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Some Wood Borers Attacking the Trunks and Limbs of Deciduous Trees and Shrubs  
Michigan State University Agricultural Experiment Station  
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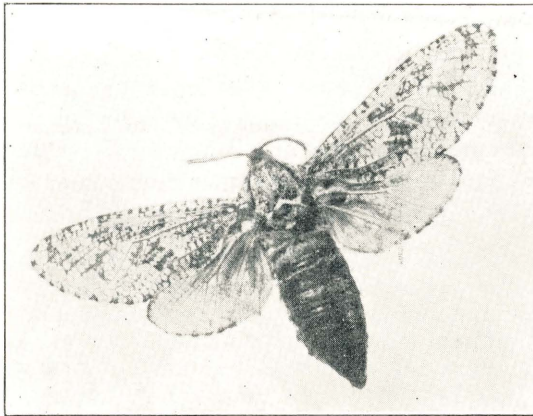
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# Some Wood Borers Attacking the Trunks and Limbs of Deciduous Trees and Shrubs

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E. I. McDANIEL

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Carpenter Moth

AGRICULTURAL EXPERIMENT STATION  
MICHIGAN STATE COLLEGE  
Of Agriculture and Applied Science

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SECTION OF ENTOMOLOGY

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East Lansing, Michigan

## **FOREWORD**

The selection of the insects discussed in this bulletin is based on inquiries received by the Department of Entomology of Michigan State College during the last 20 years. No attempt has been made to include a complete list, but certain representative types have been selected. The bulletin is presented with the hope that it may be of value to nurserymen, city foresters, landscape gardeners, and others interested in the control of insects destructive to shade trees.

R. H. PETTIT.

# SOME WOOD BORERS ATTACKING THE TRUNKS AND LIMBS OF DECIDUOUS TREES AND SHRUBS

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E. I. McDANIEL

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## WOOD BORERS

Many species of wood borers kill trees, and, though certain species are capable of attacking and killing healthy trees, they usually establish themselves first in unhealthy or weakened tissue which is found adjacent to scars caused by injuries. Borers often attack trees following a severe defoliation, and, where trees are attacked for several successive seasons, they are particularly attractive to borers. Any condition which tends to lower the vitality of trees is favorable to the development of this group of insects. They are always most destructive to recently transplanted trees, though healthy trees are attacked often during periods of drought.

Numerous protective devices and remedial measures have been developed for the control of borers in trees. Various mechanical barriers, such as wire screen guards or temporary casings of wood or paper are more or less successful protections against certain species which confine their attacks to the lower section of the trunk if the barriers are used with an understanding of the habits of the species to be controlled.

The injection of a few drops of carbon disulphide into the openings of tunnels and the subsequent plugging of the entrances with mud or grafting wax is an old and well-tried remedy. It is effective where carried out systematically, but the application is a tedious process. **Carbon disulphide is highly explosive** and must always be stored and handled with caution. Recently, several methods have been devised for borer extermination with the hope of reducing the time and effort necessary to kill borers with carbon disulphide and to eliminate the mechanical injury which is almost sure to follow the age-old method of "worming" the tree either with a knife or a wire.

**Calcium Cyanide Paste**<sup>1</sup>—Calcium cyanide paste is made by stirring enough calcium cyanide into a vegetable oil to make a thick paste. The amount of calcium cyanide required varies with the temperature; enough is required to make a paste of the consistency of thick paint. Of the various vegetable oils recommended by Petch, **raw linseed oil** holds first place because it is cheap and available. Cottonseed oil or castor oil would serve equally well as a carrier. Clean away gum and

<sup>1</sup>1930. Petch, C. E. The Round-headed Apple Tree Borer and Its Control. Circular No. 73, Canadian Dept. of Agr. p. 4.

castings from borer tunnels and apply a liberal coating of calcium cyanide paste to the injured area. Make this treatment early in the season when the activities of the borers first become apparent. **Remember, calcium cyanide is a violent volatile poison and must always be stored and handled with care.**

**Poison Oil Spray**—The use of a poisoned oil spray is recommended by Craighead<sup>1</sup> for control of the locust borer (p. 13). It is equally as effective when applied against other species infesting the trunk or larger limbs. Precautions must be taken against getting any of the spray on the foliage. A light application is sufficient, especially on trees known to be susceptible to oils.

**Paradichlorobenzene and Cottonseed Oil**—The use of paradichlorobenzene dissolved in cottonseed oil was originated by Snapp<sup>2</sup> as a control measure against the lesser peach borer. During 1931, experiments were carried on with this solution against the round-headed apple tree borer and the flat-headed apple tree borer<sup>3</sup> with gratifying results.

The following formula has been found very effective in controlling borers when applied in daubs over the injured area, either in early spring or late fall. Do not paint the trunk of the tree with the preparation.

Paradichlorobenzene .....	1 pound
Cottonseed oil .....	2 quarts

Warm the cottonseed oil slightly and stir in the paradichlorobenzene. (Paradichlorobenzene is sold under various trade names—e. i.: "Crystal Gas", "P. D. B.", "Paradow", "Paracide", "Dichloride".) It is not advisable to apply this preparation in the heat of the summer. This treatment kills any borers in the tunnels at the time of application, but does not prevent trees from becoming infested.

**Borer Repellent**<sup>4</sup>—The following borer repellent has been used in Michigan for a period of 10 or 15 years. It was originated as a repellent against the flat-headed apple tree borer but has since been found useful in protecting choice trees from other borers, as well.

Potash soap .....	50 pounds
Water .....	3 gallons
Naphthalene .....	25 pounds
Flour .....	2 pounds

Heat the soap (Potash soap is now available in liquid form and can be obtained through various wholesale dealers in insecticides) and water until the temperature reaches 180 degrees F. Stir in the flour (where Bentonite is substituted for flour the paste remains in a semi-liquid state for a longer time), and add the naphthalene. Bring the temperature up to 180 degrees F. (the melting point of naphthalene is 176 degrees F.). After the mixture has been thoroughly stirred at

<sup>1</sup>1919. Craighead, F. C. Protection From Locust Borer. U. S. D. A. Bull. No. 787, p. 11.

<sup>2</sup>1930. Snapp, Oliver I. Jr. Ec. Ent., Vol. 27, pp. 636-638.

<sup>3</sup>1931. Hutson, Ray. Michigan Quarterly Bul., Vol. 14, No. 1, pp. 27-30.

<sup>4</sup>1932. Pettit, R. H. Mich. Quarterly Bul., Vol. 5, No. 4, May, pp. 170-171.

180 degrees F., chill as quickly as possible, stirring the mixture occasionally while cooling. The more quickly the mixture is cooled the smaller will be the particles of naphthalene and the more effective the repellent.

### Round-headed Apple Tree Borer

*Saperda candida*

The round-headed apple tree borer is a native insect and is generally distributed throughout the eastern United States. At times, it develops into an important pest on various ornamentals belonging to the rose family. Particularly is this true where an old orchard is being converted into a park or cemetery, or where an old, neglected orchard is adjacent to new landscaping projects. It is of local importance, attacking both introduced and native trees. It is particularly destructive to apple, pear, and quince, but has been reported from peach, cherry, plum, wild crab, hawthorn, service berry, various species of thorns, mountain ash, and choke cherry.

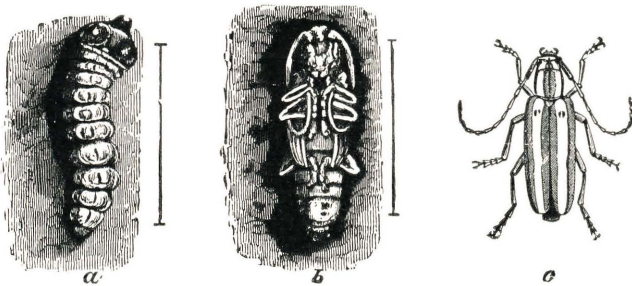


Fig. 1.—Larva, pupa, and adult of Round-headed Apple Tree Borer.

