is quite like our *Anthomyia* in habits and general appearance. The eggs are very small and white. The larvæ greenish-white, slender, tapering towards the head. They are 1.7 m m long. The puparium is shorter, oblong, and of a brown color. The fly is yellow, with the dorsal surface of its abdomen and thorax black. It is quite hairy. The length is 1.3 m m, about .05 of an inch. The eggs are probably laid in May or in early June. The larva mines the leaves and stems of white clover, possibly red as well, much as the radish maggot gouges out the plant on which it feeds. Late in June the maggot crawls from its tunnels and falls to the earth, which it enters to form the puparium. The flies appear about two weeks later. There are two and may be three broods a season. If these little sappers and miners ever become so numerous as to do serious injury we will have to resort to feeding our clover down and use ensilage for winter.

Tortrix Sulfureana Clem. Clover (attacks grass). Tortrix flavedana Clem. Sericoris instrutana, Clem. Leaf rollers.

Order Lepidoptera. Family Tortricidae.

Forbes, Ill. En. Report, Vol. XIV., p. 17.

Comstock, Rept. Comm. Agr. 1880, pp. 255-258.

These insects, which are closely related to the codling moth and the apple tree leaf rollers; which are so harmful to our orchards in early summer, are all found in Michigan and the other Northern States, and South even to the Gulf. While they attack all the clovers they are not confined to them, but work on many other garden and field plants. In all the species the larvæ draw the leaves about them by means of silken threads, which they spin, and when disturbed drop and hang suspended by means of a thread, which, like a spider, they can spin as needed. A more harmful leaf roller attacks the clover seed, and will be described later.

The larva of the first species is yellowish-green, the second green, the third yellow. The larvæ are about $\frac{1}{2}$ of an inch (12 to 14 m m) long. The pupæ are shorter and brown in color. The moth of the first species is bright yellow, with a y-shaped purple mark on each front wing. The same color marks the front and outer margins of the same wings. The back, or secondary wings, are yellowish, varying to brown. It expands a little more than $\frac{1}{2}$ of an inch. The second species is a little larger. The males are dark brown, with reddish-yellow markings. Hind wings reddish. Females red, with oblique obscure bands across front wings. Females expand $\frac{3}{4}$ of an inch. The males are not quite so large. The color of the moth in the third species varies from yellow to yellowish-brown. It is about the size of the sulfureana.

These are seen feeding on the rolled up leaves, which serves both for home and food in May and June, and again in August, so there are two broods a year.

I have found Paris green sure death to orchard and shade tree leaf rollers, and without doubt it would kill these that infest the clover. Its practicality however in this case is not so apparent. It is to be hoped that parasites and other enemies will prevent these leaf rollers from becoming very serious pests.

Without doubt other Tortricids will be found to attack the clover, but as all are so nearly alike in their character and habits, what has been said will apply in a general way to all of them.

Drasteria erectea Cram. Clover Drasteria.

Order Lepidoptera. Family Noctuidæ.

Saunders, Ont. En. Report, 1881, p. 47, Ill.

Saunders, Ont. En. Report, 1875, p. 36, Ill.

French, Ill. En. Rep., Vol. VII., p. 133, Ill.

Coquillett, Ill. En. Rep., Vol. X., p. 148.

Packard, Guide to Study of Insects, p. 317.

This is as common as any moth in Michigan, and the same is true in many other States. The familiar, short, jerky flight reminding us of the tiger beetles, is seen from early spring till late autumn. Though so common, and though with slight exception (it sometimes feeds on grass) the caterpillars feed exclusively on clover, yet I think the insect is not considered a foe to be dreaded. It may be that in case of crops like the clover, where plants are numbered by the million, we suffer more from insect attack than we know.

The larva is reddish-brown, marked with longitudinal lines of dark, white and pink color. When full grown it is 3 cm (1¼ inches) long. There are only three pairs of pro legs, so the caterpillar, like others of the lower Noctuids, is a geometer, or "measuring worm." It spins a loose cocoon, in which, as also in its gait, it reminds us of the true geometers. The moth is well represented in the figure. The fore wings are dusky-brown, with darker bands crossing them,



FIG. 142.

one near the base, and another, sometimes incomplete, midway between this and the outer margin, near the apex, is a quite dark patch. Dashes of dull brown are scattered along the wing. The moth expands nearly 3 c m ($1\frac{1}{4}$ inches).

The caterpillars will be seen feeding on the clover all the summer long, and at the same time the moths may be started on their short journeys as we walk over the clover fields.

Colias Philodice. Common Yellow Butterfly.

Order Lepidoptera. Family Papilionedæ.

Saunders, Ont. En. Report, 1881 p. 47, Ill.

French, Ill. En. Report, Vol. VII., p. 147.

Packard, Guide to Study of Insects, p. 250.

What was said of the abundance of the Clover Drasteria is even more applicable to our yellow butterfly. Few insects are more common, more widely distributed, or better known than the sulphur-yellow butterfly which gladdens the pasture and roadside, and flecks the damp places along the roadways of all our Northern States. What was said of the food, habits, and destructiveness of the *Drasteria erechtea* can also be said as truly of *Colias philodice*.



FIG. 143

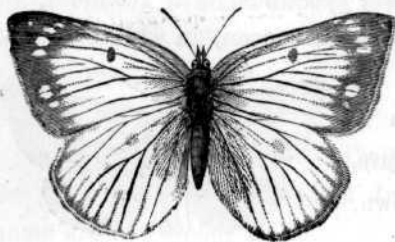


FIG. 143

Fig. 143 shows the male and female of this familiar butterfly. The eggs are long, tapering, ribbed, and though yellow at first change as the embryo develops, first to red and then to brown, just prior to hatching.

The young larva is brown with a yellowish tinge. Later it changes to green. The green head has a yellowish-white stripe on each side, with a dash of red at the lower edge. The body is

hairy, and when full grown the caterpillar is 2.5 c m, or one inch, long. The chrysalis, like that of our cabbage butterfly, *Pieris rapæ*, which it resembles, is suspended by an anal tuft and a shoulder girdle. It is pale green, tinted with yellow. On each side of the head is a dark red line, and yellow stripes are seen on the sides near the tip. The yellow, occasionally very nearly white, butterflies with wings bordered with black, sometimes gray, black, or brown are well shown in the figure. The border is narrower in the male, and encloses yellow spots in the female. A black spot is seen on the front wings of both sexes. The secondary wings are bordered with dark in both sexes, and bear an orange spot. The antennae and fringe to the wings are pink. The body is black above and paler below. The size is given in the figure.

The eggs are laid in May and August on the clover, and other leguminous plants, as peas, etc. The caterpillars are feeding from four to six weeks. The chrysalids are fastened to clover or other object, and last about twelve days. The butterflies swarm in May and again in July and August, when they are often so thick as to remind us of a snow storm.

What was said of damages and remedies in considering the last insect applies as well to this one.

Insects Attacking Clover Seed.—While the damage done to clover by some of the insects already described, especially the borers, is quite serious at times, the danger from those attacking the seed is still more formidable, and may well cause anxiety. Happily the number in this list is very limited.

