by Denver P. Burns

Insect Enemies of YELLOW-POPLAR

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RICHARD D. LANE, DIRECTOR

THE AUTHOR

DENVER P. BURNS, entomologist, received his B.S. degree in agriculture (1962) and M.S. (1964) and Ph.D. (1967) degrees in entomology at The Ohio State University. He joined the U. S. Forest Service in 1962 and has specialized in the biology and ecology of hardwood insects. Currently stationed at Delaware, Ohio, he is a member of the Northeastern Forest Experiment Station project conducting research into the biology and behavior of insects affecting hardwood quality.

YELLOW-POPLAR, like the other desirable hardwoods, is attacked by a variety of insects. However, only four species of insects are considered economically important: the tuliptree scale, the yellow-poplar weevil, the root-collar borer, and the Columbian timber beetle. These are native enemies of yellow-poplar *(Liriodendron tulipifera* L.) wherever the tree grows.

THE TULIPTREE SCALE

[*Toumeyella liriodendri* (Gemlin)]

This sucking insect has been considered more a nuisance than a serious pest of yellow-poplar. However, research recently conducted by the author and Dr. David E. Donley demonstrates that this insect is often responsible for the failure of yellow-poplar to regenerate successfully on old-field sites.

The scale damages its host by removing large quantities of phloem sap (fig. 1). It can be found on yellow-poplars of any size, but it damages seedlings and saplings most severely. It feeds

Figure 1.—Female tuliptree scales excreting honeydew. The honeydew is composed of phloem sap and metabolic products on the scale.

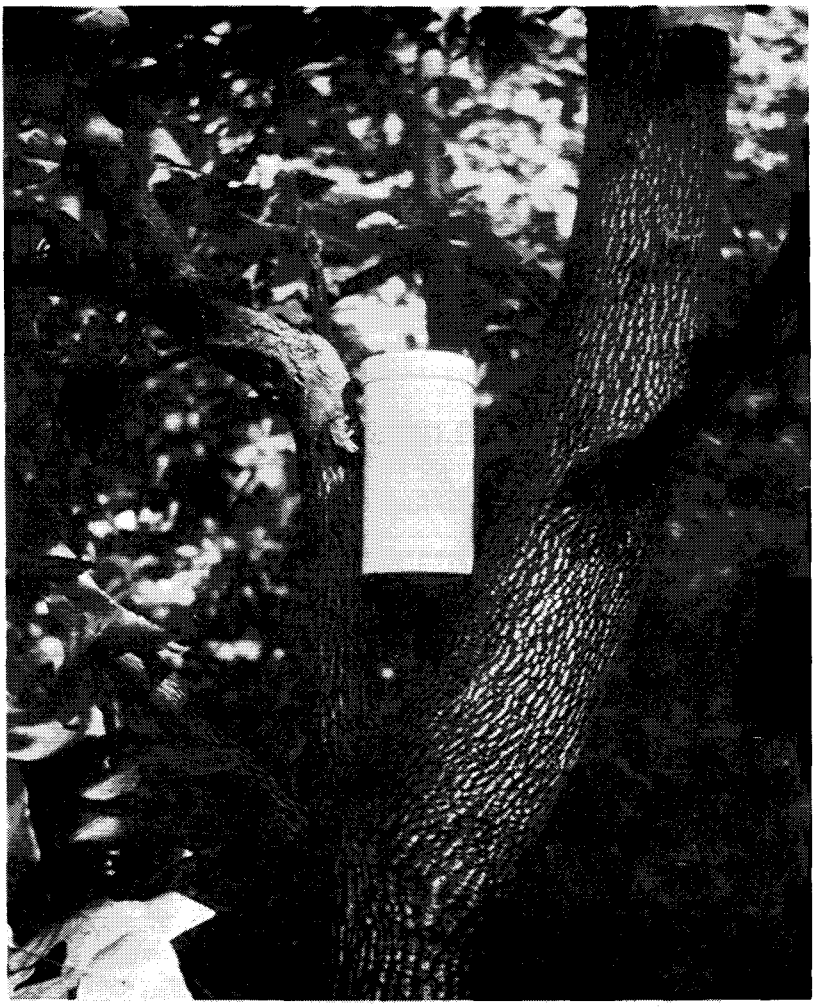


Figure 2.—A crook on a yellow-poplar tree, caused by scale attack. The carton is 8 inches tall.

on twigs and stems less than 1.2 cm in diameter, and on adventitious twigs and callus wound tissue.

