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CONTENTS

Moths Collected at Hot Springs, Virginia (Lepid.).

By HENRY SKINNER.

It not infrequently happens that entomologists go on collecting trips or spend their vacation in the country and give no thought to general entomology but confine their entire attention to the group or order in which they are specially interested. This appears rather selfish to the writer and not good for entomology. Mr. Morgan Hebard is an exception to this rule. His principal work is with the Orthoptera but he does not neglect the other orders. The moths listed were in an excellent state of preservation and it was a pleasure to study them. The collection is noteworthy on account of the number of genera and species collected at one place in a short period of time. Butterflies were also collected and the true *Lycaena lygdamus* taken.* Mr. Hebard has very kindly supplied the following notes in regard to the locality and his method of collecting the specimens.

"Hot Springs, Virginia, is situated close to the western border of the state in its central portion. At an elevation of

* Ent. News, 1917, xxviii, 212.

Observations on Psyllobora taedata LeConte, a Coccinellid Attacking Mildews (Col.).[1]

By W. M. Davidson,[2] Alhambra, California.

Psyllobora taedata LeConte is a common coccinellid throughout the cultivated portions of California and the writer has observed it the past eight years in numerous localities. It occurs in about equal abundance in the coastal regions and in the interior valleys.

In all stages the insect is to be found associated with fungus infestations of the mildew type and it appears to be especially attracted to rose and apple powdery mildew (*Sphaerotheca pannosa* Lev. and *Podosphaera oxyacanthae* De Bary respectively).

The adult beetles hibernate either singly or in small colonies in sheltered locations. They issue forth in April and thenceforth breeding takes place until November and even December.

Pre-eminently a phytophagous insect, the species, nevertheless, is wholly beneficial in that it confines its feeding to destructive fungi. It, however, rarely attacks incipient mildew outbreaks, but rather well established infestations and in this respect conforms to the normal character of predatory coccinellids.

The adult beetles are small convex insects, about 2.2 mm. in length by 1.6 mm. in width; sordid yellowish-white, liberally blotched and spotted with brown and brownish-black maculations. Immature stages are whitish; the larvae and pupae bearing grayish markings.

Description of Stages.

The *ovum* is white, elongate, oval, deposited with the long axis at right angles to the leaf or stem surface. Length .6 mm., width .2 mm. The eggs are generally deposited on the surface of a leaf attacked by fungus, more rarely on the stem. When the foliage is being curled by the action of the fungus the eggs are usually placed inside the curl. They are rarely deposited in groups larger than 4; most often there are either 2 or 4 in a group.

The newly-hatched *larva* is short oval, light gray, armed with long

[1] Published with the permission of the Secretary of Agriculture.

[2] Deciduous Fruit Insect Investigations, Bureau of Entomology, U. S. Dept. of Agriculture.

slender whitish hairs, legs hyaline. Size .77 mm. x .23 mm. Twenty-four hours after hatching the larva is white with a gray head. The lateral pairs of thoracic and abdominal tubercles are white, the dorso-lateral and medio-dorsal gray. The tubercles bear whitish hairs and those of the lateral rows are the longest, about seven-eighths the length of the anterior margin of the pro-thorax.

After each molt the body color of the larva is gray with a median lighter stripe, the general color becoming paler as the instar progresses, so that at the end of each instar the insect is white. Following the first molt the larva measures about 1.6 mm. x .55 mm., following the second about 2.2 mm. x .62 mm., and following the third about 2.7 mm. x .8 mm.

The full-grown larva measures 3.1 mm. x 1.2 mm. It is elongate, sordid white, the eyes black, the head gray. The thoracic sclerites have ovoid, dusky gray tubercles armed on the margins with rather long pale hairs. The medio-dorsal and dorso-lateral tubercles of abdominal segments 2 to 7, inclusive, are circular and gray, the color on those of segment 7 inconspicuous; segment 1 has a pair of medio-dorsal gray tubercles and the dorso-lateral pair yellow. On each lateral margin is a row of sordid white tubercles. Each tubercle bears several pale hairs, those on the lateral tubercles being longest. Legs sordid whitish, coxae gray. Venter white.

