ARTICLE I.—PREPARATORY STAGES OF THE 20-SPOTTED LADYBIRD.

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Offices and Experiment Grounds on the Farm of the Ohio State University.

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This series of the Bulletin of the Ohio Agricultural Station is intended to embody the technical results of the work of the Station. It is not expected that these results will be of direct service to farmers in general, but it is hoped that they may be found useful by workers in other stations and thus indirectly serve the cause of agriculture.

BY CLARENCE W. WOOD.

About the middle of September, the present season, I found the larvae and pupae of this handsome little lady-bird, abundant on the leaves of various composite plants in the Olentangy bottoms on the Station farm. They were found especially on false or blue lettuce (Mulgudium floridana, and M. acuminata), iron-weed (Vernonia), and various kinds of false sunflower (Helenium). The larvae generally occurred on the under leaf surface, to which also the motionless pupae were attached. Most of the plants upon which the insects were found were infested by plant lice (Siphonophora rudbeckiae) from which I surmised that the Coccinellids might be feeding upon them, although no observations to that effect were made, and it is perhaps more probable that they subsist upon fungus spores, or smaller insects than these plant lice. At the time they were first seen (September 19) a few adult beetles were present, but most of the specimens were in the larva or pupa state—the latter apparently being more numerous than the former.

The length of pupal life is about a fortnight, a larva under observation in a breeding cage having attached itself for pupation September 26, pupating a day or two afterwards, and emerging as an adult October 9.

It frequently happened that both the larvae and adult beetles were caught and killed by the mucilaginous exudations of the involucres of the blue lettuce plants which they inhabited.

I found none of the unhatched eggs, but egg shells, doubtless belonging to this species, were not uncommon on the leaves, occurring in clus-
ters of from four or five to seven or eight. They were elongate oval in form, and about one mm. in length; and were probably whitish before hatching.

The adult beetle is shown at Fig. 1, c, Plate I. It is a small, whitish hemispherical insect, with numerous black spots upon its back.

**DESCRIPTION.**

The larva and pupa may be described as follows:

**LARVA.**—Plate I, Fig. 1, a. Length 4 mm.; width 1.2 mm. Body with many tubercles arranged in rows and with rather long spinose hairs. White: mouth parts reddish brown; eyes and spot just above dusky; two large dusky spots on dorsum of prothorax; a pair of similar spots each side the dorso-median line on each of two following segments, with another spot near the outer margin; only two spots on the first abdominal segment, but four on each of the following except the last three; two on the second and third from the last. Tarsi more or less dusky.

Described from many specimens.

**PUPA.**—Plate I, Fig. 1, b. Length 2.2 mm.; width 1.6 mm. Shape broadly ovate. General color whitish; eyes brown, blackish in older specimens, a row of black spots running on each side of dorso-median line from the thorax to the next to the last abdominal segment, broadening into a band along middle of abdomen, with one or two dark spots on the middle segment's between the band and the side margin.

In older pupae the eyes and wing covers are dusky and the spots of the beetle show distinctly.

Described from many living specimens.

**ARTICLE II. STUDIES IN POND LIFE. I.**

**BY CLARENCE M. WEED.**

One of the richest fields awaiting investigation by the naturalist is that of the transformations, habits and mutual relations of the myriad forms of aquatic life with which our inland lakes, rivers and ponds are teeming. Numberless problems, of great scientific as well as economic interest, lie wrapped in

"The green mantle of the standing pool,"

or beneath the rippling surface of every babbling brook.

There is on the Station farm, in the bottoms of the Olentangy river, a series of ponds fed by springs, and seldom completely drying out, which are exceedingly rich in aquatic life, both animal and vegetable, including within their borders nearly all forms found in fresh water ponds in the central United States; and it seemed that the opportunity for careful and con-
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Continuous study of the habits and mutual interactions of these various organisms ought not to be neglected. Accordingly the subject has been taken up, such odd moments being given to it as the pressure of other duties would permit, and the present article contains a few of the results obtained.

1. ON THE LIFE-HISTORY OF THE LARGER TYPHA-BORER (*Arasema obliquata, G. & R.)*

[Plate I, Fig 2]

One of the most interesting aquatic lepidopterous larvae is the species above named, which bores the stems of the Cat-tail Flag (*Typha latifolia*). It is abundant in the ponds of the Olentangy bottoms, a large proportion of the Typha stems showing evidence of its work. I call it the Larger Typha Borer to distinguish it from another lepidopterous larva (*Nonagria oblonga*) having similar habits, which may be called the Smaller Typha Borer.

This insect was first described in 1888 by Grote and Robinson, who apparently were not acquainted with the larva,* and the first published account of its life-history appeared in 1883 in the report of a discussion between Drs. Riley and Kellicott at a meeting of the Entomological Club of the American Association for the Advancement of Science.† The aquatic habits of the insect are there described and the conclusion is reached that it is single brooded north and double brooded south. Nothing further of importance concerning the insect appeared until 1888, when an animated discussion took place‡ between Messrs. Kellicott, Brehme, Moffat and Johnston concerning the place of hibernation of the larva, some contending that it remains in the Typha stalks through the winter, pupating in them in the spring, and others that it leaves the stalks in autumn and hibernates in logs and similar situations on shore, pupating there in spring. The observations reported showed that both sides must be correct, and that both situations are sometimes chosen for hibernation.

**OBSERVATIONS.**

My observations on the species began April 4, 1889, when two larvae were taken from a log lying on the shore of one of the Olentangy ponds. The under side of the log was in the water, but the larvae were under the bark of the upper side, considerably above the water level. One of the larvae was placed in a breeding cage. It pupated April 10, and emerged as a moth May 7.

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‡Ibid., v. XX, pp. 119, 120, 238; v. XXI, pp. 75, 76, 99.
A pupa of the insect was next found in a rough cell beneath the bark of a log in a situation similar to the one above mentioned. Placed in a breeding cage, in an unheated room, it emerged as a female moth May 10.

One of the larger ponds was next visited April 13, and a great number of Typha stalks were examined. The first stalk cut open, which was in the water some distance from shore, contained a dead Arzama pupa. Another stalk contained a living larva surrounded with evidence of recent feeding, and in another a larva which had become shortened preparatory to pupation was found. In the course of the search, which was continued for nearly two hours, a half dozen more larvae were found in the stalks, some of them being shortened for pupation and the others active and feeding.

Four of these larvae were put in a breeding cage. Three days later (April 16) part of them had become pupae, and when the cage was next examined, April 25, all had pupated. One pupa was removed, the others being left in the cage, and May 11 a fine pair of moths had emerged. The day following the third pupa transformed.

No further observations were made upon the species until October 14, when a large number of larvae, mostly full grown, but some not over two-thirds grown, were found in the Typha stalks.

The larva, shown somewhat enlarged at Plate I, Fig. 2, a, is a rather handsome insect, and swims readily by an undulating, snake-like movement of its body. It is especially interesting on account of the peculiar position of two of the spiracles which are placed on the caudal margin of the eleventh segment. The antennae are also peculiar, as will be seen from Fig. 2, b, Plate I, where one of them is represented highly magnified.

The general form of the pupa is shown at Plate I, Fig. 2, c. It is reddish brown in color, and is about 30 mm. long.

The moth is a rather handsome, brownish insect, with an oblique dark band across each front wing. It is represented, natural size, at Plate I, Fig. 2, d.

DESCRIPTION.