***Cecidomyia leguminicola*, Lint. Clover Seed Midge.**

Order Diptera. Family Cecidomyiidae.

Lintner, *Canad. Entomol.*, XI., p. 44, pp. 121-124, 1879.

Lintner, *Rept. N. Y. Ag. Soc.*, 1878, pp. 62-64.

Lintner, *Rept. In. In.*, 1878, pp. 4-6.

Lintner, *Rept. N. Y. Ag. Soc.*, 1880, pp. 37-41.

Lintner, *Rept. Ent. Soc., Ont.*, 1879, pp. 28-30.

Lintner, *N. Y. Ag. Soc.*, 1882, p. 198, Ill.

Riley, Ann. Rept. Comm. Ag., 1878, pp. 250-252, III.

Riley, Ann. Rept. Comm. Ag., 1884, p. 411.

Comstock, Ann. Rept. Comm. Ag., 879, pp. 193-197.

Saunders, Rept. Ont. En. Soc., 1881, p. 38, III.

This is not only one of the most alarming of our clover pests, but may be regarded as one of the most to be dreaded insects now infesting the valuable crops of the United States. It not only does very serious damage, but is spreading with great rapidity. Prof. Lintner first discovered it in a limited area in Eastern New York. Now—1885—it is known to exist in Virginia, Pennsylvania, New Jersey, Ontario, Michigan, and all through New York. The fact that the insect may remain in the seed, and thus be carried with it any distance, adds to the

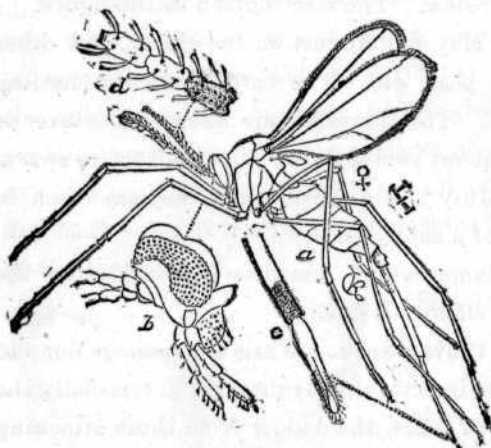


FIG. 144.

dangers threatened by this comparatively new pest.

Fig. 144 *a* shows the female midge, ovipositor extended; *c*, ovipositor more magnified; *b*, head more enlarged; *d* shows greater enlargement of three joints of antennæ.

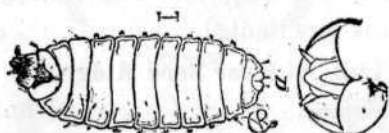


FIG. 145.

Fig. 145 *a* shows maggot or larva; *b*, head more magnified.

The eggs are oval, pale yellow, and only .025 m m (.01 of an inch) long.

The larva or maggot varies from white to dark orange or orange-red. It is when full grown 2 m m (1-12 inch) long.

The pupa is orange, with brown eyes. It is found in a tough silken cocoon with more or less earth sticking to it,

As will be seen by the figures the flies resemble closely the wheat midge, *C. tritici*. The abdomen is red, thorax brownish-red. The antennæ are 15-jointed in the male, and 16 in the female. The wings are hairy, the palpi and ovispositor each four jointed. The male is about 1.5 m m long, the female about 3 m m. The male expands about 3.5 m m, the female 4 m m. The size varies a little. The dark scales obscure the red color, so that the flies appear dark. Underneath the color is yellowish-gray. As with the wheat midge and Hessian fly the ovispositor and clasping organs are very prominent.

The eggs are pushed, by means of the ovipositor, down into the heads of red or white clover, and lodged between the hairs that surround the separate florets. They are not glued nor placed in the florets. As with the Hessian fly the eggs may be laid singly, or in groups of two, three, four or five. As many as 50 eggs are sometimes placed in a single head of clover.

The larva affects each seed much as does the wheat midge each wheat kernel.

After absorbing the life from the seed the larva, like the maggot of the wheat midge, leaves the seed and wriggles till it escapes from the clover head and falls to the earth. Often the head of clover seems alive as a maggot pushes from nearly every seed in its effort to reach the ground. The pupa is found in its cocoon just beneath or upon the earth, under some protecting leaf, etc. The flies have been seen in New York in May, August, and quite likely some flies may issue in October. Thus there are surely two broods in New York, and possibly three. There are certainly three farther South. The larvæ will be seen full grown in the seed at the North in May, in July, and again in September. They probably pass the winter as pupæ.

Of late the larvæ have been found in seed in the market.

This is an unwelcome fact, and explains the rapid distribution of these insects.

The only remedy suggested is deep plowing when the larvæ are yet only partly grown. It has been suggested that abandoning clover for a time might be wise. That this will suffice is hardly to be expected. There is enough wild clover to prevent the extermination or any great diminution of these insects. We can hope more from parasites. Already Mr. Howard finds *Eurytoma funebris* and *Platygaster error* engaged in this good work. Success to them, and may their tribe increase.

If seed is found stocked with the larvæ it should be put into a close vessel, as a jug or barrel, and bisulphide of carbon added. This will kill all the larvæ post haste. Even an open barrel, water tight, may be used by placing a buffalo robe, or other air-tight cover, over it. The fact that this insect is as far West as Michigan, and possibly as far as Illinois, makes it a matter of general interest. In the future, clover seed will be valuable.

***Grapholitha interstinctana*, Clem. Clover-seed Caterpillar.**

Order Lepidoptera. Family Tortricidae.

Comstock, Rept. Conn. Agr. 1880, p. 254.

Clemens, Proceed. Acad. Nat. Sci. Phil. 1860, p. 351.

Grote, Bull. Buffalo Soc. Vol. I., p. 92.

These caterpillars are also quite widely distributed. Grote and Comstock have taken them in New York, Grote in Pennsylvania, Comstock in Washington, and I have found them quite common in Michigan. A single larva feeds on several and often all the seeds of a single head of clover. Sometimes I would find two larvæ in a single head. The insect was quite common about Lansing last summer—1885

The larvæ are dirty white, often greenish, 8 m m long, and spin white cocoons in the clover heads. The bodies bear many white hairs.

Chrysalis light brown; 5 m m long. The anal segment bears six hooks, two dorsal, four lateral. The moths are small, brown, often nearly black, with white lines and dots marking the wings. They expand 10 m m.

The moths lay the eggs in May and August. The larvæ are feeding in June, and probably a second brood in September. The moths are easily caught in the clover fields in May and August.

By cutting the crop early we might destroy the larvæ, though I should fear we would not. Remedies for this and the midge would be about the same. An Ichneumon parasite was found preying on these by Prof. Comstock. It is *Phanerotoma tibialis*. It is light brown, with a large dorsal yellow spot, and is 3.5 m m long.

Insects Attacking Clover Hay. *Asopia costalis*, Fabr. Clover Hay-worm.

Order Lepidoptera. Family Pyralidæ.