**Injury**—*Saperda candida* attacks trees near the ground level, the female seldom placing her eggs on the trunk more than two or three feet above the base, and the larvae work independently of each other. Where young trees are infested, they are often girdled the first season. An accumulation of rust-red sawdust and borings on the ground at the base of the tree is an indication of the presence of these borers. This cannot be depended upon as a criterion, however, since borers are often present when sawdust is not in evidence.

**Life History and Habits**—In its northern range three years are required to complete a life cycle; further south two years are sufficient. Winter is passed in the larval stage, pupation taking place about the time that apples bloom. Three weeks are required to complete the pupal stage. Adults remain in their pupal burrows a week or longer after they develop, appearing in the open in Michigan early in June. They emerge over a period of two or three weeks and are active for about two months. The beetles are on the wing during the day or early

evening, and egg-laying begins about 10 days after the females emerge. The eggs, which hatch in 15 or 20 days, are laid singly or in groups, each female depositing 25 or 30 eggs during her life-time. The young larvae feed at first in the inner sapwood, making irregular galleries in the inner bark of young trees and later tunnel into the sapwood. On mature trees where the bark is thick, the first winter is passed in the larval tunnel in the bark; during the second season, the borers work in the wood. The larvae keep their tunnels free from chewings and frass until they prepare to pupate, then each larva mines a tunnel, an inch or so long, upward in the solid wood and plugs the entrance with shredded wood fiber. Here, the transformation to an adult takes place.

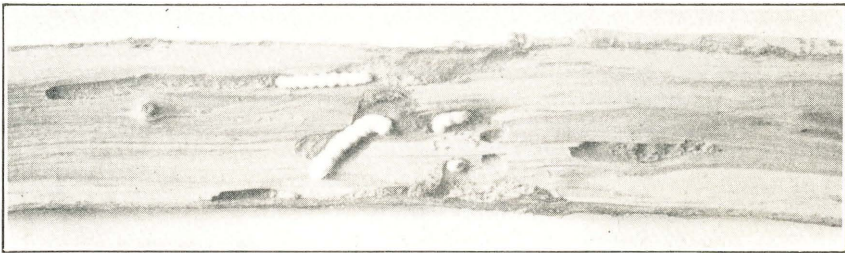


Fig. 2.—Work of Round-headed Apple Tree Borer. Slightly reduced.

**Description**—The adult is a conspicuous beetle about three-fourths of an inch long, light brown in color, with two broad white bands extending back from the head to the tips of its wing covers. The tops of the legs and the under side of the body are also white. The mature larva is a legless grub measuring from one to one and one-half inches in length.

**Control**—The borer can be killed by an application of paradichlorobenzene and cottonseed oil (see p. 4) applied with a paint brush to the opening of the tunnel through which the borer is ejecting castings. Where trees are grown in parks or in ornamental plantings, remove all infested trees in the immediate vicinity or treat such "brood trees" for borers.

### Spotted Apple Tree Borer

*Saperda cretata*

The life history, host-plants, and distribution of the spotted apple tree borer are practically the same as those of the round-headed apple tree borer. There is a decided difference, however, in the character of the injury inflicted. The spotted apple tree borer confines its attacks to the larger limbs. The eggs are usually laid in pairs and the larvae mine in opposite directions. The strikingly-colored beetle is uniform brown, with two broad silver-white stripes along the sides of the

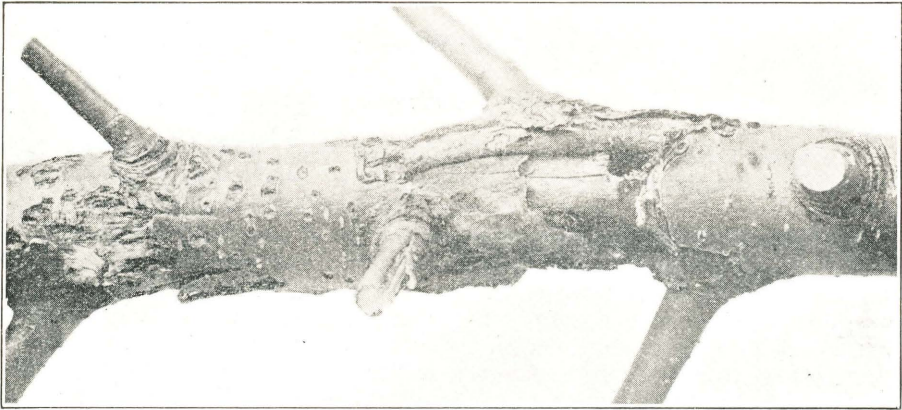


Fig. 3.—Work of *Saperda cretata* in apple.

thorax and abdomen, but each wing-cover is ornamented with two conspicuous white spots.

**Control**—The same control measures recommended for the round-headed apple tree borer will be effective for this species.

### Elm Tree Borer

#### *Saperda tridentata*

The elm borer occurs throughout the northeastern United States. It confines its activities to elms and attacks trees which are low in vitality. It is primarily a pest of street trees or trees growing under adverse conditions and is often found working in trees weakened by an attack of one of the elm curculios, *Magdalis*. The attack is evidenced by the thinning of the foliage at the top and by the dead limbs here and there throughout the tree. Infested trees die gradually as the beetles work from the top down. It usually requires about three years to kill a tree.

**Description**—The adult beetles measure about one-half inch in length and are greyish-brown ornamented with brick-red bands and black spots. The beetles appear during the last of May and are on the wing until the middle of August.

**Control**—Prevention is the most satisfactory control for this species. Since it infests sickly or dying trees, anything that keeps the tree healthy and vigorous serves as a check on the infestation. Where a tree has once become heavily infested it should be cut and burned in the spring before the beetles emerge.

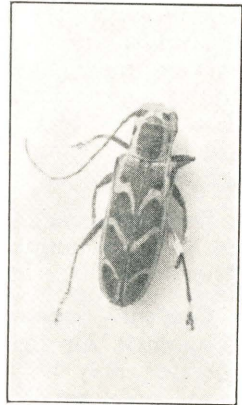


Fig. 4.—*Saperda tridentata*.



### Alder Borer

#### *Saperda obliqua*

The alder borer breeds in both alder and hazel and is generally distributed throughout the eastern section of the United States and Canada. Its work is similar to that of *Saperda candida*, in that the larvae attack the alder near the ground level and may extend their activities for several inches down into the roots themselves. Usually a number of larvae work together, often riddling the main trunk, weakening it to such an extent that it breaks in the wind. Conspicuous, irregular, gall-like growths which develop over the injured surface at the ground line are almost a sure indication of the presence of this beetle. The adults are rust-red or reddish-brown in color, marked with dark bands which continue over the head. Although generally distributed, the adults are seldom seen, for they rest quietly on the foliage and may pass for a bit of dead leaf unless examined closely.

**Control**—Cut and burn badly-infested trees. Where it is desirable to save trees, treat the infested area with paradichlorobenzene and cottonseed oil (p. 4) when the trees are dormant.

### Linden Borer

#### *Saperda vestita*

The linden, or basswood, borer is common throughout the north-eastern part of the United States. It confines its activities to linden, attacking healthy, vigorous trees as readily as those low in vitality. The larvae of the linden borer attack trees near the ground level, mining under the bark and into the wood, working downward into the surface roots. Occasionally, lower branches may be infested. The adults appear during mid-summer and feed on the green bark of the new shoots, leaf stems, and the larger veins of the leaves. The eggs are laid in groups of two or three in notches cut in the bark by the female.

**Description**—The black adults are robust beetles, measuring about an inch in length, and are covered with a dense grey pubescence. There are three bare black spots on each wing-cover.

