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L. O. HOWARD, Entomologist and Chief of Bureau.

PAPERS ON CEREAL AND FORAGE INSECTS.

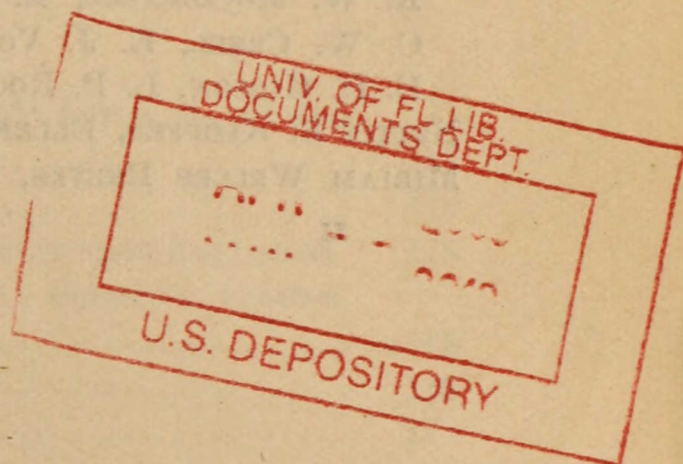
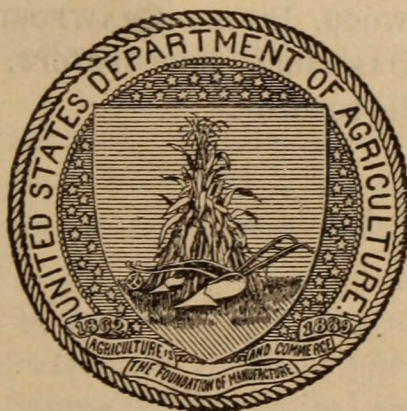
THE ALFALFA LOOPER.

BY

JAMES A. HYSLOP,

Agent and Expert.

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PAPERS ON CEREAL AND FORAGE INSECTS.

THE ALFALFA LOOPER IN THE PACIFIC NORTHWEST.

(Autographa gamma californica Speyer.)By J. A. HYSLOP,
Agent and Expert.

INTRODUCTION.

The first record of this moth of economic importance is an unpublished note by Mr. Theodore Pergande¹ made June 29, 1895, wherein he records having received from Mr. E. W. Baker, of Grand Junction, Colo., a few specimens of the larvæ of a *Plusia*, determined on the note as "*Plusia gamma* (?)," with the statement that the larvæ do much damage to the leaves and blossoms of alfalfa. Material was not preserved, so actual specific determination is impossible. As *Plusia gamma* L. is a European species, presumably it was *P. gamma californica* Speyer, now known as *Autographa gamma californica*.

The depredations of this species have not as yet been sufficiently serious to cause damage in the Palouse region of Washington and Idaho, although its attacks on alfalfa and clover have attracted the attention of many ranchers. The larvæ are usually very numerous in the early spring and gradually increase in numbers until the first hay cutting, when they appear to reach the maximum. They do not seem to be inconvenienced by the removal of the hay crop, but immediately turn their attention to the young second growth, on which larvæ are to be found throughout the summer until the early frosts.

The alfalfa looper in this locality has been held in check by a number of parasites and a disease, but any change in environmental conditions which might tend to reduce the efficiency of these natural checks or accelerate the reproduction of these moths would undoubtedly cause a serious outbreak, such as occurs periodically with the highly parasitized white-marked tussock moth, *Hemerocampa leucostigma* S. & A. It does, however, offer an excellent illustration of the statement, so often made, that many injurious insects are held in check by their parasites. Such cases as the above justify the arti-

¹ Bureau of Entomology Notes, No. 6692.

ficial introduction of parasites as one of the efficient measures to be taken in the control of a serious pest.

That *Autographa gamma californica* may appear in enormous numbers is evidenced by one of the earliest biological records on this species. A note in the Bureau of Entomology files, made by Mr. Koebele¹ in 1886, states that on the morning of April 30 he examined a mass of material collected from within an electric light globe at Los Angeles, Cal. Of 4,161 moths examined, 2,005 were *Autographa gamma californica*. He further states that the larvæ were numerous on a variety of plants. In anticipation of such an outbreak the biological notes and other data at hand in this office are herewith published.

DISTRIBUTION.

Specimens of this moth (*Autographa gamma californica*) in the United States National Museum were collected in Los Angeles County, Kern County, Placer, Alameda, and Fresno, Cal.; Colorado; Nevada; Seattle, Pullman, and Easton, Wash.; and along Kaslo Creek, in British Columbia. Mr. T. H. Parks, of this office, has collected larvæ of this species at Cokeville, Wyo., and Idaho Falls and Blackfoot, Idaho, in all cases feeding on alfalfa.

SEASONAL HISTORY.

This insect, in the Palouse region of Washington, passes the winter as hibernating pupa and probably also as the adult moth, since much-battered adults are to be seen early in the spring. Late in May and throughout June the adults are to be seen in the alfalfa and clover, darting rapidly away when disturbed. They are active in bright sunlight, feeding on the nectar from the clover and alfalfa blossoms. The flight, though short, is very direct and so rapid as to render the insect almost invisible.

