

The Ohio Naturalist,

PUBLISHED BY

The Biological Club of the Ohio State University.

Volume XIV.

MAY, 1914.

No. 7.

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THE CHEESE SKIPPER. (*Piophilha casci* Linné.)* 1.

AN ACCOUNT OF THE BIONOMICS AND THE STRUCTURE OF DIP-TEROUS LARVAE OCCURING IN HUMAN FOODS WITH PARTICULAR REFERENCE TO THOSE WHICH HAVE BEEN RECORDED AS ACCIDENTAL PARASITES OF MAN.

DON C. MOTE.

The cheese skipper, *Piophilha casci* Linne, is, because of its habits, of considerable economic importance to man. Manufacturers of cheeses and smoked meats have sustained large losses from the ravages of the larva of this fly. Cases are on record where from \$1500 to \$2000 have been lost in one season. The possible relation of this fly to myiasis increases its importance. The Bureau of Entomology, U. S. Department of Agriculture, has one record of its occurrence in man. Alessandrini reports, as a result of experiments with this species on dogs, that it passes through the digestive tract uninjured and that it may cause intestinal lesions in the dog. It is therefore desirable that medical men, public health officers, meat inspectors, and parasitologists have a knowledge of the anatomy and breeding habits of this fly. The investigations upon which this account are based were begun at the Ohio Experiment Station in September 1912, when the larval stage of the cheese skipper was brought to the laboratory in some bacon that had been purchased of a local meat dealer. The bacon was placed in a jar and has with an additional quota of bacon, nourished many broods of larvae.

* Determined by Professor J. S. Hine.

The Egg. Figs. 3 and 4.

The egg is cylindrically oval, slightly narrowed posteriorly; dorsal side, concave; ventral side, convex; lateral sides, somewhat parallel. A gelatinous cap covering the micropyle is situated upon the anterior end. Length .68 mm to .75 mm. Width .18 mm to .2 mm. (10 eggs).

The chorion is smooth, partially transparent, pearly white. A delicate mosaic work of regular pentagonal facets was observed upon a small portion of the chorion of one egg. The others were covered with some material which probably obscured the sculpturing.

In the breeding jars the eggs were found on bacon, switzer cheese, ham and slightly putrid beef-steak, rarely in clusters, being, as a rule, scattered singly over the surface pointing in various directions. No eggs were ever found upon the sides of the jars.

Duration of the egg stage 23 to 54 hours. Temperature range 60° to 80° F. - Normal saline solution will hasten the hatching process. The chorion collapses after the larva emerges.

The Larva. Figs. 6-14.

The Larva may be observed through the partially transparent chorion several hours before hatching. When ready to emerge the anterior end of the egg shell is pulled back slowly, receding about $4\frac{1}{2}$ μ , and is then suddenly shoved forward. After several of these backward and forward movements, the egg-shell splits across the anterior end and back on the sides a distance of about .2 mm. (Fig. 5.) Through the opening thus made the larva emerges. The larvæ are active immediately after they emerge from the shell.

The newly hatched larvæ measure, when fully extended, from .8 to .88 mm. long; when contracted .7 to .75 mm. long. Width .1 to .15 mm. To the unaided eye, the young larvæ, except for the black chitinous mouth parts, are white. Under the binocular they have a dusky granular appearance. Through the partially transparent integument the two main tracheal tubes, for their entire length, are visible.

In shape, the larvæ are cylindrical, blunt at the posterior end, tapering gradually toward the anterior end. The segments are as distinct and of the same number as in the mature larvae. The integument is smooth and devoid of vestiture, except for three faint transverse, irregular rows of black chitinous teeth or spines on the antero—ventral portion of each of the 7 segments, posterior to and including the sixth segment.

The cephalic segment is bilobed, each lobe bearing on its antero—dorsal surface an antennal tubercle. Between the oral lobes extend the paired falcate mouth-hooks. The cephalopharyngeal skeleton extends nearly the length of the first two

segments. Except for its slenderness and smaller size, the cephalopharyngeal skeleton is similar to that in the adult larva. The tracheal trunks open to the exterior through two anterior and two posterior spiracles, similar in structure and position to those of the mature larva. On the caudal segment are found the two posterior, two dorsal, and the paired angular lateral projections present in the adult. The paired angular lateral projections are not so prominent as in the mature larva.