The scale causes four kinds of injury. It can kill the tree. You rarely notice attacks for only 1 year that can kill 2-, 3-, and 4-year-old seedlings. Death of the tree is more striking when older trees are killed as the result of severe scale attacks for two or more consecutive years. Trees more than 10 inches d.b.h. have

been killed by the scale. Basal sprouts often develop when saplings are killed, but they in turn are attacked by the scale and die within a few years.

Scale attack often kills the leader, and one or more of the lateral branches assume apical dominance. This results in a crook at the junction of the lateral branch and the stem (fig. 2), or a double top. The crooks may disappear as the tree trunks increase in diameter, or they may persist as a permanent defect.

The third kind of damage occurs when the leader and upper laterals are killed so that no lateral branch assumes dominance. When this happens, the tree becomes bushy and may survive until overtopped by its competitors.

The most subtle expression of damage is the loss of vigor. Symptoms of vigor loss become visible when the lower branches of open-grown yellow-poplars blacken and die and the foliage of the upper crown becomes thin and sparse (fig. 3). The leaves and trunk of the tree usually become black with sooty mold growing on the honeydew. The premature pruning of the lower branches would be desirable except that the tree often dies or adventitious growth occurs.

The scale has one generation per year *(Burns and Donley 1970)*. From mid-August until first frost the females give birth to tiny crawlers, the motile stage of the insect. The crawlers walk over the bark and either stick their mouthparts into the tree or walk onto the leaves. The scale spreads from tree to tree when crawlers on the leaves let go and are blown about.

Once the mouthparts are inserted into the tree, the crawler cannot remove them. The crawler molts within a few weeks to the second instar or overwintering stage. The size of a pinhead, and charcoal-colored, it is found on the undersides of twigs and other protected locations.

In spring the scales begin to grow and excrete honeydew. The males pupate under an opaque whitish cover in late May. The cover is easily seen and remains on the tree for several months after the males emerge and mate with the females in mid-June.

Growth of the females continues into August, when they mature and produce crawlers, thus completing the life cycle.

Figure 3.—The tree on the left has typical form for open-grown yellow-poplar. The tree on the right has been repeatedly attacked by scale. Note the sparse foliage, numerous dead twigs, and the stub of the broken-off second stem.

Many insects collect tuliptree scale honeydew and use it for food *(Krombein 1951; Burns 1964)*. Some species of ants are numerous and active when collecting honeydew and their activity disrupts or prevents the feeding or egg-laying of parasites and predators of the scale. Thus the presence of some species of ants allows scale populations to remain at high levels for several years so that the host trees are killed or seriously damaged. When ants are not present, parasites and predators generally are effective control agents.