**Control**—Basswoods in ornamental plantings should be examined frequently for the work of this borer. Trees in regions known to be infested may be protected by borer repellent (see p. 4), or the injured area may be treated with paradichlorobenzene and cottonseed oil before growth starts in the spring (see p. 4).

## Poplar Borer

### *Saperda calcarata*

Serious outbreaks of the poplar borer, or aspen borer, as it is sometimes known, are always local. Sickly trees, trees low in vitality, or those previously infested with borers are preferred to healthy ones; although, in a region of healthy trees the beetles center their attacks on certain individual trees, reducing their vitality and eventually converting them into "brood trees". Infested trees can always be "spotted", by the coarse, excelsior-like shreds of wood, chewings, and bits of frass that are constantly being crowded out of the tunnel by the larvae and which collect in conspicuous piles about the base of the tree. Where trees are vigorous, sap frequently flows from the opening of the tunnel and discolors the bark beneath the opening.

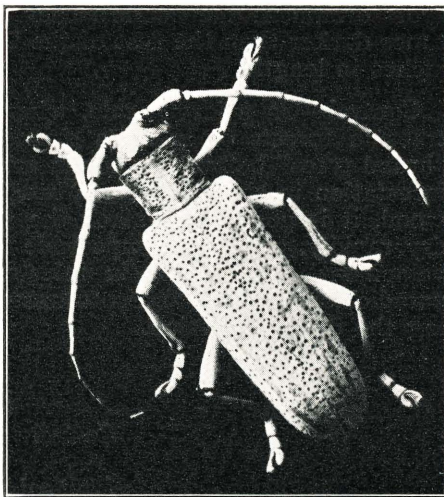


Fig. 5.—Adult of Poplar Borer. Enlarged.

**Injury**—The larvae work in the trunks and larger limbs, usually confining their attention to the middle third of the tree. This is particularly evident where rows of Lombard poplars are infested. The eggs are laid in openings in the bark, and the young larvae feed for a time in the outer bark, then in the cambium, and later in the wood itself, where they excavate winding tunnels often an inch or more in diameter. Trees so tunneled are correspondingly weakened, often to such an extent that they break with the first high wind. Such injury is most evident when it occurs in a Lombard poplar windbreak. The poplar borer is one of the most destructive borers known to infest cottonwood, willow, or poplar. It seldom causes the death of the tree, but other insects, as well as certain destructive fungi, usually follow an attack of the borer and kill the tree.

**Hosts and Distribution**—The poplar borer breeds in various species of cottonwood, poplars, and willows. It is most destructive to cottonwood and Lombard poplar. It is generally distributed throughout North America wherever its host trees grow.

**Life History**—From two to three years are required to complete a life-cycle. In any local infestation, there is always an overlapping of broods. Larvae in all stages of development are to be found in the same tree. Winter is spent in the larval stage, pupation not taking place until late in spring. The adults are present from July to September.

Shortly after the beetles appear, they seek injured areas in the bark on the trunk and larger limbs where they deposit their eggs. These eggs hatch and in a few days the young grubs make their ways into the outer bark, where they feed for a time before entering the cambium and finally the wood itself.

**Appearance**—The adults are long-horned wood-borers, measuring from an inch to an inch and one-half in length. Their uniform light-grey color is mixed with tiny black spots, and elongated, yellowish spots ornament the beetle's back. The antennae are long and sometimes darker than the rest of the body. The larvae measure about two inches in length.

**Control**—On a large scale, where the beetles become established in trees in forests or in trees growing in wood-lots the destruction of "brood trees" before the adults emerge is usually sufficient to hold an infestation in check. Where "brood trees" are cut and split into firewood, it is possible to stack the wood in such a manner that it will dry rapidly, making it impossible for the larvae to complete their development. The borers in infested trees can be killed by applying paradichlorobenzene and cottonseed oil (p. 4) to the injured area during the dormant period.

### Cottonwood Borer

#### *Plectrodera scalator*

The cottonwood borer is a large, conspicuous, black and white Cerambycid beetle, measuring about one and one-half inches in length.

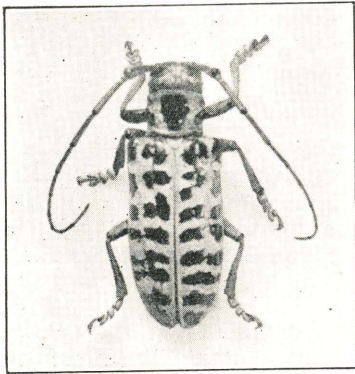


Fig. 6.—Cottonwood Borer.  
Slightly enlarged.

It is particularly destructive to cottonwoods, poplars, and willows in the mid-West. The beetle has been collected in Michigan but is not present in sufficient numbers to cause economic loss. The life history of this species is very similar to that of the poplar borer, but the work is decidedly different. The larvae attack the tree, mostly at the base or below the ground level and at times completely girdle the tree just below the surface of the ground. Trees of all ages are attacked.

The adult beetle deposits her eggs during August and September. In districts where the beetle is present in sufficient numbers to warrant control measures, it has been found worth while

to protect the bases of desirable trees with screen barriers. After a tree has become infested, treat the injured areas with paradichlorobenzene and cottonseed oil during the dormant period.

**Locust Borer***Cyllene robiniae*

The work of the locust borer is apparently limited to the common black locust, *Robinia pseudacacia*, and to the rose acacia, *R. hispida*. It is a common pest of the black locust in all parts of the United States east of the Rocky Mountains. Black locusts growing in open stands or as isolated shade trees are usually attacked by the locust borer. "Wet places" on the bark and accumulations of sap about injured areas in fall and spring are the first indications of the work of this beetle; later masses of frass and borings are crowded out through

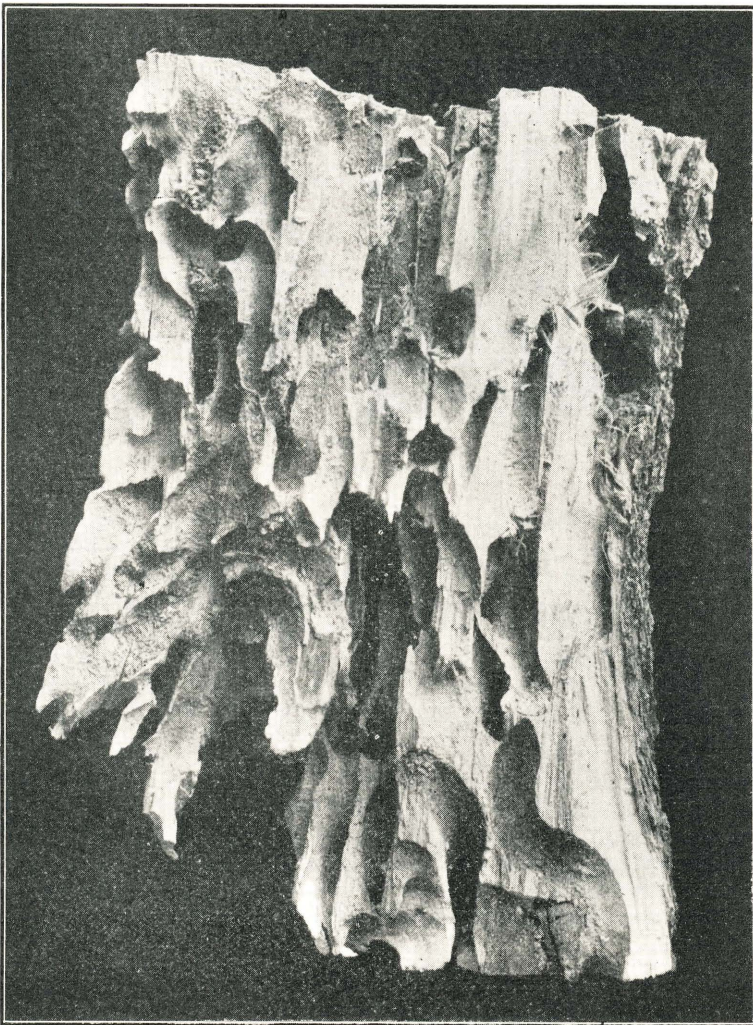


Fig. 7.—Work of Locust Borer.

openings in the bark and accumulate on the trunk and about the base of the tree. Infested trees frequently break off a foot or more above the ground. Limbs of mature black locust often are killed by the attack of this beetle, and swollen places on the trunk or limbs are usually the result of the tree's attempt to heal the wound caused by the larvae.