The full grown larva (Fig. 7) measures 9 to 10 mm. in length, and about 1 mm. in width (5 live specimens). Preserved specimens measure 8 to 9 mm. in length, 1.17 mm. in width, and .9 to 1.17 mm. in height. General shape of larva is cylindrical; truncate at posterior end; tapering gradually to a bilobed, narrower anterior end. Widest portion in the region of the 7th and 8th segments. To the unaided eye the general color is white to yellowish white; under the binocular yellowish-white to brown, especially in the regions posterior to the 4th segment. The tracheal trunks, the black chitinous mouth parts, and viscera are visible through the integument. Except for the three irregular transverse rows of spines already mentioned, the integument is smooth. The body of the larva is divided into thirteen segments.

The bilobed cephalic or pseudoccephalic segment is .15 mm. wide. The antennal tubercle (Fig. 13) located on the antero-dorsal surface of each of the oral lobes consists of three segments and measures .026 mm. long by .017 mm. wide at its base. The cephalopharyngeal skeleton (Fig. 14), visible through the integument, extends from the ventral middle portion of the pseudo-cephalic segment to the posterior part of the second segment. It consists of two uncinat mandibular sclerites (m. s.). These articulate posteriorly with the hypostomal sclerite (h. s.). The hypostomal sclerite consists of two irregular lateral bars united by two ventral bars of chitin. Posteriorly the hypostomal sclerite articulates with two processes on the anterior edge of the lateral pharyngeal sclerites (l. p.). Each of the lateral pharyngeal sclerites are wider posteriorly than anteriorly, and the posterior is deeply incised. They are united dorsally at the anterior end by a dorsal sclerite (d. p. s.) and ventrally they are continuous with the floor of the pharynx.

The caudal end of the larva (Fig. 8) measures .77 mm. wide and .71 mm. high (preserved specimens). On the posterior surface of the last segment and ventral to the caudal spiracles are located two fleshy tubercles .17 mm. apart (p. t.); each tubercle measures .13 to .17 mm. long and .068 wide at base. On the dorsal surface of each spiracular lobe is a fleshy tubercle (d. t.) measuring .05 mm. in length by .025 mm. in width. On the lateral surfaces of the last segment are located paired angular-like projections, (l. an.) measuring about .05 mm. long by .068 to .085 mm. wide at the base.

The tracheæ open to the exterior through two anterior and (a. s. p.) two posterior (p. s. p.) spiracular processes. The anterior or prothoracic spiracles (Fig. 13) are situated laterally at the posterior of the second body segment. Each spiracle consists of from 8 to 10 short, rounded lobes. The posterior spiracle (Figs. 8, 9, 12) are each situated at the ends of two very short fleshy projections from the dorsum of the terminal body segment. They are .12 mm. apart and so situated that they face each other. When the caudal segments are retracted, the spiracular lobes become less prominent and the stigmata become closely apposed. The posterior end of the tracheal trunk divides into three parts, each part possessing a stigmatic orifice. (Figs. 8, 9.).

The larval instar extended over a period of fourteen days. (average temperature 67 deg. F.) Larvæ were reared on bacon, switzer cheese, ham, fresh lean or fat beef possessing a slight putrid odor. Murfeldt and others report that it occurs in cheese, ham, especially the fatty parts, and oleomargarine. In addition to the usual method of locomotion of the cruciform larva, these larvæ at times leap or skip through the air. They accomplish this, to use the apt description of Prof. Putnam, by "bringing the under side of the abdomen toward the head while lying on their sides and reaching forward with their head and at the same time extending their mouth hooks, grapple by means of them with the hinder edge of the truncature, and pulling hard, suddenly withdraws them, jerking its self to a distance of 4 or 5 inches." The larvæ do not necessarily in preparing for the jump, have to lie on their sides. They may form the loop with only the tips of the caudal and cephalic ends touching the surface of the substance upon which they are feeding. One larva under observation sprung at least 4 inches high and a linear distance of about 6 inches.