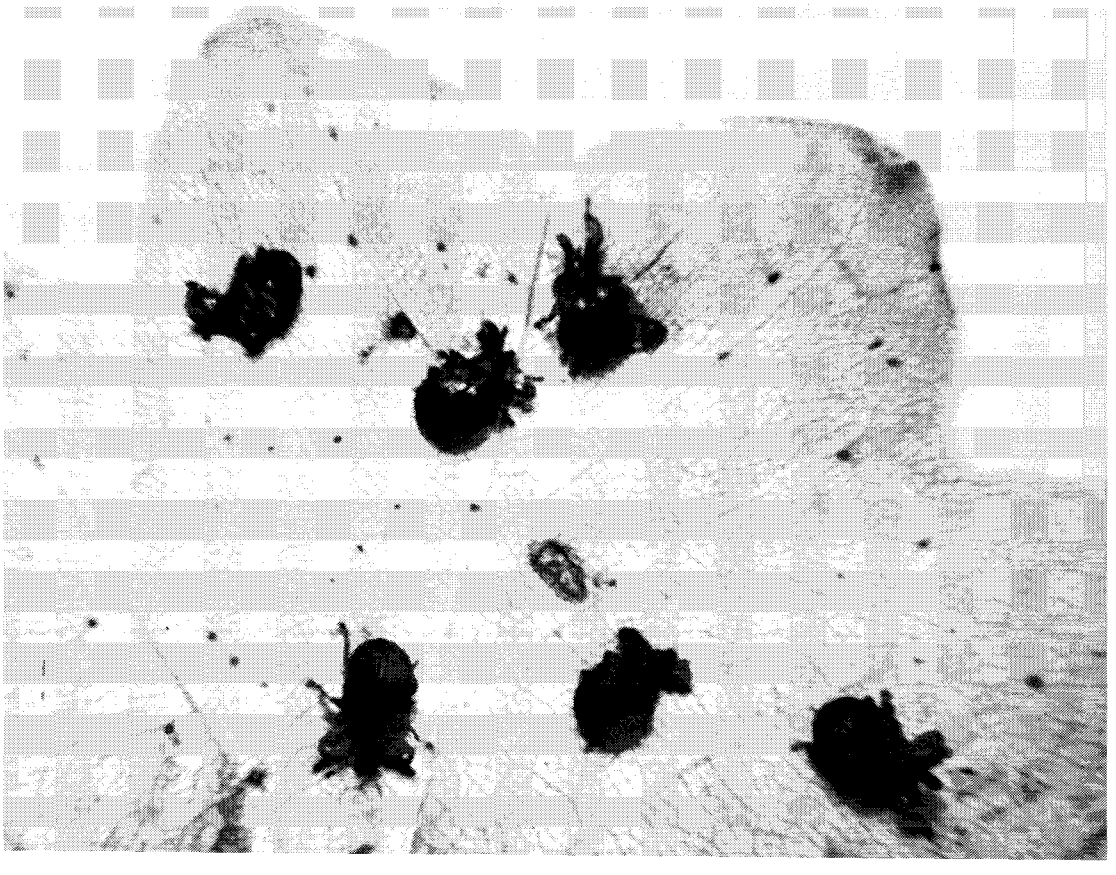
THE YELLOW-POPLAR WEEVIL

{*Odontopus calceatus* Say}

This defoliator is a small blackish beetle that feeds on buds and foliage. In its larval stages, it mines the leaves of yellow-poplar, sassafras, and magnolia (fig. 4). It has been observed since the mid-1880's but was not considered a serious pest of yellow-poplar until 1960.

In 1960, yellow-poplar was attacked over large areas of Appalachia; the most severe infestation centered in eastern Kentucky. The beetle has been abundant each subsequent year except 1963 and 1966. The infestation in 1965 was centered along the Ohio River from Cincinnati eastward. In 1966, two severe frosts killed most of the larvae; but by July 1967 the population level was again high.

Figure 4.—Adult yellow-poplar weevils.



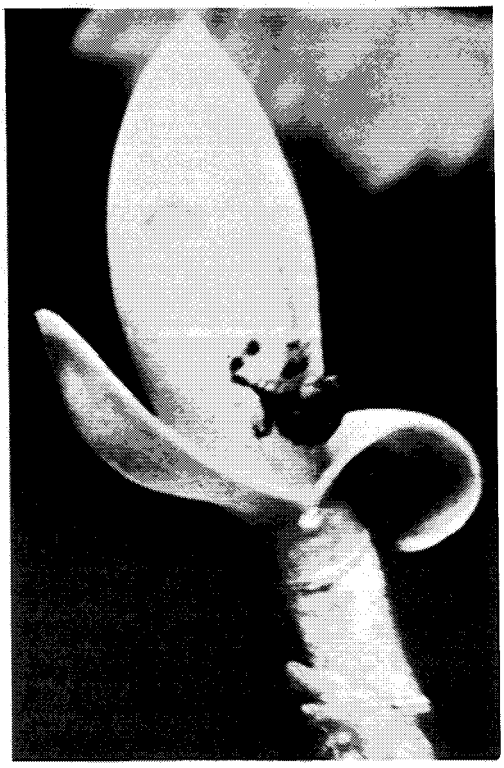


Figure 5.—Adult weevil and feeding punctures in bud.

