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NOTES ON THE HABITS OF APHIOCHAETA ALETIÆ.

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A somewhat detailed account of observations on the habits and development of a member of the dipterous family Phoridae may be pardoned in view of the impression given in the literature that little is known of the activities of these flies. In his study of corn insects in Ohio, Dr. C. R. Neiswander has in the past few years, found specimens of the spindle stalk-borer (*Achatodes zea* Harris), a noctuid, in corn stalks. In the season of 1927, he took it very commonly in elder. On June 24, Dr. Neiswander showed the writer some larvæ of a hymenopterous parasite issuing from the backs of this borer. Incidental to observations on this parasite during the rest of the summer, the writer found three other species of insects, two dipterous forms, and one other hymenopterous species attacking these caterpillars. To date, December 1927, only one adult insect has appeared from the accumulated parasite material. This has been identified as *Aphiochaeta aletiae* Comst. of the dipterous family Phoridae,† and it is the remarkable habits of this species that constitutes the occasion for this paper.

SUMMARY OF THE LITERATURE ON PHORIDÆ.

In his paper on this family, Malloch (1) states "that very little is known about their larval habits". "Those that have been reared have been for the most part upon fungi, or upon dead decaying animal or vegetable matter. Some species have been reared from snails and a few from the bodies

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of bees, ants, or beetles, but whether the whole of these species were true parasites or not is a matter for conjecture. Several species are myrmecophilous." Malloch then (pp. 412-413) gives a list of some species whose habits are more or less known.

A survey of the economic literature on Phoridae as given in the Review of Applied Entomology, Series A and B since 1913 when Malloch's paper appeared, demonstrates even further variety in the family habits. Morris (2) reared *Hypocera incrassata* Mg. from nearly full grown larvæ of *Bibio marci* that were unhealthy or dead after two weeks in the laboratory. He regarded this as a case of parasitism "being the first definite record of an insect parasitic on Bibionid larvæ." Wildermuth (3) records *Aphiochaeta perdita* from the pupæ of the alfalfa caterpillar (*Eurymus eurytheme*), and, inasmuch as the chrysalids were alive when collected, believes that "the flies could not be acting as scavengers, but must have been true parasites." *Aphiochaeta* sp. is listed by Snow (4) as a parasite of the cutworm, *Euxoa auxiliaris* Grote. The larvæ "were first seen actively moving around in" two cutworms, and fifteen adults issued from one of these. Ainslie and Cartwright (5) working with the lotus borer (*Pyrausta penitalis* Grote), obtained *Aphiochaeta chaetoneura* Mall., but state that they "were undoubtedly scavengers" because sound larvæ or pupæ were not attacked, and they lived equally well on putrid vegetable matter." The larvæ of various lady-beetles (6) are attacked by *Aphiochaeta fasciata* Fall. in France. In Mexico, Nocedo (7) records *A. scalaris* Lw. as a newly found parasite of *Schistocerca peregrina*, while Oberstein (8) in Germany, found many larvæ of *Phora rufipes* Meig. attacking swollen seeds and young seedlings of Woll-Luzerne.

In the field of medical entomology are habits as follows: Roberg (9) obtained nine phorid species from decaying animal matter, none of which were *Aphiochaeta*. *Aphiochaeta ferrugines* was found by him to be the commonest of flies breeding in human faeces, and evidence shows this species to be a possible carrier of Asiatic cholera and, by analogy, other alimentary infections. The same species (*A. scalaris* Tw. = *A. ferruginea* Brunetti) develops in decaying meat according to Fletcher (10), and Spooner (11) found it in milk which suggested to him the possibility that this is the source of the larvæ which have caused myiasis of the human intestine. The same writer cites records of its occurrence on onions in the West Indies,

in decaying insects in Brazil, and as a parasite of *Hyphantria cunea* in Florida. Cases of cutaneous myiasis in man and animals, involving *A. xanthina* Speis. and *A. rufipes* Mg. in India, are described by Patton. This writer (13) later reports *A. xanthina* bred from dung of horses, cats and dogs, from stale and decaying meat, and from dead insects. The females will oviposit in sores.