May 2, 1887, Mr. Koebele¹ records observing one of these moths, at Alameda, Cal., ovipositing on *Malva rotundifolia* at 3 o'clock in the afternoon. Definite data relative to the length of the egg stage of this species have not been obtained, though several female moths were confined for that purpose. They fed greedily on sugar sirup but refused to oviposit. However, Mr. E. O. G. Kelly, of this bureau, captured a female of *Autographa brassicae* Riley in an alfalfa field at Wellington, Kans., on October 27, 1909. This moth died the following day, after laying eight eggs. These began hatching on November 2 and were all hatched the next day. This limits the egg stage of *Autographa brassicae* to seven days, and this is very likely the time of incubation of the other species of this genus.

¹ Bureau of Entomology Notes, No. 95 K.

Early in June the young larvæ become numerous in the fields, walking very much as do geometrid larvæ or "measuring worms." This is due to the fact that the larvæ have prolegs on only the fifth, sixth, and ninth abdominal segments. If disturbed they curl up and drop to the ground, the older larvæ lying there tightly curled up and refusing to move when irritated, but larvæ of the second and third instars when touched alternately straighten out and curl up very suddenly, thus jumping about spasmodically. The larvæ while young feed upon the epidermis of the leaves, skeletonizing them and giving to the attacked plant a brownish appearance. The older larvæ—that is, after the third molt—eat from the edge of the leaf toward the midrib, entirely consuming the leaves. The larval period lasts about two weeks, there being five molts with periods of about three days elapsing between each. When ready to pupate the larva spins a loose white silken cocoon (Pl. XI, fig. 2) among a number of leaves, usually well up in the plants, incorporating two or three leaves in its structure. The larva completes the cocoon in about half a day and, at least in the case of specimens reared in our insectary, pupates the day following that on which the cocoon is completed. The length of the pupal stage of specimens reared in our laboratory was very uniformly 10 or 11 days. Dr. H. G. Dyar¹ gives 12 days as the length of this period, and Mr. Koebele² records the length of the pupal stage as from 10 to 15 days. He gives an exact rearing record³ wherein he mentions a larva collected at Piedmont, Cal., February 24, 1888, which pupated on March 5, the moth emerging March 22, making a pupal period of 17 days. Dr. F. H. Chittenden, of this bureau, gives from 6 to 22 days as the pupal period of a closely related species, *Autographa brassicæ*.

Thus the time elapsing from egg laying until the adult emerges covers a period of from 26 to 48 days, probably being about 30 days in the Palouse country of Washington.

The first adults of the second generation appear in early July, and adults continue quite numerous throughout this month, belated individuals having been collected as late as August 3. There are two generations, and probably three in the case of the earlier appearing individuals, and larvæ in all instars are to be found in the field as late as the end of August, but these very late larvæ probably succumb during the winter.

Mr. T. H. Parks, of this office, records finding the larvæ of this species about half grown in the alfalfa fields about Salt Lake City, Utah, as early as May 22, in 1911. Larvæ were found throughout June. The first pupa found in this locality was obtained on June 5

¹ Entomologica Americana, vol. 6, p. 14, 1890.

² Bureau of Entomology Notes, No. 95 K.

³ Bureau of Entomology Notes, No. 389 K.

from a larva in one of the rearing cages. Mr. Parks records obtaining an adult in his cages on July 7, and observed another adult in the alfalfa fields near the Salt Lake City Field Laboratory on August 2. On August 23 one of these moths was found under a board lying along a fencerow adjoining an alfalfa field near Salt Lake City.

FOOD PLANTS.

Mr. Koebele¹ records the larva of this species as feeding on cabbage, barley, and elder (*Sambucus* sp.) at Los Angeles, Cal.; on dock (*Rumex* sp.) at Piedmont,² Cal., and records collecting a female while ovipositing and also larvæ while feeding on *Malva rotundifolia* at Alameda, Cal. We have collected the larvæ and reared adults from red clover, alfalfa, and garden peas at Pullman, Wash.

DESCRIPTIONS.

THE EGG.³

"Egg hemispherical, rounded at the base, the apex with a rounded depression. Finely creased vertically; color pale yellow."

THE LARVA.

First instar (?).—Body slender, pale creamy white, with long black hairs; head conspicuously large, shining black; thoracic legs blackish; only three pair of prolegs, situated on abdominal segments 5, 6, and 9, prolegs concolorous with body. Length, 1.8 mm.

Second instar.—Body segments 7 and 8 enlarged, 9 small; color pale green, marked with cream-colored longitudinal lines as follows: A subdorsal line, very fine and wavy; a stigmatal line, broader, straight, sharply defined dorsally, and fading out ventrally; segments ornamented with transverse row of black papillæ bearing black hairs; head cream-color; thoracic legs cream-color, with tips of claws ferruginous. Length, 3 mm. to 5 mm.