Riley, Mo. Ent. Rept. Vol. VI., p. 102, Ill.

Saunders, Ont. Ent. Rep. 1880, p. 45, Ill.

French, Ill. Ent. Rep., Vol. VII., p. 47.

This insect works on dried clover or clover hay while in the mow or stack. It is generally distributed, and scarcely a season goes by that I do not receive specimens, with request for information regarding the natural history and habits of the insect. This belongs to the same family as the bee moth and the meal moth, *Pyralis farinalis*, Harr., which is often very common about barns where meal is stored, and which sometimes also feeds on clover hay.

The color of the larva, Fig. 146, is dark brown, lighter beneath. The intersegmental spaces are darker than the segments, which makes the larvæ appear to be ringed. It is 18 m m ($\frac{3}{4}$ of an inch) long. The cocoon is white, and 12 m m long. The chrysalis is yellow in color; length $\frac{1}{2}$ of an inch. The imago, or moth,

is purple, with a silken lustre. There are two bright yellow spots on the primary wings. The posterior wings are lighter in color than the primaries. All the wings are margined with orange, which terminates with a glossy yellow fringe. They expand about 2 c m., or .8 of an inch.

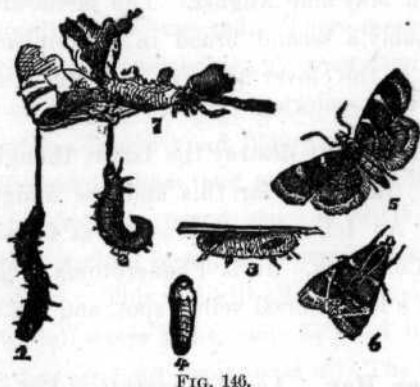


FIG. 146.

In Fig. 146, 1 and 2 shows the larvæ suspended by threads; 3 represents the cocoon; 4 the chrysalis; 5 moth with wings spread; 6 moth at rest; and 7 larva concealed in a case of silk which it has spun.

These moths are attracted by lights, and are often seen about our lamps in mid-summer. The eggs are laid on clover. The larvæ work in a silken case, and so often fairly mat the hay in one great mass. The larvæ attract attention in summer working upon the hay, but more usually in February and March, when stacks and mows of clover may be fairly alive with larvæ. These often crawl far into the stacks, where they are protected from cold, and so are sometimes said to bear a zero temperature without becoming dormant, though the truth is they have had a warm nest. I have seen them drop from a mow suspended by a silken thread, so thousands could be swept away by one stroke of a rake. They often leave stack or mow and seek some concealed place in which to pupate.

It is probably true that leaving clover hay in mow or stack year after year will promote the rapid increase of these pests. Feeding out all the hay each winter would be a wise precaution, or if any hay is to remain over let it be other than clover.

Of the many other species mentioned at the beginning of this article none are as yet sufficiently important to demand full de-

scription, Most work as much if not more on other plants. Some are very rare insects, and others, though common, seem not to attract any general attention by their presence.

Insects Injurious to Grass Crops.—The insects which are known to attack our grasses make even a more formidable list than those injurious to the clovers. Eighty or more species either depend wholly or in part upon our grasses for food. In the following list Hy. after the name indicates that the insect belongs to the order Hymenoptera; Lep., Lepidoptera; Dip., Diptera; Col., Coleoptera; Hom., Homoptera; Hem., Hemeptera; Or., Orthoptera. Ill. refers to Ill. Entomological Reports; Mo. to Missouri Entomological Reports; U. S. Reports, U. S. Commissioner of Agriculture; Harr., Harris Injurious Insects; Ont., Ontario Entomological Report; Pack., Packard's Guide to the Study of Insects; Streck., Strecker's Catalogue of Macrolepidoptera; Fitch, Fitch's N. Y. Reports:

Acridium Americanum, Drury, *Or.*, Ill., Vol. IX., p. 129. *Mc.*, Vol. VIII., p. 103, Ill.

Agonoderus, all of the species, *Col. Ill.*, Vol. XII., p. 111.

Agrotis c. nigrum, Linn, *Lep.*, Ill. Vol. VII., pp. 89, 202. *Ibid.* Vol. X., p. 132.

Agrotis fennica, Tausch, *Lep.*, Rep. Mich. St. Board Ag. 1883, p. 423. *Ont.* Vol. XV., 1884, pp. 13, 15, 21, 24. *Mich. Hort. Rep.* 1884, p. 81.

Agrotis saucia, Hüb., *Lep.*, Ill. Vol. VII., pp. 94, 211. *Ibid.* Vol. X., p. 134. *Mo.*, Vol. I., p. 74. *U. S.* 1884, p. 297, Ill. *Harr.*, p. 444.

Agrotis tessellata, Harr., *Lep.*, Ill. Vol. VII., pp. 91, 206. *Ibid.* Vol. X., p. 133. *Harr.*, p. 445. *Ont.*, Vol. X., p. 39.

Amara, all the species, *Col.*, Ill. Vol. XII., p. 110.

Anisodactylus, all the species, *Col.*, Ill. Vol. XII., p. 111.

Aphis Maidis, Fitch, *Hom.*, Fitch, Vols. I. and II., p. 318. Ill. Vol. XIII., p. 46.

Arctia (Leucarctia) acraea, Sm., *Lep.*, *Harr.*, p. 351. *Pack.*, p. 286. Ill. Vol. VII., pp. 79, 183. *Ibid.*, Vol. X., pp. 115, 170. *Ibid.* Vol. XI., p. 62.

Arctia phalerata, Harr., *Lep.*, *Harr.*, p. 347. Ill. Vol. VII., p. 181. *Ibid.* Vol. X., p. 115.

Blissus leucopterus, Say, *Het.*, Harr., p. 198. Ill. Vol. VII., pp. 15, 40. Ibid, Vol. XII., p. 32. Ill. Mo., Vol. II., p. 15, Ill. Ibid, VII., p. 19.

Bryobia pratensis, Gar., *Acarina*, Ill. Vol. XIV., p. 73.

Bryobia pallida, Gar., *Acarina*, Ill. Vol. XIV., p. 74.

Calathus gregarius, Say, *Col.*, Ill. Vol. XII., p. 109.

Caloptenus bivittatus, Say, *Or.*, Ill. Vol. IX., p. 126. Mo., Vol. VII., p. 173, Ill.

Caloptenus differentialis, Thos., *Or.*, Ill. Vol. IX., p. 127. Ill. Mo., Vol. VII., p. 173. Ibid, Vol. VIII., p. 153.

Caloptenus femur-rubrum, De G., *Or.*, Ill. Vol. I., p. 99. Ibid, Vol. VII., p. 35, Ill. Harr., p. 174, Ill.

Caloptenus sprætus, Tho., *Or.*, Ill. Vol. I., p. 82. Ibid, Vol. VII., p. 35, Ill. Ibid, Vol. IX., p. 121. Mo., Vol. VII., p. 121. Ibid, Vol. VIII., p. 57. Ibid, Vol. IX., p. 157. Report of U. S. Entomological Commission.

