DEPARTMENT OF THE INTERIOR.
UNITED STATES GEOLOGICAL SURVEY.
F. V. HAYDEN, U. S. GEOLOGIST-IN-CHARGE.

FIRST ANNUAL REPORT

OF THE

UNITED STATES

ENTOMOLOGICAL COMMISSION

FOR

THE YEAR 1877

RELATING TO THE

ROCKY MOUNTAIN LOCUST

AND

THE BEST METHODS OF PREVENTING ITS INJURIES AND OF GUARDING AGAINST ITS INVASIONS, IN PURSUANCE OF AN APPROPRIATION MADE BY CONGRESS FOR THIS PURPOSE.

WITH

MAPS AND ILLUSTRATIONS.

WASHINGTON:
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1878.

at the same work. The Asilid-flies have been justly styled the h[awks] of the insect world. They pounce upon many kinds of insects, and we shall presently see, are very fond of locusts. Their larval habits [are] but imperfectly known, but so far as known they are said by most autho[rities] to be vegetarian, Harris having reared the Silky Asilus (*Asilus serice[us]* Say) from larvæ feeding on the roots of rhubarb. The egg-feeding ha[bit] here recorded would show that the carnivorous habit of the ma[ny] flies belongs likewise, in some species at least, to their larvæ.

ERAX BASTARDI.—*Larva.*—(See Fig. 35, *c*.) Length 1.05 inches. Only twelve joints, [the] three anterior and the three posterior ones tapering gradually, the rest of equal width; slightly depressed; translucent yellowish-white; the chitinous covering tolerably firm however; a swollen lateral ridge; two rufous dorsal spiracles on joint 1, and two similar ones on joint 11. Head dark brown, very retractile, pointed, divided at tip into two mandibulate points, and having two unguiform appendages; anal segment with two depressed longitudinal lines above, ridged on anterior edge, and with a central depressed line below. It makes use of its head in crawling.

Pupa (Fig. 35, *b*).—Stout, honey-yellow; the leg and wing-sheaths soldered together though separated from the abdomen; eyes large and dark; head with two large brown spines in front, and a lateral set of three rather smaller ones; thorax with two small thin rounded dorsal projections, and a set of two small lateral spines just behind the head; abdomen, with each segment ridged in the middle and furnished on this ridge with a ring of brown blunt thorns sloping backward; anal segment with a few rather stouter spines.—[*Second Mo. Ent. Rep.*

Click-beetle Larvæ.—We have discovered three distinct larvæ of this family preying upon the locust eggs. One of these (Fig. 36, *a*) is by far the most common, and was found with the same habit on several occasions by Mr. A. N. Godfrey, of Manhattan, Kans. These larvæ are popularly known as wire-worms, and there are many different species, some of which are well known to be grievous pests to the farmer, by destroying the roots of various cultivated plants. We have, however, long known that some species were carnivorous,[63] and the egg-feeding habit of the three in question is confirmatory evidence. We have failed to rear any of them to the perfect state, and they do not accord with any described species that have been determined.[69] Fig. 36, *a*, shows the more common species, with (*b*, *c*) its head and anal joint; *d*, *e*, the anal joints of the other two.

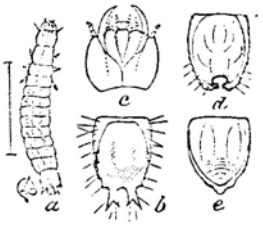

FIG. 36.—*a*, Elaterid larva that feeds on locust-eggs; *b*, head from beneath; *c*, anal joint from above; *d*, *e*, anal joints of other species with the same habit. (After Riley.)