The larva and pupa of this species may be described as follows:

**LARVA.**—Plate I, Fig. 2, a, b. Length, 40 mm.; transverse diameter, 11 mm.; vertical diameter, 6 mm. Subcylindrical, slightly flattened transversely. General color, grayish; head, antennae, cervical shield and true legs brownish. Head smooth, shining, having a very few brown hairs; five ocelli arranged in a semi-circle on each side, just back of antennae, and a sixth one just below each antenna. Antennae three-jointed; basal joint inconspicuous; second joint long and thick, surmounted on its outer distal angle by a long slender hair; third joint small, spherical, situated on the concave tip of second. Skin finely rugose. Dorsum of first segment behind head bearing cervical shield; of 2d, bearing three deep oblique impressions; of 3d, bearing two similar oblique impressions; of
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4th, bearing a deep transverse impression slightly back of the middle, with a faint indication of an oblique impression just in front of it; of 5th to 10th, bearing a similar transverse impression slightly back of middle; of 11th, bearing a short longitudinal impression on each side of median line, beginning at anterior border and running two-thirds distance to posterior border, and also having a similar longitudinal impression on each side lower down. Segment 12 very short, less than one-fourth length of 11, its dorsal surface depressed considerably below dorsal surface of 11, to make room for the spiracles on the posterior margin of 11. Dorsum of segment 13 forming cdna, semi-circular, smooth. Spiracles situated vertically on side of segments 1, 4, 5, 6, 7, 8, 9, 10, and nearly horizontally on the posterior margin of 11, above dorsum of 12. Prolegs on ventral surface of segments 6, 7, 8, 9, skin between each pair with oblique impressions in the shape of a V.

Described from several specimens.

Pupa.—Plate I, Fig. 2. c. Length 3 mm. Reddish brown, head and thorax dark brown. Of normal shape, with a large, blunt, tubercle-like projection at caudal end, the surface of which is deeply reticulate. Described from one bred specimen.

2. ON THE LIFE-HISTORY OF THE TOOTHED-HORNED FISH-FLY. (Chauliodes austricornis, Ramb.)

[Plate I, Fig -]

The insects belonging to the Neuropteroo genus Chauliodes have received comparatively little attention in this country, no important addition to our knowledge of them having been made since the publication of Hagen's Synopsis of the Neuroptera of North America, and the observations recorded by Walsh in the second volume of the Proceedings of the Entomological Society of Philadelphia. The species named above, which was discussed by Walsh, is the only one whose immature stages have been described, and the transformations of this are only partially known.

Although in the present article I can add but little to the account given by Walsh, it seems worth while to record my observations, and to illustrate the insect in its several stages. Moreover, my description of the imago is, I believe, the first one in which both sexes have been described at length. I am indebted to the kindness of Dr. H. A. Hagen for the verification of my determination of the species.

OBSERVATIONS.

The first larva noticed in 1889 was found early in spring in a lot of material from the bottom of a small lake on the University grounds. It was placed in an aquarium, where it lived for some time. A few days later another larva was taken in the same situation.

The larvel were next taken April 4th, under the bark of logs lying in the water of one of the Olentangy ponds. They were above the water
level in rude cells which had been gnawed out of the soft bark and wood. Part were put in alcohol, and the three remaining placed in a breeding cage containing partially decayed wood. When the cage was next examined April 22, the larvae had pupated. One pupa was put in alcohol. A fine male imago emerged April 30, and another of the same sex appeared May 6.

Two larvae were next found under the bark of a log in a similar situation April 10. One was preserved in alcohol and the other placed in a breeding cage. It emerged as a female imago April 24.

Again, May 4, a larva and pupa were found under the bark of a log. Each had made a rough cell. They were placed in a breeding cage, and three days later (May 7) the larva had pupated. A male Chauliodes emerged May 10, and the other, also a male, followed May 13. In this case the pupa state could not have lasted longer than eight days.

Two nearly full grown larvae were next taken early in October, from material from the bottom of one of the Olentangy ponds. They were placed in an aquarium, and their habits studied for some time. Their ordinary mode of locomotion is by crawling along weeds, and the debris of various kinds which gathers at the bottom of ponds, but when alarmed they can swim rapidly by suddenly doubling the body up, bringing the head in contact with the abdomen, by which means they are propelled some distance through the water. They evidently live upon various animals, as I have seen them feeding on dead Back-swimmers (Notonecta undulata), flies which had fallen into the aquarium, and in one case a spider which I had thrown in. When a Notonecta or Zonathia would come near the Chauliodes larva while feeding, the latter would snap viciously at it with its powerful jaws.

I surmise that these larvae have some protection from the attacks of Zonathia fluminea and similar predatory creatures, for, although it would seem that the Zonathia with its powerful beak could easily kill them, I have never known it to be done. When handled, the Chauliodes larvae occasionally eject from the mouth a considerable quantity of a blackish fluid, reminding one of the similar habit of certain locusts (Acrididae).

These Chauliodes larvae also have a peculiar habit of walking on the surface of the water, body downward. They can move along in this manner quite rapidly.

DESCRIPTION.

The various forms of this insect may be described as follows:

LARVA. — Plate I, Fig. 8, a. Length from head to tip of abdominal appendages 40–50 mm. General color, dingy brown; head piceous; legs, antennae and dorsum of thoracic segments lighter brown than abdomen. Head sub-quadrate, shining, with scattered
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punctures. Antennae 5-jointed; each joint more slender than the one preceding; joint I, short, large; II twice as long as I; III longest, three times length of II; IV very short, about equal to I in length; V long, pointed, slightly shorter than III. Ocelli lateral just caudad of antenna, six in number, four being more distinct than the other two. Dorsum of first thoracic segment entirely chitinous, shining, smooth, except for scattered shallow punctures; color brown mottled with black, and having a longitudinal dark stripe on median line, and a transverse impression slightly in front of posterior border, running into the base of a marginal disc on each side. Dorsum of second thoracic segment chitinous, not more than half as wide as first, each with a faint transverse impression near its anterior border, and another near the posterior border, the latter running obliquely forward on each side until it meets the former. Ten abdominal segments: segment I half as long as II, but segments II to VIII subequal, segments I to VIII each having “a lateral, subterminal, exarticulate seta nearly at right angles to the body, and about as long as the body is wide,” (Walsh) immediately above and slightly in front of which on segments I to VII are the spiracles, which are wanting on the sides of segment VIII. Dorsum of segment I having an indistinct transverse impression near its cephalic border, behind which are two transverse oblique impressions, dorsums of segments II to VIII each having a distinct transverse impression near cephalic border, caudad of which are two other similar but less distinct impressions. Terga of abdominal segments having also more or less distinct longitudinal oblique impressions. Tergum of segment VIII having a pair of fleshy, exarticulate, contractile filaments 5 mm. long, extending caudad from its caudal surface on the tips of which are the spiracles of segment VIII. Segment IX (which according to Walsh’s description is a “fleshy pillar” extending caudad from segment VIII) short, cylindrical; segment X with pair of fleshy prolegs, armed with two strong, shining, curved claws, each proleg having also on its dorso-lateral surface a fleshy tapering seta extending beyond the claws. Tarsi of thoracic legs, one-jointed, with two terminal claws.

Described from two specimens.

PUPA.—Female. Plate I, Fig. 3, b. Length when extended 38 mm. Normally partially curved as shown in figure. Dingy brown, head darker. Antennae curved over the eyes. Tarsi five-jointed, with two claws. Wing pads prominent. Eight abdominal segments. At tip of abdomen are “two robust abdominal appendages, confluent towards their base, and about 2 mm. long, and an inferior process of two similar ones which are connate throughout.” (Walsh).

Described from one reared specimen.

IMAGO.—Male. Plate I, Fig. 3, c. Length from head to tip of wings 58 mm., wing expanse 85 mm. General color luteo-cinereous; eyes, antennae, mandibles, except tips, quadrangular space between ocelli, two oblique stripes united at upper portion ventro-caudad of eyes, a large oblique blotch dorso-caudad of eyes, four small and one large spots in a transverse series on occlipt between blotch last mentioned and median line, an indistinct irregular longitudinal line along prothorax each side of median line, and another along margins, tarsi and more or less of femora and tibiae, base of wings, part of dorsal and ventral surface of meso and metathorax, more or less of abdomen, and spots on the veins of the wings, fuscescent. Anterior wings subcinereous; veins yellowish white interrupted with black. Antenna 13 mm. long, multarticulate, punctate on inner surface, and densely clothed with fine hairs. Eyes prominent. Ocelli three, arranged in a triangle, one looking cephalad, and the other two caudo-laterad.