**Life History**—There is one annual generation and the winter is passed in the larval stage in the bark. In the spring, the larvae feed for a time in the cambium, later entering the sapwood, where they mine out long, winding tunnels. The infested sapwood eventually becomes heartwood as the tree matures, and the trunks of infested trees when broken appear honey-combed with tunnels of borers. As the larvae feed, they push the frass and chewings out through the entrance hole. As the tunnel lengthens and becomes plugged, openings

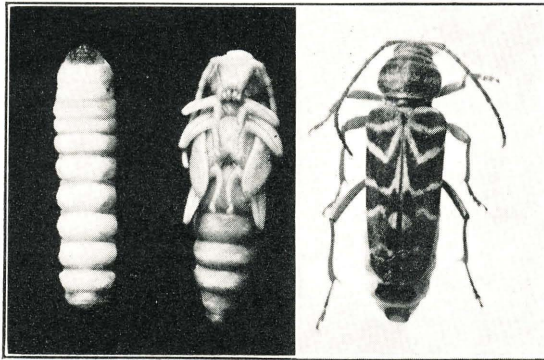


Fig. 8.—Larva, pupa, and adult of Locust Borer. Enlarged.

are usually made at intervals and chips and frass are pushed out. The larvae grow rapidly and reach maturity in August. They construct their pupal cells, and the adults emerge later and feed for a time on the pollen of goldenrod and other autumn flowers. They are sun-loving beetles and may be found any bright afternoon wandering up and down the rough bark of the locust seeking suitable places for the females to deposit their elongate eggs, which are laid individually or in clusters. These hatch in a short time and the young remain in the bark until spring.

**Appearance**—The adults are beautiful beetles, measuring about an inch in length and with antennae shorter than the body. They are black, marked with irregular, transverse, zigzag, bright golden-yellow lines. The mature larvae are creamy-white, slightly flattened, with thorax thickened. They are nearly one inch long, while the white, naked pupae are thick-bodied and measure about three-fourths of an inch in length.

**Importance**—The locust borer is the most important insect enemy of black locust in the eastern United States. It has been common knowledge among entomologists for years that black locust trees growing in dense stands are less severely attacked by the locust borer,

even when the beetles are present in numbers. Young trees growing in the open are not attacked until they are at least one and one-half inches in diameter.

**Control**—No really effective control has yet been discovered for the locust borer. Its ravages can be checked more or less by growing commercial plantings in compact blocks where the shade will be dense or by growing young locust trees in dense stands of other hardwoods.

Isolated trees may be kept free from borers by applying a coat of borer repellent (p. 4) to the tree late in August or early in September. After the borers gain entrance to the trunk, they can be killed either with a treatment of paradichlorobenzene and cottonseed oil (see p. 4) early in May or by the use of a poisoned oil spray, as recommended by Craighead.\* This spray is made as follows:

Arsenite or arsenate of soda .....	¼ pound
Water .....	5 gallons
Miscible oil .....	1 quart

Agitate thoroughly and apply to the bark just as the new growth appears at the tips of the twigs in the spring. Apply the spray thoroughly so it reaches all places where the larvae are working, taking care not to hit the foliage. It may be necessary to repeat this spray every year or so until the tree trunk becomes six inches or more in diameter.

It is inadvisable to start locust plantations in districts where golden-rod abounds because this plant is the one most attractive to the beetle, which feeds on its pollen.

### Painted Hickory Borer

#### *Cyllene picta*

The painted hickory borer is common in Michigan. The adult beetle very closely resembles the locust borer, *Cyllene robiniae*. It measures about three-fourths of an inch in length and is black with irregular, golden-yellow, zigzag lines. The painted hickory borer appears in the spring, while the locust borer appears in the fall. This insect has been reared from hickory, black walnut, butternut, mulberry, and osage orange.

**Control**—Trees can be protected by borer repellent (see p. 4). After the borers become established in the tree, they can be killed by injecting carbon disulphide into the tunnels and closing the opening or by an application of paradichlorobenzene and cottonseed oil (see p. 4) to the affected area during the dormant period.

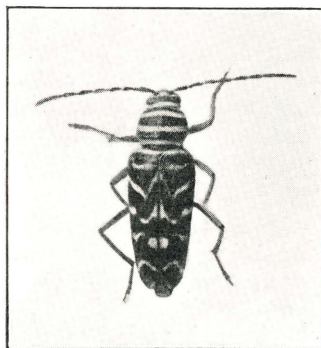


Fig. 9.—Painted Hickory Borer. Enlarged.

\*1919. Craighead, F. C. Protection from the Locust Borer. U. S. D. A. Bull. No. 787, p. 11.

### Ivory Spotted Long Horn

*Eburia quadrigeminata*

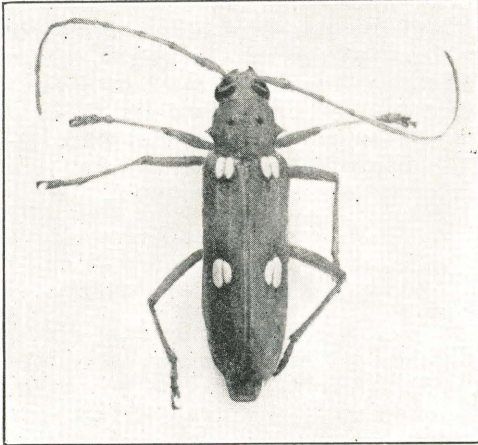


Fig. 10.—Adult of Ivory Spotted Long Horn.

This conspicuous, long-horned beetle is found occasionally throughout the eastern portion of the United States. The adults measure about an inch in length and are dull brown with two pairs of brilliant ivory marks on each wing-cover, one pair near the base and other near the middle. The mature larvae measure an inch or more in length. They have been reported as breeding in oak, ash, honey-locust, hickory, and hard maple. The species responds to the same control measures as the painted hickory borer.

### Sugar Maple Borer

*Glycobius speciosus*

The sugar-maple borer is one of the most destructive insects infesting sugar maple in the northeastern United States. It prefers trees growing in open stands, in parks, lawns, or along roadsides, and it has become so destructive in some localities that the growing of sugar maples in the open has been discontinued. The trees lose vigor slowly and their death is often attributed to other causes. Apparently, the beetle is able to attack and kill healthy, vigorous trees. Its work is spectacular, since it usually kills large limbs here and there throughout the tree, or causes the bark to slough off from either the trunk or the larger limbs.

**Injury**—Where several borers work in close proximity, they are capable of killing the bark over a large area and often completely girdle the tree. A favorite place for the beetle to deposit her eggs seems to be in the crotch of larger branches. The larva first girdles the branch and then completes its development in the wood.

**Life History**—Two years are required to complete a life-cycle. The adult beetles appear in July and continue their activities until about the first of September. A rusty, moist-appearing discoloration appears on the bark where the young borer enters, and considerable frass occasionally is pushed out. During the first season, the young larvae feed immediately beneath the bark, and, during the second season, they work more deeply into the heartwood, where they form pupal cells. The more mature larvae are about two inches long and may extend their burrows several feet, longitudinally or transversely, in a season. The adult beetles are about an inch in length and are velvet-black with brilliant yellow markings. They revel in sunlight and are in evidence on bright, hot days.