Chytolita morbidalis, Guen., *Lep.*, Ill. Vol. X., pp. 138, 182.

Coccinellidæ, *Col.*, Ill. Vol. XII., p. 116.

Cotalpa lanigera, Linn., *Col.*, Ill. Vol. XIII., p. 146, Ill. American Naturalist, 1869, pp. 186, 441. Harr., p. 24, Ill. Mo. Vol. V., p. 10.

Crambus vulgivagellus, Clem., *Lep.*, Lintner's Ent. Report, Vol. I., p. 127. Canadian Entomologist, Vol. XII., p. 17. Ibid, Vol. XIII., p. 181. Am. Nat., Vol. XV., pp. 574, 750, 914. Ont. 1881, pp. 6, 13. U. S. 1881-1882, p. 179.

Ctenucha virginica, Char., *Lep.*, Ill., Vol. X., p. 170. Lintner's Ent. Con., Vol. III., p. 155. Pack., p. 283.

Debis Portlandia, Fab., *Lep.*, Ill. Vol. X., p. 92. Strecker's Catalogue, p. 148.

Dichelia Sulfureana, Clem., *Lep.*, Ill., Vol. XIV., p. 17. Fernald's Catalogue, p. 21. U. S. 1880, p. 255.

Drasteria erectea, Cram., *Lep.*, Ill. Vol. X., p. 148. Ont. 1881, p. 47, Ill. Ibid, 1875, p. 36.

Elateridæ, *Col.*, Harris, p. 55. Ill. Vol. V., p. 92. Ibid, Vol. VI., p. 21. Ibid, Vol. VII., p. 19. Ibid, Vol. XII., p. 27. Mo., Vol. II., p. 16. Fitch, Vol. X., p. 63.

Elater mancus, Say, *Col.*, Harris, p. 56.

Galerita janus, Fab., *Col.*, Ill. Vol. XII., p. 108.

Glyphina eragrostidis, Midd., *Hom.*, Ill. Vol. VIII., p. 144.

Gortyna nitela, Guenee., *Lep.*, Ill. Vol. VII., p. 100. Ibid, Vol. X., p. 151. Mo., Vol. I., p. 56. Ibid, Vol. III., p. 105. Ibid, Vol. VIII., p. 37.

Hadena devastatrix, Bruce, *Lep.*, Ill. Vol. VII., p. 216. Mo. Vol. I., p.

83. *Ibid*, Supplement, p. 56. Harris, p. 445. Fitch, Vols. I. and II., p. 315.

Harpalus, all of this Genus, *Col.*, Ill. Vol. XII., p. 112.

Heliophila phragmitidicola, Guenee, *Lep.*, Ill. Vol. VII., p. 224.

Heliophila Harveyi, Grote (albilinea, Hübn) *Lep.*, Mo. Vol. IX., p. 50. Ill. Vol. VII., p. 223.

Isosoma Elymi, French, *Hy.*, Ill. Vol. XI., p. 81. Canadian Entomologist, Jan., 1882.

Isosoma hordei, Harr., *Hy.*, Ill., Vol. XI., p. 75. Fitch, Vol. VI.-IX., p. 154. Harris, 553. Mich. Ag. Rept. 1884, p. 322. Mo. Vol. II., p. 92.

Lachnosterna fraterna, Harr., *Col.*, Ill. Vol. VI., p. 101. Harris, p. 32.

Lachnosterna fusca, Fröhl, *Col.*, Ill. Vol. VI., p. 97. *Ibid*, Vol. VII., p. 33. Mo. Vol. I., p. 156. Ill. Harris, p. 30. Fitch, Vols. I. and II., p. 248.

Lachnosterna hirticula, Knoch., *Col.*, Ill. Vol. V., p. 87. Harris, p. 32.

Lachnosterna ilicis, Knoch., *Col.*, Ill. Vol. V., p. 87.

Lachnosterna pilosicollis, Knoch., *Col.*, Harris, p. 33. Ill. Vol. V., p. 87.

Laphygma frugiperda, Guenee, *Lep.*, Ill. Vol. VII., pp. 97, 219. *Ibid*, Vol. X., p. 138, Vol. XIV., p. 55. Mo. Vol. II., p. 41.

Leucania pseudargyria, Guenee, *Lep.*, Ill. Vol. X., p. 139.

Leucania albilinea, Hübn., *Lep.*, Mo. Vol. IX., pp. 50-55.

Leucania unipuncta, Haw., *Lep.*, Harris, p. 627. Ill. Vol. VI., p. 56, VII., p. 101. Mo. Vol. I., p. 109. *Ibid*, Vol. II., p. 37. *Ibid*, Vol. VIII., pp. 22, 182. *Ibid*, Vol. II., p. 37.

Leucarcia acraea, Smith, *Lep.*, Ill. Vol. VII., p. 183. *Ibid*, Vol. X., p. 170, Packard, p. 286.

Limothrips poaphagus, Com., *Het.* Fernald, Grasses of Maine, p. 42. Comstock Notes on Entomology, p. 120.

Loxopeza atriventris, Say, *Col.*, Ill. Vol. XII., pp. 109, 115.

Lygus lineolaris, Beauv., *Hem.*, Ill. Vol. XIII., p. 115. Mo. Vol. II., p. 113. Harr., p. 201. U. S. Vol. 1884, p. 312.

Macroductylus subspinous, Fabr., *Col.*, Ill. Vol. I., p. 24. *Ibid*, Vol. VI., p. 103. Lintner Rept., Vol. I., p. 227. Harr., p. 35. Fitch Vol. II., p. 245. U. S. 1863, p. 567, 1867, p. 71, 1868, pp. 87, 104. Am. Entomol., Vol. I., p. 251. Mich. Pom. Report 1872, p. 667. Mich. Ag. Report 1874, p. 145.

Neonympha Canthus, Linn., *Lep.*, Ill. Vol. X., p. 91.

Neonympha eurytris, Fab., *Lep.*, Ill. Vol. X., p. 90. Strecker's Catalogue, p. 148. Harris, p. 306. Pack., p. 264.

Neonympha gemma, Hüb., *Lep.*, Ill. Vol. X., p. 91. Strecker's Catalogue Macrolepidoptera, p. 150.

Neonympha phocion, Fabr., *Lep.*, Strecker's Catalogue, p. 149. Buffalo Bulletin, Vol. II., p. 244.

Neonympha sosybius, Fabr., *Lep.*, Ill. Vol. X., p. 91. Strecker's Catalogue, p. 149. Buffalo Bulletin, Vol. II., p. 145.

Nephelodes violans, Guen., *Lep.*, Ill. Vol. VII., pp. 29, 220. Ibid, Vol. X., p. 139. Lintner's En. Report, Vol. I., p. 99. Am. Ento., Vol. III., p. 231. Am. Nat., Vol. XV., p. 575. Canadian Entomologist, Vol. VIII., p. 69. Trans. Kan. Acad. Science, Vol. IV., p. 45.