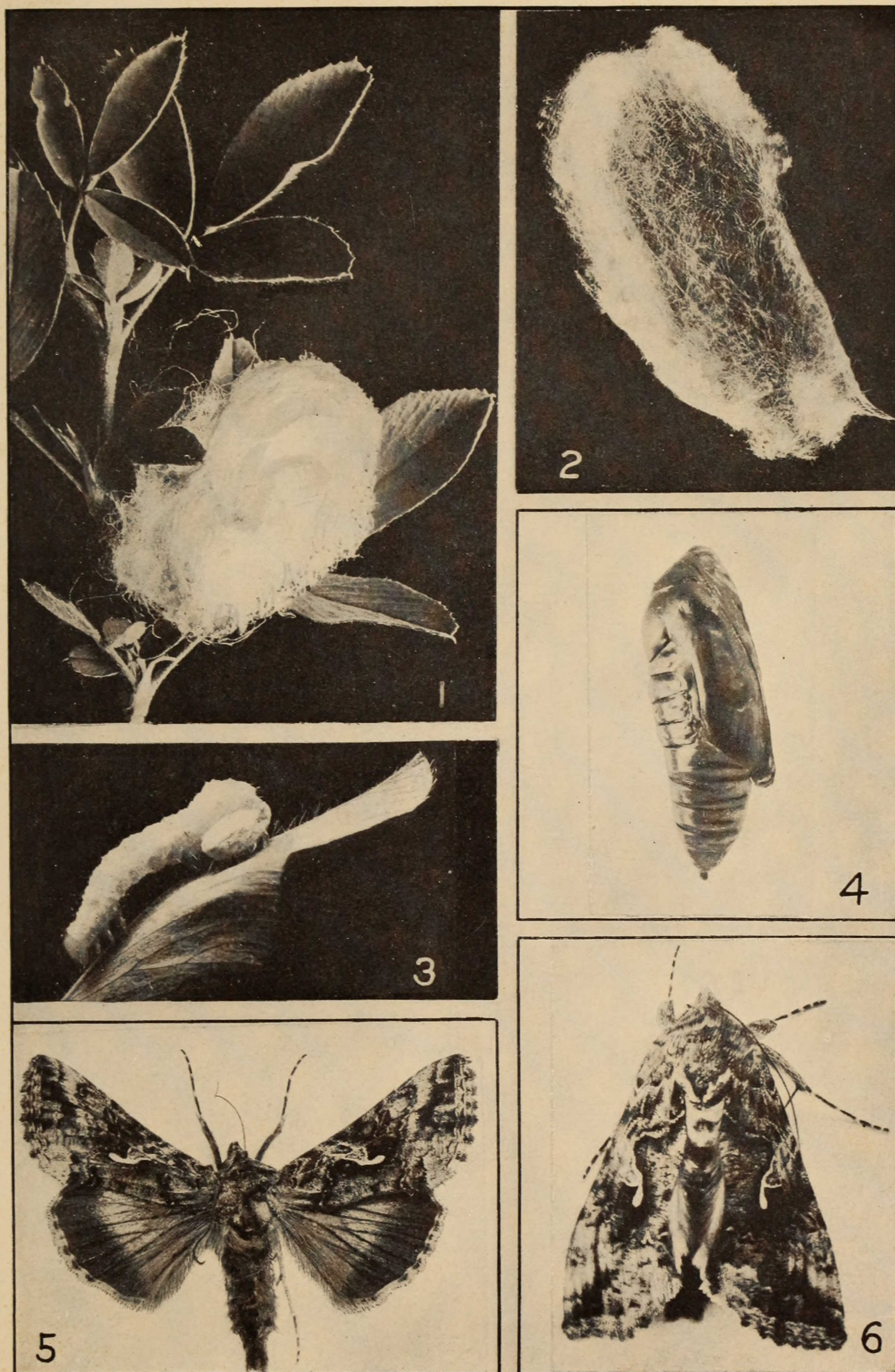
Third instar.—Body papillæ white, with black dots at base of hairs; three longitudinal lines in subdorsal space, the more dorsal one fine, clearly defined and wavy, the middle one broad and indistinct, and the third one about as fine as the first but less wavy; stigmata on first thoracic and first to eighth abdominal segments, pale, with oval black margins, that on eighth abdominal segment much larger than others; mandibles pale reddish brown; eyes with series of six black dots arranged in a ventrally directed semicircle near the base of the antennæ. Length, 6 mm. to 9 mm.

Fourth instar.—Body darker green, papillæ in two transverse rows, the papillæ of one row alternating with those of the other; head green, paler than body, mandibles and palpi brownish; thoracic legs infusate; marginal hooks of prolegs ferruginous-brown. Length, 10 mm. to 14 mm.

¹ Bureau of Entomology Notes, No. 95 K.

² Bureau of Entomology Notes, No. 389 K.

³ Entomologica Americana, vol. 6, p. 14, 1890.



THE ALFALFA LOOPER AND ITS PARASITES.

Fig. 1.—Cocoon cluster of *Apanteles hyslopi*. Fig. 2.—Cocoon of alfalfa looper (*Autographa gamma californica*). Fig. 3.—Larva of alfalfa looper with cocoon of *Microplitis alaskensis*. Fig. 4.—Pupa of alfalfa looper. Fig. 5.—Adult alfalfa looper. Fig. 6.—Adult alfalfa looper at rest. All enlarged. (Original.)

Fifth instar (fig. 45).—Body dark olive-green, dorsal edge of stigmatal line opposed by an almost black line which fades into the general body color dorsally; head brilliant green, mandibles and palpi brown, a black oblong patch on posterior margin of eye extending from near median line almost to base of mandibles; thoracic legs almost black. Length, 21 mm. to 28 mm.

THE PUPA.

(Pl. XI, fig. 4.)

"Pupa depressed somewhat above the wing cases at back of the thorax, the eyes prominent, the tongue case projecting below the wing cases, forming a round prominence over the first abdominal segment. The cremaster is short and blunt, and the hooks with which it is furnished are fastened in the silk of the cocoon. Wing cases slightly creased. Color brownish-black, but paler at the joinings of the parts and between the abdominal joints. In occasional instances the whole pupa is pale."