The species of Phoridae, and those of *Aphiochaeta* in particular, therefore have habits ranging from scavengers on plant and animal remains to true parasites on insects and higher animals. Most often, however, the object of attack gives evidence of decomposition in greater or lesser degree.

APHIOCHAETA SP. FROM THE SPINDLE STALK-BORER.

Among the spindle stalk-borers collected on June 25, the writer noticed one individual that bore fifty small eggs on the back of the abdomen. No others carrying eggs in this way were found. The eggs were two-fifths of a mm. long and one-third as thick, with ends broadly rounded, and the surface smooth and whitish (Fig. 2). The parent fly had no definite scheme of depositing the eggs, but scattered them about miscellaneously here and there, this way and that, some lying upon others in a criss-cross manner.

Among the jumble of eggs were noticed several minute maggots awkwardly making slow progress hither and thither. Some stood up attached to the borer by the blunt end of their abdomens and explored the surroundings. Some maggots were still present on the back of the borer on June 26 and 27, and others had died there. Some died before hatching, but most eggs were empty. By June 28, all live maggots had disappeared from the back of the caterpillar. Where did they go, and what were they doing in connection with the borer? They did not penetrate the body as parasites. The borer was alive, and scarcely seemed to be a subject for attack of scavenger maggots.

The answer was found on June 28, when, by careful scrutiny of the caterpillar and its burrow in the elder stem, six maggots were seen in a cluster writhing over one another in a mass at the posterior end of the caterpillar. They were not attached to the borer. Further inspection revealed four more maggots of the same kind, but larger, moving about actively in the rectum of the borer. In a short time, these had disappeared

further into the lumen of the alimentary tract of the *Achatodes*, and in all subsequent observations, the maggots proved to have a strong negative light response. The anus of the borer was already widely and permanently distended. During the next week, daily examination showed that their occupancy of the rectal chamber was the true habit of the maggots in this case, and futhermore, they not infrequently left this cavity and reentered it, by way of the anus at all times. The body wall of the caterpillar was not broken by them. Almost daily, one or more of the maggots were seen outside of the caterpillar, and several times individuals were caught in the act of entering their habitation; or, if not conveniently located to enter the borer when their cage was opened, they took refuge under the borer's body. When the *Achatodes* lies in its normal position the anal aperture is almost flat on the floor of the burrow in the elder stem, which provides leverage for the maggots and makes entrance very convenient. The maggots also move more or less over the outside of the body, supported by the irregular surfaces of the segments.

The presence of the larvæ in the hind third of the body caused this portion to bulge out noticeably whenever they were inside the caterpillar. Only four of the maggots reached maturity. Most of the fifty were never seen. The borer had a tunnel a foot or more long extending from one internode to another. If it was able to crawl when the first maggots attacked it, this would suggest that many maggots died of starvation.

DEVELOPMENT OF THE FLY.

Hatching seemed to be distributed over several days, and the eggs may have been deposited at different times. The egg shells clung to the borer as long as the latter was observed. Some larvæ had gone from the eggs on June 25, and half grown larvæ were seen on June 27. On the 25th, small larvæ still crept over the caterpillar. Growth was rapid. The days were the hottest of the summer. The larva stage required at least eleven days and probably not more than fifteen days. All the four surviving maggots had transformed to puparia by July 6, and the first puparium was seen on July 2. Upon maturity, the larvæ left the body of the borer and somehow secured themselves to various levels of the burrow of the caterpillar. Only one adult developed from the puparia even though they were kept moist constantly. This fly issued during the day of

July 13, and required between seven and eleven days to transform. The adult is restless, very active, able to run rapidly and travels also by short flights, and by jumping.

FOOD OF THE APHIOCHAETA LARVÆ.