Pamphila Delaware, Edw., *Lep.*, Ill. Vol. X., p. 96.

Pamphila vitellius, Fabr., Strecker's Cat., p. 171. Proceed. Ent. Soc. Phil. II., 18, 19.

Pamphila hobomok, Harr., *Lep.*, Strecker's Cat., p. 172. Harr., p. 313. Canadian Ent., Vol. I., p. 66. Proceed. Bos. Soc. Nat. Hist., Vol. XI., p. 381. Ill. Vol. X., p. 97.

Pamphila Iowa, Scud., *Lep.*, Strecker's Cat., p. 173.

Pamphila Mystic, Edw., *Lep.*, Strecker's Cat., p. 165. Proceed. Ent. Soc. Phil., Vol. II., p. 15. Canadian Ent., Vol. I., p. 66. Packard, p. 270.

Pamphila Peckius, Kerby, *Lep.*, Ill. Vol. VII., p. 160. Ibid, Vol. X., p. 178. Harris, p. 315.

Pamphila phylæus, Dru., *Lep.*, Strecker's Cat., p. 164. Ill. Vol. X., pp. 96, 176.

Pamphila Samoset, Scud., *Lep.*, Strecker's Cat., p. 174. Proc. Ent. Soc. Phil. Vol. II., p. 507. Trans. Ent. Soc., Vol. I., p. 3.

Pamphila Sassacus, Harr., *Lep.*, Harr., p. 315. Ill. Vol. VII., p. 159. Ibid, Vol. X., p. 97. Boston Soc. Nat. Hist., Vol. II., p. 346.

Patrobus longicornis, Say, *Col.*, Ill. Vol. XII., p. 113.

Philometra serraticornis, Grote, *Lep.*, Ill., Vol. VII., p. 246.

Platynus limbatus, Say, Ill. Vol. XII., p. 109.

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Pulvinaria innumerabilis, Rath., *Hom.*, Ill. Vol. XIV., p. 103. Mich. Ag. Rep. 1883, p. 429. Ill. Am. Naturalist, Vol. XII., pp. 655-661. Proc. Dav. Ia. Acad. Sci., Vol. II., p. 293. U. S. 1884, p. 350.

Rhizobius poæ, Thom., *Hom.*, Ill. Vol. VIII., p. 166.

Satyrus alope, Fab., *Lep.*, Ill. Vol. VII., p. 156. Ibid, Vol. X., p. 92. Strecker's Cat., p. 157. Harris, p. 305.

Satyrus nephele, Kirb., *Lep.*, Ill. Vol. VII., p. 156. *Ibid*, Vol. X., p. 92. Vol. VI. *Proceed. Ent. Soc. Phil.*, p. 195. *Harr.*, p. 306. *Bull. Buffalo Soc.*, Vol. II., p. 242.

Scelodonta pubescens, Mels., *Col.*, Ill. Vol. XIII., p. 163.

Scepsis fulvicollis, Hubn., *Lep.*, Ill., Vol. X., p. 171.

Schizoneura panicola, Thom., *Hom.*, Ill. Vol. VIII., p. 138. *Ibid*, Vol. XIII., pp. 42, 51.

Sciara? Dip., Ill. Vol. XIII., p. 59.

Selandria? Saw Fly, *Hy.*, U. S. 1884, p. 401.

Siphonophora avenae, Fab., *Hom.*, *Fitch*, Vol. VI-IX., p. 91. *Mo. Vol. II.*, pp. 5, 6, 10. *Ill. Vol. VIII.*, pp. 29, 51.

Siphonophora setariae, Thom., *Hom.*, Ill. Vol. VIII., p. 56.

Spilosoma Virginica, Fabr., *Lep.*, *Harris*, p. 349. *Ill. Vol. IV.*, p. 188. *Ibid*, Vol. VII., pp. 80, 183, 277, 280. *Ibid*, Vol. X., pp. 116, 169. *Packard*, p. 287. *Mo. Vol. III.*, p. 68.

Sphenophorus parvulus, Gyll., *Forbes' Notes*. Seen eating grass in July and August.

Sphenophorus sculptilis, Uhl, *Col.*, *Lintner*, *En. Rep.*, Vol. I., p. 253. *Mo. Vol. III.*, p. 59. U. S. 1879, p. 248. *Ibid*. 1880, p. 272. *Ont.*, 1880, p. 56. *Am. Nat.*, Vol. XV., p. 915. U. S. 1881-1882, p. 139.

Tychea panici, Thom., *Hom.*, Ill. Vol. VIII., p. 169.

In the above list I have given only such species as I know, or have good reason to believe, feed in part or wholly on grass. I have given references that the literature may be more easily investigated, though many authors referred to do not speak of the insects as enemies to our grasses, they do give habits and characters which are important.

In the list given others might very safely have been included. It is probably true that all the species of *Lachnosterna*—allies of our May or June beetle, the common white grub—and many species of related genera, are injurious to grasses, as they quite generally feed on the roots of these plants in the grub or larval state. It is also probable that others of the genera *Agrotis*, *Hadena*, etc., perhaps all the cut worms, are enemies of our meadows and pastures. Till within a couple of years *Agrotis fennica*, the Black Army Worm, was supposed to be one of the most in-

offensive of these moths. Now we know that it may devastate whole meadows. Recently a Paratid, or snout moth, *Crambus vulgivagellus*, Clem., which has been supposed to be innocuous, did immense damage in Northern New York. The same moth is seen each year in Michigan and other States, and we do not know when it, or other species of the same genus, may not come to any locality in our Northern States to the ruination of our meadows and pastures. Another moth, *Nephelodes violens*, Guenee, has had a history similar to that of the *Crambus*, just mentioned. This moth I find while trapping moths by sugar every year here in Lansing, sometimes in great numbers. We cannot tell when it may come in devastating numbers in any locality in the United States. It is probable that several species of *Elaters*—spring beetles—the dreaded wire worms, are great pests to our meadows. It is quite likely that they do far more damage to grasses than is known or suspected. The same may as truly be said of the army worm moth, and other species of the *Heliophila* (*Leucania*). We note their ravages only when they come in armies. Yet I notice they are quite common every year, and as they are not usually driven by force of numbers to leave the meadows for other pasturage their blasting work, though not inconsiderable, is unnoticed. Many species of grass-hoppers, not mentioned in the above list—indeed nearly all of our locusts—are at times more or less destructive to grasses, and like the cut worms, wire worms, white grubs and army worms, work unperceived. Only when they come in swarms, as they have the past season (1875), do they attract attention.

In the above list I have not included any of the *Chlorops*, or *Oscinis*, but from the habits of the closely related *Meromyza*, as wheat enemies, the abundance of the flies of these genera on grass in summer, and the added fact that we often find the maggots mining in the culms makes it possible that they do more or less harm to our species of *Gramineæ*. It has been thought that

these maggots were what caused the June grass to wither in summer, as so frequently observed. This is more likely due to species of thrips, three or more of which I have taken from the culms. Sometimes the grass withers from the attack of the stalk borer, *Gortina nitela*.