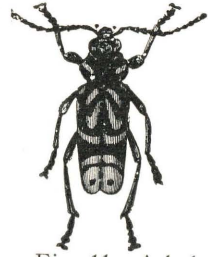


Fig. 11.—Adult of Sugar Maple Borer.

**Control**—The use of paradichlorobenzene and cottonseed oil will control this insect under conditions where it is possible to make the application (see p. 4).

### Oak Twig Pruner

*Hypermallus (Ellaphidion) villosus*

This beetle is a true twig pruner and local outbreaks are common. It is widely distributed throughout the eastern portion of the United States and Canada and when present in numbers the ground beneath the infested trees is littered with severed twigs.

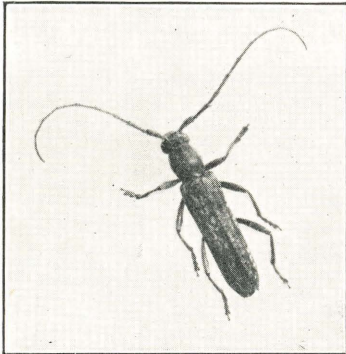


Fig. 12.—Oak Twig Pruner. Enlarged.

**Injury**—The oak twig pruner is not as a rule considered a serious menace to mature trees. Young trees are at times deformed by over-pruning and their development retarded. The beetle usually lays her eggs singly in the bark of twigs and small branches less than one inch in diameter. The young larva is a cambium miner; later it enters the wood, tunneling downward through the center of the twig. When it reaches maturity, it cleverly constructs a place for pupation by cutting off the twig from the inside. The wood is cut away in a straight right angle cut, but the bark is left intact.

The larva then retreats up the twig, plugging the lower part of the tunnel with chips of wood and chewings. Occasionally, a wind storm comes before the operation is complete, and the larva-infested twig may not be completely severed. Under such conditions, it may remain suspended from the tree, retaining its dead leaves until late in the season. This is especially common when oak is attacked. Where the twig is completely girdled, it breaks with the first provocation and



falls to the ground. Here, unless clean-up measures are instituted, the twig containing the larva is protected by a blanket of snow through the winter.

**Hosts**—In Michigan, this beetle has been most abundant on oak, hickory, maple, peach and apple. It has been reported in oak, maple, hickory, chestnut, locust, sassafras, sumac, red bud, bittersweet, apple, pear, plum, peach, orange, grape, and quince, as well as various ornamental shrubs.

**Life History**—Under ordinary conditions, the life-cycle is completed in one year, although occasionally more time is required. Adults usually appear in June and deposit their eggs singly on twigs and smaller branches. The eggs hatch and the larvae develop rapidly, often reaching maturity by September. Winter is usually passed in the larval stage in severed twigs under the trees.

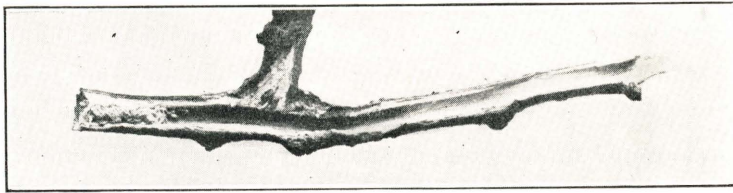


Fig. 13.—Twig of oak cut off by larva of pruner.

**Description**—The adults are slender, grayish-brown beetles measuring over a half-inch in length. The antennae are longer than the body and the wing-covers each terminate with two sharp spines.

**Control**—Collect and burn the fallen twigs late in the fall or in the early spring. This is the only control measure required. Where a local infestation is severe, the more thorough and extensive the clean-up campaign the sooner the epidemic will be checked.

### Hickory Twig Girdler

#### *Oncideres cingulatus*

The work of the hickory twig girdler is often confused with that of the oak twig pruner. It differs, in that the twig is girdled by the adult beetle and from the outside instead of by the larvae from the inside. The beetle chews away the bark and part of the wood, leaving the partially severed twig so weakened that it readily breaks with the first wind.

The severed twigs, which contain eggs, collect under the trees and the larvae do not complete their development until the following year. The adult beetles measure about three-fourths of an inch in length and vary in color from dusky, reddish-brown to tan, being ornamented with a distinct band across the wing-covers. There is one annual

generation, and the adults appear late in the summer. They confine their activities largely to hickory, pecan, and oak, although they also attack persimmon, apple, pear, peach, and quince. The species occurs throughout the northeastern United States.

**Control**—The same control measures recommended for the oak twig pruner will also be effective against the twig girdler. See p. 16.

### Flat-headed Apple Tree Borer

#### *Chrysobothris femorata*

The flat-headed apple tree borer is especially destructive in young apple orchards or to recently transplanted deciduous trees, especially maples. The loss is always more pronounced when young orchards are set out in close proximity to woods or where old orchards are converted into cemeteries or parks or opened up into city subdivisions. The beetle is incapable of completing its development within tissues of trees in full vigor. Eggs may be laid in healthy trees, but the larvae perish before they reach maturity. Unhealthy trees or parts of trees which, for some reason, are low in vitality furnish ideal breeding quarters.

**Hosts and Distribution**—A thorough study of this beetle has been presented by Brooks,\* who lists the following hosts for the flat-headed apple tree borer: Apple, pear, peach, apricot, plum, prune, cherry, quince, currant, walnut, pecan, hickory, cottonwood, willow, weeping willow, beech, chestnut, oak, elm, sycamore, mountain ash, service berry, hawthorn, red bud, sugar maple, soft maple, horse chestnut, basswood, Japanese persimmon, and box elder. The beetle is distributed throughout North America.

**Life History**—The beetles are on the wing from the first of June to the last of September. Eggs are laid during practically all of this period, the greatest number of eggs being laid in June and July. Each female lays about 100 eggs, depositing them singly in cracks or crevices of the bark, under bark flakes, or where the bark has been injured by sun-scald, hail bruises, or about some mechanical abrasion. The eggs hatch in from 15 to 20 days; and, if the tree is low in vitality, the young larvae will be able to establish themselves between the inner bark and the sapwood, where they develop rapidly. Early in the fall when the larvae have completed their development, they tunnel back into the heartwood and construct pupal chambers, where they remain until they pupate in the spring. Larvae from eggs in healthy, vigorous trees do not seem to be able to establish themselves in the inner bark of the sapwood and eventually die. Where the infestation is severe, larvae in practically all stages of development will be found throughout the year. There is one annual generation, although under adverse conditions two years or longer may be required to complete a life-cycle.

\*1919. Brooks, Fred E. U. S. Dept. Agr. Farmers' Bul. 1065.

**Description**—The adults are active, sun-loving beetles, which fly with a low, droning sound on a warm day. They are flat, metallic-appearing beetles, measuring about half an inch in length. The general color and markings vary somewhat, but the majority of the beetles are dull, dark-brown with a greenish, metallic luster. Each wing-cover is marked with two conspicuous greenish spots and with a dull, green, elongate, irregular band. The under surface is metallic bronze. The larvae are creamy-white and are slightly over an inch and a quarter long. The second thoracic segment is decidedly flattened and much broader than any of the other segments.