Described from three bred specimen.

IMAGO.—Female. Plate I, Fig. 3, d. Length, head to tip of wings 50 mm. Wing expanse 80 mm. Besides its larger size, it differs from the male in having serrate antennae.

Described from one specimen bred in Ohio and two collected in Michigan.
Original description.

Description.

Description of female. Habitat given as “Savanna; South Carolina (Zimmerman).”

Notes receipt of both sexes from Walsh. Had before received a female from Illinois, through Uhler.

Larva described. Said to occur under the loose bark of floating logs, apparently beneath the surface of the water. Retires under logs, etc., on dry land to assume the pupa state, for which it forms a rude cell. Pupae described. First imago appeared May 28.

[Not seen]

Mention of Walsh's observations on the larva.

Larvae said to be “like the hellgrammite, but considerably smaller, and with no caudal filaments; while the last pair of spiracles is on the tips of a pair of contractile filaments.”

3. ON THE LIFE-HISTORY OF THE SAGITTARIA CURCULIO. (Listronotus latiusculus, Boh.)

[Plate II, Fig 1]

About the middle of September I found that a large proportion of the leaf and flower stalks, as well as the receptacles of the seed-heads of the common Arrow Leaf (Sagittaria variabilis), had been bored out by a Rhyncophorous larva which was then present in great numbers. A careful examination of many of the infested stalks and seed-heads was made September 19. The receptacles, so far as found, contained only larvae and pupae—the former occurring especially in the younger, greener heads, and the latter in the older, drier ones. In the stalls, however, all three stages were found—larvae, pupae and imagoes—the latter proving to be a curculionid, which was subsequently identified by Professor S. A. Forbes as Listronotus latiusculus, Boh.

Many of the infested seed-heads were placed in breeding cages. The pupae began emerging as beetles September 28, proving to be the same species that inhabited the stalks, and the beetles continued to appear until
the middle of October. A number of the Sagittaria stalks were also put in breeding cages, and a great many beetles, like those already found in them, emerged during the following fortnight.

The injury to the seed-heads is mainly confined to the receptacle, although many of the seeds are also more or less eaten. Frequently five or six larvae or pupae were present in a single receptacle.

In the infested stalks the larvae and pupae were very numerous, and in many cases had eaten all of the inner portion, leaving only the outer skin. Such stalks of course were brown and dead.

The length of the pupa state, as determined by two larvae reared in breeding cages, is eleven days.

The various stages of the insect are shown, considerably magnified at Fig. 1, Plate 2—a representing the larva, b and c the pupa (b being a dorsal and c a ventral view) and d the adult beetle, which is brownish and about a quarter of an inch long.

**DESCRIPTION.**

The larva and pupa of the Sagittaria Curculio may be described as follows:

**Larva.**—Plate II, Fig. 1, a. Length, 6 mm; width, 2 mm. A footless, whitish grub with the head brown and the body furnished with sparse, brown, recurved hairs. Segments transversely wrinkled especially, on dorsum of abdomen.

Described from many specimens taken in receptacles and leaf and flower stalks of *Sagittaria variabilis*, September, 1889.

**Pupa.**—Plate I, Fig. 1, b, c. Length, 5 mm; width, 3 mm. White; eyes brown in young specimens, becoming black as time of transformation to beetle approaches. Of normal curculionid form. Body sparsely covered with elongate, spinose, brown hairs. A convex tubercle, terminating in a brown spinose hair on each caudo-lateral angle of the last abdominal segment.

Described from many specimens taken in seed-heads *Sagittaria variabilis*, September, 1889.

4. **ON THE FEEDING-HABITS OF THE LESSER WATER BUG (Zaitha fluminea, Say.)**

[Plate II, Fig. 2.]

It is well known that this interesting insect is predacious, devouring a variety of animal organisms found in its environment, but records of precise observations on its feeding habits are very scarce. We obtained these bugs in considerable numbers from one or two of the Olentangy ponds, and kept many of them alive in aquariums, together with large numbers of other species from the same situation, so that an excellent opportunity was afforded for studying their habits in this respect.

Probably the most important element of food, as revealed in our aquariums, consisted of the larvae and nymphs of Dragon-flies (*Labbeliu-
These were captured continually and greedily devoured. Two or three Zaithas would exterminate all but the very largest of these in an aquarium in a short time.

The next most abundant victim was the common Undulating Back-swimmer (Notonecta undulata) shown at Plate II, Fig. 3. In one aquarium in which a large amount of pond material, including half a dozen Zaithas, had been placed, four were in sight at one time, each with one of these back-swimmers grasped in its front legs, and its beak inserted in the body. Similar observations were made a great many other times.

Univalve snails also occasionally contribute to the diet of this insatiable creature, as one was observed feeding upon a small snail with a spiral shell. May-fly larvae (Ephemeridæ) also form part of its food, as was shown by similar observations.

Various terrestrial insects which fall upon the water are probably also devoured, as the bugs were frequently seen feeding upon flies and wasps thrown in the aquarium.

5. ON THE FEEDING HABITS OF THE UNDULATING BACK-SWIMMER (Notonecta undulata, Say).

[Plate II, Fig 4]

The predaceous habits of this insect have frequently been alluded to in entomological literature, and the purpose of the present note is merely to record some of the more important elements of its food in our ponds, as determined by observations made in newly-stocked aquariums.

Perhaps the insects most frequently captured by it were May-fly larvae (Ephemeridæ), which were always greedily devoured when opportunity offered. A small species of Water Boatman (Corisa alternata) also suffered severely from its deadly assaults, and even good sized Dragon-fly larvae were occasionally seized.

I think these insects have the power of ejecting a poison into their victims, as on two occasions I have had their beaks inserted into the skin between my fingers, and the pain produced was very much like that of a bee-sting—being much more severe than would be caused by the mere puncturing of so fine a point.

6. AN AQUATIC LEAF-BEETLE (Donacia subtilis, Kunze).

[Plate II, Fig 3]

Last July I found this species exceedingly abundant on various water plants at Pine Lake, in Ingham county, Michigan. It seemed especially o prefer the common Yellow Pond Lily (Nuphar advena), upon the leaves
and petals of which it was feeding in great numbers, a dozen sometimes occurring in a single blossom.

On returning to Columbus I found the same insect almost equally abundant on aquatic plants in the Olentangy ponds—here seeming to prefer, in the absence of Water Lilies, the common Burr Reed (Sparganium ramosum) the parenchyma of which it ate with avidity.

This species evidently plays an important role in effecting the pollination of Nuphar advena, as the specimens in the blossoms were almost invariably thickly dusted with the yellow pollen from the stamens. It is interesting to note that Müller has found that a congeneric species in Europe (Donacia dentata) aids in the pollination of the European representative of our Yellow Pond Lily—Nuphar luteum.\(^*\)

This beetle also forms an important element in the food of the Bull-frog (Rana catesbyiana), it occurring frequently and often abundantly in the stomachs of specimens collected at Pine Lake, in July.

7. AN AQUATIC LADYBIRD (Hippodamia 13-punctata, DeGe.)

While collecting insects in the Olentangy ponds, September 24, I found this Ladybird very abundant in the pupa and imago stages on the leaves of various water plants, the adults apparently feeding on certain plant-lice, which were numerous in the same situation. Two larvae were also seen.

On referring to our collections made during the last two seasons, I found that although there were a great number of most of the other indigenous Ladybirds, there was but one of the present species, and that had been taken last July, on water-plants, in Pine Lake, Michigan, where, as I remember, this species was rather abundant.

I afterwards collected the beetles and pupae repeatedly in the Olentangy ponds, the latter being attached to the leaves of a variety of water-plants. No larvae was seen after September 24.

LITERATURE.

I have been able to find no reference to the aquatic habits of this insect in American literature, any mention of the species being infrequent as compared with most of the other members of the family. Among the more important references are the following:

In his First Report as State Entomologist of Missouri, Dr. Riley men-
tions this species as third in importance of the four Ladybirds that prey upon the Colorado Potato Beetle.