I have also omitted all mention of leaf hoppers in the above list. Yet it is not improbable, indeed I think it certain, that various species of *Tettigonia Heleochara* and *Jassus* may and do often quite considerable damage to our grass crops. The larvæ of these tree or leaf hoppers are often seen enveloped in their spittle, like secretions, on our grasses, and as such insects must suck all their nutriment from the grass, they can but be quite a serious damage. Of the Hemiptera, with the exception of a few lice, plant and bark lice, the tarnished plant bug and the chinch bug, the above list speaks not. It is quite likely that other plant and bark lice, and several Heteroptera, especially of the genera *Capsus* and *Phytocoris*, may be found to work no inconsiderable harm to our grasses.

It will be seen that there are included in the list several genera of the family Carabidæ, all of which have been considered heretofore as predaceous species, and so beneficial. Prof. S. A. Forbes has well shown that many of these ground beetles are largely vegetable feeders, and that grass is the principal food of most of these species. Prof. Forbes also finds that nearly if not all of the Coccinellidæ (lady bird beetles) feed in part on the pollen of grasses. These probably do very little harm.

As was remarked in reference to the insects infesting our clovers, many in the above list live in part on other plants, and many do very little apparent harm to pasture or meadow. A detailed description will be given only of such species as are noted enemies.

Lachnosterna fusca, Frohl. May Beetle—White grub.*Order Coleoptera. Family Scarabæidæ.*

Without doubt the White Grub, which is the larva of the common May beetle, though probably other species of this same and allied genera are much like this one in appearance and habits, is one of the very worst enemies of the grasses, as by eating off the roots whole meadows, pasture fields, and lawns are entirely ruined. Often the roots of the grass are so entirely consumed that all may be raked off, leaving the entire field as clean as a well tilled summer fallow.

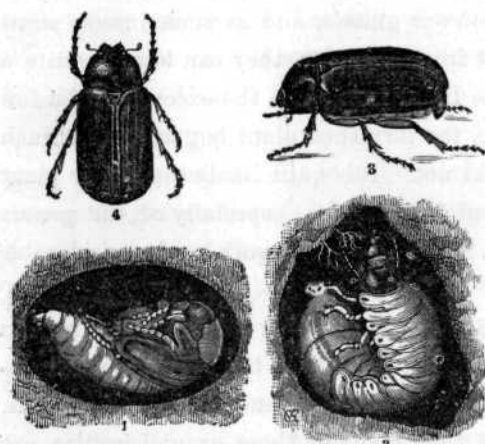


FIG. 147.

The figure (147) shows the insects in the several stages so well that little else is needed. The eggs are laid in the grass fields. The white, usually curved and wrinkled grubs with brown heads, feed for three years. The pupa is found in earthen

cells, and is not different from other eopterous pupæ.

In May and June the beetles come forth from the earth, and the females lay their eggs each to the number of from forty to sixty. It is probable that these eggs are always laid either in grass plats or where other vegetation is rank and plentiful. The beetles are nocturnal, and as is well known are attracted by lights, and so often become very annoying as they enter our rooms and houses. Sometimes the beetles so swarm in trees as to remind one of a swarm of bees. Indeed they often do no little mischief in eating the foliage of oaks and other trees during these summer love feasts. The grubs eat for three seasons.

Thus they are often found in the same grass field of varying sizes. The third spring they transform to pupæ, and in May the beetles begin to appear. It is during the second summer that they do the most harm. They are now large and sleek, and when they are very numerous, as is often the case, they sometimes do great damage, not only to grass but to our cereal crops and corn.

Fall plowing, by giving the birds and other insectivorous animals a better chance, is often practiced with excellent results in fighting these pests. Sometimes swine is turned into the meadows where they fatten on the grubs instead of on the grass which the grubs have already destroyed. Nothing is better where a field is badly infested than to turn in swine. In lawns the bare space must be spaded up and either sodded or else new grass seed sown. Rolling, which is sometimes advised, will do little or no good. I have already spoken of birds. The crow, black-bird, or purple grackle is specially serviceable. I have seen a flock of those birds clean a lawn in exceedingly quick time. Predaceous wasps and beetles also prey upon these grubs. They are also often seen to afford a pasturage for large fungous growths, which destroy them. Not only do white grubs do harm to our grasses, but they also attack corn, wheat and strawberries which are planted upon sod, and the latter when grown for a series of years in one place.

Agrotians. Cut Worms.

Order Lepidoptera. Family Noctuidæ.

Not only the real cut worms of the genera *Agrotis*, *Hadena*, and *Mamestra*, but many species of the same genera that do not cut off the food as do the typical cut worms, are often injurious to the grasses. From the very nature of our grasses much harm might be done, and yet unless it were very great go unnoticed by the practical man. It is more than likely that with the more intensive agriculture of the future, made necessary by a more

dense population, note will be taken of these injuries which now are unnoticed. While we may believe that most of our cut worms attack and destroy many a spear of grass in pasture and meadow, we actually know that *Agrotis fennica* may utterly devastate whole meadows, as it has done in parts of Michigan for the past two years.

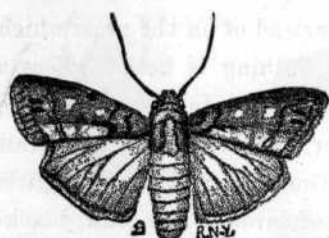


FIG. 148. *Agrotis fennica* and wing of var.



FIG. 149.



FIG. 150.

These gray, sober colored noctuid moths, Fig. 148, lay their scores of white eggs upon the stems of grasses. The larvæ, Fig. 149, may be dirty white or variously striped. Those which spend the day beneath the ground are more frequently light colored. They pupate in the earth. Fig. 150 shows the pupa.

The moths of different species may be found from June to October. *Agrotis fennica* is seen as a moth in July. It is probably true of all the species that the eggs are laid soon after the moths appear.

In most cases these hatch the same season, and the larvæ become partly grown, but do their greatest mischief the following May and June. The eggs of *A. fennica* do not hatch till spring, when the larvæ eat ravenously and grow very rapidly. So we see that in all cases June is the dreaded month when these insects lay heavy tribute on the produce of the farmer.

We must depend on the natural enemies very largely to overcome these injurious insects in our grass fields. The extent of the area of grass fields, the number of insects and their concealed condition makes all kinds of known warfare impracticable. When they cover a field, as did the *A. fennica* the meadows in Bay county, Michigan, we may adopt the same remedy as in case of

the white grub, give up the fields to the swine. While we may bandage our grape-vines, fruit trees, and garden plants, and thus protect them, and while we may bait the cut worms of clean cultivated corn fields with bunches of grass poisoned with the arsenites and thus kill them, or later dig them out at a profit, none of these methods are available in the meadow.

Leucania unipuncta, Haw. Army Worm.

Order Lepidoptera. Family Noctuidae.

