

SILK SPINNING FLY LARVÆ.

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In a brief paper printed in *Science* recently a silk spinning cave larva was described by me and referred to the order Diptera. Its general appearance and its habit of making a thread are features in which it approaches the larvæ of Lepidoptera, a resemblance which has been commented on by others in conversation with me since. Yet the larva in question is unmistakably Dipterous, and it was part of my object in publishing the note to call attention in an indirect way to the fact long, but not very generally, known,* that larvæ of certain flies approximate the Lepidoptera, in spinning silken threads. In saying that they produce silk, I wish, however, to be understood as in no way implying that the threads have the exact chemical and physical properties of the silken fibres made by the silkworm. They are silk from the biological, not from the commercial point of view. They are produced by special glands differing little, if at all, from the silk glands of other insects, are employed by these larvæ for a purpose, and are not consequently to be compared with the trail of slime left by a slug or worm.

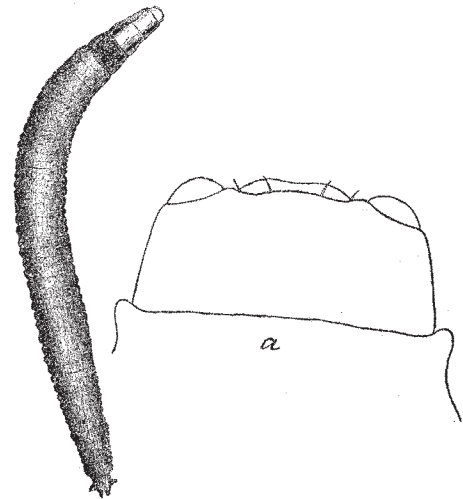


FIG. 1.

My attention was first attracted to such larvæ while making examinations of Kentucky caves. I have, however, been long familiar with other larvæ belonging to the same order, which habitually spin threads having a very important relation to their welfare. In small streams in McLean County, Illinois, occurs a larval *Simulium* which produces such threads. Another species is extremely abundant in rills in eastern Kentucky, where the rocks

over which water flows with considerable speed are literally blackened with it. Since the note referred to was published I have observed that these latter will when disturbed let themselves loose in the current and then shoot down stream emitting their threads at the same time so that they can check their descent and secure a fresh hold on the rocks, perhaps to return along the thread to their first position. By closing the blades of my forceps over the rocks I have repeatedly drawn out a string of these larvæ, each one suspended by the thread it had let out as it floated down stream.

In addition to this thread-spinning habit the cave larvæ have peculiarities of structure which render them worthy of careful study. I have already described two of them, and have collected several others in Kentucky. All are more or less vermiform, being long, slender, cylindrical, generally translucent, so that the internal organs show more or less distinctly through the body wall. The resemblance to a small Lumbricoid worm is heightened by the fact that their bodies are coated with a slime, the derivation of which is uncertain, but which is probably not

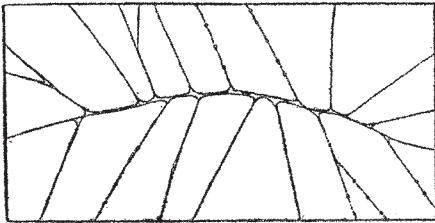


FIG. 2.

derived from the glands engaged in secreting the thread. There are common features also in the structure of the head and mouth-parts, and in the presence of a singular convex area above the base of the mandible resembling a very large ocellus. In several of those examined this is of enormous size, and gives the head a most bizarre appearance.

That they are Dipterous larvæ is sufficiently evident from their resemblance in general structure to larval *Sciara*. The recent discovery of the pupa of one of the species, with wing pads and halteres clearly apparent, confirms the opinion I had reached in this regard. While engaged in attempting to rear the adult of this species I received additional proof in the shape of a letter, quoted from below, from that most excellent observer and collector, Mr. H. G. Hubbard, together with three stages of a closely related species which he discovered some years ago in a cave in Jamaica. The larva of this species is closely allied to one found by me during the past August living in hammock-like webs slung across depressions on the under side of stones and lumps of earth. The latter species was taken in a small cave near Lexington, and has afforded me an opportunity to observe more closely the product of the spinning glands of these interesting insects, and to watch the larva while making its web. This larva shows the same attachment for its web as does the species previously described. In one instance an example was compelled by particularly rough treatment to creep to the earth at one side of its web, where it remained drawn up in an uncomfortable position, but turned promptly when left unmolested for a moment and made its way back on the web again. Three living examples were at one time thrown into a watch glass of water preparatory to killing them in an extended condition, when every one fastened itself to the bottom by pouring out the glutinous material from its mouth and then began to wriggle like an uncomfortable earthworm, always with the whole length of the body free from the glass. In this case the slime coating of the body showed no ten-

dency to glue the body down, whereas the matter from the glands opening at the mouth retained all its adhesive properties—an evidence that the slime is of different origin, and is produced for a different purpose.