In the third volume of the Canadian Entomologist (p. 13) Mr. Wm. Saunders states that this species preys upon the Cherry Plant-louse (Myzus cerasi).

In the Sixth Report of the State Entomologist of Illinois, Dr. Thomas includes (p. 102) the Thirteen-spotted Ladybird in a list of insect enemies of the Colorado Potato Beetle, and also (p. 173) describes the adult beetle, but gives no further details concerning its habits.

Again in the Eighth Report of the same series (p. 174) Dr. Thomas briefly describes the imago, including it among other plant-lice enemies.

In his treatise on Insects Injurious to Fruits, Mr. Wm. Saunders includes this species among the enemies of the Apple Plant-louse (Aphis mali).

The aquatic habits of this Ladybird have, however, been recorded in Europe, although apparently not generally known, the only mention I have seen being by Mulsant, who states that this species is found upon aquatic plants.6

In view of the above facts, I think we may conclude that the Thirteen-spotted Ladybird has a decided preference for aquatic plants, upon which it, as a rule, develops, but that it also occasionally occurs among plant-lice on terrestrial vegetation.

DESCRIPTION.

The Thirteen-spotted Ladybird is shown at Plate II, Fig. 5, b. It has frequently been described in our entomological literature, and will be easily recognized from the figure.

The pupa is also shown on the same plate at Fig. 5, a. It may be described as follows:

PUPA.—Plate II, Fig. 5, a. Length 5 mm., width 3 mm. Form ovate. Color black; a narrow yellow band running caudal on dorso-meson from base of wing-sheaths to cauda, crossed near cephalic border of abdomen by a similar transverse band, the two making a good representation of a cross; the sides of the abdomen also more or less blotched with yellow, and in some specimens the thorax is blotched with the same color. The transverse band is sometimes interrupted with black on each side of the dorso-meson.

Described from many living specimens taken on aquatic plants, September, 1890.

8. ON THE EGGS OF THE GIANT WATER BUGS. (Belostoma americum, Leidy, and Benacus griseus, Say.)

[Plate II, Fig's 6 and 7]

Considerable confusion exists in entomological literature concerning the eggs of the insects named above. The subject was first brought up

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6 Coléoptères de France, Securipalpes, p. 34 "Elle se trouve sur les plantes aquatiques."
by the editors of the American Entomologist* in 1868, when the egg which, as I shall presently show, is that of Belostoma americanum, was figured and described as belonging to the Hellgrammite (Corydalus cornutus). Practically the same account was published by Dr. Riley in his Fifth Missouri Report (pp. 142-145); and also by Packard in his Guide to the Study of Insects (7th ed. p. 607).

In 1876, however, Dr. Riley read a paper before the American Association for the Advancement of Science, entitled "On the curious egg-mass of Corydalus cornutus (Linn), and on the eggs which have hitherto been referred to that species," in which he described the true eggs of the Hellgrammite, and made the following surmise concerning the others:

As to the nature of the eggs that have hitherto been mistaken for those of Corydalus, I can only surmise. The specimens from which the figure was made were destroyed with the Walsh cabinet in the Chicago fire; but I have a very distinct recollection of them, and judging from the nature of the eggs of Perthostoma, with which I am familiar, there is little doubt in my mind that these supposed eggs of Corydalus really belong to Belostoma grandis, which is the only aquatic Heteropterous insect of sufficient size to lay them.

I have been able to find no further references to the subject in the literature published since that time.

OBSERVATIONS.

While collecting insects on the edge of a pond on the outskirts of Lansing, Mich., July 3, 1882, I found a mass of eggs, like those figured in the Fifth Missouri Report (p. 143, Fig. 70) beneath a board lying at the water's edge. The eggs gave evidence of having been freshly laid, and beside them was a living Belostoma americanum. The following April I forwarded some of the eggs to Dr. Riley with an account of the circumstances of their capture, suggesting that the observation confirmed his surmise concerning their origin. In reply, Dr. Riley sent under date of April 30, 1883, a letter, in which he said:

I thank you sincerely for your communication and the specimens accompanying, sent by you on the 26th inst. An examination of the eggs demonstrates the correctness of your conclusion, and confirms my original surmise that these are the eggs of Belostoma grandis. I am very much pleased to have the question thus settled.

Within the last few years it has been shown that Belostoma grandis is a South American species, and that the insects belonging to this genus which occur in the northern United States are Belostoma americanum, Leidy, and B. griseus, Say. The latter, however, has lately been placed

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* American Entomologist, V. I, No. 4.
† 9th Mo. Report, pp 125-129.
in a sub-genus erected especially for it, and so is more correctly known as *Benacus griseus*.

The species figured by Dr. Riley as the probable parent of the eggs previously referred to Corydalis and there called *Belostoma grandis* is evidently *Benacus griseus*—a species which differs from the closely allied *Belostoma americanum*, (Plate II, Fig 7,) in its darker and more shining appearance, and especially in the shape and structure of the second joint (femur) of the first pair of legs. In *B. americanum* this joint is swollen in front near its base and has on its inner margin a longitudinal groove into which the next outer joint (tibia) can be fitted, while in *B. griseus* the inner margin of the anterior femur is much less swollen and has no groove for the reception of the tibia.

A recent examination of the specimen collected at Lansing, in connection with eggs mentioned above, showed that it was *B. americanum*, and consequently that the eggs figured by Riley belonged to this species rather than *B. griseus*, the eggs of which are apparently undescribed.

Early last April a living specimen of *B. griseus* was brought me in a small pail containing an inch or two of water. The insect was left in the water over night, and the next morning several large eggs had been laid by it.

I afterwards obtained the eggs a number of times by confining bugs caught at electric lights in vessels containing a little water. They were generally laid in masses resembling Fig. 6, Plate II, being fastened in place by a mucilaginous substance on the lower end. When first deposited the eggs were of a pale green color, but soon began to show brownish longitudinal stripes. The eggs were kept moist in the hope that they would hatch, but unfortunately none of them did so.

I have also received through the kindness of my brother, Howard E. Weed, two sets of eggs of *B. americanum* collected in Missaukee county, Michigan, near the northern extremity of the lower Peninsula. Both sets are on the same piece of wood. One had hatched, the young bugs escaping by the opening of a hinged cap on the top of the egg, but the other lot, which was deposited in part directly on top of the hatched set had never developed.

**DESCRIPTION.**

*Belostoma americanum.* Egg. [Riley's 9th Mo. Rapt., Fig. 32.] Length 5 mm.; width 2 mm. Oblong-ovate. General color brown, spotted with black; lighter below a whitish crescent near top with a distinct black spot in its apex. This crescent indicates the margin of the cap by the opening of which the insects escape. Deposited in masses of forty to sixty or more, along the borders of ponds. Described from many specimens.
**Benacus griseus.** Egg. Plate II, Fig. 6. Length 6 mm.; width 2.5 mm. General color of recently laid specimens greenish brown, with longitudinal stripes of darker brown. A faint indication of a whitish crescent near top, with a black spot in its apex. Deposited in masses, with a mucilaginous substance gluing them to each other at their bases, and to the substance on which they are laid.

Described from many specimens obtained from bugs in confinement.

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**ARTICLE III.—A PARTIAL BIBLIOGRAPHY OF INSECTS AFFECTING CLOVER.**

**BY CLARENCE M. WEED.**

It rarely happens that such a combination of insect attack upon a great crop plant occurs that two vital parts are simultaneously destroyed, yet this is the condition of Clover in Ohio to-day. Not content with the destruction of the seed crop by the Midge which has taken place for years, Nature has thrust upon us a more serious enemy—the Clover Root-Borer. Both of these insects are present, especially in the northern part of the State, in vast numbers, and have caused no little apprehension as to the future production of this invaluable plant.

These two pests, however, are not alone in their destructive attack, but, on the contrary, are aided by a host of other species which work upon every part of the plant, from the tiny rootlet concealed beneath the surface, to the exposed stem, leaves and blossoms.