The above description of the larval stages of this moth agrees in substance with that published by Dr. H. G. Dyar¹ for this species in California. The larvæ, however, are not constant in the matter of coloration. Adult larvæ were found without the characteristic black markings, while others had the entire head black. Some larvæ were of the same pale-green color in the fifth instar as in the fourth, while others were almost white.

That we had the first instar is only an assumption from the number of subsequent molts obtained. Dr. Dyar's description of the pupa is used, as it agrees identically with those found in the Northwest. The pupa is dark olive-green, with brown shadings and pale intersegmental bands when first formed, but soon becomes uniformly brown.

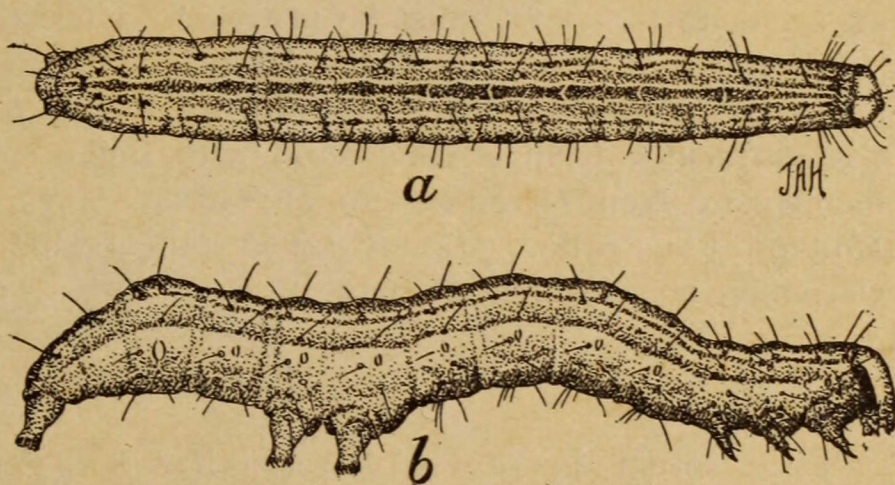


FIG. 45.—The alfalfa looper (*Autographa gamma californica*): a, Larva, dorsal aspect; b, same, lateral aspect. Enlarged $2\frac{1}{2}$ diameters. (Original.)

THE ADULT.²

(Pl. XI, figs. 5, 6.)

The following is a translation of Speyer's original description:

Two California males from Moschler's collections differ from the European *gamma* (which I can, however, only compare with native specimens) in the following points: The color of the dorsal surface of the forewings is a clear, light-blue gray, except the punctuation which is rose colored or rust colored; this is exhibited in all the *gamma* found here by me, and also in several distinct variations.

¹ Entomologica Americana, vol. 6, p. 14, 1890.

² Stett. Ent. Zeit., vol. 36, p. 164, 1875; syn: *russea* Hy Edwards.

The *gamma* mark is somewhat differently shaped: Both its upper arms diverge, thus cutting off a broader equilateral triangle, through the upper median border, between them. The outer arm of this figure forms at its inner side an obtuse angle and is directed parallel with the hind edge (of the wing) while in the European species it is more basally directed. The lower arm of the *gamma* sign runs nearly horizontal. In this direction the black enclosed part, supported by the two outer arms, is more snout-shaped while in the German forms this form is approximately a rectangular space, rounded at its apex. The ring spot is surrounded by a whitish margin, elongate, and inclined very obliquely basally. The posterior diagonal band runs from the subcostal to the inner branch of the median (branch 2), not in a smooth curve as in *gamma* but in an unbroken straight line and is not so strongly curved basally opposite the lower arm of the *gamma* sign as in the latter. On the under surface, as in the French forms, the wings are clear white with, especially on the forewings, sharp black mottlings. The remainder of the border of the underside, as is also the color of the hind wings, is lighter colored than the European forms. This form may be easily separated from moderately light varieties in color and design by these important distinctions—the *gamma* sign and the posterior diagonal band.

Whether we have to do with a distinct species, a local variety, or merely an accidental variety, must be proved by more extensive comparisons.

Specimens of *gamma* from the Atlantic States, where they are said to be indigenous by Ruhordem, Koch, and Grote, I have not yet seen. They are, when the *californica* form is considered with them, spread over the whole northern hemisphere from Greenland to Abyssinia. They should be found even in New Holland [Australia], cf., my Geographical Distribution of the Butterflies of Germany, etc., Volume II, page 219.

PARASITES.

This moth is severely parasitized. At the field laboratory in Pullman, Wash., we obtained five hymenopterous and two dipterous parasites and observed a disease during the seasons of 1909 and 1910.

On July 12, 1909, two small larvæ of the alfalfa looper, measuring about 14 mm. in length, had contracted to 8 mm., became turgid, quite hard, and changed to a rich ferruginous brown. On July 22 of the same year two specimens of *Rhogas autographæ* Vier. (fig. 46) emerged. On close examination of this improvised puparium it is found to be almost entirely made up of the abdominal segments 7 to 12 of the lepidopterous larva (see fig. 47). The thoracic and anterior abdominal segments 1 to 6 contract to form an almost black annulated cap over one end of the puparium, with the transparent head shield terminating this cap. Segment 13, bearing the anal prolegs, terminates the other end of the puparium and is also transparent. Segments 9 and 10 each bear the transparent skin of their respective prolegs. The hair papillæ on segments 7 to 10 are pale and collected in a darker elevated band around the middle of their respective segments. The adult in emerging gnaws a smooth, circular hole through the dorsum of the eleventh and twelfth segments.