**Injury**—On the young trees, larvae usually excavate long, winding tunnels, which may completely girdle the trees. On older trees, the tunnels are usually broad and flat and confined to a smaller space. The larvae work first between the cambium and the bark, later tunneling into the sapwood. The tunnels between the cambium and the bark are filled with fine, sawdust-like pellets, while the tunnels into

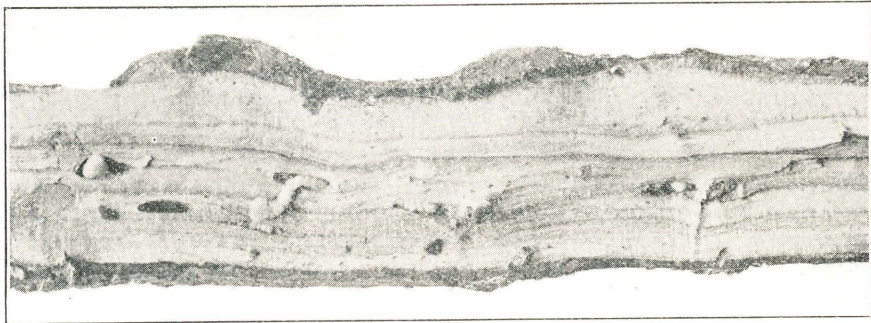


Fig. 14.—Work of Flat-headed Apple Tree Borer.

the sapwood usually contain a quantity of coarse, excelsior-like borings. Exteriorly, the work of these larvae may be detected by the peculiar wet or greasy appearance of the bark over the tunnels in the cambium. Such injured areas are usually depressed.

Where smaller, recently transplanted trees are attacked, it is not uncommon for them to be partially or completely girdled the first season. Trunks of young trees are attacked from the ground level up to and beyond the branches. As many as 25 larvae have been removed from a small tree five feet high.

The adults on older trees confine their attacks to portions of the trunks and limbs which are exposed to the sunlight. Where mature trees are attacked year after year, the eggs of each brood are laid along the burrows made by the previous year's brood. The bark on such areas becomes impaired and finally splits. Eventually, it may be killed for a space of several feet.

Timber felled during the flight of the beetle or just previous to its appearance often serves as a favorable place for the adults to lay their eggs and, under ordinary conditions, it is possible for a complete life-cycle to develop. Where felled trees are floated in water or shaded, they do not serve as important breeding centers.

**Control**—Cut and burn badly-infested trees before the first of May. Cultivate, fertilize, and see that recently transplanted trees have sufficient water until they become well-established.

Shade the sides of the trees exposed to the sunlight during the time the beetles are on the wing.

Cut and burn old and run-down apple trees when converting an orchard into parks, cemeteries, or a nursery. Such orchards are invariably infested with flat-headed apple tree borers which desert the old orchards and attack newly-transplanted ornamentals.

Take precautions to prevent sun-scald and see that all mechanical injuries, hail bruises, or frost injuries are so protected that the adult beetles will not find scars suitable for egg-laying purposes.

It is possible to prevent infestation by keeping the trunks of the trees protected with borer repellent (p. 4). The first application for this species should be made about the first of June and repeated at intervals up to October.

After borers become established in the tree, they may be controlled by applying a coating of paradichlorobenzene and cottonseed oil (p. 4) to the injured area. This material should be used when the tree is not in condition to grow rapidly.

### Bronze Birch Borer

#### *Agrilus anxius*

The bronze birch borer tunnels underneath the bark of the trunk and limbs of birches and poplars. The last half century has witnessed several spectacular outbreaks of this borer throughout the Great Lakes region and the St. Lawrence valley, both in the United States and in Canada.

**Injury**—Trees infested with the bronze birch borer die from the top downward and the infested trees invariably succumb within two or three years. Fewer leaves develop on the affected limbs and later the top dies. Branches girdled early in the season retain their dead leaves in the fall even after other foliage has naturally dropped. An examination of the bark in the dying part of the tree reveals ridges which develop over the larval tunnels. Each larva excavates a long mine, sometimes girdling the trunk or limb several times.

**Distribution and Host-trees**—The bronze birch borer is a native insect, and probably occurs wherever its host-trees grow. Fisher,\* in his revision of the American *Agrilus*, gives the following distribution for the United States: "Arizona, Colorado, Connecticut, Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Virginia, West Virginia, and Wisconsin". Fisher records that specimens have been reared from various birches and aspens in the United States.

\*1928. Fisher, W. S. A Revision of the North American Species of Buprestid Beetles belonging to the genus *Agrilus*. Smithsonian Institution, U. S. National Museum, Bull. 145, pp. 160-166.

**Life History**—The bronze birch borer has a one-year life-cycle. It winters in its tunnel as a larva and pupation does not take place until April or May. In Michigan, the adults appear early in June and feed for a short time on the foliage and new growth of poplar and willow before returning to birch to deposit their eggs. In the absence of birch, any of the host trees above mentioned may be utilized. The eggs are laid on rough places of the bark, usually several eggs in each spot selected. The eggs hatch and the young larvae construct their long, winding, frass-filled tunnels, first in the inner bark and later in the cambium, engraving both bark and wood. When its growth is completed, each larva constructs a cell in the solid wood and here it pupates.

The adults are sun-loving beetles. Isolated trees or groups of trees near recent lumbering operations are preferred to those growing in dense stands, and unhealthy trees or trees in low vitality are preferred to vigorous healthy ones growing under natural conditions.

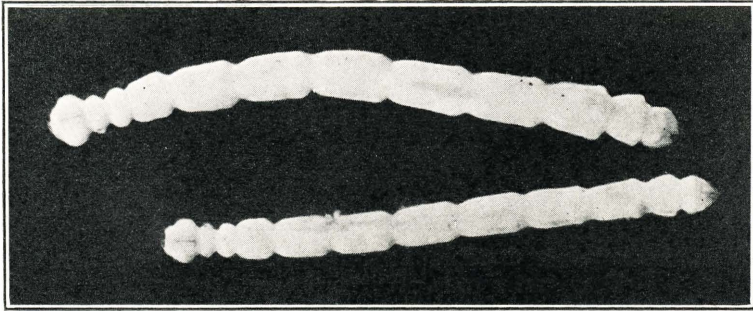


Fig. 15.—Larvae of Bronze Birch Borer. Enlarged.

**Appearance**—The adults are typical Buprestids or flat-headed borers. They are slender, sub-cylindrical, olive-bronze beetles varying from one-third to one-half inch in length. The larvae are white, slender, ribbon-like, footless grubs. When mature, they are about two inches long.

**Importance**—The bronze birch borer is a killer of trees, especially those low in vitality. It is a moot question whether vigorous, healthy trees are attacked, but where once infested the host seldom recovers.

**Control**—The best protection for isolated trees in parks or on lawns is to see that they are well fertilized and that they have sufficient water.

Where individual trees in a stand are infested, they should be cut and burned before the adults have an opportunity to emerge. To be effective, this drastic clean-up method should be applied to an extended area. Any infested trees in a community serve as sources of the pest. Cutting out and burning tops and infested limbs is scarcely worth while, since an ill-formed tree remains.

Under forest conditions delay opening up a stand, if possible, until

the birches are ready to cut. Where birches are left, the beetles inevitably appear and kill the remaining trees. Drought conditions invariably bring about attacks of bronze birch borer, and it is always worth while to see that birches at least never suffer from lack of water. Where possible they should receive a liberal application of a nitrogenous fertilizer, such as nitrate of soda, early in the spring.

### **Two-lined Chestnut Borer**

*Agrilus bilineatus*

The two-lined chestnut borer is common throughout the eastern portion of the United States and southern Canada. It infests chestnuts and oaks. It is quite similar to the bronze birch borer, both in appearance and life history. It usually attacks trees weakened from some other cause but, under some conditions, it may become a primary pest in that it attacks and kills healthy trees. As in the case of the bronze birch borer, the trees die from their tops down.

**Life History and Appearance**—There is one annual generation, and the winter is passed as larvae in cells in the outer bark. Adults appear about the last of May or early June and deposit the eggs for the forthcoming generation. The larvae are typical Agrilids, feeding both in the inner bark and in the cambium. Each larval tunnel is a foot or more long and is more or less at an angle with the grain of the wood. Where the larvae are numerous, the tunnels often interlace and it is possible for several larvae to completely girdle a tree.

The adults measure about three-eighths of an inch in length. They are slender, dark beetles with a conspicuous yellowish gold line down each wing-cover and along the sides of the thorax. The body is sparsely covered with a fine, yellowish pubescence.