In view of these facts, and of the importance of the Clover plant to the agriculture of the State, I have undertaken an extended investigation of the insects affecting it; and as a basis for future work, have prepared the following bibliography, which, though by no means complete, is believed to include references to the great majority of the economic articles relative to the subject. In its preparation free use has been made of Dr. Lintner's list of Clover insects,* and in some cases of Mr. T. F. Hunt's Bibliography of Insects Affecting Indian Corn,† although generally when the bibliography has been published by him, I have not thought it worth while to duplicate his entries, but have simply referred to one or two of the more important articles, considered from the present point of view, and cited the reader to his article for the other references.

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* Trans. N Y. St. Agr. Soc, v. 21
† Misc. Essays Econ. Entomology, Springfield, Ill., 1896, pp 97-123
In certain groups of insect, the locusts and grasshoppers for example, I have included only those species which have been known to do serious injury to clover, omitting a large number of species which undoubtedly occasionally include it among their food-plants.

At the end of the bibliography appears a systematic list of the insects discussed which shows that more than eighty species are known to attack clover. But I have no doubt that with advancing knowledge this list will be greatly extended, and that within the next few years it will reach a hundred.

Each entry has been made independent of all others in accordance with the most approved bibliographical methods.
PART I. BIBLIOGRAPHY.

Order Lepidoptera.

Family Papilionidae.


Imago described. Occurs sparingly in Illinois. Three brooded. Larva feeds on the different species of Clover, and Lupine and sometimes may be found on pea-vines.


Larva said to be "not positively known, but that of a very closely allied species, if it is not synonymous" is described, and said to feed upon Cassia and Clover.


Larva described. Feeds on different species of Clover.


Male, female and larva described. Latter feeds upon Clover, Lupine, and sometimes Peas.


Larva described. Feeds upon Clover, Lupine, and Pea-vines.


Butterflies appear twice a year. Description of butterflies and caterpillar. Latter feeds on Clover, Medicago, Lucerne, and occasionally is found on Pea-vines.


Short description of larva and butterfly. Larva feed on CLOVER, Lupine and Pea.

Eggs deposited on CLOVER and also on Pea and Blue Lupine. Account of transformations. Common, but not reported as injurious.

Bibliography. General account of life-history. Larva feed on CLOVER, peas, etc. Not known to do serious damage.


Description of imago and larva. Larva feeds on CLOVER and Cassia.

1881. MIDDLETON, NETTIE. *Telias nicippe.* 10th Rept. St. Ent. Ill., p. 79.
Short description of larva. Feeds on CLOVER, Senna and Cassia.


Brief description of imago and larva. Latter feeds on leguminous plants.

1881. MIDDLETON, NETTIE. *Telias lisa.* 10th Rept. St. Ent. Ill., p. 79.
Very brief description of larva. Said to feed on leguminous plants.


Mentioned in a list of insects which prey upon CLOVER.

Family Nymphalidæ.

8. Melitaea Editha, Bd.

Mentioned in a list of insects affecting CLOVER, on the authority of Henry Edwards.

Family Lycaenidæ.


Ins. Clover Plant, p. 5.
Mentioned in a list of CLOVER insects.
WEED—INSECTS AFFECTING CLOVER.


Included in list of Clover insects.

**Family Hesperidæ.**


Mentioned in list of Clover insects.

**Family Bombycidae.**

12. **Arctia Achala**, G. & R.


Mentioned in list of Clover insects on authority of Stretch.


Included in list of Clover insects.

14. **The Isabella Tiger Moth.** *Pyrrharctia isabella*, Sm.-Abb.


15. **The Fall Web-Worm.** *Hyphantria cunea*, Drury.


Mentioned in a list of insects affecting Clover.


Lengthy account of life-history with elaborate description of larval changes. Larva feeds on *Amorpha fruticosa, Baptisia, Prunus serotina, Clover, Sassafras, Black Locust, Indian Corn, Willows, Elm, Hop-vine, Balsam Poplar, Balm of Gilead, Dogwood, Choke Cherry, Currant, Cotton*, and perhaps on *Ironweed, (Vernonia.)* Parasites are a species of Microgaster, and *Ophion maerium.*


Bibliography as a corn insect; seventeen entries.

Family Noctuidæ.


Treated as a cabbage cutworm. Larva resembles *A. annexe.* Extended description of larva and pupa. Food-plants include *Clover, grass, Cabbage, Cotton* and different weeds.


Account of outbreak in Michigan. Description and figure of larva, pupa and moth. A dipterous parasite is described by Williston as *Scopolia sequa,* n. sp. Food consists of onions, peas, buds of fruit trees, every garden flower and plant, *grass, Clover, Dock* and *Mullein.*


General discussion of the insect, especially as a cabbage cut-worm. All stages described. Larva feeds on *grass, Clover, Plantain, Dandelion, Cabbage, Cotton,* and many other plants.


Included in a list of insects affecting *Clover.*


General account of life-history and habits.


Bibliography as a corn insect; eleven entries.


Included in list of Clover insects.

22. Mamestra Renigera, Steph.


Included in a list of insects affecting Clover.


Original description of larva, chrysalis and moth, with account of life-history. Two brooded. Larva feeds on cabbages, cauliflowers, spinach, beets, and other garden vegetables with succulent leaves. Hand-picking suggested as a remedy.


Account of life-history and habits. Larva feeds on cabbage, beets, spinach, snow-berry, (Symphoricarpus racemosus), honey-suckle, mignonette, asters, asparagus, Lambs-quarter (*Chenopodium album*), and "are also said to occur on the flowers of Clover." Figure of moth and caterpillar.


Included in list of Clover insects on authority of Glover.


General article describing various stages, habits and life-history. Food-plants: garden vegetables, especially cruciferous plants, asters, snow-berry (*Symphoricarpus racemosus*), Lambs-quarter (*Chenopodium album*), and "are also said to occur on the flowers of Clover." Hand-picking when young recommended.


Mention of occurrence on cabbage in Nebraska.

24. Prodenia Commelinae, Sm.-Abb.


Included in a list of insects affecting Clover, on authority of Dr. Riley.


Elaborate discussion under following heads: Bibliography; caterpillars in St. Lawrence county; unsuccessful attempt to rear the caterpillars; description
of the larva; notes of the occurrence of the larva; published observations on the larva; the moth; distribution of the species; its natural history; parasitic attack; preventives and remedies. Feeds on grasses, Clover and other plants.


27. The Cabbage Plusia. Plusia brassicae, Riley.


1884. Riley, C. V. Plusia brassicae. Rept. U. S. Dept. Agr., 1888, pp. 119-122, pl. I, t. 2, 2 a, pl. XI, t. 2. Elaborate discussion under following sub-heads: Range; food-plants; habits and natural history; closely related to an European species; natural enemies; remedies. Food-plants are: cabbage, kale, turnip, tomato, mignonette, dandelion, dock, Crepis, Chenopodium, Clover, Senecio scandens, Celery, Japan quince, lettuce. Natural enemies are: Apanteles congregatus, Capidosoma truncatellum, and a fungus, Botrytis riley, Farlow.


1878. French, G. H. Drasteria erechtea 7th Rept. St. Ent. Ill., pp. 283-284. Moth and larvae described. Author supposed that Clover was the only plant on which larva fed, but was informed by Dr. E. R. Boardman that the moth had been reared from a chrysalis taken from a potato stalk.

Common, but never reported to do much damage. Account of life-history with
description of various stages. Larva feeds on CLOVER.

388, fig. 142.
Bibliography. Moth common in Michigan. Description of larva and moth.
“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.”

30. HYPENA SCABRA, Fabr.

Larva described. Feeds on CLOVER. May to September.

Family GEOMETRIDAE.

31. HEMMATOPIS GRATARIA, Fabr.

Larva abundant on WHITE CLOVER.

32. ASPILATES DISSIMILARIA, Hüb.

Ins. Clover Plant, p. 5.
Included in a list of insects affecting CLOVER.