This insect is so largely the prey to insect enemies, parasitic and predaceous, that it is only rarely that it does marked injury. Yet the entomologist knows that the moths are very common each year, and there can be no doubt but that it does considerable injury in our grass fields every season. It is only when its numbers, through favorable surroundings, become so immensely numerous as to make it necessary for the caterpillars to swarm forth from the meadows to get food, that we usually take note of its presence or become conscious of its power for mischief.

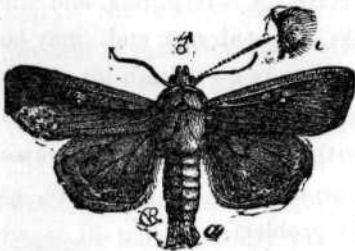


FIG. 151.

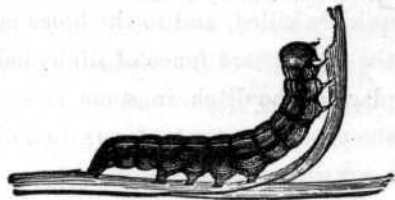


FIG. 152.

The figures show well the appearance of the insect in its several stages. The moth, Fig. 151, is yellowish-brown, often with a greenish tinge with a descal white dot on each front wing, which gives the specific name.

The caterpillar, Fig. 152, is striped longitudinally with dark and light gray lines. It pupates like all noctuids in the earth.

The moths are abundant in August and September. The eggs are laid in the sheaths of the grass. The caterpillars are nearly

grown in July, and then is when they devastate meadow and oat field.

Here as elsewhere, with the enemies of our grasses, we must trust largely to the other insects and birds that prey upon them. Usually this is sufficient to so reduce their numbers that their presence causes no anxiety, or even makes itself known to the farmer. When they migrate, in armies; threatening meadow and grain field, it is recommended to scatter straw, and when they become involved in its meshes to burn them, straw and all. Also to poison with the arsenites a portion of the grain or grass on the side of the field towards which the army is advancing, and thus hope by wholesale poisoning to save a portion of the crop. This has usually failed, as the army is often so large that they can devastate acres even though poisoned in this manner. The most satisfactory method yet recommended has proved to be the furrow or ditch. This is left steep on the side toward the field to be protected, and to have holes, like post holes, dug in it at frequent intervals. These holes receive the caterpillars, and the latter, by use of a convenient stick, large at one end, may be quickly killed, and so the holes made ready for a fresh lot of victims. A board fence of slight height has been made to take the place of the ditch in some cases with good results. Of course the encouragement of our insectivorous birds will aid here, as everywhere, to help solve this insect problem.

Elaters. Wire Worms.

Order Coleoptera. Family Elateridae.

The wire worms, like the white grubs, are the larvæ of beetles, live between two and three years in the earth, and by feeding upon the roots often do great injury to cereal crops, corn, and though not so much dreaded in meadows and pastures, they are, beyond question, often quite injurious to nearly all our grasses.

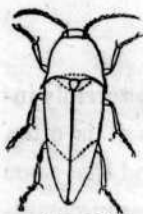


FIG. 153.



FIG. 154.

The various species of spring beetles, Fig. 153, are seen in June, and not infrequently fly into our rooms. Their long, slim form, usually brown color, and especially their habit of springing when placed on their back, which is effected by a sort of ventral spring pole arrangement, give ready means to identify the beetles. The long, cylindrical grubs, Fig. 154, with their six jointed thoracic feet, are also hard to mistake. Indeed the name wire worms is very appropriate.

As in case of white grubs the eggs are laid in meadows and pastures about the roots of grasses, where for three years the slender grubs eat and grow. While complaint is not usually made of injury to grass, yet such injury must be common and extensive. The grass blades are so countless that though numerous plants are killed they are not missed; but let the sward be plowed, and the second year plant corn, or sow oats or wheat, and if the wire worms are present—they are now rapidly approaching maturity—they often do incalculable damage, ruining, it may be, whole fields of grain. That they do not more injury the first year after plowing is not so strange. It is the habit of the grubs of this family of beetles to eat rotten or decaying wood, etc., and so it is quite likely that these wire worms, with changed habits, really prefer a diet of decaying roots for a change, especially as it may the better satisfy the cravings of the old time inherited appetite. With the exception of buckwheat, peas and beans, there is hardly a crop but what is levied upon by these insatiable wire worms. The only recommendation that our present knowledge offers to resist these terrible pests is either to summer fallow for one year in hopes to starve the grubs, or else to sow some crop that is distasteful to them the second year after plowing the green sward.

Blissus leucopterus, Say. Chinch Bug.*Order Hemiptera. Family Ligæidæ.*

This destructive bug, though very small, is often so terribly injurious that in Illinois, Iowa, Missouri and Kansas it is often the author of millions of dollar's worth of damage, and that some times in a single State. What has been said of the other insects already referred to as to damage to grass, corn and wheat applies to this as well. That the chinch bug is more susceptible to seasonal peculiarities—especially wet—than most insects, is well known. While in very wet years it does little damage, in dry years it sweeps as "with the besom of destruction" the great prairies of the West. That it does so little damage in Michigan, New York and the East is doubtless owing to the fact that the climate is too rigorous for it. Very likely the hibernating bug succumbs to the severity of our long, cold winters.

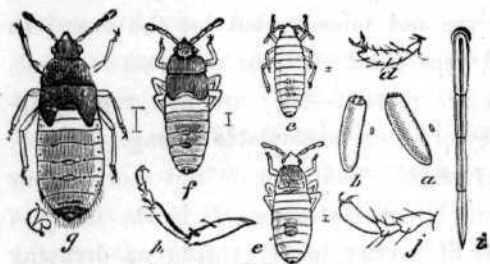


FIG. 155. Chinch bug.

This insect, Fig. 155, is hardly 4 m m long, or less than 3-20 of an inch. Its color is black with white wings marked with black spots. The bugs hiber-

nate in winter. In May they swarm forth in nuptial flight, and soon after the egg laying begins. There are two or three broods, so from June on they will be seen in all stages. The wingless larvae, the short winged and equally active and hungry pupæ and the full fledged imago will all be seen sucking the juices from the plants at one and the same time.

Neatness in farm operations, not leaving corn-stalks and rubbish in the fields to protect and harbor the bugs in winter, is about the only remedy possible. Prof. Forbes, whose admirable researches and suggestions have been so valuable, has found that

the kerosene emulsion will kill the bugs, but owing to their numbers and habits it is hardly a practical remedy.

Caloptenus—many species. **Locusts, or Gray Grasshoppers.**

Order Orthoptera. Family Acrididæ.

Although no grass insect is more serious in its destructiveness than the Western locust, or grasshopper, *Caloptenus sprætus*, Thom., when it comes to make its presence felt, yet from the fact that it can never attack the vegetation except in a limited area West, and even there comes only rarely to scourge the country, it perhaps on the whole is not so serious to our forage crops as the insects already referred to. Our common, red-legged grasshopper, *Caloptenus femur-rubrum*, De G., with several other species, often do very serious harm in our Eastern States. Yet the fact that they come only rarely in great numbers, and then scarcely ever two years in succession, makes the insect less dreaded than it would otherwise be.