Following the fourth molt or ecdysis the insect becomes a pupa. The *pupa* is short, oval, sordid white or whitish gray in ground color; head white, eyes black; prothorax white, the margin sometimes light gray; wing pads gray, darker towards the apices; legs whitish; second abdominal segment bears two small, light gray spots, one on either side of the medio-dorsum; third segment with 6 sub-circular black spots in a transverse row, innermost pair largest, outermost pair smallest; fourth segment with four smaller black spots corresponding to the two inner pairs on preceding segment; venter whitish; short whitish vestiture occurs all over the body. Darker individuals have six black spots on segment 2 and on the fifth segment four spots like those on the fourth, also two small blackish spots at the medio-dorsum of the suture dividing the second and third thoracic sclerites. Length of pupa 1.9 mm. to 2.1 mm. Width 1.2 mm. to 1.3 mm. Height .85 mm. to 1.05 mm.

The *adult beetle,* which emerges from the pupa, is convex and broadly oval; the pronotum subimpunctate, whitish with a median and four other brown spots arranged in a semi-circle and sometimes coalescing into an arc; elytra whitish or yellowish-white, each with three brownish-black subcircular spots, two variably shaped light brown spots and a median light brown vitta; the maculation of the elytra is variable as to the relative sizes of the spots, but the markings occupy a collective area slightly greater than that of the pale ground color. Antennae and legs yellowish-brown. Venter of thorax and abdomen dark brownish-black.

BIOLOGY.

In rearing the immature forms, glass vials with cotton stoppers were used and when records of the length of instars were desired the food given was rose mildew (*Sphaerotheca pannosa*).

Between September 12 and 30, 1918, a female deposited 110 ova, or 6 per day; another deposited 106 ova between September 10 and October 4, 1918, or 4.2 per day. The largest number deposited in a single day by an individual was 14, each female on one occasion reaching this amount. During the egg-laying period the beetles fed on rose mildew. The adult female commences oviposition about ten days after emergence.

Out of a total of 74 eggs under observation during August and September, 1918, all but two hatched. Field observations also indicate that very few eggs of this species are infertile.

TABLE I.

Incubation periods of 14 clusters of eggs during 1918; Sacramento, Calif.

Cluster No.	Number of Eggs	Date of Deposition	Date of Hatching	Incubation Period (Days)
1	10	July 17	July 22	5
2	2	Aug. 25	Aug. 30	5
3	17	Aug. 29	Sept. 3	5
4	8	Aug. 30	Sept. 4	5
5	6	Aug. 31	Sept. 5	5
6	2	Sept. 18	Sept. 27	9
7	4	Sept. 18	Sept. 26	8
8	5	Sept 19	Sept. 28	9
9	9	Sept. 20	Sept. 28	8
10	5	Sept. 20	Sept. 29	9
11	3	Sept. 21	Sept. 29	8
12	13	Sept. 21	Oct. 1	10
13	18	Sept. 25	Oct. 2	7
14	3	Sept. 26	Oct. 3	7

From Table 1, it is seen that the minimum incubation period at the warmest part of the year is about 5 days and that in the second half of September around the autumnal equinox it is increased to about 8½ days.

In the field the eggs are always placed close by a fungus infestation so that newly hatched larvae find a food supply at hand. All through their larval existence the insects under observation fed on the fungi; when the mycelial filaments were thick the insects cut semicircular swaths through them, somewhat reminiscent of the manner of feeding of certain lepidopterous and saw-fly larvae on leaves.

TABLE II.