33. THE CLOVER GEOMETER. *Cymatophora crepuscularia*, Tr.

VI, fig. 5.
Larva taken on WHITE CLOVER, Rose, Common Locust and Box-elder. Larva
described.

34. EUPHITHEIA INTERRUPTOFASCIATA, Pack.

Description of larva, which feeds on CLOVER.

Family PYRALIDÆ.

35. MEAL SNOUT MOTH. *Asopia farinalis*, L.

Brief description of moth. Larva “feeds on straw and corn, and Mr. Riley has
found it feeding on CLOVER.”
Bibliography as a corn insect; ten entries.


Past history and damage. Description all stages except egg. New hay should not be put on old.

Account of life history and habits, mostly compiled from Riley.

Account of life-history with description of all stages. Larva feeds on Clover Hay. Two or more brooded. New hay should not be stacked with old.

Bibliography. General account of life-history, with short descriptions of various stages. Larva “works on dried Clover or Clover Hay while in the mow or stack.” Advises that old hay be not left in mow from season to season.


Mentioned in a list of Clover insects.


Included in a list of Clover insects.


Described as new. Said to “live in stale Indian meal and emptying cake made thereof.”

Description.

Reported from Massachusetts. Larva and its habits described.

*E. sece* given as a synonym.

Bibliography as a corn insect; two entries.
Family Tortricidae.

40. The Oblique Banded Leaf Roller. Cacoecia rosaceana, Harris.

Caterpillars curl up terminal leaves of apple and rose. Pupate in June, and moth emerges early in July. Latter described for first time.

Brief general descriptive account. Worms and moths vary greatly as reared upon Rose, Apple, Peach, Cherry, or other leaves. Surmise that it may be same as the European L. rosana, Linn.

Description of moth. "The larva binds together the leaves of the Rose and other plants."

Described as new.

1866. Packard, A. S. Lozotaema rosaceana. Guide Study Ins., p. 385, pl. 8, fig. 12.
Brief account of life-history. Larva feeds on Rose, Apple and Strawberry.


Larva described. Feeds on Apple, Cherry, Crab-apple and Horse Chestnut.

An elaborate article discussing life-history, habits, food-plants, natural enemies and remedies. Two-brooded. Bred from Apple, Cherry, Siberian Crab-apple, Lilac, Horse-chestnut, Raspberry, Strawberry, Rose, Burdock (Lappa officinalis), Thistle, (Cirsium lanceolatum), Red Clover, Rag-weed (Ambrosia artemisiifolia), Smart-weed (Polygonum pensylvanicum), Knot-grass (P. aviculare), and larva found on Dogwood, Burr-oak, Poplar, Hazel, Sumac, Wild Raspberry (Rubus strigosus), Wild Blackberry, (R. villosus), Wild Sunflower (Helianthus gross-serratus), and Blue Vervain (Verbena hastata). Destruction of larvae by hand, and spraying with arsenites suggested as remedies.

Bibliography: Habitat (Maine to California), and food-plants; latter being as follows: Rose, Apple, Peach, Cherry, Yellow Birch, Plum, Cotton, Clover, Honeysuckle, Beans, Strawberry, Cornus stolonifera, Crataegus.

Bred from Clover and Acer dasycarpum. Larvae also observed eating out pistils and stamens of freshly opened Apple blossoms.
41. Lophodorus trifera, Walker


42. Tortrix Pallorana, Robinson.


1885. FORBES, S. A. Tortrix pallorana. 14th Rept. St. Ent. Ill., p. 74; pl. VI, fig. 9. Reared from larvae feeding on Clover.

43. The Sulphur Leaf Roller. Dichelia sulphureana, Clemens.

1885. FORBES, S. A. Dichelia sulphureana. 14th Rept. St. Ent. Ill., pp. 17-20. History of literature; description of all stages but the egg; distribution; life-history; injuries. Besides food-plants before noted, it has been bred from Indian corn, Common Burdock, (Lappa major), Verbena urticifolia, Monarda fistulosa, and Erygeron canadense. Also bred from Red Clover. Three Ichneumonid parasites reared.


44. The Pale Clover Tortricid. Amphisa discopunctana, Clemens.


47. Phoceptoris Angulifasciana, Zell.


48. THE CLOVER-SEED CATERPILLAR. *Grapholitha interstinctana.* Clemens.

Original description of adult.

Described as new.

Again described as new. Habitat New York and Pennsylvania.

Larvae found in July, 1874, in New York, on clover heads, eating into and destroying the seed. Cocoons spun among florets. Also found at Washington, D. C., where there were probably three broods a season. A parasite, *Phanerotoma tabialis,* bred from it. Larva and pupa described at length, and Grote’s description of adult quoted. Cutting clover early in June recommended as a remedy.

Description of several stages. “A single larva feeds on several, and often all the seeds of a single head of clover.” Probably two-brooded. “By cutting the crop early we might destroy the larvae, though I should fear we would not.”

49. THE CLOVER LEAF MINER. *Gelechia roseosuffusella,* Clem.

[Not seen.]

[Not seen.]

[Not seen.]

Moth received from Utah. It is very widely distributed over North America.

On page 110 states that larva mines leaves of red clover, and on page 146 gives a list of bibliographical references.

Mentioned in a list of insects affecting clovers, on authority of Riley.

50. ANAPHORA AGROTIPENELLA, Grote.

[Not seen.]

[Not seen.]

On page 110 states that larva feeds in clover sod, and on page 129 gives bibliographical references.

**ORDER DIPTERA.**

**Family Oscinidae.**


Comstock refers to discovery of a larva mining the upper surface of white clover leaves in the District of Columbia, which when reared proved to be a new species of Oscinis which Burgess describes as O. trifolii. Probably three broods in a season.


Life-history and habits from Comstock.


**Family Cecidomyidae.**

52. The Clover-Seed Midge. *Cecidomyia leguminicola*, Lint.


Worms found in clover heads during 1877-8 destroying seeds. Conjectured to be a species of *Cecidomyia*.


Perfect insect raised from worms in clover heads proves to be a *Cecidomyia*, apparently undescribed.


Received from western New York where it is very injurious to clover. Life-history similar to that of wheat-midge. Description of all stages except egg and pupa. Comparison with wheat-midge and Hessian fly. Probably present for many years. “If the injuries of this insect should become serious, the clover-seed raiser will be obliged to abandon for a series of years the growth of this crop, as in no other way are we likely to affect the multiplication of the enemy.”


Occurs in Vermont, District of Columbia and Virginia, and probably in all states adjacent to New York. White clover is also infested. Eggs and pupa described. Variations in the larva and adult noted. Certainly two and possibly three broods in New York. Early cutting of clover recommended as best remedy. Two parasites recorded— *Eurytoma funebris*, n. s., and *Platypaster error*, Fitch.
   Life-history, injuries, etc.

   Description of egg, larva, pupa and fly, with account of life-history and parasites. Danger of distribution in Clover seed mentioned, and early cutting of Clover advised as a remedial measure.

   Thinks gas lime would be a good remedy.

   Specimens received from Mifflin county, Pennsylvania, where seed crop of Clover had been entirely destroyed.

   Bibliography. Exists in Virginia, Pennsylvania, New Jersey, Michigan, Ontario and New York. General account of life-history and injuries. “The only remedy suggested is deep plowing when the larvae 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.”

   Less damage reported from central New York than previously. Note of appearance in Canada and extract from Fletcher concerning preventive measures.


   Original description of larva, gall, pupa, male and female. Occurs on Red Clover.

   First announcement of occurrence in America. Found at Washington on White Clover. First flies seen appeared June 23. Descriptive notes on appearance of larva, cocoon and adult, followed by translation of Low’s original article describing the insect.

   Short sketch of life-history compiled from Comstock.

   Ins. Clover Plant, pp. 15-16, Fig. 6.
   Life-history after Comstock.

1887. Cook, A. J. *Cecidomyia trifolii.* Beal’s Grasses of North America, v. I., pp. 383-385; Fig. 141.
   Account of life-history mostly compiled from Comstock. “Even in considerable numbers it does no very serious harm, and unless it change its habits will never be a serious pest.”
WEED—INSECTS AFFECTING CLOVER.

