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Gypsy Moth Handbook

Major Hardwood Defoliators of the Eastern United States



Major Hardwood Defoliators of the Eastern United States

by

Robert L. Talerico¹

In 1974 the U.S. Department of Agriculture initiated the Combined Forest Pest Research and Development Program, an interagency effort that concentrated on the Douglas-fir tussock moth in the West, on the southern pine beetle in the South, and on the gypsy moth in the Northeast. The work reported in this publication was funded in whole or in part by the program. This manual is one in a series on the gypsy moth.

Introduction

A variety of leaf-eating insects periodically defoliates hardwood trees in forests, on recreation sites, and in residential areas in the Eastern United States. An occasional defoliation during the life of a forest stand probably has little effect on the overall growth of the stand, but several years of severe or varying levels of defoliation can have negative impacts on the forest community: Increased susceptibility to other insects and diseases, reduced foliage, and altered wildlife habitat.

In recreation areas, the unsightliness of defoliated trees can result in decreased visitor use and revenue. A homeowner with a wooded lot plagued with defoliating caterpillars may incur the expense of spraying and possibly the cost of tree removal if mortality occurs.

¹Research entomologist, Forest Insect & Disease Laboratory, Hamden, Conn.

General Characteristics



The insects discussed here complete one generation each year. The adult moths lay eggs, and in the spring these eggs hatch into caterpillars, or larvae, the most familiar life stage. It is the larvae that eat the leaves of the trees. After 4 to 6 weeks of feeding, larvae spin cocoons and enter a resting (pupal) stage. In

about 2 weeks moths emerge, mate, and begin the life cycle once again.

Caterpillars feed on leaves in different ways. A "free feeder" will eat most of the leaf material (fig. 1).

Figure 1.—Leaves fed upon by free-feeding insects.



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Figure 2.—Leaves tied or matted together by insects for food and shelter.

Figure 3.—A leaf roll formed by an insect for food and shelter.

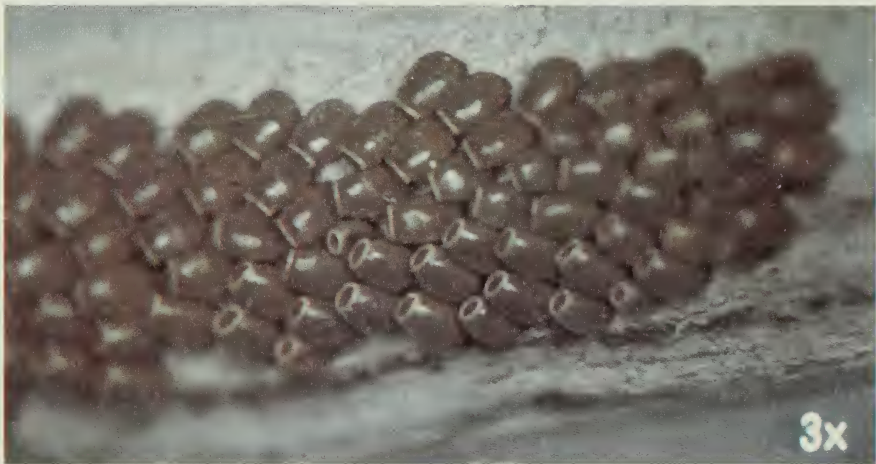
Some larvae, called leaf tiers, construct feeding shelters by tying several leaves together (fig. 2). The caterpillar lives and feeds within this mat of leaves, adding more leaves for food as needed or moving to other leaves. Other larvae are leaf rollers, which make a feeding shelter by rolling up the edge of a leaf and live and feed within this roll (fig. 3). Another roll is constructed when the food supply is exhausted or the roll becomes unsuitable for food or shelter.

Some common names of these insects are derived from their peculiar method of movement—measuring worms, inchworms, loopers, spanworms, and cankerworms. The movement is produced as the larva brings its hind legs up to the forelegs, forming a loop with the body, and then extends the forelegs forward.

A behavioral trait shared by the loopers, tiers, and rollers is the reaction of the larvae when they are disturbed. The slightest jarring of the branch or leaf they are on causes larvae to fall or descend on silken threads to other branches or leaves, where feeding continues.

To help landowners and others to identify these defoliating pests, this booklet describes eight insects and details their life stages. For positive identification of these insects and control recommendations, consult your county agricultural agent, State experiment station, or the U.S. Department of Agriculture.