**Control**—The same control measures recommended for the bronze birch borer should be effective against this species, where applied to an extensive area.

### **Bark Beetles**

*Scolytidae*

There are a number of destructive bark beetles, Scolytidae, that infest deciduous trees and shrubs. This group includes many forms that mine in the bark and the cambium, and which are commonly known as wood engravers. Of this group, the hickory bark beetle is undoubtedly the most destructive, infesting deciduous trees in the northeastern United States. It is usually considered a primary pest, since it is capable of killing healthy trees, although outbreaks of this species can invariably be traced back to adverse weather condition, drought, change in water table, hard-pan, the opening of a stand of trees containing hickory, or some other equally obvious adverse condition.

## Hickory Bark Beetle

*Scolytus quadrispinosus*

Hickory trees infested with the hickory bark beetle and growing in isolated places are usually doomed before the infestation is discovered. The presence of wilted leaves, of dead twigs and limbs, of rosetted terminal growths, or of quantities of sawdust about the trunk of the tree is an indication of the work of this beetle. If the weather turns cool and there is sufficient moisture, an infested tree may "pull through" the first year, but the attack is serious, since such trees are breeding centers for the infestation of all hickory trees in the immediate vicinity. Epidemics of this bark-beetle always occur in cycles, and outbreaks can be expected after periods of prolonged drouth.

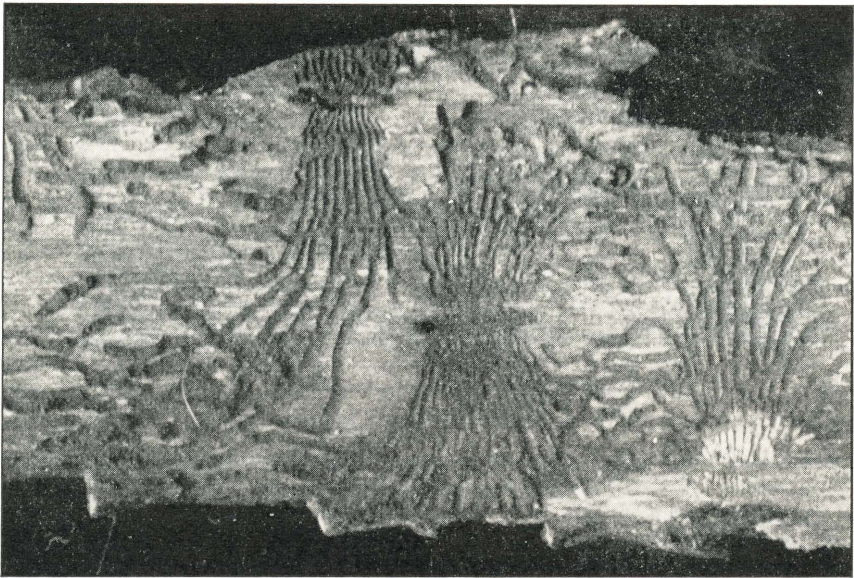


Fig. 16.—Tunnels of Hickory Bark Beetle in hickory bark.

**Distribution and Hosts**—The hickory bark beetle is common throughout the eastern United States. It is a serious enemy of shag bark and pignut hickory, and apparently equally destructive to butternut and pecan. Late in June, 1932, several pecan trees on the campus were partially defoliated by these beetles, while at the same time they entered the trunk to build their brood chambers.

**Life History**—There is one annual generation, and winter is passed in the mature larval stage in cells at the ends of the larval mines. In Michigan, adults begin to emerge by the middle of June and are in evidence up to the first of August. About this time, the beetles con-

gregate on certain individual hickory trees and construct their vertical egg galleries an inch or more in length in the bark and the cambium. Notches are cut along each side of this tunnel and in each notch an egg is laid and sealed in with a bit of frass. The eggs hatch in a week or 10 days and the young larvae tunnel at right angles to the egg gallery.

**Appearance**—The adults are thick-bodied, black or dark-brown beetles about one-fifth inch long. The larvae are fleshy, legless grubs. The mines constructed by both adults and larvae are quite characteristic. The wood and the bark are both engraved. The adults when selecting a place on the trunk to build their egg galleries are apparently careful to space their workings far enough from those of their neighbors so that the tunnels of their young will not overlap. The egg galleries



Fig. 17.—Grooves scored in sapwood, showing galleries started by Hickory Bark Beetles.

are vertical, running with the grain of the wood. The young tunnel out at right angles to the egg galleries, those at either end eventually turning up or down in order that their tunnels may not overlap. Where small limbs are attacked the larvae shortly turn and work with the grain of the wood. In trees allowed to stand until the beetles have emerged, the surface of the bark is punctured with round holes, through which the adults have emerged. The beetles feed for a time on new twig growth, tunneling or excavating cavities near the tips of small branches. This leads to the death of the leaves borne by the branch tips and results in the formation of large rosettes of dead leaves which appear quite conspicuous against the bright green of the living foliage.

**Importance**—The hickory bark beetle is without doubt the most destructive insect attacking hickory in the eastern United States. A few beetles are always present wherever hickory grows, and, while sickly trees are preferred, a generation of beetles may concentrate their attack on healthy, vigorous trees, killing them within six weeks.

There is no possibility of saving a tree in which a number of beetles have become established. Isolated trees or those in open plantings



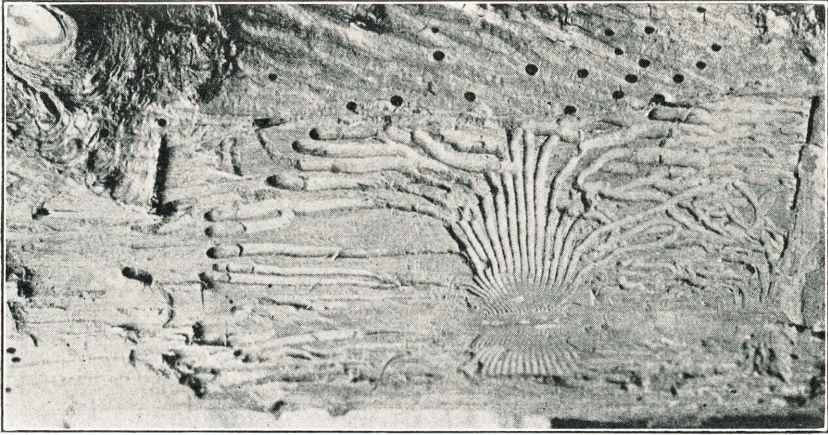


Fig. 18.—Hickory branch with bark partially pared away showing galleries of Hickory Bark Beetles.

are especially susceptible during dry, hot weather. Hickory trees growing in wood-lots or under forest conditions where the under-growth is dense and the tops are well-shaded often escape attack, even when isolated trees or those growing in open plantings succumb.

**Control**—Spray hickory trees in parks and on ornamental plantings with arsenate of lead, using two and one-half pounds to fifty gallons of water, early in June or when the beetles first appear in numbers on the foliage. Take particular care to cover the new growth. Keep trees in a vigorous state by judicious use of fertilizer and water during the summer months. Cut and burn all infested trees before the adults emerge in the spring. Trees only slightly infested serve as brood-trees and are dangerous to healthy individuals in the immediate vicinity. During an epidemic, all infested trees in the entire community should be destroyed to obtain effective control. Refrain from opening up a piece of woods until hickories are ready to cut, or remove such hickory trees as would otherwise be left to mature, because

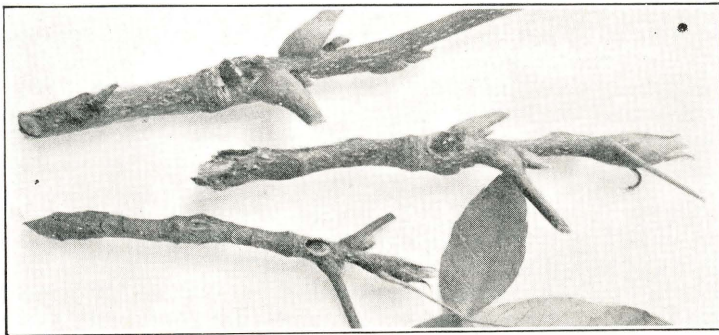


Fig. 19.—The Hickory Bark Beetle working in tips of twigs.

such trees invariably serve as breeding places for the hickory bark beetle, and infestations built up in this way spread to valuable trees growing in parks, wood-lots, or ornamental plantings. Cut trees close to the ground and see that the bark is removed from all stumps. Where infested trees are cut, trim the trunks, submerge the logs in water, and burn all slash.