On July 29, 1909, a larva was observed with a cocoon fastened between the middle and anal prolegs (Pl. XI, fig. 3). The moth larva was still alive, though unable to move from the cocoon, and died the following day. On August 1 an adult hymenopteron, *Micro-*

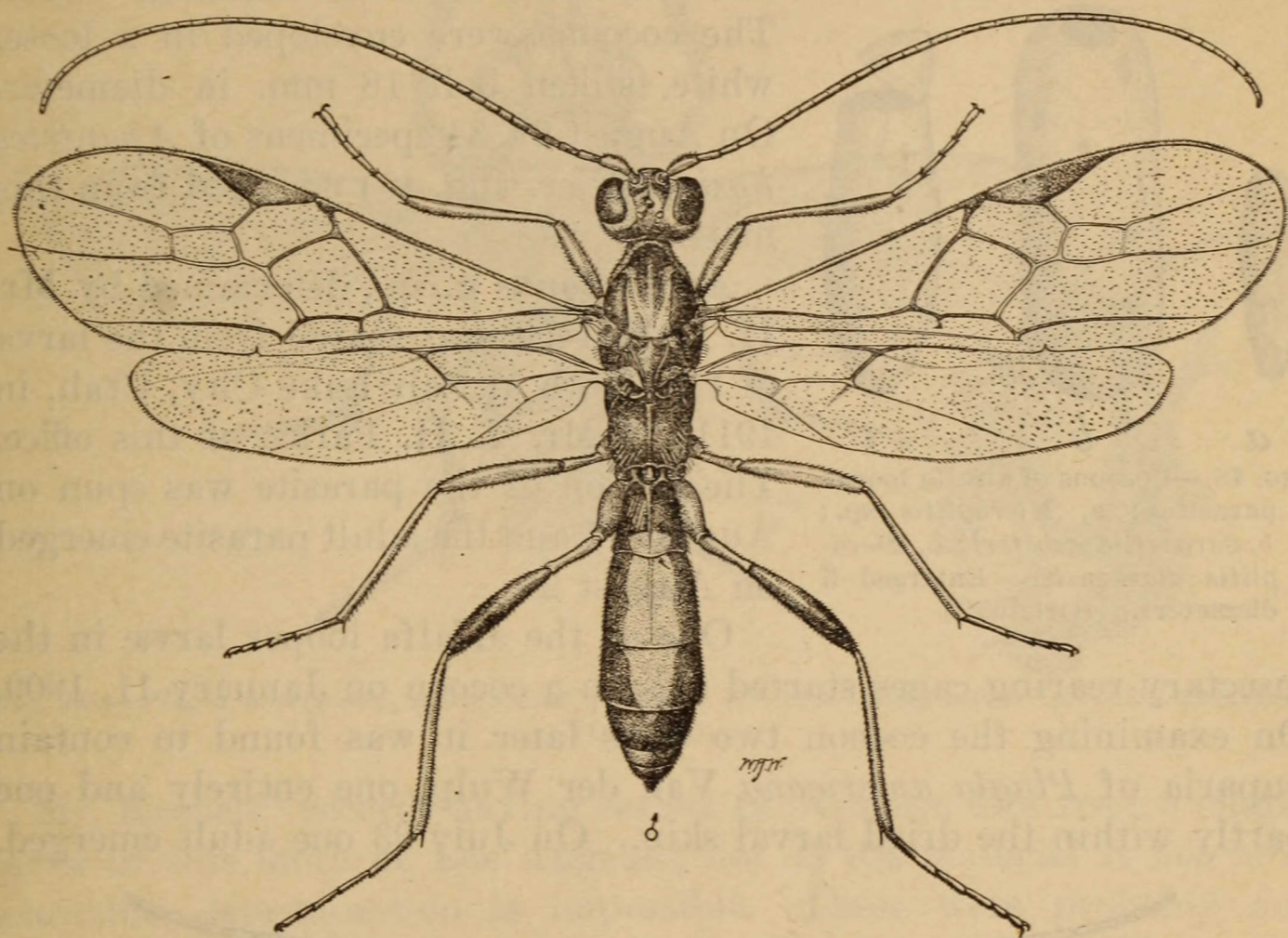


FIG. 46.—*Rhogas autographæ*, a hymenopterous parasite of the pupal stage of the alfalfa looper. Greatly enlarged. (Original.)

plitis alaskensis Ashm., emerged from this cocoon. The cocoon of this parasite (fig. 48, *c*) is pale green, 5 mm. long, cylindrically ovoid, and slightly pointed at the anterior end. In emerging the adult very neatly cuts a cap from the anterior end, this cap often remaining fastened to the cocoon by a few threads. On August 12 another larva was found bearing one of these cocoons, and on August 14 an adult parasite emerged.

Microplitis n. sp., determined by Mr. H. L. Viereck, was reared from the larvæ of these moths on June 28, 1910. This parasite spins a tan-colored cocoon which measures 3.53 mm. in length (fig. 48, *a*).