The weevil has one generation per year throughout the Ohio River Valley *(Burns and Gibson 1968)*. Adults overwinter in leaf litter. On warm days in late April and early May in the latitude of southern Ohio and Pennsylvania the weevils begin to feed. In Florida and Mississippi, adults have been taken in late February. Before bud break, the weevils attack the swelling buds and make puncture-like feeding marks (fig. 5). They also attack the stipules. As the leaves unfold and enlarge, the insects feed upon them too. Rice-shaped holes in the leaves, about 1/6 inch in diameter, result when the adult weevils puncture the buds or feed from the undersurface of the leaves.

Mating and oviposition occur in May and early June. The eggs are placed in a 1/4 inch section of the midrib on the underside of the leaves. The midrib is partially or wholly destroyed by the oviposition and breaks over. As the newly hatched larvae move

from the midrib into the mesophyll, their boring action accentuates the midrib damage.

The larvae commonly feed side by side in one or two groups in a communal mine. Occasionally a leaf contains two mines. If the two mines are on one side of the midrib, only one mine is extensive; however, if the mines are on opposite sides of the midrib, both mines usually develop normally. Each mine may contain 1 to 19 larvae. The mined portion of the leaf inflates and the tissues become dry. As the larvae grow and extend the mines, they extrude continuous filaments of dark fecal material; and the filaments are more conspicuous than the larvae when the mines are opened.

When ready to pupate, the larvae move to an inflated portion of the mine and spin spherical silk cocoons. The length of the pupal stage, as well as the length of the other stages, appears to depend on the weather. In southwestern Pennsylvania the first adults emerge from leaves in early June.

The newly emerged weevils feed on the foliage. Sometimes they chew through the leaves, but more often they remove only the lower epidermis and mesophyll, leaving the upper epidermis intact (fig. 6). This feeding produces numerous chlorotic spots

Figure 6.—Weevil injury to yellow-poplar leaves.

and results in the burned appearance of severely attacked trees. Feeding by the newly emerged weevils causes the most extensive damage to the host.

By mid-July most of the adults have entered a period of aestivation, which is continuous with diapause during the winter. Only a few weevils are active in August.

There is no effective control measure known for the yellow-poplar weevil other than chemical sprays for the adults. Parasitism of the immature stages has occurred at rates up to 50 percent but has not prevented continued large populations. The factors that have allowed this insect to become a pest since 1960 have not been identified.

THE ROOT-COLLAR BORER

[*Euzophera ostricolorella* Hulst]

Tulip-poplar borer and tulip bark borer are other common names for this insect. This pest is the larva of a moth. The larva bores in the phloem tissue at the base of yellow-poplar trees. Attacks are confined mostly to an area from 2 feet above the soil line to 2 inches below. Fewer than 10 percent of the attacks observed by Hay *(1958)* were between 2 and 10 feet above the ground. He indicated that trees over 10 inches d.b.h. receive most attacks, but occasionally a tree as small as 6 inches d.b.h. is infested.

The borer attacks are not generally serious by themselves, but they permit the entry of stain organisms or, more serious, they provide entry points for rots or other pathogens or for carpenter ants. The bark at the base of an infested tree often appears loose, and exit holes are visible in the bark. In 1954, near Lamasco, Kentucky, many trees were killed or dying as a result of root-collar borer attacks and/or introduced pathogens. In northern Indiana, trees infested with the root-collar borer have shown considerable dieback and mortality *(Schuder and Giese 1962).*

The adult moths first appear in June and in lesser numbers in September and October, indicating a partial second generation.

Figure 7.—Mature larva of the root-collar borer. The larva first bored down 3 inches, then reversed direction and was extending its tunnel upward.

The adult is a dark gray moth with a slightly reddish wing base. It is about 1¼ inches long. Egg-laying has not been observed, but the eggs are probably laid in crevices of the bark. The larvae bore into the phloem and make a vertical tunnel about 4 inches long and a ¼ inch in diameter (fig. 7). The tunnel surfaces are stained black, and watery black frass may ooze from the entrance hole.

