OBSERVATIONS ON THE BIOLOGY AND MORPHOLOGY OF *OPHYRA AENESCENS*

(DIPTERA: MUSCIDAE)

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Ophyra aenescens was described by C. R. W. Wiedemann (1830) from specimens he collected in New Orleans, Louisiana. Wiedemann placed this species in the genus Anthomyia but Stein in 1897 transferred it to Ophyra Robineau-Desvoidy 1830.

Aldrich (1905), and others, have placed Ophyra in the family Anthomyiidae. After studying terminalia Crampton (1944) stated that Ophyra is a typical muscid and not an anthomyid. Our observations on the larval characters of *O. aenescens* indicate it is a typical muscid and we believe this species belongs in the family Muscidae and subfamily Phaoniinae. Two names, *Ophyra argentina* Bigot and *O. carbonaria* Shannon and DelPonte, are considered synonyms of *O. aenescens*.

This species was not studied by us for any known economic importance, but because it seemed unusual to find large numbers of both larvae and adults at a small municipal dump during the winter months when air temperatures were often below freezing.

Method of rearing flies in the laboratory.—The following method was developed for rearing flies in the laboratory. Adults were kept in a cage 10 inches wide, 12 inches high, and 13 inches deep. The floor and one end were of wood and the other end was fitted with a muslin sleeve. The sides and top were screen. Water and food were provided by a wad of wet cellucotton sprinkled with cane sugar. Few eggs were laid and none of them hatched until the flies fed on animal flesh, and fish meal was satisfactory for this purpose.

Stender dishes of moist fish meal were used for oviposition. Moistness is necessary to prevent desiccation of the eggs. The dish must be loosely filled so as to leave cracks and crevices on the surface of the meal in which the flies place their eggs.

Masses totaling 300 to 400 eggs, gathered with a spatula, were put just under the surface of the medium for larval development. This medium consisted of 320 grams of the standard Chemical Specialties Manufacturing Association preparation, 25 grams fish meal, 200 cc. diamalt, one cake yeast, and 20 grams of brewers' yeast. These ingredients were thoroughly mixed and cold water was added until the mixture became moist. This amount of material filled a 6 inch diameter and 9 inch high battery jar about half full. After the eggs were added the top was covered with cheesecloth and the jar was kept at 80° to 82°F in a room illuminated from 7 A.M. to 8 P.M. No additional water was added as is usually done when rearing houseflies. When larval activity ceased the jar was uncovered and placed in a cage where the adults emerged.

Observations on the life history in the laboratory.—The eggs adhere to each other when laid and form masses. Counts of several masses revealed an average of 74 eggs per mass. It is difficult to remove individual eggs from their neighbors and separated eggs are often injured because they rarely hatch. Several females may oviposit in the same place but individual egg masses are usually evident. As stated earlier, the eggs are usually placed in cracks but in soft material, such as damp fishmeal, the ovipositor is often used to make a small hollow place in which the eggs are laid.

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The freshly laid egg is ivory white in color, approximately one millimeter long, and the greatest diameter is at the middle from which it tapers to the ends (fig. 1). The anterior end is flattened and the posterior end rounded. The dorsal surface has two ribs, or ridges, that extend the length of the egg. At first the chorion is smooth but after 12 hours of embryonic development longitudinal striations appear over its surface.

At 82°F the incubation period was 12 to 16 hours. In hatching a slit appears on the dorsal surface at the flattened anterior end and it quickly extends posteriorly between the two ridges. The larva crawls out head first.

The effects of low temperatures on eggs were studied as follows. Five tests were made using two egg masses for each test. The eggs were placed in shell vials half-filled with distilled water and the experimental temperatures were maintained for 48 hours after which the vials were placed at room temperature. None of the eggs in water which froze hatched. The lowest temperature at which exposed eggs hatched when returned to room temperature was 1°C. When kept at 8°C for 48 hours followed by room temperature, almost every egg hatched. A few experiments were run at high temperatures and the eggs hatched when maintained as high as 108°F but all larvae died within a few hours suggesting that they cannot develop at this temperature.

There are three larval instars which are similar in general shape, have 12 easily recognized segments, and superficially resemble the common housefly. Spination is limited to the locomotor pads. The newly hatched larva is about 1.5 mm. in length and the third instar may be as long as 13 mm. Each instar is characterized by distinctive features.

The first instar larva. The first segment has two pairs of papilla-like structures on the dorso-lateral surfaces which, in this stage only, look alike. The mouth hooks (fig. 2) are lightly pigmented. The anterior spiracles located laterally on the second segment, can be seen only with difficulty. The transparent integument permits observation of the tracheal system.

The second instar larva. The two pairs of papilla-like structures on the first segment are now different with the more dorsal pair being longer and annulated. The anterior spiracles are clearly visible with the stalk of each spiracle having five or six hemispherical knobs on the anterior margin. The heavily pigmented cephalopharyngeal skeleton (fig. 3), visible through the integument, extends posteriorly into the third segment.