Ichneumonid (?) Larva.—"Next to the Anthomyia egg-parasite in importance is a much larger, more sluggish, yellowish grub (Fig. 37, [*a*]) measuring about half an inch when extended, which is found within and beneath the locust eggs, lying in a curved position, the body being [bent] so that the head and tail nearly touch each other. It is a smooth gru[b]

[68] Mr. Riley has reared *Hemirhipus fascicularis* (Fabr.) from larvæ preying on those of *Cyllene p[ictus]* (Drury); *Elater luctuosus* Lec. from larvæ that fed on those of *Dendroides canadensis* Latr., and *O[edemerus] jus clavipes*, Fabr. He has also bred *Melanotus communis* Gyll. from a Black oak badly infested [by] *Chrysobothris femorata*.

[69] The larva of *Elater luctuosus* is dark brown, with the anal joint punctate, diminishing to a point, terminating in a sharp thorn. That which Fitch considers *Melanotus communis* has three blunt dentations and four longitudinal impressions on the anal joint, somewhat as in Fig. 36, *c*. That which he believes to be *Agriotes truncatus* Melsh. (the *A. obesus* of Harris, and described in full by Dr. G. H. H[orn] in *Can. Ent.* vol. iv, Fig. 4, as *A. mancus* Say), has a smooth, rather pointed anal joint, with two conspicuous dorsal spots. That of *Hemirhipus fascicularis* is broad, with a narrow, upturned anal [joint] having a few rounded thorns and two terminal sharper and larger ones. That of *Ludius attenu[atus]* has a perfectly smooth and polished anal joint.

with a very small, brown, flattened head, with the joints near the head swollen, and the hind end tapering, and with deep, translucent sutures beneath the joints, which sutures show certain venous marks and mottlings, especially along the middle of the back. It exhausts the eggs, and leaves nothing but the shrunken and discolored shells."

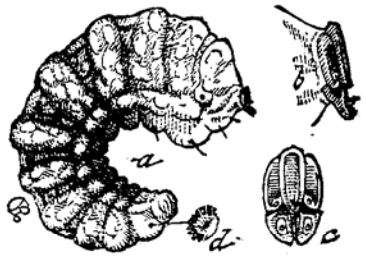

FIG. 37.—UNDETERMINED EGG-PARASITE OF ROCKY MOUNTAIN LOCUST.

This parasite has been found in Minnesota, Iowa, Kansas, and Missouri, and in 1876 destroyed about one per cent. of the eggs. The following letters refer to it:

The other day, as I was strolling through the fields, I stopped to examine some eggs. I found the ground in spots quite full of white grubs, worms or maggots, whatever they may be called. Many of them were in the egg-pods, busy at work. I collected a few, and sent to you in a small vial by mail for your examination. The ground was high and dry where found.—[S. D. Payne, Kasota, Le Sueur County, Minn., September 28, 1876.

I think the Silky Mite has done good service in destroying eggs in one or two counties, particularly Nobles. But we are getting, in addition, continual newspaper reports of white grubs destroying the eggs. I started out to see for myself, and have found a number, which I send you.—[A. Whitman, Saint Paul, Minn., September 7, 1876.

Though we have endeavored to rear quite a number of them to the perfect state, we have met with no success. The characters of the grub show it to be Hymenopterous, and probably of the family Ichneumonidæ. It hibernates in various stages of growth, and we have found the larva unchanged throughout spring and early summer, and have kept a few alive from the fall of 1876 to September, 1877, all dying in the end unchanged and without spinning a cocoon. The larva of *Pimpla instigator* is said by Motchulsky to prey on the eggs of European locusts.

ICHNEUMONID (?) LARVA.—Average length, 0.50 inch. Body curved, glabrous, tapering posteriorly, swollen anteriorly. Color opaque whitish, with translucent yellowish mottlings, and some venous marks at sutures, especially along medio-dorsum. Sutures deep. A lateral row of swellings. Head small, flattened, dark brown, in five pieces, consisting above of a frontal ovoid piece and two lateral pieces of somewhat similar form, and each bearing near tip a minute, two-jointed palpus; beneath of two broad, subtriangular jaws, having forward and lateral motion, and each, also, bearing near the center, in a depression, a two-jointed feeler. A spiracle each side in a fold between joints 2 and 3, and another on each side of the penultimate joint, 12. None otherwise perceptible.