In view of the common occurrence of the larvæ of an internal hymenopterous parasite in the spindle stalk-borers in June, it was thought possible that the *Aphiochaeta* larvæ might be devouring the parasites. But such Hymenoptera were apparently lacking. The maggots had not entered the body further than the posterior third. This region was found to be empty, the proctodæum had been entirely reduced to an unrecognizable state, and only small amounts of fat body adhered to the inner surface of the body wall. Anterior to this region, the contents of the body were undisturbed and normally white. This situation showed that not the faeces of the caterpillar, but its store of adipose tissue was the chief source of food of the *Aphiochaeta* larvæ.

RELATION OF APHIOCHAETA TO THE SPINDLE STALK-BORER.

The borer was almost or quite full-grown and flabbid, when first seen on June 25, and scarcely moved from its original position while it lived—a period of seven days after its discovery. The body showed indications of disease—the anterior third of the body, and the last three abdominal segments being darkened; and the flabbid condition also pointed to this state. Other larvæ of this size were found entirely blackened, weakened and killed by a disease at the same time. Hence, the borer was probably quite feeble when the first maggots hatched. However, inasmuch as the maggots that were first seen in the rectum were about half grown, the status of the borer at the time they made their initial entrance is not positively known. But the occurrence of the disease is not in doubt, and this caterpillar may not be regarded as a normal individual. Some degree of putrefaction or similar phenomenon would seem to have been the influence that attracted the parent *Aphiochaeta* to it for oviposition. If parasitism be defined as existence of one or more organisms at the expense of one other normal individual, then *Aphiochaeta* was, in the present instance, a high grade scavenger, and not a true parasite. Inasmuch as diseases of lepidopterous larvæ and pupæ are common, and

because their presence is often not indicated externally until they have reached an advanced stage of development, it is plausible that most, if not all, instances of attack by Phoridae may be upon organisms more or less debilitated by internal disorders.

Aphiochaeta sp. may not be considered as obligated to *Achatodes zea*, although its ability to find a borer in a stem with few openings indicates a keen sense if not a regular habit. This caterpillar pupates in June and July in old stems of the previous year's growth, and no more larvæ occur till the next

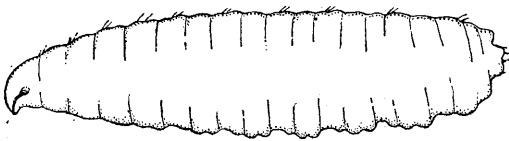


Fig. 1-19X

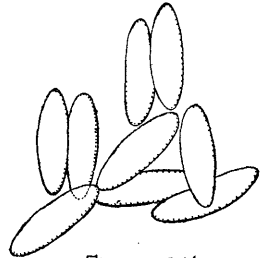


Fig. 2-32X

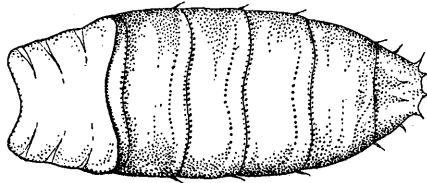


Fig. 3-24X

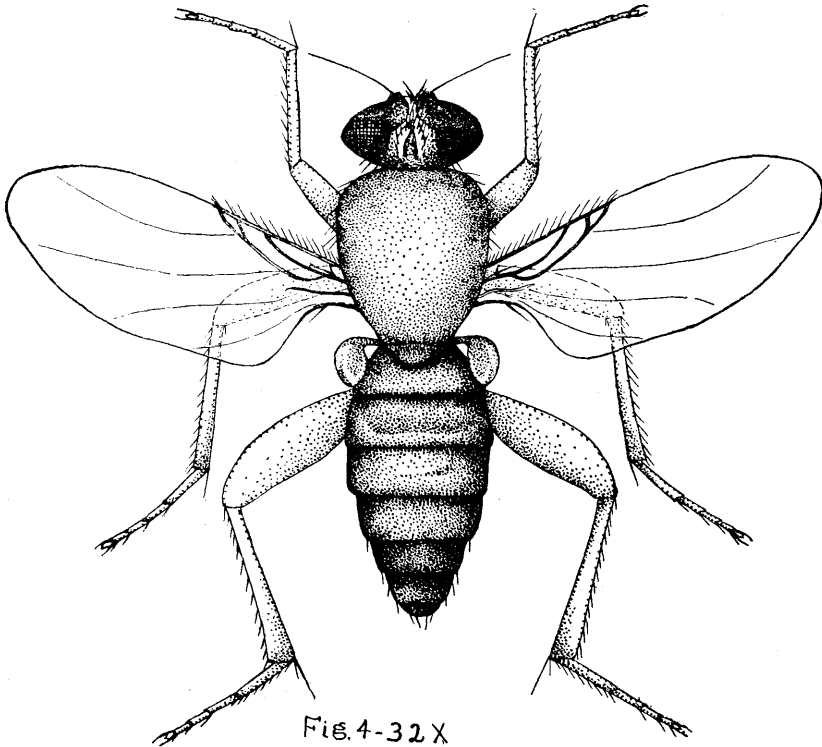
year. But the occurrence of another generation of *Aphiochaeta* is indicated by the development of an adult. It may be that an earlier as well as a later generation arises in the excreta of the borers, upon decaying organic matter or upon insects of an entirely different sort. If so, entrance to a source of food by way of the anus is not habitual, although extremely unusual, and broadens our present conception of the eccentricity and diversity of habit in the family Phoridae.