In late summer, pupation occurs in a cocoon spun in the tunnel. The adult either emerges as part of the second or fall generation, or overwinters and emerges the following spring. Apparently there are Dipterous and Hymenopterous parasites of the larvae, as evidenced by pupal cases in the borer tunnels, but none has been reared and identified. Woodpecker activity was noticeable on nearly every borer-infested yellow-poplar in the 1954 Kentucky infestation. Only small-scale control tests with insecticides have been made.

THE COLUMBIAN TIMBER BEETLE

{*Corthylus columbianus* Hopkins}

This beetle is a pest of many hardwoods in addition to yellow-poplar. Damage to lumber by this insect is variously called "flagworm", "spotworm", "patchworm", "black holes", "steam boats", and "pinhole damage". In yellow-poplar the defect is called "calico poplar" (fig. 8). Attacks by the beetle do not kill the host, but the defects may seriously degrade the wood from what appears to be a sound tree.

The Columbian timber beetle has at least one generation per year and may have two or more depending on the host and geographical location. The beetles overwinter as adults or pupae in the tree in which they were reared. Some adults may go to another tree, bore a simple gallery, and overwinter in it.

In May the beetles emerge and attack new trees or reattack their host trees. Most attacks occur the lower 6 feet of the bole. Attacks are marked by small damp spots and fine white dust from the boring. The adults excavate a main gallery directly into the sapwood. A secondary gallery may branch off to either side. The main gallery is about 1/16 inch in diameter and a few inches long. The secondary galleries are the same diameter but are shorter. Niches or egg cradles are bored at right angles to the galleries. Most of the niches extend upward, although a few extend downward. The galleries, niches, and a stain that is always associated with them degrade the wood.

After the niches are constructed, mating occurs within the

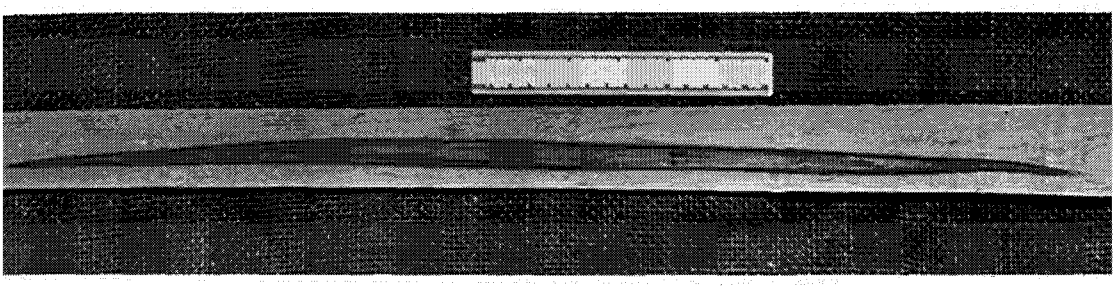


Figure 8.—"Calico poplar", the stain defect associated with Columbian timber beetle attack in yellow-poplar, is shown here in profile in a piece of rotary cut veneer. A gallery in cross-section and an egg niche are also visible. The ruler is 6 inches long.

gallery. The female lays an egg in each niche then plugs the niche with frass. The eggs hatch within 6 days, and the larvae mature in about 2 weeks. Symbiotic fungi and yeasts growing on the walls of the niches serve as food for the larvae. Pupation requires 8 or 9 days and occurs in the niche, with the head of the pupa oriented towards the plug. The life cycle can be completed within 4 weeks.

No satisfactory control measures for this insect are known.