Order Coleoptera.

Family Erotylidae.


Original description.


Bibliographical references.


Brief description of adult.


Larvae bore pith of stalks of Red Clover. Eggs inserted in stem; larva changes to pupa in lower part of its burrow. One brood a season, adult beetle hibernating. Larva described at length. Two immature parasites found in burrow.


Account of life-history after Comstock.


Bibliography, life-history, remedies.


Bibliography. Life-history after Comstock with his illustration. Widely distributed. In case insect is destructive, early cutting of Clover is suggested as a remedy.

55. Lachnosterna serricornis, Lec.


Notice of injury to Clover.

Family Chrysomelidae.


1788. Fabricius, — *brunnea*.

Original description.


Described as now.

3* o. Ex. St.
A *Colaspis* very similar to *C. st igosa* reported as doing serious injury to grape-vines.

Reported by correspondent destroying grape-vines.

Reported by several correspondents to prey on terminal shoots and young leaves of grape in Ohio and Illinois. Adult figured. Synonymy discussed.

Discussion of injuries to grape-vine, synonymy, and larval habits. Adult thought to devour larvae of Grape Leaf-folder (*Desmia maculalis*). Larvae feed on strawberry roots. Larva described.

Life-history after Riley.

Long discussion as an enemy of strawberries. Literature treated of and all stages described. Larvae feed on strawberry roots. Single brooded; larvae hatching in spring, and becoming full grown by July; adults eat leaves of Strawberry and Grape, and has been found feeding on blossoms of CLOVER and willow.

57. **The Corn Root Worm Beetle.** *Diabrotica longicornis*, Say.

Original description of adult. Specimens collected near Rocky Mountains.

Extended and complete account life-history of the insect, its injuries and the best means of preventing them. In three beetles taken from clover blossoms Nov. 18, 1883, 'the pollen and fragments of the petals of CLOVER made about sixty per cent. of the food.'

Bibliographical record; twenty-three entries.

58. **The Twelve Spotted Leaf Beetle.** *Diabrotica 12-punctata*, Oliv.

Adult seen feeding on the blossoms of Red Clover.

Family Tenebrionidae.

59. **The Meal Worm.** *Tenebrio molitor*, Fitch.

Family Meloidae.

60. Macrobasis unicolor, Kirby.


Family Otiorhynchidae.

61. Graphorhinus vadosus, Say.


1886. Forbes, S. A. *Epicerus imbricatus*. Misc. Essays Ec. Ent., Springfield, Ill, 1886, p. 21. Reported by correspondent to injure pear leaves. Beetles come out of the ground "and may be seen with their heads just sticking out, as if the earth had not been broken above them." From specimens sent, eggs were obtained. Pear leaves were "found stuck together by their opposed surfaces with a closely packed layer of slender white eggs between them."


Family Curculionidae.

63. Sitones lineellus, Gyll.

64. SITONES FLAVISCENS. Marsh.

Included in a list of CLOVER insects on authority of Kaltenbach and other European authors.

65. SITONES HISPIDULUS, Germ.

In report of meeting of Entomological Society of Washington by C. L. Marlatt, acting Recording Secretary occurs the following: "Mr. Schwarz read a note on the spread of *Sitones hispidulus*, a European CLOVER insect which has probably been recently imported. Its sudden appearance in great numbers in Washington, and the likelihood of its becoming a dangerous enemy to Clover in this country were discussed."

66. THE PUNCTURED CLOVER LEAF WEEVIL. *Phytonomus punctatus*, Fabr.

1755. FABRICIUS. *Curculio punctatus*. Syst. Ent., p. 1°0, no. 119.
Original description.


1787. FABRICIUS. *Curculio punctatus*. Mant. Ins., v. I, p. 117, no. 221.

Description.

1801. FABRICIUS. *Curculio punctatus*. Syst. Eleuth., v. II, p. 529, no. 133.
Description and bibliographical references. Inhabits Switzerland.

Described as a new species.

*P. opinus* Lec. identical with *P. punctatus*.

Appearance in CLOVER fields of New York.

Introduction into New York; injuries, description, etc.

Discovery in New York. Discussion of allied species, and life-history.

Statement that *P. opinus* Lec. is a synonym.

An elaborate article discussing the insect under the following sub-heads: Habits of the Genus; History of the Species in North America; Life-history of the species; Number of Annual Broods; Remedies; Natural Enemies; Description of Earlier States.
WEED—INSECTS AFFECTING CLOVER.


A lengthy discussion of the species under the following sub-heads: Description of the Beetle; The Cocoon; Not previously known as a Clover Pest; Its First Notice; Life-history of the Species; Possibly not lately Imported; Distribution; Remedies.


Beetles found in Ridgway, Ont. Wafted across the lake by a strong wind in August.


Account of a fungous disease of the larva of *P. punctatus*, a species of *Entomophora* to which the author gives the name *phytonomi*.


Larva affected with *Entomophora phytonomi* found in spring of 1886. Believes that no resting spores are developed but that the fungus hibernates as mycelium in bodies of living larva.


Family Calandridæ.


Very injurious in vicinity of Washington to leaves of young Cabbage, Clover, and various other plants.

Family Scolytidæ.


Received from Western New York, where great damage had been done. A new enemy to American agriculture. Review of European literature. Comparison with *H. opaculus*; and description of larva and pupa. T-lephorid larva, apparently *Telephorus bilineatus*, preys upon larva. “No other mode of prevention suggests itself to my mind than the plowing under of the Clover in the spring of the second year.”


Specimen received from Ithaca, N. Y., identified as this species.

1880. LINTNER, J. A. *Hylastes trifolii.* Rept. N. Y. St. Agr. Soc. 1879, pp. 41–42; fig.

[Not seen.]
1882. Saunders, Wm. *Hylastes trifolii.* Rept. Ent. Soc. Ont., 1881, pp. 43–44; fig. 15. Account of life-history, mostly after Riley, under the following heads: How and where the egg is deposited; The larva or grub; The pupa or chrysalis; Localities infested: Remedies.

1882. Lintner, J. A. *Hylastes trifolii.* 1st Rept. on Inj. and other Ins. N. Y., p. 54. Thinks gas lime a good remedy.


**ORDER HEMIPTERA.**

**Family PhytoCoridæ.**


1887. Lintner, J. A. *Psecilocapsus lineatus.* Count. Gent., v. LII, p. 517; 14 July, 1887; abstract in 4th Rept. on Ins. N. Y. 1888, p. 200. Insects infesting currant bushes at Fairmount, N. Y., are *Psecilocapsus lineatus* (Fabr). Description of it is given and of its method of injury. It cannot be killed by application to the leaves, as it is a suctorial insect. Remedies are burning refuse garden materials where it hibernates, killing the hibernating female when returning to the bushes in early spring for oviposition, and beating the larva and pupa into a pan of water and kerosene (Lintner).
Family COCCIDE.


A root coccid found on roots White Clover, accompanied by an ant (*Lasius*) in May, is described under above name as new.


Observed on Clover.


Observed on Clover.

Family THRIPID.E.


Specimens sent from Geneva, Wisconsin, as injuring the blossoms of Wheat and Clover early in July; characters of the Thripidae given; their numerous food plants; abundance, habits and injuries of the Grain Thrips, *Thrips cerealisum*, in England. The several stages of the Wisconsin species are described, and it is named *Thrips tritici* (Lintner).

Notes on presence in Clover heads, and probability that the Thrips subsist on tissues of the clover.

ORDER ORTHOPTERA.

Family ACRIDID.E.


Original description.

Extended discussion of the insect under the following heads: Ravages in the Merrimac Valley, New Hampshire; Historical; Characters; Range and Life-history; Natural Enemies; Remedies. Devours Clover, Oats, grasses and Corn.

Bibliography as a corn insect; five entries.
75. The Red-Legged Locust. *Caloptenus femur-rubrum*, De G.

