Insect-Produced Silk
From Textiles to "Tents"

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The first thing that comes to mind when most people hear the word "silk" is the lustrous cloth produced by the silk worm industry in China and Japan. For more than 2000 years, the Chinese were the only people who knew the origin of this material. For a time, it was valued at its weight in gold, and disclosing its source was punishable by death! A second common connection people have with this amazing substance is the intricate webs associated with certain kinds of spiders. Silk is produced by just a few groups in the insect world and only two types of forest pests; defoliators whose larval or caterpillar stages give rise to moths, and the larvae of primitive groups of wasps known as sawflies.

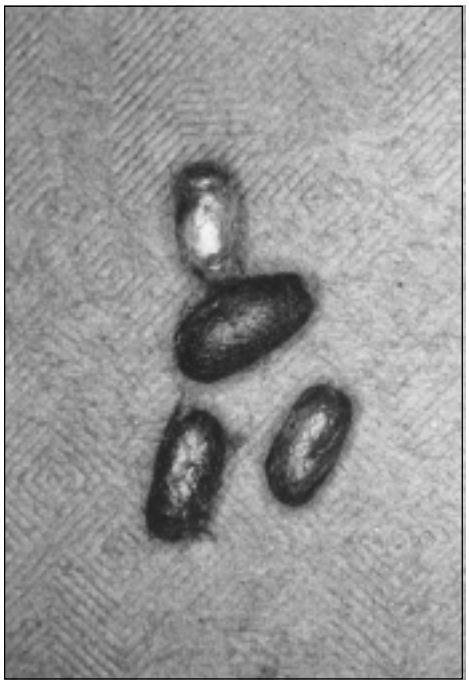

Figure 1 *Brown to reddish-brown sawfly cocoons (actual length = ¼")*

What is Silk?

Silk originates and is stored as a proteinaceous liquid in modified salivary glands located within the insect head. When there is a need for silk, the liquid is transported via small tubes to the spinneret, a structure that protrudes beneath the mouthparts on the underside of the head. The spinneret of a spider, on the other hand, originates at the end of the abdomen on its lower surface (i.e., the underside of the end of the posterior body segment).

How do Insects Use Silk?

Even though the diameter of a single strand of silk is only a small fraction of that of a human hair, insects can use these fibers, individually or collectively, to accomplish an amazing array of activities that enhance survival.

Many moth and sawfly larvae spin **cocoons** (Fig. 1) to protect the immobile, defenseless pupal stage during which the mature caterpillar transforms into an adult. A cocoon is spun from a single thread of silk and may incorporate a variety of substances, such as soil particles, leaf tissue, litter, or it may consist of pure silk.

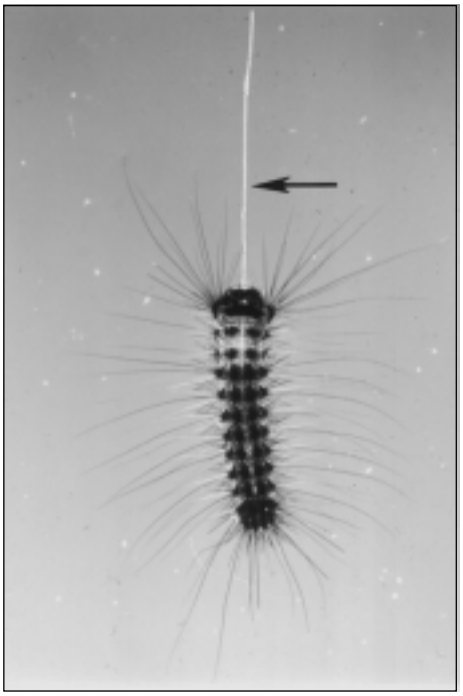

Figure 2 *Young gypsy moth larva (1/8" long) in the act of dispersing. Note body hairs and silk "parachute" (arrow).*