Larval and pupal instars of twenty-one individuals, 1918, *Sacramento, Calif.*

DATE LARVA						Date Adult Emerged	Larval and Pupal Stages (Days)
Hatched	Molt 1	Molt 2	Molt 3	Tailed	Pupated		
July 15	July 20	July 21	July 22	July 25	July 26	July 30	15 (11-1- 4)
" 15	" 20	" 21	" 22	" 25	" 26	" 30	15 (11-1- 4)
" 15				" 25	" 26	" 30	15 (11-1- 4)
" 15				" 25	" 28	Aug. 1	17 (13-1- 4)
Aug. 30	Sep. 4	Sep. 10	Sep. 16	Sep. 20	Sep. 22	Sep. 29	30 (23-1- 7)
" 30	" 4	" 10	" 16	" 22	" 25	" 30	31 (25-1- 5)
Sep. 4		" 12	" 14	" 21	" 23	" 30	26 (19-1- 7)
" 4		" 12	" 14	" 21	" 24	Oct. 1	27 (20-1- 7)
" 5	" 8		" 16	" 20	" 22	" 1	26 (17-1- 9)
" 16			" 27	" 30	Oct. 2	" 10	24 (16-1- 8)
" 16			" 27	Oct. 1	" 2	" 10	24 (16-1- 8)
" 19	" 21	" 25	" 28	" 1	" 2	" 10	21 (13-1- 8)
" 24	" 28		Oct. 4	" 9	" 14	" 25	31 (20-1-11)
" 27			" 6	" 10	" 13	" 26	29 (16-1-13)
" 27			" 6	" 10	" 14	" 26	29 (17-1-12)
" 29		Oct. 7	" 10	" 16	" 18	" 29	30 (19-1-11)
" 29		" 7	" 10	" 16	" 19	" 29	30 (20-1-10)
" 29		" 7	" 10	" 16	" 19	" 30	31 (20-1-11)
Oct. 3	Oct. 8	" 12	" 17	" 23	" 20	Nov. 9	37 (23-1-14)
" 3	" 8	" 12	" 17	" 24	" 26	" 10	38 (23-1-15)
" 3	" 8	" 12	" 17	" 26	" 29	" 14	42 (26-1-16)

Previous to the final ecdysis the larva casts three skins; the average length in days for the four larval instars was found to be respectively 4.6, 3.7, 4, 7.1 (8 individuals), but the average for the last instar included 2.1 days from the time the larva tailed (attached itself for pupation) until the molt to the pupa actually took place.

The increase in the duration of the larval and pupal stages synchronized in general with the gradual lowering of temperature. Thus in October the larval stage was over twice as long and the pupil stage four times as long as the corresponding stages in July.

The cycle from egg deposition to adult emergence is passed in July in about 20 days, towards the end of September in about 33 days, a month later in about 50 days. Allowing an additional ten days to cover the period from emergence of the beetle to oviposition, it is found that the life cycle in midsummer is passed in a month. It appears doubtful if there are ever more than five generations in a year. All the experimental larvae recorded above were supplied only with rose

mildew for food. In no instance was cannibalism displayed by either adults or larvae.

Experiments with Animal food.

Since this coccinellid has been reported as feeding on certain animal forms (red spiders, aphids, scales) the writer made a series of experiments to determine whether larvae under laboratory conditions would thrive on such food.

Experiment A.

Two Psyllobora larvae hatched July 19. Until the 23rd they were fed on mildew; on that date and up to the 28th they were offered walnut aphids (*Chromaphis juglandicola* Kaltenbach). On the 25th, two aphids appeared attacked but otherwise no aphids were injured. July 28th both larvae were alive, having molted on the 25th, and another species of aphidid (*Macrosiphum* sp.) was substituted for the walnut aphid. July 29 one of the Psyllobora died, having exhibited no visible increase in bulk since the 23rd; the other was alive and was offered *Macrosiphum rosae* Linne. The following day the surviving beetle larva not having attacked the aphids was returned to a mildew diet, but it died August 3 without having shown visible increase in bulk since July 23. Contemporaneous beetle larvae were completing their cycle in 11 days.

Experiment B.

Five larvae hatched September 5; at once two were offered rose mildew, and 3 provided with *Aphis gossypii* Glover (instars ii-v). Two days later one of the latter group died and the following day both the survivors died; no aphids had been attacked, nor did the larvae show visible growth. Both the larvae fed on mildew cast the third molt September 16; one of these was cast out, but the other pupated on the 22nd, the imago subsequently emerging October 1. This beetle was offered walnut aphids from October 2 to 8, but refused them.

Experiment C.

Eight larvae hatched September 16; all were fed on mildew until the 20th, when two were offered red spiders (*Tetranychus* sp.). These two larvae died on the 26th without having visibly grown, and having been daily offered *Tetranychus*. September 21 three other larvae were offered young black scales (*Saissetia oleae*). On the 23rd one was returned to a mildew diet and subsequently pupated October 2. September 25 the two remaining not having exhibited any visible growth and not having attacked any scales were offered *Aphis gossypii*. They refused the aphids and died subsequently without exhibiting visible increase in bulk. The three remaining larvae of the lot were fed on rose mildew throughout the larval period and pupated October 2 to 4.