Sargaritis websteri Vier. is one of the most numerous parasites of the alfalfa looper at Pullman, Wash. The first specimen obtained emerged on August 14, 1909. The following year specimens emerged June 21, July 5, and July 25. This species spins a cocoon (fig. 48, *b*)

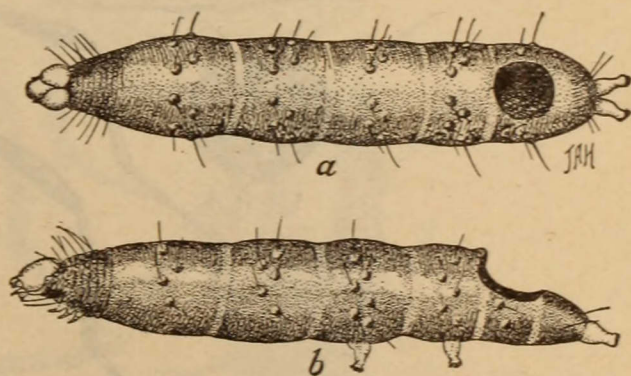


FIG. 47.—Larval skin of alfalfa looper from which *Rhogas autographæ* has issued: *a*, Dorsal aspect; *b*, lateral aspect. Enlarged 6 diameters. (Original.)

which is bluntly oval, mottled with brown, and measures 6.53 mm. in length.

On August 27 a dead larva of the alfalfa looper with a mass of hymenopterous cocoons fastened to it (Pl. XI, fig. 1) was found in an alfalfa field in Pullman, Wash. The cocoons were enveloped in a loose, white, silken ball 18 mm. in diameter. On August 29, 34 specimens of *Apanteles hyslopi* Vier. (fig. 49) emerged from this mass.

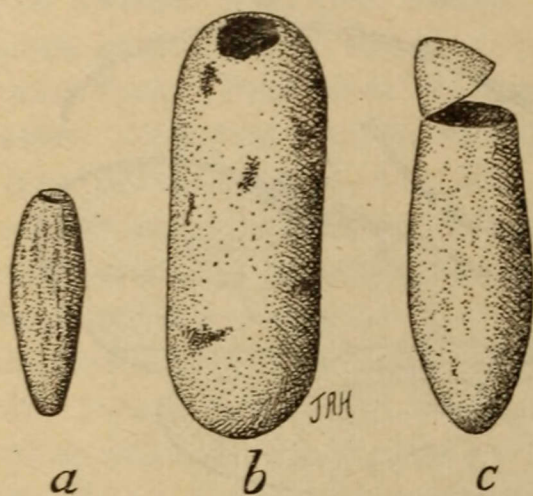


FIG. 48.—Cocoons of alfalfa looper parasites: *a*, *Microplitis* sp.; *b*, *Sargaritis websteri*; *c*, *Microplitis alaskensis*. Enlarged 5 diameters. (Original.)

Ameloctonus n. sp., determined by Mr. H. L. Viereck, was reared from the larva of this moth at Salt Lake City, Utah, in 1911, by Mr. T. H. Parks, of this office. The cocoon of the parasite was spun on August 17, and the adult parasite emerged on August 23.

One of the alfalfa looper larvæ in the insectary rearing cages started to spin a cocoon on January 11, 1909. On examining the cocoon two days later it was found to contain puparia of *Plagia americana* Van der Wulp, one entirely and one partly within the dried larval skin. On July 23 one adult emerged,