Elm Spanworm
Ennomos subsignarius (Hübner)



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The elm spanworm is found in most areas of the Eastern United States and adjacent Canada. The caterpillars feed on elm, ash, hickory, and oak but rarely on yellow-poplar. In the past this insect has been a serious defoliator of shade trees in large cities; more recently, severe and widespread outbreaks have occurred in forested areas of the southern Appalachians and Connecticut.

Spanworm eggs are laid in irregular, single-layered, compact masses on the underside of twigs or large branches or on tree trunks. They are bright yellow green when first laid in the summer but darken to a dull olive or gray in winter (fig. 4).

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Figure 4.—Elm spanworm egg mass.

Figure 5.—Elm spanworm larva.

Figure 6.—Elm spanworm pupa and cast larval skin.

Figure 7.—Adult elm spanworms.

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In the spring, egg hatch occurs about the time tree buds begin to unfold. The manner and location of feeding change as the larvae grow. Young larvae feed on the underside of leaves, causing a shothole effect. As they mature, larvae eat all leaf material between the major veins. Full-grown larvae are about 50 mm (2 in) long and are usually dull, slate black with a rust-colored head (fig. 5). Color variation occurs in mature

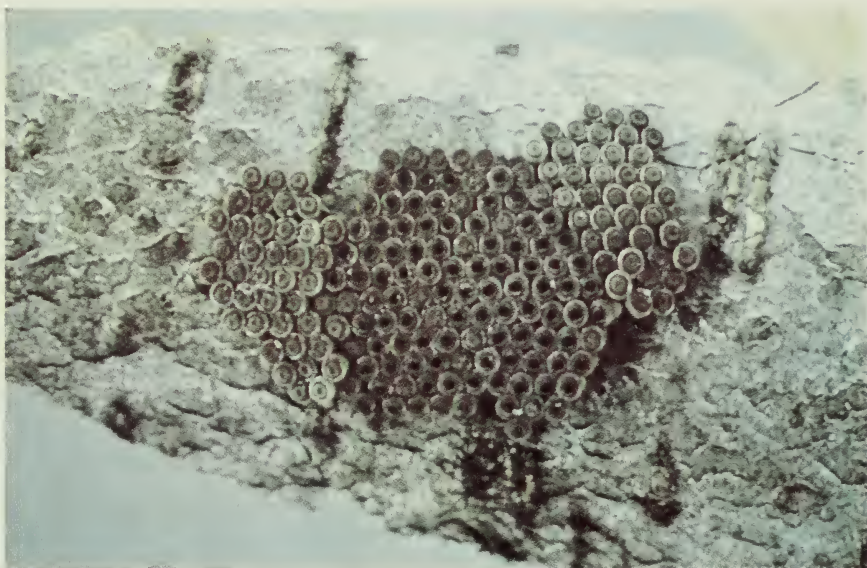
larvae in response to increased population levels. Mature larvae pupate in loosely constructed silken cocoons between partially consumed leaves, on branch tips, in bark crevices, or on understory vegetation (fig. 6).

The adult moth, which emerges in July, is pure white and has a wingspan of 30 to 37 mm (1 to 1.5 in) (fig. 7).

Cankerworm

Alsophila pometaria (Harris) and
Paleacrita vernata (Peck)

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Cankerworms have been documented as native North American tree pests since colonial days. Spring and fall cankerworms are similar in distribution, appearance, and the damage caused. The fall cankerworm lays its eggs in November and early December, and the spring cankerworm in late February and March. The female moths of both are wingless. Cankerworm infestations have been reported in the Canadian Maritimes, southern Canada, and the Eastern, Midwestern, and Western United States. The spring cankerworm tends to range further to the Southwest and West. Both have a wide range of hosts that include deciduous forest, shade, and fruit trees. Apple and elm seem to be

preferred, but many oaks, maples, hickories, ashes, and beech are also fed upon.

The fall cankerworm lays about 100 eggs in an aligned, compact, single-layered, reddish-brown mass, which becomes gray as it weathers (fig. 8). The masses can be found directly on small branches, at the juncture of a branch and a tree trunk, and directly on tree trunks. Occasionally a single egg will be laid. It is possible to distinguish old eggs from new by the absence of a covering on old eggs.

The eggs of both species of cankerworms hatch in the spring, and it is not unusual to find them feeding together on expanding buds and foliage. Larval feeding lasts 4 to 6 weeks. Feeding by young larvae produces a shothole appearance on the leaves. Older larvae consume all leaf material but the major veins.