The third instar larva (fig. 5). Again the papillae on the first segment are different with the ventral ones barely visible and the dorsal ones quite antenna-like. West (1951) calls corresponding structures on the housefly sensory lobes. The anterior margin of the first segment in dorsal aspect appears bilobed, and these oral lobes in ventral view superficially resemble the adult oral disc.

The cephalopharyngeal skeleton consists of eight sclerites (fig. 4). The mandibular sclerites are anteriormost and form the two mouth hooks which may be

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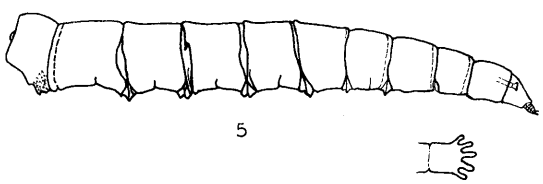
EXPLANATION OF PLATE FIGURES

FIGURE 1. Egg.
FIGURE 2. Cephalopharyngeal skeleton, first instar larva.
FIGURE 3. Cephalopharyngeal skeleton, second instar larva.
FIGURE 4. Cephalopharyngeal skeleton, third instar larva.
FIGURE 5. Third instar larva.
FIGURE 6. Caudal spiracle, third instar larva.
FIGURE 7. Puparium, four days old, containing a pupa.
FIGURE 8. Head of female.
FIGURE 9. Wing.
FIGURE 10. Thorax, lateral view.
FIGURE 11. Male external genitalia, lateral view.



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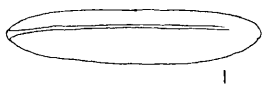

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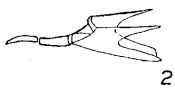

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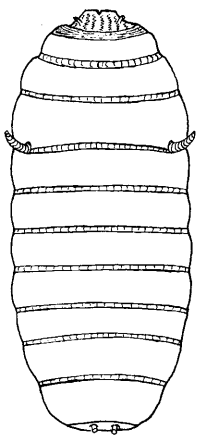

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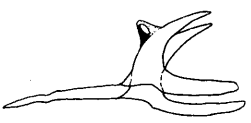

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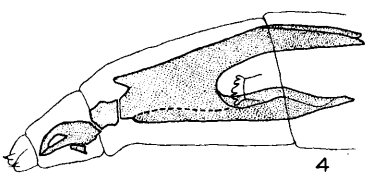

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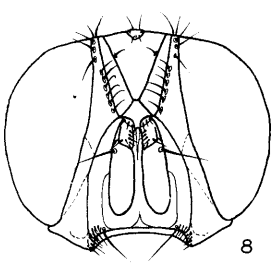

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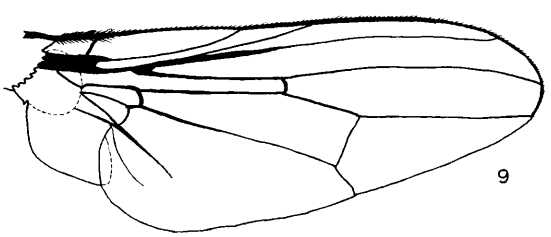

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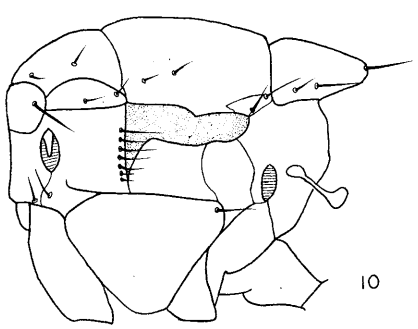

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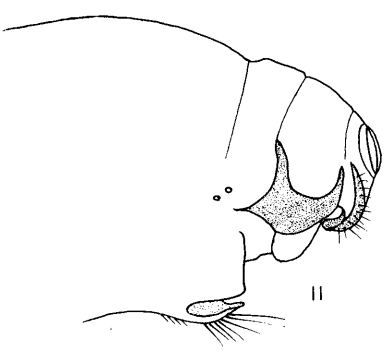

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extended from the oral cavity when used in locomotion and feeding. The bases of the mandibular sclerites articulate with the hypostomal sclerite. Each mandibular sclerite at its posterior-ventral margin has a dentate sclerite. The posterior margin of the hypostomal sclerite articulates with the fused portion of the two large pharyngeal sclerites which are the most conspicuous parts of the cephalopharyngeal skeleton. Each pharyngeal sclerite has a dorsal wing and a ventral wing. The two ventral wings are joined and form a support for the pharynx; the two dorsal wings are bridged anteriorly by the dorsopharyngeal sclerite.

From anterior to posterior there is a gradual increase in the diameter of the segments except for the last one which is conspicuously elevated over the one in front of it. The locomotor pads are on the fourth through the twelfth segments, although poorly developed on the eleventh, and they are covered with minute recurved spines. The locomotor pad on the twelfth segment is the largest and separated into two lobes with the anus between them. The caudal spiracles (fig. 6) appear as a pair of raised, heavily pigmented, circular discs near the center of the posterior surface of the terminal segment. Some of the internal organs can be seen through the body wall but fat accumulates and obscures these structures and gives the larva a creamy white color.