EMERGENCE OF THE ADULT: RELATIONSHIP.

In emerging, the adult removed entirely the terga of the first four segments, the sterna remaining intact and entire.

Hence, the aperture is not terminal, but dorso-terminal. Neither is it circular as in the calyptrate Diptera, but trapezoidal in shape. These features are not strictly cyclorrhaphous, but there is no suggestion of a straight or T-shaped seam, hence the relationship of the species is decidedly with the suborder Cyclorrhapha.

The adult (Fig. 4) is one and six-tenths mm. long, robust, with a prominent humped and somewhat spiny pronotum.



The angular black eyes stand out conspicuously. The antennæ are globular and one-segmented, with a long arista bearing short fine pubescence. The thorax is brown, the first and third segments much reduced above, and the halteres are large and scale-shaped. On the basal half of the front margin of the wings is a row of stout hairs, and the venation is reduced to three longitudinal veins and two basal ones, to the distal one of which the longitudinal veins are attached. The legs are amber-colored at base, with dusky tibiæ and tarsi, and all

the femora are flattened and enlarged for jumping, those of the hind legs being the largest. The abdomen is black, seven-segmented, tapers posteriorly, and is strongly depressed.

DESCRIPTION OF THE LARVA.

The larva (Fig. 1) is of the muscoid type with sub-conical body. All were entirely white except one that had several fine transverse rings of black segmentally on the front end of the body. The rings persisted until the maggot was full grown. Newly hatched individuals measure 1.09 mm. long, and the largest were 3.10 mm. in length. Viewed from above, fifteen pairs of lateral, cuticular, sharp conical processes, or hairs, arranged segmentally, are visible. On the posterior end is a slightly heavier pair of similar construction that forms a curved transverse row with the lateral pair of the last segment. On each segment are also a pair of humeral and two pairs of dorsal processes, like the lateral pair in size and form. The median dorsal pair arises near the front edge of the segments, the lateral pairs are median on the pleuron, and the other four of each segment form a crooked line with the others. No such structures occur on the venter.

Each dorsal segment consists of three transverse areas. The first, which bears the median dorsal processes, is as long as the third, and the second is two-thirds the length of either of the other two. The first is slightly and more sharply convex than the third, and the middle one lies lower than either the first or third. Three low rounded fleshy elevations are present on the sterna. They are arranged in triangles by segments, the third member situated anterior to the pair. A fourth and similar hump is located in front of the anterior member of the triangle.

DESCRIPTIONS OF THE PUPARIUM AND THE ADULT.

The puparium (Fig. 3) is rich, light brown, and about two one-fifth mm. long, and has a maximum width of one mm., both ends being noticeably narrowed. The venter is moderately convex, and the dorsum somewhat more rounded. A prominent humeral ridge, rounded above, extends from end to end on each side. To these are united similar transverse segmental ridges.

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