Figure 8.—Egg mass of fall cankerworm. Old eggs can be distinguished from new eggs by the presence of holes in tops of eggs.



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Full-grown fall cankerworm larvae vary from light to dark green and are about 25 mm (1 in) long (fig. 9). Mature spring cankerworm larvae are 18 to 30 mm (0.8 to 1.3 in) long and vary considerably in color, ranging from reddish to yellowish brown, yellowish green, or black. The head is light and mottled with a yellowish stripe along each side of the body, and a broad, greenish-yellow stripe runs the length of the undersurface of the body.

Some older fall cankerworm larvae have a dark stripe running lengthwise down the back; light-green larvae have white lengthwise lines. Larvae of the fall cankerworm have three pairs of hind legs or claspers. One pair is smaller, sometimes indistinct, and in front of the two obvious hind legs (fig. 10). The spring cankerworm lacks this additional pair of hind legs.

When the larvae finish feeding in early July and are ready to pupate, they crawl or spin down on silken threads to the ground and prepare cocoons in the soil. Fall cankerworm adults emerge in November and early December, frequently after some freezing weather; spring cankerworm adults emerge in late February and March. Fall cankerworm male moths are brownish gray with a wingspread of 25 to 35 mm (1 to 1.4 in) (fig. 11);

Figure 9.—Fall cankerworm larva.
Figure 10.—Side view of fall cankerworm larvae showing the three pairs of hind legs.
Figure 11.—Adult male fall cankerworm.

Gypsy Moth
Lymantria dispar (Linnaeus)

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the wingless females are about 12 mm (0.5 in) long (fig. 12).

Spring cankerworm adults are similar to the fall cankerworm. Male moths have a wingspan of 21 to 30 mm (1.0 to 1.3 in). The forewings are silky brownish gray, crossed by three jagged dark lines. The hindwings are pale ashy gray with a darkened central spot. Females are wingless, generally white, with brown or black hairs, with a dark stripe down the back. Both have two transverse rows of reddish spines on the back. These are more prominent in the female and give the back a reddish cast.

Figure 12.—Female adult fall cankerworm. Note the lack of wings.

Gypsy moth egg masses were brought to the Boston area in 1869 from France for experimental crossbreeding with the silkworm. Unfortunately some of the larvae escaped and became established on the local vegetation. The insect has now spread throughout New England, the Mid-Atlantic States, southeastern Quebec, and central Michigan. Scattered infestations have been reported along the east coast to Florida and as far west as California. Hosts include most hardwoods and any conifer that might be mixed in with the more favored hosts of oak, gray birch, and poplar. Yellow-poplar and ash are usually avoided, but in outbreak situations the larvae will eat just about anything.

In late summer, eggs are deposited in masses (fig. 13) containing 75 to 800 eggs that are covered with buff to light-brown hairs from the female's abdomen (fig. 14). These hairs insulate the eggs from low winter temperatures. Most egg masses are deposited on the trunks and limbs of trees, but they can also be found under stones, inside hollow trees and stumps, on leaves, and on various manmade objects. Eggs hatch in late April or early May, usually about the time the oak leaves are expanding.

Newly hatched larvae move from the egg masses toward the top of the tree. When disturbed, larvae will spin down on silken threads; this behavioral trait, along with a small body size and long body hairs, makes this stage very susceptible to



airborne dispersal by the wind. This type of dispersal can spread an infestation up to 1.6 km (1 mile) in flat terrain or more than 7 km (4.4 miles) in hilly topography.

A full-grown larva is 40 to 60 mm (1.5 to 2.4 in) long. The head has patches of yellow markings; the body is a dusty or sooty black with tufts of hair on each body segment. On the back is a double row of five pairs of dark blue spots, followed by a double row of six pairs of brick-red spots (fig. 15).

Young larvae chew small holes in leaves. Older larvae feed on leaf edges, consuming entire leaves except for the larger veins and the middle rib. Feeding by the large larvae occurs mostly at night.



During the day, the larvae congregate in sheltered locations. If trees are completely defoliated before the larval stage is finished, larvae leave the bare trees to search for another food source. This short distance movement can become a nuisance in wooded residential areas. The homeowner becomes acutely aware of the wandering larvae, which fall into swimming pools and climb all over lawn furniture, patios, and shrubbery.

Figure 13.—Gypsy moth egg mass.
Figure 14.—Closeup of eggs of the gypsy moth.