Pupation takes place in the skin of the third larval instar; hence, the covering of the pupa is a puparium and the pupa is of the coarctate type. The puparium (fig. 7) of twelve recognizable segments is a deep reddish brown within six hours after the onset of pupation. The first segment is reduced in size, roughened in texture, and retains the old larval anterior spiracles represented by a pair of light yellow minute projections. The ventral surface bears persistent locomotor pads on the last segment. Two days later the pupal spiracles, called spiracular horns, appear on the latero-dorsal surfaces between the fifth and sixth segments. These spiracular horns appear to be the pupa's only source of air since dissection reveals the larval spiracles are not connected with the pupa after the horns are fully developed. The minimum duration of the pupal stage was four days.

The distinguishing characters of the adults of this species are indicated in figures 8, 9, 10, 11, and in the key for separation of the three species of the genus found in north America.

The sexes can be easily separated by the contiguous eyes of the male and the separated eyes of the female and by the wing position at rest. The female holds her wings parallel to each other and the male's wings are crossed half way between the fifth and sixth veins. The male is 6 mm. in length and the female is usually no more than 0.5 mm. longer.

In the laboratory, males lived an average of 15 days and females lived an average of five days longer. Mating was not observed until the second day after emergence and eggs were produced two days later. To get some idea of reproductive capacity, pairs of newly emerged flies were placed in cages and the total number of adult flies obtained from each of six such pairs is indicated in table 1.

A generation took place in as little as 14 days in the laboratory at 80°F ± 2°. At temperatures above and below this range development was retarded. For eggs the minimum period to hatching was 12 hours, the larval stages had a minimum of five days to pupation, and the minimum pupal time was four days before the adults emerged. The preoviposition period was four days. The maximum life observed for males was 18 days and 35 days for females.

Additional field observations.—As mentioned earlier all stages of *Ophyra aenescens* were found throughout the year and winter temperatures at ground level and above were often below freezing. No evidence was obtained that any stage went into a dormant period under unfavorable conditions. None of the life history stages was found to withstand freezing temperatures.

Three series of temperatures were taken in the field, about two inches under the surface of fermenting garbage where living larvae were present, when air temperatures five feet above the ground were 12°, 28° and 32°F. The data for the first temperature are apparently lost but for the second temperature five readings were from 96° to 106°F and for the third temperature eight readings were from 100° to 110°F. The larvae crawl around a lot and concentrations of them are found where the temperature is from 80° to 90°F and they pupate in areas of similar temperature.

Survival of adults during winter appears possible due to several characteristics of behavior. The adults are seldom found far from the fermenting garbage on which they feed and on which the eggs are laid. At night the adults stay on their food, walking over it and feeding and crawling under its surface, which is in distinct contrast to other species studied which were observed to leave their food and spend the night on vegetation or buildings nearby. Thus, the adults are able to avoid the cold of winter and also unfavorable periods of intense heat during summer.

TABLE 1

The offspring reaching adulthood and their sex of six individually caged pairs of parents

Cage Number	1	2	3	4	5	6
Male offspring	145	163	148	158	158	234
Female offspring	180	176	128	192	167	204
Total offspring for each pair	325	339	276	350	325	438

This species is able to fly considerable distances and Bishopp (1921), studying dispersal of flies by flight, took four specimens 4.4 miles from the point of liberation.

Since 1930 when *Ophyra aenescens* was described from specimens collected in New Orleans the species has been reported from a number of southern states, islands of the Caribbean Sea, and various places in Mexico, Central and South America. In the northern states Leonard (1926) reported this species for New York; specimens in The Ohio State University Entomology Museum were collected in Southern California, and we have taken specimens in Ohio, Kentucky, and West Virginia.

Two additional species of Ophyra are known to occur in the United States. These are *O. leucostoma* (Wied.), which is common and widely distributed, and *O. capensis* found at Troy, N.Y. and kindly reported to us by Dr. H. R. Dodge. These three species can be separated by the following key.

1. Palpi rufous-yellow; hind tibia with one long postero-dorsal bristle beyond middle, and two short antero-ventral bristles: calypters yellow; one humeral bristle ..... *aenescens.*
   Palpi black 2
2. Hind tibia conspicuously curved; two humeral bristles; calypters fuscous.. ..... *leucostoma.*
   Calypters white ..... *capensis.*

SUMMARY

All stages of *Ophyra aenescens*, a typical muscid fly, were found in and around decomposing garbage at a small municipal dump in winter when air temperatures were often below freezing. This observation stimulated a study of the biology of this species both in the field and in the laboratory. These observations are

reported and the different stages in the life history are described and illustrated. The method used in culturing the flies in the laboratory is described.

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