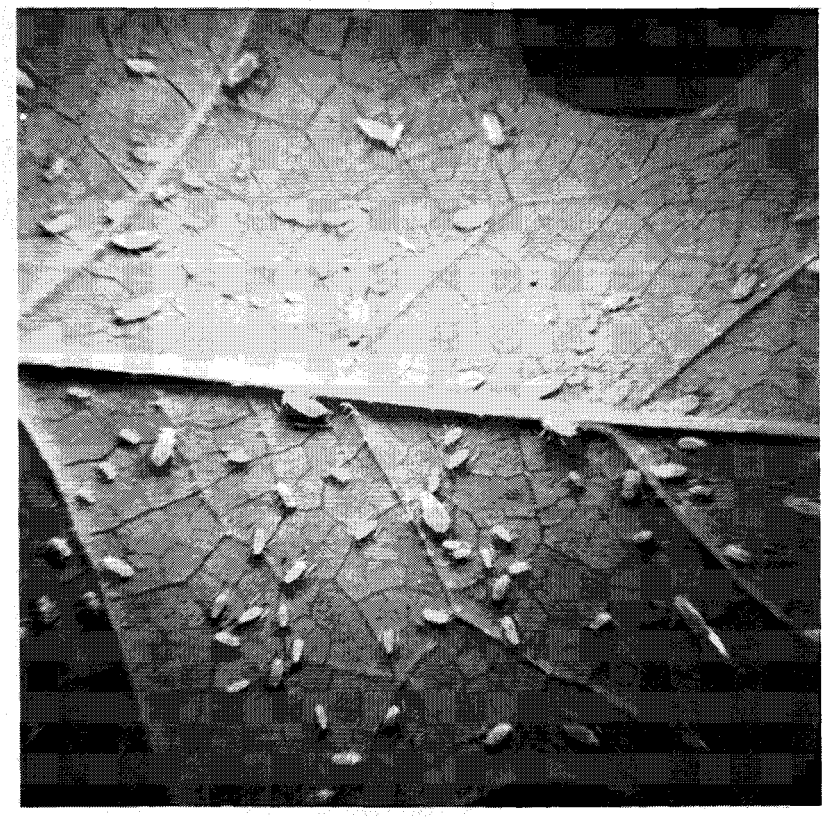
OCCASIONAL PESTS

Yellow-poplar has been reported as a host for more than 100 species of insects. Some of them cause observable damage when they are abundant. In addition, many insects are found on and in the vicinity of yellow-poplars infested with tuliptree scales. Flies, bees, and wasps particularly are attracted to the honeydew, to other insects attracted to the honeydew, or to the dead twigs killed by the scale.

The tuliptree aphid *Macrosiphon liriodendri* Mon. is often found feeding on the undersides of the leaves (fig. 9). It is a large pale-green aphid that seldom is found in great numbers. When it is abundant, the foliage becomes pale and will fall prematurely *(McCarthy 1933)*.

The tulip gall fly *Thecodoplosis liriodendri* (O.S.) produces

Figure 9.—The Tuliptree aphid *Macrosiphon liriodendri* Mon. on the underside of a yellow-poplar leaf.



1/2-inch wide greenish-yellow or greenish-brown spots or blisters on the leaves. Several species of fungi also cause leaf spot in yellow-poplar. Only the insect-caused spots have a hollow area beneath the upper surface of the leaf. This is the mine chewed by the immature (maggot) stage of the fly. Doane and others (1936) reported that this insect is often abundant enough to do considerable damage in the South.

The larvae of the tulip tent maker moth *Polychrosis liriodendran* Kearfott occasionally defoliate yellow-poplars. The larva constructs a small web on the underside of the leaf, usually near the midrib, and skeletonizes part of the leaf. As the leaf is skeletonized, it is folded together and held with silk. Defoliation

by this insect is very localized: only a few trees are noticeably attacked in a given area.

Larvae of two species of the giant silkworm moths feed on yellow-poplar foliage, consuming most or all of the leaf blades. They are the spice-bush silk moth *Callosamia promethea* (Drury) *(Craighead 1950)* and the tuliptree silk moth *C. angulifera* Walker *(Herrick 1935)*. The larvae of both species reach 2 inches in length. The larva of *C. promethea* has coral-red tubercles or stalks on the second and third anterior segments; these stalks show conspicuously against the bluish-green epidermis. These insects overwinter as pupae in brown cocoons dangling from yellow-poplar twigs. The cocoon is formed in a leaf, which is prevented from falling off the twig by the petiole of the leaf being securely fastened with silk. Most cocoons of *C. angulifera* fall to the ground.