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Larval feeding is completed by mid-June or early July and is followed by pupation, which lasts about 2 weeks. The pupa is dark reddish brown with a sprinkling of reddish hairs. Adults emerge and mate from mid-July through August. Egg laying occurs at this time.

The male moth has a wingspan of about 37 mm (1.4 in) and is dark brown with black bands across the forewings (fig. 16). The female is white with variable black bands across the forewings (fig. 16) and her abdomen is covered with buff or light-brown hairs. She is larger, with a wingspan of about 50 mm (2 in), but rarely flies.

Figure 15.—Gypsy moth larva.

Figure 16.—Adult male (brown) and female gypsy moths.

Half-Wing Geometer
Phigalia titea Cramer

17



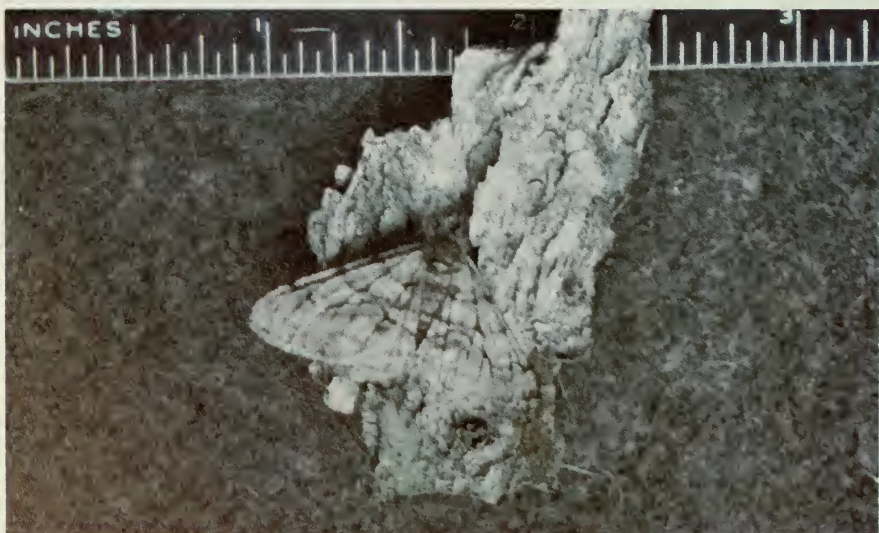
The half-wing geometer is frequently found in association with cankerworms, elm spanworm, and linden looper. Its distribution is believed to be in the eastern half of North America (southern Canada and various States along the Atlantic coast). Hosts of this geometer are most hardwood trees, including various oaks, hickories, and red maple.

Eggs are laid in early spring in protected locations on branches, on tree trunks, and under loose pieces of bark (fig. 17). The eggs hatch in April, and the larvae feed until early June. At first the larvae feed only

Figure 17.—Half-wing geometer eggs.



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on the leaf surface, but as they grow and develop, they feed on all leaf tissue between the major veins. A full-grown larva is about 37 mm (1.5 in) long. The head and body are cream colored with many lengthwise black, wavy lines that make the larva appear black (fig. 18). Usually by the first week in June larval feeding slows, and the larvae crawl or spin down on silken threads to the ground and begin to pupate in the soil.

The adult male moth is gray with black markings and has a wingspan of 37 mm (1.5 in) (fig. 19). The female is ash gray, resembling the cankerworm, but with very small (3 mm, 0.13 in), functionless wings. The adults emerge from late March to mid-April, even in adverse weather conditions.

Figure 18.—Half-wing geometer larva.

Figure 19.—Adult male of the half-wing geometer.

Forest Tent Caterpillar
Malacosoma disstria (Hübner)

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Figure 20.—Forest tent caterpillar egg mass.

Figure 21.—Forest tent caterpillar larva.

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The forest tent caterpillar is a native insect that occurs throughout most of the United States and Canada. This caterpillar feeds on a wide variety of hardwoods. In the North and West, trembling aspen is preferred. Forest, orchard, and ornamental trees are also acceptable, and several extensive outbreaks of the insect have occurred in the past.

Eggs are laid in masses containing 100 to 350 eggs. The mass is a cylindrical band, ringlike in shape and 25 to 37 mm (1 to 1.5 in) wide, that encircles the twig (fig. 20). The ends of the mass are square, and the whole mass is coated with a dark-colored, glue-like substance. Winter is spent in the egg stage, and hatching occurs in the spring about the time the tree buds begin to swell.