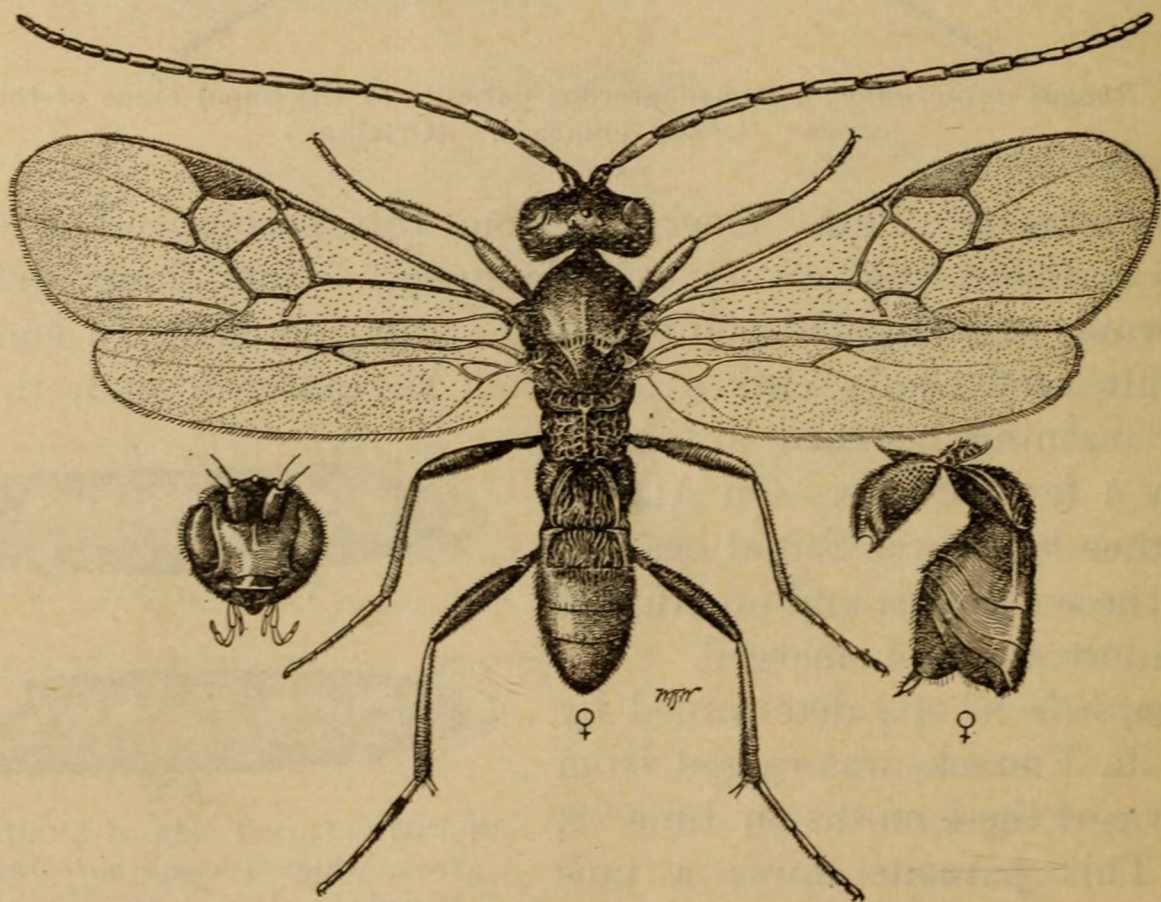


FIG. 49.—*Apanteles hyslopi*, a hymenopterous parasite of the alfalfa looper. Greatly enlarged. (Original.)

and on either July 24 or 25 another emerged (fig. 50). Several more of these flies were reared, and the number that would emerge from a larva was always directly associated with the size of the larva. A very small larva in our cages produced one fly, a medium-sized larva two, and a full-grown larva produced five of these parasites.

Two specimens of a dipterous fly, *Phorocera saundersii* Will. (fig. 51), were reared from a larva of the alfalfa looper on May 18, 1910.

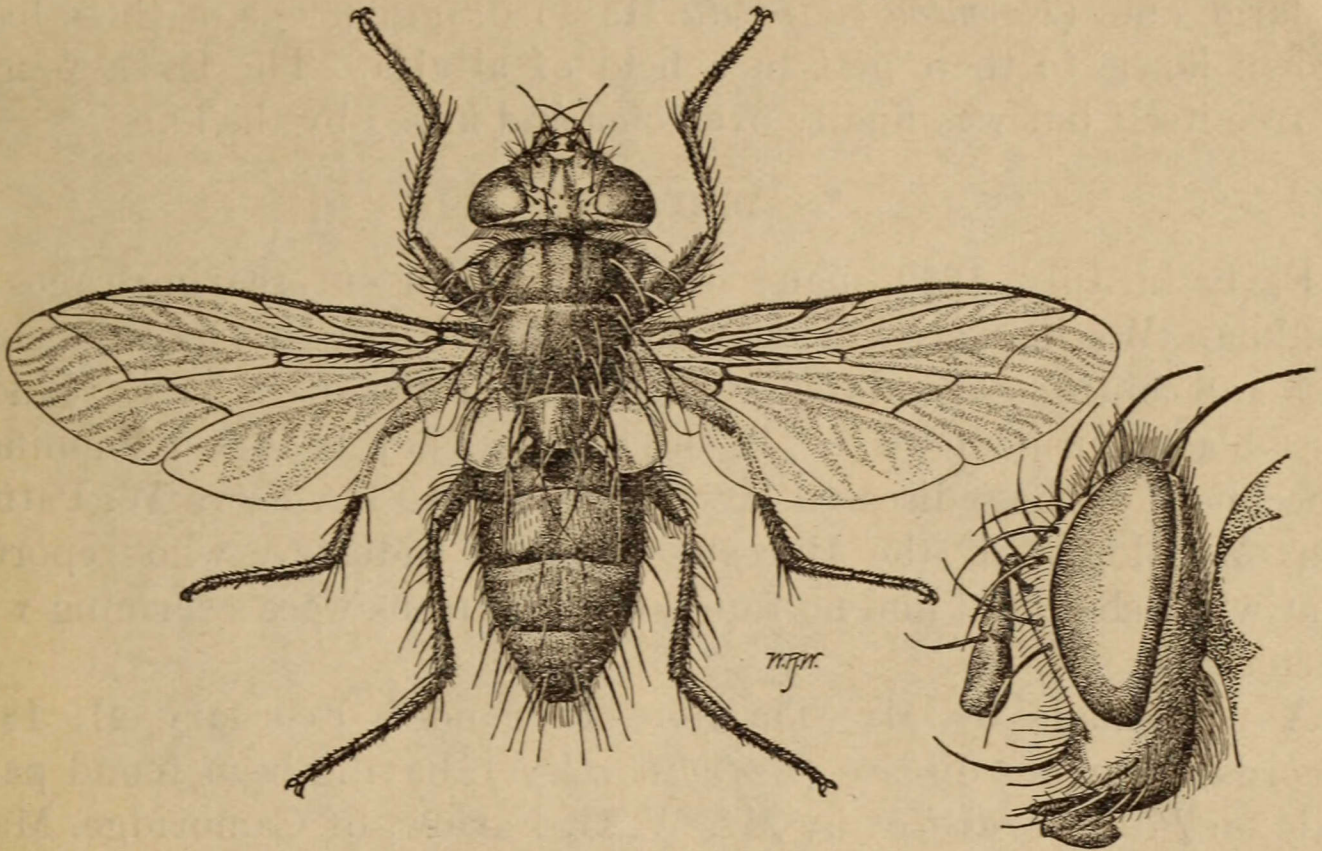


FIG. 50.—*Plagia americana*, a dipterous parasite of the alfalfa looper. Greatly enlarged. (Original.)