FIG. 156.



FIG. 157.

Fig. 156 shows the Western locust, and Fig. 157 our red-legged locust, which insects resemble each other very closely. The principal difference is the longer wings of the *C. sprætus*. Like the Chinch bug the transformations of these insects are incomplete. The larvae in early summer, the pupa in mid-summer, and the imago in late summer all look alike, and have identical habits as to their food. They differ only in size and development of wings, which are at first wholly absent, and then appear for a time only as stubs, or mere pads. The imago in August and September lay their large eggs in the ground. In all stages they are ravenous and indiscriminate feeders.

Dr. C. V. Riley, in his elaborate investigation of this insect,

names and describes many mammals, birds, and other insects that destroy this pest. He also describes many mechanical appliances for the destruction of the pest. In California the past season locusts which were very common and harmful were destroyed by use of poison. Bran, sugar and arsenic were mixed and left where the insects could gain access to the mixture. Whether this can be made available in fields to protect grass, oats, etc., is yet to be decided by actual trial.

Crambus Vulgivagellus, Clem. The Vagabond Crambus.

Order Lepidoptera. Family Pyralidae.

This insect is not rare in Michigan, nor in other Northern States, yet it has rarely attracted attention as a serious pest in agriculture. In 1881 the pastures in parts of Northern New York were quite seriously damaged by this pest. It belongs to the same family as the bee moth, and to the same genus as the corn-root web worm, *Crambus zeellus* Fernald, which has done considerable damage in Illinois the past summer (1885).

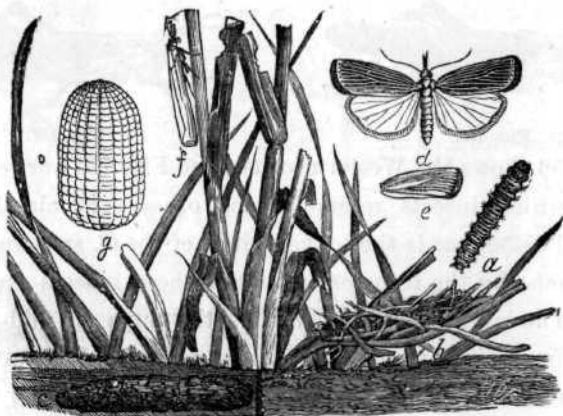


FIG. 158.

The moth, *d*, Fig. 158, expands 2.5 cm (1 inch) and like all of the species of this genus has a slender body. The front wings are of a dull yellow color. There are rows of black scales between the veins and a sub-marginal row of black dots near the

outer border. The fringe has a golden reflection. The hind wings are pale yellow, with long paler fringe. The thorax and abdomen is yellow. The projecting beak—the palpi—which gives the name snout moths to this family is well marked.

The very small eggs, *g*, Fig. 158, are yellow till near hatching when they turn pink. Like the eggs of many butterflies they are ribbed, both longitudinally and transversely. The transverse ridges are less marked than the others. The eggs are .7 m m by .3 m m. The color of the caterpillar, *a*, Fig. 158, is dull green, with shining black head. There are brown tubercles along the body, each of which bears a black hair. When full grown the larva is about 2 c m ($\frac{3}{4}$ of an inch) in length. The cocoon, *b*, Fig. 158, is spun close to the earth. It is curved, attached to grass, and varies much in size. The average length is 2.25 c m, or $\frac{9}{10}$ of an inch. Some cocoons are much enlarged at one end. The pale brown pupa is much the same as chrysalids of moths in general. It is 1 c m ($\frac{1}{4}$ of an inch) in length.

The eggs are deposited in dry pastures and meadows in late August. They seem to be merely dropped on the ground. They hatch in a little over a week, and the young caterpillars eat sparingly, but do little harm ere they go into winter quarters. They commence to feed as soon as the grass starts in spring. The brown spots in the grass fields where all has been eaten to the very roots, which latter have not been disturbed, show to the unobservant even that a serious enemy is at hand. When very numerous whole acres are fairly mown off close to the ground. While they prefer June grass they will eat any grass, and even oats and wheat. Like the corn-root Crambus they spin a web in which they live while devastating the meadows. They feed by night, and when not feeding are concealed in a cylindrical case of pieces of grass and fecal pellets held together by silken threads. The most damage is done in May. Often the caterpillars gather in immense numbers on the trunks of trees near the ground.

They spin their cocoons late in May, which are placed upright in the ground just below the surface. They do not pupate till the first of August, and do not emerge as moths till late in the same month.

Prof. J. A. Lintner, who has given an excellent account of this pest in his 1st An. Rep., speaks of several enemies, parasitic and predaceous, which are probably what keep this pest from doing greater damage. He also suggests burning by firing the pastures. He further recommends trying a liberal application of lime, plaster, ashes, and especially gas-lime. Plowing in autumn would doubtless destroy the eggs. We may reasonably hope that we shall not have frequent attacks of this insect; possibly it will never do so much damage again. Yet it has come once, and so we may at least fear that it will again, and to be fore-warned is to be fore-armed.

Before closing it is well to state that in company with the above Prof. Lintner found a caterpillar, the larva of a moth common in Michigan and all through the North. It is *Nephelodes violans*. I have space only to state that it was not very injurious, though may increase and become so at any time. What has been said as to habits, and especially of remedies, in relation to the Crambus and army worms, will probably be true of this insect if it should ever become a serious enemy.

I have not space to describe more of the insects noxious to our grasses. Those described are the only ones which have given anxiety, and while the others may become more numerous and therefore harmful, they are not likely to do so. In connection with the list given above I have referred to authors who have written upon each insect, and in many cases not only are the descriptions full but excellent illustrations add to the interest and value of the treatises. It is not unlikely that new enemies will attack our forage crops; but if so they will almost certainly be like one or more of the old familiar ones, and so by studying

their habits and determining their natural history we shall at once know which of the old and well tried remedies to adopt.

CHAPTER XVII.

THE FUNGI OF FORAGE PLANTS.

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Grasses afford a nidus for the development of a large number of fungi, so that they are a favorite collecting ground with students of these plants; but the greater number of species are found on dry stems and leaves, which they seize upon, as a rule, only after their death, and though the number of truly parasitic species is by no means small, there are but few that seriously injure valuable grasses. The number of noxious species on clovers and other forage plants of the pea-family is also small; hence this chapter includes a few which are of such frequent occurrence as to attract general attention.

For the most part the fungi of forage plants are directly injurious by weakening them and appropriating to themselves the food needed for making a good growth; but they likewise lower the nutritive value of the crop that is produced. In cases where seed is an object, the loss is even greater, since the yield of diseased plants is greatly lessened, while the quality of their seed is always poor. The annual loss in our meadows and pastures due to these causes cannot be stated, from the lack of reliable statistics, but in some seasons a moderate estimate places it in the millions.

Besides these direct injuries to the crops the fungi of grasses are the cause of a very considerable loss to the farmer in another way. Ergot and corn-smut have long been known to possess ac-