22



23

Figure 22.—Pupal case of forest tent caterpillar.

Figure 23.—Adult male (left) and female forest tent caterpillars and an egg mass.

Linden Looper
Erranis tiliaria (Harris)

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Young larvae feed on the expanding buds; the older ones eat the foliage. Young larvae from one egg mass feed together as a group on a leaf or leaf cluster. As the larvae grow and mature, the group breaks up and each larva feeds alone on the foliage. Full-grown larvae are about 50 mm (2 in) long with a light bluish-black head and a few scattered white hairs. The back of the body is marked lengthwise with a row of whitish-yellow, keyhole-shaped spots. The remainder of the body is various shades of gray (fig. 21).

Larvae lay down strands of silk as they move about. They also form silk mats on the trunks and branches on which they collect in groups to rest between feedings. Contrary to the common name, a tent is not constructed by the larvae. As they approach maturity, they wander about individually in search of food or places to pupate.

Pupation occurs in pale-yellow cocoons about 25 mm (1 in) long that are spun in folded leaves, bark crevices, and other protected sites (fig. 22). Depending on the geographic location, the appearance of adults occurs from late May in the South to early July in the North. The stout-bodied, light buff-brown adults have a wingspread of 25 to 37 mm (1 to 1.5 in) (fig. 23).



This looper is a native defoliator that may be found in southeastern Canada and throughout the Eastern United States. It defoliates forest, shade, and fruit trees, such as basswood, elm, hickory, maple, oak, birch, and apple, and is often found with cankerworms.

Eggs are laid singly or in small groups, usually in bark crevices. Winter is spent in the egg stage. Hatching occurs in April and May as the leaf buds are expanding. Larvae feed on the foliage until July, then they crawl to the ground and burrow 25 mm (1 in) or more into the soil to pupate. The full-grown larva is about 37 mm (1.5 in) long, bright yellow, with 10 black wavy lines running lengthwise down the back. The head is rusty brown (fig. 24).

Figure 24.—Linden looper larva.



Figure 25.—Adult male (left) and female linden looper.

Male moths have a wingspan of about 42 mm (1.7 in). The forewings are buff colored and marked with two transverse wavy brown bands and a sprinkling of brown dots. The hind wings are lighter and without distinctive markings (fig. 25). The female is wingless, about 12 mm (0.7 in) long and is colored from light gray to brown, with two rows of black dots on her back (fig. 25).

Oak Leaf-tier
Croesia semipurpurana (Kearfott)

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The tiers are a very important group of defoliators. It is not unusual for tiers, rollers, cankerworms, and loopers to feed on the same trees. The oak leaf-tier has been collected in many States, from New York south to Texas, from Massachusetts west to Minnesota, and from adjacent areas in southern Canada.

Tiers appear to have a preference for red, scarlet, black, and pin oaks. Periodically the tier has been a serious defoliator of forested areas in Pennsylvania, and tree mortality has been attributed to tiers following a number of years of sustained heavy defoliation.

In June, eggs are laid singly on twigs with rough bark, where they overwinter. After hatching the following April, the young larvae enter unopened buds and feed on the developing leaves. Large populations can destroy nearly all the buds on a tree. Surviving buds produce leaves riddled with holes. Major defoliation results from the feeding of older larvae, which feed more openly but from within their protected webbing and shelter. The full-grown larva is about 12 mm (0.5 in) long and dirty white to light green (fig. 26). It has a pale brown head and black to brown front legs.

Figure 26.—Oak leaf-tier larva. Note black bar on lower side of head or cheek area.

Oak Leaf Roller

Archips semiferanus (Walker)

27



A black bar on the lower side of the head or cheek area is a distinctive character for identification. When larvae mature in mid-May, they spin down on silken threads to the ground and pupate in the litter beneath the tree. Adults emerge and mate from late May through June.

The oak leafroller adult moth is small, with a 12 mm (0.5 in) wingspan. At rest the wings appear bell shaped. A great deal of variation exists in the color pattern of the moth's forewing, which may vary from almost uniform yellow to yellow with dark brown markings (fig. 27).