1773. DE GEER, CARL. *Acridium femur-rubrum*. Mem. pour Serv., p. 498; pl. 42, f. 5.

Original description.


Injuries in meadows, with extract from article by President Dwight, discussing ravages. Favorite food is CLOVER and Maize. Notes on habits and life-history.


Injuries in Northern Illinois with account of investigations of egg enemies, etc. CLOVER and other crops severely injured.


Bibliography as a corn insect; fifteen entries.


Elaborate discussion of injuries, life-history and remedies.


Original description.


Described as new.


footnote.

States that *A. flavo-vittatum* is the same as Say's *A. bivittatus*, Burmeister's *A. femoratus*, and *A. milfertt*, Serv.


Bibliography. Many specimens captured in the far west.


p. 127.

Injuries of this and two closely allied species in Livingston county, Ill., 1885.


Original description.

Notes on an outbreak of indigenous locusts in Central Illinois in 1884-5. Great damage done in many localities, especially to clover. Account of abundance of enemies to the eggs; methods of destroying young grasshoppers, and probabilities of future injury.


Bibliography as a corn insect; ten entries.

ORDER NEUROPTERA.

Family Poduridæ.

79. THE GARDEN FLEA. *Smynthurus hortensis*, Fitch.


80. THE FIELD FLEA. *Smynthurus arvalis*, Fitch.


Described for first time. Often very abundant, especially in clover fields. Account of habits.

ORDER ACARINA.

81. THE CLOVER MITE. *Bryobia pratensis*, Garman.

1885. GARMAN, H. *Bryobia pratensis*. 14th Rept. St. Ent. Ill., p. 73; pl. VI, fig. 7.

A large brownish-red mite noticed in May "on clover and blue grass, the former of these plants especially, sometimes suffering severely from the pest" is described as new under above name. "The leaves of the clover turned yellow and their growth was arrested where the mite was abundant."

82. THE PALE CLOVER MITE. *Bryobia pallida*, Garman.


Found in company with *B. pratensis* on clover and grasses at Normal, Ill., in May, 1884. Described as new.
PART II. SYSTEMATIC LIST OF CLOVER INSECTS.

ORDER LEPIDOPTERA.

Family Papilionidæ.

1. Callidryas eubule, Linn.
2. Colias caesonia, Stöll.
3. Colias euryheme, Bd.
5. Terias nicippe, Cram.
6. Terias lisa, Bd.
7. Terias delia, Cram.

Family Nymphalidæ.

8. Melitea editha, Bd.

Family Lycaenidæ.

10. Lycaena comyntas, Godt.

Family Hesperidæ.

11. Eudamus pylades, Scudd.

Family Bombycidæ.

14. Pyrrharctia isabella, Sm.–Abb.
15. Hyphantria cunea, Drury.

Family Noctuidæ.

17. Agrotis malefida, Guen.
18. Agrotis fennica, Tausch.
19. Agrotis annexa, Treitsch.
20. Agrotis saucia, Hübn.
WEED—INSECTS AFFECTING CLOVER.

22. Mamestra renigera, Steph.
23. Mamestra picta, Harr.
24. Prodenia commelinae, Sm.—Abb.
25. Nepheleodes violans, Guen.
27. Plusia brassicæ, Riley.
29. Drasteria erechtea, Cram.
30. Hypena scabra, Fabr.

Family Geometricidae.

31. Haematopis grataria, Fabr.
32. Aspilates dissimilaria, Hüb.n.
33. Cymatophora crepuscularia, Tr.
34. Eupithesia interruptofasciata, Pack.

Family Pyralidae.

35. Asopia farinalis, Linn.
36. Asopia costalis, Fabr.
37. Asopia olinalis, Guen.
38. Tetralopha, n. sp., Lintner.

Family Tortricidae.

40. Cacecia rosaceana, Harr.
41. Lophoderus triferana, Walk.
42. Tortrix pallorana, Rob.
43. Dichelia sulphureana, Clem.
44. Amphisa discopunctana, Clem.
45. Platynota flavedana, Clem.
46. Sericoris instrutana, Clem.
47. Phoxopteris angulifasciana, Zell.

Family Tineidae.

49. Gelechia roseosuffusella, Clem.
50. Anaphora agrotipennella, Grote.
Order DIPTERA.

Family OSCIINIDAE.
51. Oscinis trifolii, Burg.

Family CECIDOMYIDAE.
52. Cecidomyia leguminicola, Lint.
53. Cecidomyia trifolii, Loew.

Order COLEOPTERA.

Family EROTYLIDAE.
54. Languria mozardi, Latr.

Family SCARABEIDAE.
55. Lachnosterna serricornis, Le C.

Family CHRYSOMELIDAE.
56. Colasps brunnea, Fabr.
57. Diabrotica longicornis, Say.
58. Diabrotica 12-punctata, Oliv.
59. Tenebrio molitor, Fitch.

Family MELOIDAE.
60. Macrobasis unicolor, Kirby.

Family OTIORHYNCHIDAE.
61. Graphorrhinus vadosus, Say.
Epicaerus imbricatus, Say.

Family CURCULIONIDAE.
63. Sitones lineellus, Gyll.
flavescens, Marsh.
65. Sitones hispidulus, Germ.
66. Phytonomus punctatus, Fabr.

Family CALANDRIDAE.
67. Sphenophorus placidus, Say.
Family Scolytidae.

68. Hylastes trifolii, Müll.

Order HEMIPTERA.

Family Phytoecoridæ.

69. Poecilocapsus lineatus, Fabr.

Family Coccidæ.

70. Coccus trifolii, Forbes.
71. Pulvinaria innumerabilis, Rathv.
72. Lecanium tiliae, Fitch.

Family Thripidae.

73. Thrips tritici, Fitch.

Order ORTHOPTERA.

Family Acrididæ.

74. Caloptenus atlantis, Riley.
75. Caloptenus femur-rubrum, DeG.
76. Caloptenus spretus, Thos.
77. Caloptenus bivittatus, Say.
78. Caloptenus differentialis, Thos.

Order NEUROPTERA.

Family Poduridæ.

79. Smynthurus hortensis, Fitch.
80. Smynthurus arvalis, Fitch.

Order ACARINA.

81. Bryobia pratensis, Garman.
82. Bryobia pallida, Garman.
EXPLANATION OF PLATES.

A straight line at the right of a figure indicates the natural size of the specimen. The plates are photo-engravings made from drawings prepared, under my supervision, by my assistant, Miss Freda Detmers. C. M. W.

PLATE I. (Original).

Fig. 1. The 20-Spotted Lady-Beetle (Psyllobora 20-maculata, Say).
   a. Larva. Enlarged.
   b. Pupa. "
   c. Imago. "

Fig. 2. The Larger Typha Borer. (Arzama obliquata G. & R.)
   a. Larva. Enlarged.
   b. Antenna of larva. Enlarged.
   c. Pupa. Enlarged.
   d. Imago. Natural size.

Fig. 3. The Toothed-horned Fish-Fly. (Chauliodes rastricornis, Ramb).
   a. Larva. Natural size.
   b. Pupa. "
   c. Imago, male "
   d. Imago, female "

PLATE II. (Original).

Fig. 1. The Sagittaria Curculio. (Listronotus latiusculus, Boh).
   a. Larva. Enlarged.
   b. Pupa, ventral view. Enlarged.
   c. Pupa, dorsal view. Enlarged.
   d. Imago. Enlarged.

Fig. 2. The Lesser Water-Bug. (Zaitha fluminea). Natural size.

Fig. 3. The Undulating Back-Swimmer. (Notonecta undulata). Enlarged.

Fig. 4. An Aquatic Leaf-Beetle. (Donacia subtilis). Enlarged.

Fig. 5. The Aquatic Lady-bird. (Hippodamia 13-punctata).
   b. Imago. Enlarged.

Fig. 6. Eggs of Benacus griseus. Natural size.

Fig. 7. The Giant Water Bug. (Belostoma americanum). Natural size.
LITTLE-KNOWN INSECTS.
AQUATIC INSECTS.