Experiment D.

Four larvae hatched on September 25 and were supplied with rose mildew. On the 27th two of the larvae were offered *Aspidiotus* sp. from Dracaena, the "armor" of the scales having been removed to enable the *Psylloborae* to feed on the soft bodies of the scales. These two larvae died respectively September 30 and October 1 without having attacked any scales or visibly increased in size since September 27. The other two were fed continuously on rose mildew and pupated October 14 and 17.

Experiment E.

Two larvae in the third instar were collected on a mildewed rose-bush, September 27, transferred to a vial and offered *Aspidiotus* sp., the "armor" removed from the scales as in Experiment D. On October 2 one of them died, the other was alive and was offered rose mildew. Neither larva showed visible increase in bulk and no scales had been attacked. The survivor subsequently transformed normally.

Experiment F.

Seventeen larvae hatched September 3 and previous to the 6th were fed rose mildew. On that day and thereafter two of the larvae were offered aphids (*M. persicae*). Both larvae died September 12. They exhibited no visible increase in size since the 6th, and no aphids had been attacked. The remaining larvae of the lot transformed normally on a mildew diet.

Experiment G.

Three larvae in the third instar were collected on a mildewed rose-bush August 27, transferred to a vial and offered red spiders (*Tetranychus*). All died on the 30th, showing no visible increase in bulk since the 27th, although one molted on the 29th. A fourth larva collected with them, fed on mildew, pupated September 2.

From the foregoing experiments it appears that under laboratory conditions aphids, red spiders, black scale and "armored" scales were refused by the larvae, the latter starving rather than partake of such animal foods.

Some similar experiments with the adult beetles had a similar result. In these aphids and red spiders were offered and in no case were eaten. The adult beetles are capable of prolonging their life without food for long periods not only during their hibernation but also in the period of activity in the spring and summer months.

The larvae of *Psyllobora* and *Thea* are said by Böving[3] to

[3] Böving, Adam. A Generic Synopsis of the Coccinellid Larvae in the United States National Museum, with a Description of the Larva of *Hyperaspis binotata* Say. Proc. U. S. Nat. Mus., vol. 51, Jan. 15, 1917.

be the only coccinellid larvae observed by him to have the mandibles produced at the apex into five teeth. The retinaculum of the mandibles (in *Psyllobora*) is also produced into five teeth. Is it possible that this is an adaptation to assist the larvae to grasp the tissues of the fungus host, the simple type of mandible sufficing for those species which grasp their animal prey? The phytophagous *Epilachna* larvae have no distinguishable retinaculum (Böving) but have the mandibular apex produced into several teeth.

A New Species of Melitaea from Montana (Lepid., Rhop.).

By Henry Skinner.

Melitaea glacialis n. sp.

♀. Palpi ferruginous, annulated black and white above, ferruginous below. Thorax and abdomen above black. Pectus below with long white hairs; legs ferruginous.

Primaries *above*: Base black; in the cell are four spots, the inner one white, small, linear and V-shaped; next one is quadrate and ferruginous, then a small white one, and an outer ferruginous spot. Beyond the cell are three small white dots, and beyond these a medial line of white spots, extending across the wing. Crossing the wing is a ferruginous fascia, 5 mm. wide. Secondaries above: The markings are quite similar to those of the primaries.

Underside with the markings nearly repeated. The secondaries below have the ferruginous fascia, a medial yellow fascia, a ferruginous inner half, with four yellow spots, two near the centre and one near the costa, the latter divided by the nervures into three parts. Expanse (one wing) 24 mm.

One specimen, taken at Two Medicine Lake, Glacier National Park, Montana, July 15, 1920, by Miss Annette F. Braun, to whom I am greatly indebted for permission to study the interesting butterflies she captured in the Park. *Type* in the collection of the Academy of Natural Sciences of Philadelphia.

This is a remarkable insect and the wide ferruginous fascia above and below distinguishes it from any species in the genus. In *Melitaea* one always thinks of aberrations, but if this specimen is an aberration I am at a loss to know the species at present. Perhaps when we know more of the butterfly fauna of the locality we can solve the problem.