Prior to pupation, the larvae left the substances upon which they were feeding and crawled in between the cotton plug and sides of the vial. This took place about 32 hours before the pale to dark brown coarctate puparia were formed. The puparium (Fig. 15) measures 4 to 5 mm. long by 1 to 1.7 mm. wide. Its general shape is ovate, with the caudal end obliquely truncate, and the antero-dorsal surface convexly and gradually depressed from about the 6th segment. The ventral transverse spines are observable as one heavy dark regular row and two paler less regular rows. The cephalic segment is slightly bilobed. The anterior spiracles are lateral to this segment. The posterior tubercles are very prominent. Above these are the stigmatal lobes, upon the dorsal surface of which are the dorsal tubercles. The pupal instar extended over a period of 12 days. Several entomologists have observed shorter periods than this, from 1 week to 10 days, and it is not unlikely that under adverse condi-

tions longer periods occur. In fact, it is probable that larvæ developing late in the season pass the winter in the pupal stage. The imago emerges by splitting off the antero-dorsal depressed area. (Fig. 16.)

The Adult. (Figs. 1, 2.)

The specific description of **Piophila Casei** Linne is inaccessible to the writer. The following, therefore, is a redescription of the species based upon only a dozen or so specimens and consequently is not as complete as it should be.

Male:—The dominant color is bronzy black; length to tip of abdomen 3.4 mm. to 3.9 mm.; to tip of wings 4.4 mm. to 4.5 mm.

Head (Fig. 2): Palps and proboscis fuscous, covered with many bristles. Face, yellow to fuscous, excavated; antennæ short, not reaching to oral margin, fuscous, non-porrect; non-setose arista; short bristle on second segment of antenna; cheeks, yellow to fuscous. Front fuscous immediately above the antennæ to bronzy black beyond; vertical triangle smooth, shiny black, bears three ocelli and a pair of ocellar bristles just posterior and lateral to anterior ocellus; compound eyes bare, color red. Bristles: vibrissæ present; also several bristles on lower edge of each cheek; post orbital bristles present; vertical bristles 2 pair, anterior pair erect convergent, posterior not as erect, divergent; post-vertical bristles extend over thorax, slightly divergent; fronto-orbital, a series of short bristles extending from a point just anterior to the vertical bristles to a point above and opposite the base of the antennæ. Row of very short bristles on ridge around antennal pit extending from vibrissæ on the left, around base of antennæ to the vibrissæ on the right.

Thorax: Bronzy black with 3 distinct rows of regularly placed short setæ; Scutellum, same color, bears 2 pairs of long setæ or bristles and several transverse parallel rows of short setæ, not easily observed. Sides,—same color, each bearing several long setæ. Legs: Covered with short spines; coxa yellow to fuscous; femur, fuscous at joints, middle blackish-brown. Anterior leg,—tibiæ, except at proximal joints, and tarsi, blackish-brown. Middle and hind legs,—Tibiæ blackish-brown to fuscous, fuscous at joints, tarsi fuscous.

Abdomen: Rectangular, sides somewhat parallel, tip blunt. Same color as thorax. Six visible segments, each bearing many short spines.

Wings: Overlap nearly to tips when fly is at rest. Wholly hyaline, iridescent, auxiliary vein indistinct or closely apposed to the sub-costa; halteres, pale yellow.

Female:—Same color as the male. Length to tip of abdomen 3.9 mm to 4.1 mm; to tip of wing 5 mm. to 5.2 mm. Abdomen,—six visible segments, pyriform.

Miss Murtfeldt was unable to get the female to oviposit on flesh meat of any kind. In the writer's experience, fresh beef-steak with a slightly putrid odor seemed to be the most desirable. Copulation was observed on the 3rd or 4th day after emergence of the imago and egg deposition on the third day after copulation. The adults lived from 4 to 10 days, the former being the length of life of flies without food and moisture, except at beginning; the latter, the length of life of flies in a small vial, containing slightly putrid steak and plenty of moisture. The females outlived the males.

Because of its breeding habits and the ease with which it is kept in captivity, this species should make a suitable one for the experimental zoologist. A few observations and inconclusive experiments were made on the reaction of the fly to heat, light, gravity and different food substances. When a jar of flies was placed near the window the majority gathered on the lighter side. After shaking or otherwise disturbing the same reaction followed. They also almost invariably alight with head pointing upward. They can be transferred from one vial to another by holding the bottom of the empty one towards the light. Deadened by cold, they can be revived by heat.