Gypsy moth adults are not able to fly, and this species disperses as a very

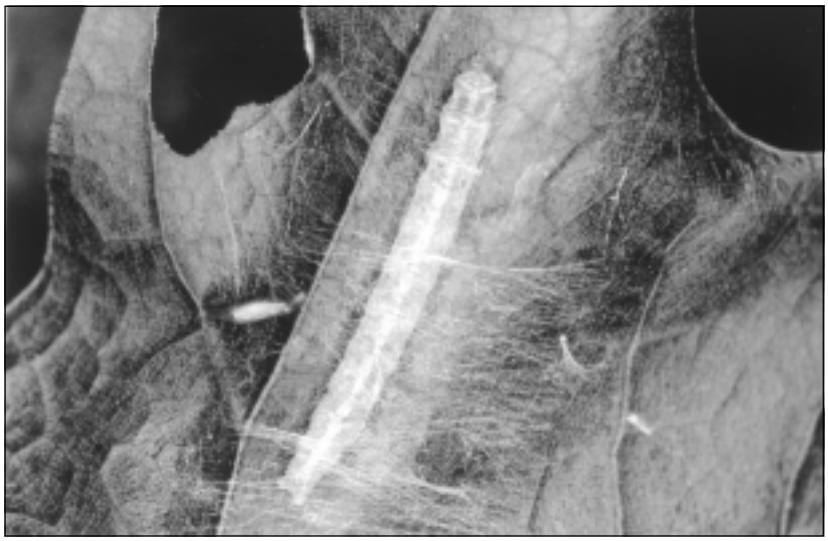

Figure 3 *Caterpillar resting beneath tent-like sheet of silk.*

Figure 4 *Shelter of the ugly nest caterpillar (14" long) on a young cherry.*

small larva shortly after emergence from the egg. **Dispersal** is accomplished when the hairy, buoyant larva moves to the periphery of the tree crown and is stimulated by air movement to drop on a silken thread (Fig. 2). When the wind is strong enough, the silk strand fractures and acts like a parachute, which may carry the caterpillar several miles. Many other species of moths, to one degree or another, rely on this method of dispersal.

Many moth caterpillars lay down a silk strand wherever they go, and this "life line" functions as a **trail marker** which helps to guide a caterpillar or its siblings back and forth from resting or nesting locations to suitable feeding sites.

Several species of moths, such as the eastern tent caterpillar (*Forest Owner* Sept./Oct. 1992) and fall webworm (*Forest Owner* Sept./Oct. 1993), build silken **tents** to protect the colony from natural enemies and unsuitable environmental conditions, such as heavy rain, desiccating winds or excessive heat. Some solitary species use a tent-like structure merely to help hold the resting larva in place on the leaf surface (Fig. 3). Others, such as the ugly nest caterpillar (Fig. 4) and cherry scalloped shell moth (*Forest Owner* Nov./Dec. 1993) use silk to incorporate leaves and twigs into a **shelter** of sorts that serves the same function. Many species use silk for **rolling or folding a leaf,** which also affords protection from vagaries of the weather and certain natural enemies (Fig. 5). Even though the leaf may be 100-200 times heavier than the caterpillar, the ingenious insect stretches a strand of silk, which is quite elastic initially, as it is spun out of the spinneret and attaches it to two sides or corners of the leaf to be rolled. As the silk strands contract, somewhat analogous to the action of a rubber band, they draw the leaf together in a manner characteristic of that insect. In the process of unrolling many leaves over the years, I have come to appreciate the strength and toughness of these structures.

When many caterpillars molt they do so on a small sheet of silk, called a **molting pad**, which is spun on a twig or leaf. This platform gives the larva a secure place to attach while undergoing the delicate business of shedding its skin and forming a new one.

Figure 5 A maple leafroller.

The next time you see a cocoon, rolled leaf or silk nest, take a moment to admire the incredible material and remarkable behavior that make its construction possible!

This is the 47th in the series of articles contributed by Dr. Allen, Professor of Entomology at SUNY-ESF. Reprints of this and the complete series are available from NYFOA. It is also possible to download this collection from the DEC Web page at: http://www.dec.state.ny.us/website/dlf/privland/linkspag.htm