Another moth larva that occasionally defoliates yellow-poplar is the tuliptree beauty *Epimecis virginaria* form *carbonaria* Haim. This is one of the Geometridae, the measuring worms. The larvae are about 1½ inches long, and they are stout when fully grown. The head capsule is small and reddish-brown; the body is yellowish to dark brown, marked with many fine, irregular, wavy, longitudinal, pale yellowish lines. The underside and legs are yellowish to light brown. The larvae are active from May through July. The larvae migrate to the ground during the day and climb trees to feed at night. Pupation occurs in the ground, and the pupa is the overwintering stage.

Occasionally yellow-poplar twigs about ½ inch in diameter are slit or torn along the branch axis with clumps of wood fibers protruding from the wound (fig. 10). These are egg-laying sites of the periodical cicadas or "17-year locusts" of the genus *Magicicada.* Many of the wounded twigs break over and die.

The adult cicadas are present from late May through June. They are smaller than the dog-day cicada and have reddish eyes, wing veins, and legs. Eggs placed in the slits hatch in 6 to 8 weeks, and the emerging nymphs immediately drop to the ground and burrow into the soil. When they find suitable roots they begin to suck the sap. This continues for 13 or 17 years depending on

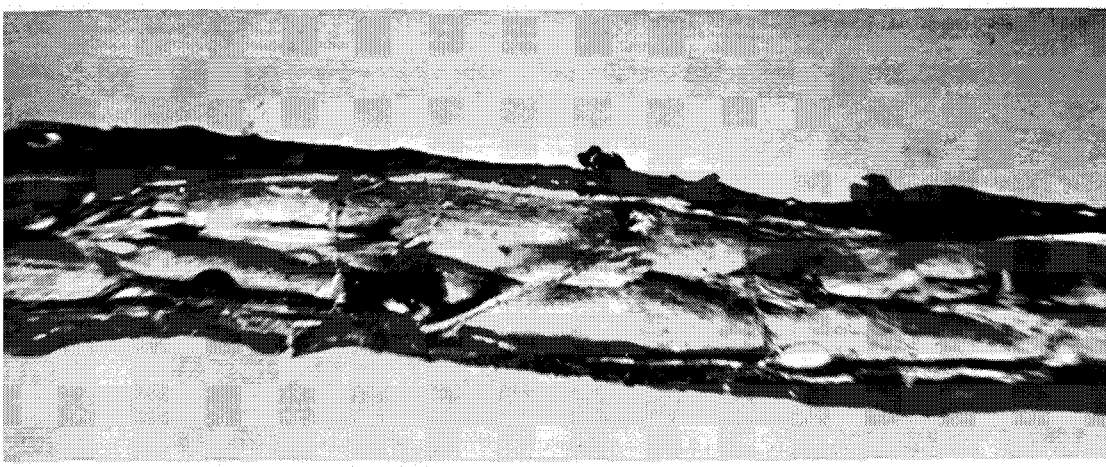


Figure 10.—This torn yellow-poplar twig was used as an egg-laying site by periodic cicadas.

the species and location. When feeding is completed, the nymphs emerge from the ground, climb vertical objects, and attach themselves; then they molt to the adult stage. There is no economical way to protect stands of yellow-poplar from this insect.

Several species of armored scales occasionally attack yellow-poplar twigs and small branches. They include the willow scurfy scale, *Chionaspis salicis-nigrae* (Walsh) *(Craighead 1950);* and oystershell scale, *Aspidiotus ulmi* Johns *(Westcott 1946).* And in Florida, Dekle *(1965)* reported he found three armored scales infesting yellow-poplar: the coconut scale, *Aspidiotus destructor* Sign.; the Harper scale, *Neopinnaspis harperi* McKenzie; and the walnut scale, *Aspidiotus juglans-reginae* Comst.

Careful examination of the twigs is necessary to find these scales—even when they are abundant. A hand lens is particularly useful. When abundant, these insects can stunt or kill twigs and small branches.

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