

NOTES ON THE BIOLOGY OF THE FIREFLIES.

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During the past year I became interested in studying the biology of the fireflies, and after looking up the literature on the group I concluded that little was known regarding them except what had been learned from a study of the adults.

The following species were studied: *Photinus consanguineus* Lec., *Photinus scintillans* Say, *Photurus pennsylvanicus* DeGeer, and *Pyropyga fenestratis* Mels. Most attention, however, was given to *Photurus pennsylvanicus*, and this paper will be limited to a discussion of that species.

This firefly, *Photurus pennsylvanicus*, is one of the largest and most common of our native species. As is common of our luminous fireflies, the adults are usually found only at night since they spend the day concealed underneath moss or grass, although occasionally specimens were found clinging to the underside of leaves of low vegetation. Like many other insects, this species has well defined centers of distribution, it being rarely found except along marshy or moist localities. Some of the smaller species of fireflies, however, seem to prefer the drier regions.

Many insects during their adult life eat little or no food, but the adults of this species, especially the females, are very voracious in their feeding habits. These females were commonly observed devouring other species of fireflies, and not infrequently the males of their own species.

In the case of nearly all our luminous fireflies the female never flies, but remains on or near the ground and there awaits her mate. In this species, however, the female is also an active flier.

It is agreed by most students of fireflies that the light-emissions serve to bring the two sexes together. In our smaller native species there is a definite interchange of flashes, by which the male is able to find the female. In this species both sexes are active fliers and they flash frequently whether in the presence of each other or not. In no case was there observed a definite exchange of flashes between the sexes of this species. Yet, on several occasions while holding females in my hand, males flew to them, and on two occasions while holding males, females flew and alighted beside the captured males. This would lead one to believe that there is a definite sexual attraction between the sexes of this species, and that the females having become active fliers, are also attracted to the males.

The characteristic place for the oviposition, by the females, is at the base of grass or moss in damp loamy soil. The eggs which are deposited about the first of June are usually placed in little cracks or depressions in the earth, and there they remain for a period of approximately 26 days, when they hatch into little larvae. These little larvae, which hatch about July first, require nearly two years to complete their growth before they transform into adults.

The larvae resemble to a considerable extent the habits of the adults as they are active only at night. This makes it rather difficult to study their

feeding habits in the field. On several occasions, however, larvae were taken while feeding on snails, which they had evidently killed a short time before being discovered. Numerous larvae were taken into the laboratory where they were placed under as nearly normal conditions as possible for the purpose of determining the nature of their food. On six different occasions a slug (*Agriolimax campestris* Binney) was placed with six larvae of *Photuris pennsylvanica* and in every case it had been eaten before morning. A slug (*Agriolimax agrestis* L.) and a snail (*Succinea avery* Say) were put with six larvae. The snail was eaten during the first night, but the slug was not killed and eaten until the third night. On two different occasions two small earthworms (*Lumbricus terrestris* L.) were placed in a jar without earth, which contained eight larvae. One was killed and eaten the second night, and the other on the fifth night. On two occasions a very large specimen of *Lumbricus terrestris* was placed with twelve firefly larvae. In each case the earthworm was not eaten, though it remained with the firefly larvae for over a week, and they received no other food during that time. On two occasions a cutworm larva of each of the following species: (*Paragrotis messoria* Harris, *Paragrotis tessellata* Harris, and *Peridroma margaritosa* Haworth) were placed in jars with six larvae and in every instance they were eaten the first night. Finally, on four different nights, two second and two third stage squash-bug nymphs (*Anasa tristis* DeGeer) were placed with six larvae, and in each instance they were eaten before morning. Some of the hard-bodied Arthropods which normally live on the ground, such as sowbugs (*Oniscus asellus* Paulmier), wireworm larvae (*Agriotes mancus* Say), ants (*Formica* sp.) and coleopterous beetles including the common ground beetles (*Nebria Pallipes* Say and *Chlaenius pennsylvanicus* Say) were placed with these larvae, but they were never eaten.

These experiments lead one to conclude that the firefly larvae probably eat any soft bodied insect larva, Mollusk or Annelid, that they happen to find in their nocturnal wanderings. Slugs, snails, cutworm-larvae, and small earthworms are probably their chief foods.

The larvae of many of the fireflies as well as certain other more or less widely separated groups of insects digest their food entirely or partially outside of their bodies. This is accomplished by the digestive juices being exuded through the mouth and hollow mandibles upon the food which is later eaten by the larva in a nearly completely digested condition. Such is true of the larva of *Photuris pennsylvanica*. When this larva first pierces its prey it immediately injects a substance by means of its mandibular canals into its body, which seems to paralyze it.

As was said before, the larva of *Photuris Pennsylvanica* lives for nearly two years before transforming to a pupa. During the cold winter months from about November first to March fifteenth it lies concealed underneath stones, logs or something similar. During the warm summer months it wanders about at night in search of food, while during the day it remains concealed.

About the middle of May of the second year when the larva is approxi-

mately twenty-two months old, it chooses a suitable spot on the surface of the ground and builds a lattice work of soft earth over itself in the shape of a small dome, by which means it conceals itself in about a day. In the construction of this cell the larva removes earth from underneath itself by means of its mandibles. This it masticates in its mouth for a short time, after which it regurgitates it in the form of a short ribbon-like mass, which it applies to the walls of the chamber.

Almost as soon as this chamber is completed the larva becomes sluggish and transforms to a pupa. The extent of the pupal period was found to vary from sixteen to eighteen days, at the end of which time the pupae transformed to adults and emerged.

So far as the economic importance of fireflies is concerned it is generally believed that they are of little or no importance. This conception is far from correct. It is true that the adults are of little value as most of them probably eat comparatively little, and most of the insects upon which they feed are not injurious. The larvae, on the other hand, are voracious little creatures which feed largely upon injurious species of animals, such as cutworm larvae, slugs, snails, etc. Most of the soft bodied animals living on the ground are injurious (unless it is the earthworm), and as the food of firefly larvae is probably limited to these small animals, they necessarily do much economic good in killing them. The slugs and cutworm larvae are among our worst economic pests, and it seems evident that they furnish a large part of the food of these larvae. Most of our fireflies live two years as larvae, hence the number of larvae that are feeding on the ground during any season is approximately twice that of the adult fireflies. Any one who has been out during a June or July evening, knows that the fireflies are one of our most abundant insects, which together with the voracious habits of the larvae leads one to the belief that they are of much more economic importance than has been attributed to them heretofore.