The following is a report of an experiment to test the comparative value of cheese, bacon, fresh beef-steak and ham as an attraction for the flies. The apparatus consisted of 7 vials and corks thru which were fitted glass tubes with lumens large enuf for the admission of the flies. One of the vials contained cheese; one fresh lean steak; one fresh fat steak; one fat bacon; one lean bacon, one fat ham, one lean ham. The vials were placed in holes in a circular piece of card-board and this card-board containing the vials was placed in a large jar. About 60 flies were admitted from the stock culture, the jar was then covered with a glass plate and placed so that the openings of the tubes leading into the vials would face the light. The flies immediately swarmed upon the glass cover which was facing the window. On the afternoon of the first day there were three flies in the vial containing the cheese, one in the vial containing the lean ham and one in the vial containing the fat ham. At noon on the second day there was one fly in the fresh lean steak vial, one in the fresh fat steak vial, four in the cheese vial, six in the fat ham vial and three in the lean ham vial. On the afternoon of the second day there were five in the fresh lean steak vial, two in the fresh fat steak vial, 5 in the cheese vial, 7 in the fat ham vial and 3 in the lean ham. The steak from which the fat and lean pieces in the vials was taken, was observed at this time to be giving off a slightly putrid odor. At noon on the 3rd day, there were 12 flies in the lean fresh meat vial, 4 in the fat fresh meat vial, 8 in the fat ham vial, 2 in the lean ham vial and 5 in the cheese vial. At noon on the 5th day the

experiment was closed with 22 dead flies in the jar; 16 (one of which was dead) females in the fresh lean meat vial; 6 live flies in the fat fresh meat vial, none in the fat bacon vial, none in the lean bacon vial, 6 ♀s, 3 ♂s, (4 of which were dead) in the fat ham vial, 2 dead males were found in the lean ham vial, 3 ♀s and 1 dead male in the cheese vial. Many eggs were found in the fresh lean and fat steak vials, the fat ham vial and the cheese vial. It would seem from this experiment that the lean fresh steak, possessing a slightly putrid odor has a greater attraction for the flies than the other substances used.

SUMMARY.

The cheese skipper because of its ravages on cheeses and smoked meats and its possible relation to myiasis is of considerable economic importance.

The fly deposits its eggs upon bacon, cheeses, smoked ham, slightly putrid beef-steak. Duration of egg stage 23 to 54 hours.