Since Sept. 3 a larva of this sort has been kept alive in a bottle. In the bottom of this is about half an inch of earth. The larva spends most of the time in the empty upper part and makes its way about in this space, building a web as it goes, with surprising rapidity. It is often fully two inches from the earth and very rarely touches the side of the bottle with its body. When engaged in web-building, it sways the forward part of the body from side to side until it strikes some object, when the thread is attached by a touch, and as the head draws away is seen to be connected with that underlying the whole length of the body. When first drawn out these threads appear under a hand lens as smooth and dry as any spider's web. The central strand upon which the larva usually lies, however, has a good deal of slime along it, forming triangular masses at the points of divergence of lateral threads. When they have been used for some time the lateral threads of a web may also show slime upon them in the form of minute scattered spherical droplets (See figure). As far as I can determine all this slime comes from the surface of the body. Occasionally a portion of the body has been seen to come in contact with the bottle, where a slimy trail nearly as wide as the body was left on the glass. If this slime had the properties of the glutinous material of which the thread is made the larva would have difficulty in getting about. On the contrary it is rather fluid, and the droplets left along the strand can be seen to be drawn up by the force of capillarity as the tip of the body passes them.

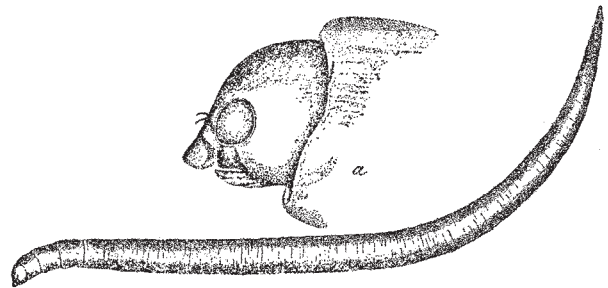


FIG. 3.

These larvæ live concealed in damp situations and it may be, as suggested by Mr. Hubbard, that the threads do not become perfectly dry. They are so fine and delicate that it would be difficult to determine this matter. The thread-making larva previously described in *Science* is at all times completely exposed on the rocks. I have had no recent opportunity to examine its threads, but the impression I have of those seen last spring is that they were dry. But the question whether or not the threads of these larvæ are completely dry has nothing to do with that concerning their essential nature. If silk must be chemically dry, then of course the thread of larval *Simulium* is not silk. It is not the product of a gland having to do with digestion. It is not a trail of slime left from the surface of the body. It is a special product, used by these larvæ exactly as the silkworm uses the product of its sericteria (even to enclosing the pupa in some cases in a very slight approach to cocoon).

Mr. Hubbard's larvæ are very much like the species upon which my observations have been made, and their threads of slime very probably have a supporting axis of other material. The following quotations are from his letter accompanying the specimens so kindly sent me. I hope to publish descriptions of all the cave species at

some future time. Adult Mycetophilid flies have been collected by me on several occasions in parts of caves in which my larvæ were found, but it will be necessary to "breed" the pupæ and adults from the larvæ before the stages can be associated with certainty.

"I have never seen your larva, but I have from a cave in Jamaica, W. I., a Dipterous larva of similar form and habits, except that it lies suspended free from the rock on a thread of ropy slime-like material. I send you specimens of this larva and also its pupa in alcohol, likewise the imago which I bred from the pupa. You will see that it is a Mycetophilid fly. No doubt you have noticed similar flies in fungi and particularly on coatings of fungi under damp logs in dark woods. The larvæ of these fungus-inhabiting flies are similarly elongate creatures and form thread-like tracks of slime across the surface of the fungus. I have frequently observed that they can be made to glide back and forth along this track precisely in the manner of your cave larva, and that they can not be induced to quit their hold upon the thread. The interesting point to which I would like to call your attention is this. The silken thread of your Mammoth Cave larva and the slime thread of my Jamaican larva as well as the slime track of the fungus Mycetophilids may all be similar products of the salivary organs and more or less allied to true silk. The Jamaican cave fly makes a thread of six or eight inches in length fastened at both ends to the rock on the underside of a ledge or stalactite, but otherwise hanging free, and on this both larva and pupa are found suspended as in a hammock. In the damp air of the caves the thread never dries and hardens like ordinary silk, but remains viscous and slime-like as in

manner. Probable imagoes also found. (I subsequently observed a pupa disclosing the fly and took specimens of all the stages.)"



FIG. 4.

the case of other Mycetophilids. Nevertheless it possesses greater strength than an ordinary filament of mucus and it occurs to me that it is nothing more or less than a form of silk which does not lose its moisture and become hard. I have read somewhere quite recently of a process for the manufacture of artificial silk from a collodion produced by the action of nitric acid upon palm fibre. This silk remains moist until passed through anhydrous ether, which removes the moisture and hardens it. I would like much to know whether the silk thread of your cave larva is not also somewhat viscous, and it would be interesting also to note the action of ether upon it.

"In the *American Entomologist*, Vol. III., p. 30, 1880, I published a brief account of cave life in Jamaica. The article refers to the fly as follows; 'A Mycetophilid fly is found upon the stalactites, where its vermiform larva may also be seen suspended by ropes of slime.' Referring to my original field notes I find the following: 'Drunilly, Parish of Trelauny, Jamaica, W. I., April 18th, 1877,—among notes of examination of a large cave, much frequented by bats and containing many tons of bat guano—under ledges of stalagmite, long Dipterous larvæ slung in glutinous threads. Pupæ also collected slung in same

Explanation of the Figures.

Fig. 1. A dorsal view of a Mycetophilid larva found under a log. a, an outline of the head as seen from above.

Fig. 2. A web of one of the cave species.

Fig. 3. A web-making cave larva. a, an enlarged side view of the head.

Fig. 4. The pupa of the larva represented in Fig. 3.