Miscellaneous Species.—In addition to the foregoing insects that attack the eggs, different species of ants have been reported to do so to some extent. We have also found certain Myriapods, and especially a species of *Mecistocephalus* within the egg-mass, and have witnessed the common White Grub (larva of *Lachnosterna fusca*) actually feeding upon the eggs, thus giving another conclusive proof that an essential vegetable feeder will exceptionally take to soft animal food.

Mr. S. H. Scudder (Proc. Bost. Soc. Nat. Hist., vol. xii, p. 99) has recorded the rearing of a Chalcid-fly (Fig. 38) from the eggs of the Carolina locust; and we have received from R. B. Potts, Worthington, Minn., an

egg-mass of our Rocky Mountain locust, every egg of which contained a Chalcid pupa. These pupæ were too dry to permit of rearing the imago, but they were probably of the same species as that reared by Mr. Scudder. It is a black, deeply pitted fly (Fig. 38, *a*), about 5mm long, belonging to the subfamily *Eurytomides*. It does not fully correspond with any of the genera defined by Westwood, Walker, or Snellen Van Vollenhoven. We hesitate to found a new genus on a single sex, but in order to christen the insect, we subjoin a brief definition:

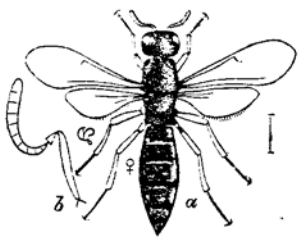

FIG. 38.—CALOPTENOBIA OVIVORA.—*a*, female; *b*, her antenna. (After Riley.)

CALOPTENOBIA, nov. gen.—♀, body elongate; strongly rugoso-punctate. Head as broad as thorax; ocelli barely distinguishable, widely apart; antennæ 12-jointed (scape + 11), the scape nearly as long as the flagellum, which is curved, slightly clavate, with joints 3, 4, 5, shortest, the others subequal, the terminal one faintly divided. Thorax elongate; collare narrow; præscutum large and swollen; scutellum small and rounded behind; metanotum concave behind, with the sides dilated and forming almost a quadrangle. Pedicil short and stout. Abdomen flattened, fusiform, 6-jointed; joint 2 excavated anteriorly, joint 3 as long as 1 and 2 together, the terminal joint very small and indistinctly separated. Wings not reaching to tip of abdomen when closed; hind pair with a fringe of sparse cilia on inner border. ♂ unknown.

C. ovivora, n. sp.—♀, color pitchy black, with sparse gray pubescence. Legs, scape, and basal joint of flagellum honey-yellow. Wings hyaline. Head and thorax broadly and confluently rugoso-punctate. Abdomen longitudinally striate. Length 5mm.

Four specimens from eggs of *Œdipoda Carolina*.

Finally, the Locust Mite, which we shall now consider, is, in the mature state, one of the most effective destroyers of the locust eggs.

ANIMALS THAT PREY UPON THE LOCUST AFTER IT IS BORN.

Red mites.—There are at least two species of red mites, and probably more, that attack the Rocky Mountain locust, the most common of which is—

THE LOCUST MITE (*Trombidium locustarum* Riley).—One of the most interesting as well as one of the most important of our locust enemies is what we may popularly call the "Locust mite." It forms a true link between those articulates which prey on the eggs and those which prey on the locusts, since it combines both traits. Referred to in previous writings under the name of the Silky mite, its natural history was first fully made out by Mr. Riley during the past summer. It differs so much in infancy and maturity that it has been referred to distinct genera, and was always known under two different names. During either period it proves a bitter enemy to the locust. In the mature form it lives in the ground, feeding upon all sorts of soft animal and decomposing vegetable matter. When the locust fills the ground with its eggs this mite flourishes upon the abundance of food which these afford, sometimes teeming to such an extent as to give the ground a scarlet hue. How numerous and how beneficial to man this mite may be as a destroyer both of the locust and its eggs is well illustrated by the statements of correspondents in the appendices (App. 18) where it is so fre-

quently referred to as the "red mite," the "little red bug," &c., as well as by the following extracts:

The course of the locusts was brought to a sudden halt by the operation of some parasite, appearing in the shape of small red mites, which attach themselves to the body, under the wings, where they suck the carcass to a dry shell; the dead bodies of the grasshoppers almost covering some plants, where they have taken hold of a leaf or stalk, and clasped it, with a dead embrace; many others fall to the ground to die, too weak to rise again. In a half day's examination, where they were very thick, we failed to find more than two grasshoppers not so attacked, and this was not local: for a distance of thirty miles across the country they were found similarly affected.—[Editorial correspondence of the *Prairie Farmer*, August 21, 1869.

A discovery has been made of great interest. A small red bug or spider, about the size of a small kernel of wheat, is found in great numbers, creeping into the holes to the grasshopper eggs and eating the contents of the eggs voraciously. Great numbers were found in the act of eating the eggs, with empty egg-shells in the same nest. The extent of the little friends is not limited, but they have been seen in many localities in different directions in this place. Mr. J. D. Johnston, Antrim, proved conclusively that these red bugs are making sure work among the eggs.—[*Madelia* (Minn.) *Times*, 1874.

Last evening, when we reached Worthington from Lake Shetek, there was quite an excitement in Worthington, owing to the fact that the citizens were generally convinced that a red parasite was destroying the grasshopper eggs. I examined the matter carefully myself, and became convinced that the destruction of the eggs in that immediate vicinity was well assured; but I determined not to write you and excite any hope until a further and more complete examination could be had. We therefore furnished our Bohemian friends with a bottle of the eggs and their pests, and the commission left in high spirits. We postponed further investigation until this morning, when I left and prosecuted the examination with vigor. The farmers in the vicinity knew nothing of these signs of deliverance until the visitors from Worthington reached them, and I feel safe in saying to you that in a circle of ten miles from Worthington there will scarcely be an egg left by to-morrow night. I send you a bottle herewith containing the cones and the parasites. We could scarcely find a cone or sack, except as they were indicated by the parasite on the surface: and each cone, which was not entirely destroyed, had from five to fifty of the red laborers at work upon the eggs. We found scores of cells with no eggs left, except the shells. * * * I stopped for fifteen minutes one and a half miles west of Wilder, where Section-Foreman Smith took me to that portion of his farm where eggs were deposited. We could find none by general digging, but wherever we found, as we frequently did, the red parasite on the surface, we found the cone beneath, with the parasite at work consuming the eggs. * * * I am aware that two years ago this parasite was found working upon the eggs at Madelia and other places, but here we have the remedy almost as soon as the eggs are laid, while in the former instances the parasite was only discovered in the spring.—[Letter from Ex-Governor Stephen Miller, written from Windom, Minn., August 15, 1876.

We send herewith a box of grasshopper eggs, together with the "silky mite," of which so much has been said. You can see a sample of the work they are doing. They are over the ground and in it wherever eggs have been laid. They suck the eggs, leaving the bare shell. We have talked with farmers from all parts of the county, and they all tell the same story—not a cell to be found that is not partially or wholly destroyed. We have personally inspected them in more than twenty different places, and are satisfied that in this county the eggs of the festive g. h. are a "total wreck." Allow us to suggest that you call for a report from every county in the State that has been infested by them.—[Letter to *Pioneer Press and Tribune*, from Bell & Gruelle, Worthington, Nobles County, Minnesota, August 16, 1876.

I send, inclosed in a circular tin box, mailed with this, some dirt containing grass-