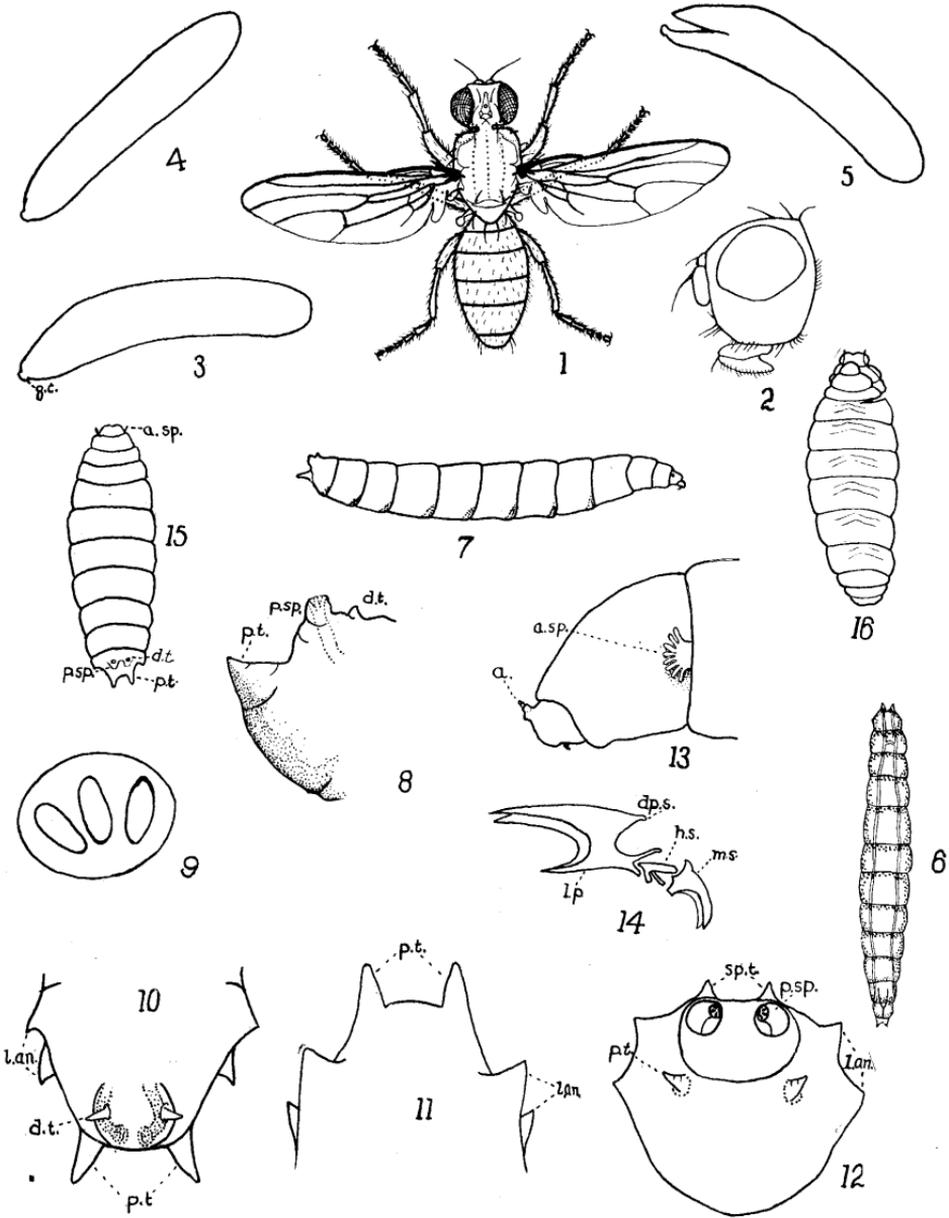
Larvæ feed upon bacon, cheese, ham, beef, oleomargarine. This insect gets its common name from the peculiar leaping or skipping habit of the larva. Duration of larval instar 14 days.

Pupation occurs in dryer places than those in which the larvæ feed. Duration of pupal stage 12 days.

The flies, in an experiment, seemed to prefer beef-steak with a slight putrid order, in preference to ham, bacon or cheese, for egg deposition. The adult flies lived longer, and the larvæ fed and matured more readily, on the beef steak than on the other substances.

EXPLANATION OF PLATE XIV.

- Fig. 1. Adult fly about 8 times natural size.
 Fig. 2. Profile of head of fly X 20.
 Fig. 3. Lateral view of egg X 50, g. c. gelatinous cap.
 Fig. 4. Dorsal view of egg X 50.
 Fig. 5. Egg after emergence of larva.
 Fig. 6. Immature larva X 50.
 Fig. 7. Mature larva X 5.
 Fig. 8. Lateral view of caudal end of larva X 40, p. t., posterior tubercle; p. sp. posterior spiracle. d. t. dorsal tubercle.
 Fig. 9. Posterior view of Caudal spiracle X 400.
 Fig. 10. Dorsal view of caudal end of larva X 35; l. an. lateral angular projections, d. t. dorsal tubercle, p. t. posterior tubercle.
 Fig. 11. Ventral view of caudal end of larva X 35.
 Fig. 12. View of posterior end of larva X 40, Sp. t. dorsal tubercles. p. sp. posterior spiracles, l. an. lateral angular projections, p. t. posterior tubercles.
 Fig. 13. Lateral view of anterior end of larva X 50, a. sp. anterior spiracle, a. antenna.
 Fig. 14. Mouth parts much enlarged, m. s. mandibular sclerites, h. s. hypostomal sclerites, l. p. lateral pharyngeal sclerites, d. p. s. dorsal pharyngeal sclerites.
 Fig. 15. Dorsal view of puparium X 8; d. t. dorsal tubercle. p. sp. posterior respiratory organ. p. t. posterior tubercle.
 Fig. 16. Pupal case after emergence of fly.



Mote on "The Cheese Skipper."