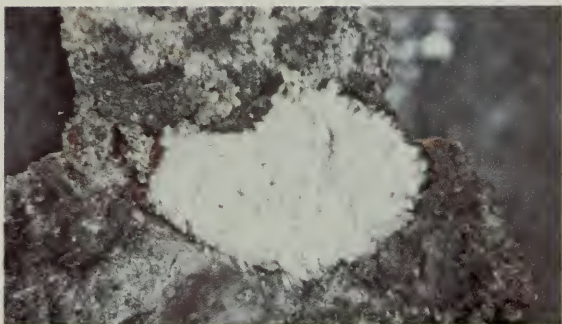
Figure 27.—Oak leafroller adult moth.

The rollers are a large group of insects that are still being identified, described, and studied by experts. This roller is periodically a serious defoliator of native oaks in the eastern half of the United States and adjacent Canada. Although all oaks are fed on, defoliation is usually most severe along ridge tops where white and chestnut oak frequently occur. Occasional feeding has been reported on witchhazel and apple. Severe infestations have occurred recently in Pennsylvania.

During July, masses of 40 to 50 eggs are laid at the base of large branches and rough bark patches on both tree trunks and limbs (fig. 28). The masses are covered with hairs from the female's body. These eggs begin hatching in late April. The larvae either fold or roll individual leaves together, forming an enclosure in which to rest and feed or from which they move out to feed. Full-grown larvae are about 29 mm (1.2 in) long. The head is black, and the body can be various shades of green (fig. 29).

Pupation occurs in silken cocoons within the roll or in bark crevices (fig. 30). The moths emerge in late June and July. At rest, the wings of the adult appear bell shaped. The forewing varies in color pattern but ranges from creamy brown at the base to gray at the tip. Midway down the wing is a distinct dark brown or gray oblique band across the wing. The wingspan is about 18 to 22 mm (0.7 to 0.9 in) (fig. 31).

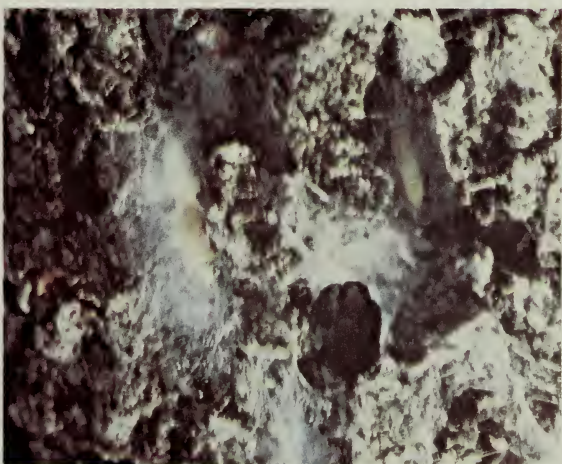
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Figure 28.—Oak leaf roller egg mass.

Figure 29.—Oak leaf roller larvae.

Figure 30.—Oak leaf roller pupae on tree trunk.

Figure 31.—Oak leaf roller adult female.

Key to Identifying Larvae

Key No.	Refer to Key No.	Key No.	Refer to Key No.
1. A. Larva feeds and lives within a leaf roll or several leaves	2	B. Larva dark blue black; whitish-yellow, keyhole-shaped spots on back <i>Forest tent caterpillar</i> (fig. 21)	
B. Larva feeds freely, does not construct leaf roll or leaf mat	3	5. A. Larval body bright yellow; back with 10 black wavy lengthwise lines; rusty-brown head <i>Linden looper</i> (fig. 24)	
2. A. Head pale brown except for a longitudinal black bar on the lower cheek (side of head); region immediately behind pale brown <i>Oak leaftier</i> (fig. 26)		B. Larval body not bright yellow	6
B. Head with irregular black markings on other areas besides cheek; often most of head dark brown to black; region immediately behind head usually darkened on top and sides <i>Oak leaf roller</i> (fig. 29)		6. A. Larval body and head cream colored with many lengthwise black wavy lines <i>Half-wing geometer</i> (fig. 18)	
3. A. Larva hairy or with tufts of hair on each body segment	4	B. Larval body light to dark green	7
B. Larva with few body hairs, almost bare	5	7. A. Larva may have a lengthwise dark brown stripe on back or white lengthwise lines; three pairs of hind legs, one pair smaller and in front of others <i>Fall cankerworm</i> (figs. 9 and 10).	
4. A. Larva dusty or sooty black; on back, a double row of 5 pairs of dark blue spots followed by a double row of 6 pairs of brick red spots <i>Gypsy moth</i> (fig. 15)		B. Larval body a dull slate black, variable; two pairs of hind legs; rust-colored head <i>Elm spanworm</i> (fig. 5)	

Acknowledgments

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