Mr. Koebele¹ records having reared 14 parasitic flies from a single larva of this moth at Los Angeles; but as the material is not now available, determination is impossible. These were probably not flies but Hymenoptera and very likely *Apanteles hyslopi* Vier. On

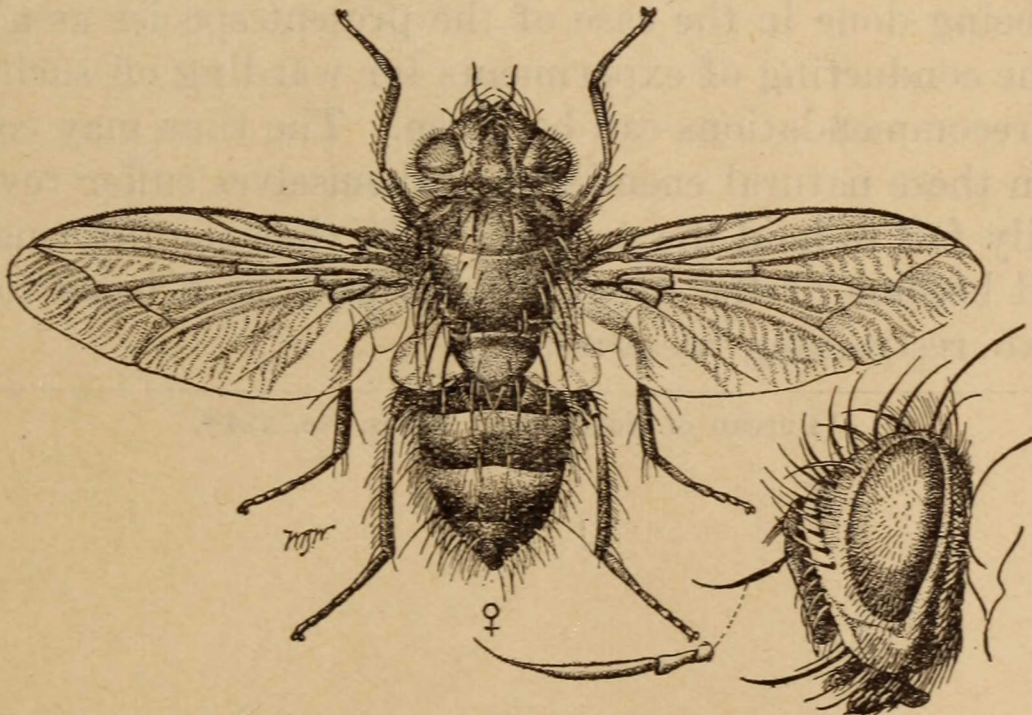


FIG. 51.—*Phorocera saundersii*, a dipterous parasite of the alfalfa looper. Greatly enlarged. (Original.)

the same note he also records rearing two flies from a larva of this moth at Alameda, Cal.

On July 8, 1909, two ants (*Formica rufa obscuripes* Forel) were found at Pullman, Wash., dragging a young larva of this insect that was alive and struggling.

¹ Bureau of Entomology Notes, No. 95 K.

Mr. T. H. Parks, of this office, also made a similar record near Salt Lake City, Utah, on August 16, 1911, wherein he observed a "number of large ants (*Formica subpolita* Mayr) dragging one of these half-grown larvæ to their nest in a field of alfalfa. The larva fought to free itself but was finally overcome and killed by the ants."

DISEASES.

Early in July, 1909, many of the larvæ in our rearing cages at Pullman, Wash., were killed by a disease. First, they became sluggish and contracted, and then turned dark brown, often being reduced to a black purulent mass. In other cases they became mummified. Specimens of these diseased larvæ were sent to Dr. Flora W. Patterson, Mycologist of the Bureau of Plant Industry, who reported that while she could find no fungi, the specimens were swarming with bacteria.

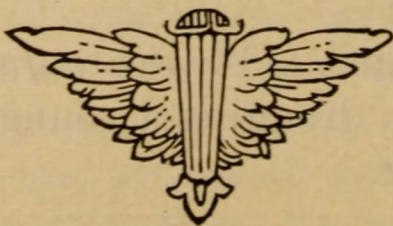
A note made by Mr. Theodore Pergande¹ February 21, 1883, records a fungous disease (*Botrytis rileyi*), having been found parasitic on *Plusia brassicæ*, by Mr. W. G. Farlow, of Cambridge, Mass.

REMEDIES AND PREVENTIVES.

Attention has already been called to the fact that in this species we have an illustration of the influence of natural enemies of a pest in protecting the interests of farmers by keeping the insect so reduced in numbers as to prevent injury to his crops. So effectually was this being done in the case of the present species as actually to prevent the conducting of experiments for warding off such injuries; hence no recommendations can be given. The time may come, however, when these natural enemies may themselves suffer reverses and temporarily fail to hold the pest in check; then the information here given will become of the utmost importance as a basis for experiments with restraining measures.

¹ Bureau of Entomology Notes, No. 294⁰².

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