### Ash Timber Beetle

*Leperisinus aculeatus*

The ash timber beetle is common throughout the eastern United States and Canada, where it usually occurs in dying or recently killed ash trees. The work of this species is almost as characteristic as that of the hickory bark beetle. Each brood chamber is constructed by two females working in opposite directions, a notch in the center indicating the common starting place. The females construct the brood chambers at right angles to the grain of the wood, frequently girdling smaller limbs. The larvae tunnel up and down with the grain of the wood for an inch or more. The removal and destruction of infested trees before the beetles emerge protects other trees in the vicinity.

### Elm Bark Beetle

*Hylurgopinus rufipes*

The elm bark beetle infests both elm and basswood. It occurs throughout the eastern part of the United States and Canada. The species is met only occasionally and is not considered important, since it confines its activities to trees of low vigor. The presence of this bark beetle is of more importance now because there is a possibility of its acting as a carrier of the "Dutch elm disease", a European disease which has recently been introduced into this country and is known to be established in several places. In Europe, the disease is apparently carried almost exclusively by bark-beetles closely related to *H. rufipes*.

**European Elm Bark Beetle, *Scolytus multistriatus***—The European elm bark beetle has been established in America for a little over a quarter of a century. So far as we know, this species has never been found in Michigan, although it is well-established along the eastern seaboard. In America, it has confined its attack to elms, usually selecting sickly trees, although in Europe it is recorded as also infesting oak, poplar, cherry, plum, and pear.

**Life History**—According to Felt\*, there are two annual generations in the New England region, adults of the first brood appearing in May and June and those of the second brood in August and Septem-

\*Felt, E. P. Manual of Tree and Shrub Insects, pp. 47-48, 1930.

ber. The egg galleries are vertical, often containing a hundred or more eggs. There is considerable overlapping of broods. Egg-laying is apparently extended over a protracted period. The adults are stout, cylindrical beetles, the females are about one-eighth inch long but the males are considerably smaller. The thorax is shiny and slightly longer than broad. The wing-covers are reddish, while the legs are light-brown. The brood chambers and larval tunnels are quite similar to those of *S. quadrispinosus* on hickory.

**Injury**—The European elm bark beetle had been practically dropped from the rank of important shade tree insects because it confined its activities to sickly trees, but with the finding of the Dutch elm disease in the northeastern United States the beetle again becomes a problem, since in Europe it is known to be one of the carriers of this dreaded malady. Trees infested by the European elm bark beetle usually die from the top down, new growth wilts and finally dies. The adults emerge through holes in the bark. The removal of the bark in the vicinity of these holes exposes the tell-tale mines of adults and larvae. Weakened trees may be killed the first season, or the process of dying may extend over two or three years.

**Control**—Cut and burn any infested trees before the beetles emerge. Keep trees growing and in a vigorous condition.

### Shot-hole Borer

#### *Scolytus rugulosus*

The shot-hole borer or, as it is better known, the fruit-tree bark beetle, is primarily a pest of fruit trees. Breeding as it does in trees low in vigor, in prunings, and in injured trees, the propriety of including it among the pests of ornamentals might well be questioned. When we consider that sickly apple, pear, or cherry trees serve as breeding-places for numerous wood-borers and other insect pests which also attack deciduous shade trees, it will be apparent that fruit trees near ornamental plantings should be kept in as thrifty a condition as possible. The fruit-tree bark-beetle breeds in the trunk, limbs, and branches of apple, peach, plum, cherry, apricot, hawthorn, quince, mountain ash, June berry, and wild cherry.

**Life History**—There are two annual generations and the winter is passed as larvae in cells under the bark. The adults emerge early in the spring and may be found feeding on healthy trees shortly after the buds swell. From four to six weeks are required to complete a life-cycle, and there is considerable overlapping of broods.

**Description**—The adults are dark-brown or black beetles, which are about one-tenth inch in length. They can readily be distinguished from other bark beetles by the peculiar shape of the abdomen. The work of this species is quite characteristic. Both males and females cooperate in excavating the egg chamber, which runs lengthwise with the grain of the wood and measures from half an inch to two inches

or more in length. The mother beetle cuts notches along either side of the chamber and the tiny grubs, when they first hatch, work at right angles to the brood chamber. As they mature, the larval tunnels widen and gradually turn, following the grain of the wood. When growth is complete, each larva excavates a cell at the end of its tunnel and here pupation takes place. When the adult is ready to emerge, it cuts a round opening in the bark about one-sixteenth of an inch in diameter and comes out. The pattern on the bark caused by the emergence of the adults has led to the common name, "shot-hole borer".

The shot-hole borer breeds sometimes in enormous numbers in recently-killed or in dying fruit trees. It does not seem able to maintain itself in healthy, vigorous plants or in wood that has been dead for some time. Unfortunately, adults may emerge and attack the twigs



Fig. 20.—Breeding galleries of Shot-hole Borer.

of perfectly healthy individuals. This habit of breeding in sickly trees and of attacking the twigs of healthy ones has proved quite disconcerting to many growers.

**Control**—Remove and burn all dying fruit, wild cherry or wild plum trees, broken limbs, or even firewood made from such trees.

### Mottled Willow Borer

*Cryptorhynchus lapathi*

The mottled willow borer infests both native and cultivated poplars and willows, as well as alder, dwarf birch, and red birch. It is an European insect, the first specimens having been taken in America in 1882. Since then, the beetle has gradually spread until it is now extensively established throughout the northeastern United States and southern Canada. A careful investigation of poplars or willows having irregular

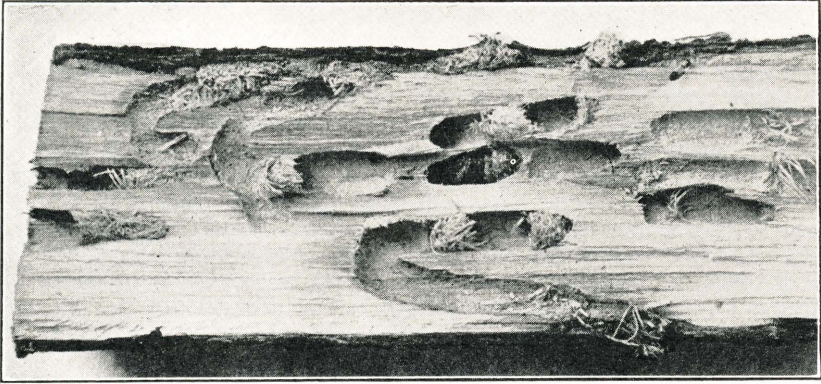


Fig. 21.—Work of Mottled Willow Borer in poplar.

galls or swellings on the branches or on the trunks of young trees will usually reveal the work of this borer. All poplars and willows over a year old are subject to attack. When mature trees are infested, the branches are usually so weakened that they either die or break down during a storm. Young trees are either killed outright or so deformed that they are worthless. The injury is always more severe when a number of poplars or willows grow in close proximity. Young poplars growing in nursery blocks, and basket-willows growing in plantations often suffer great damage. Native poplars and willows along waterways or where they are planted for wind-breaks are also subject to attack. The injury to isolated trees grown in ornamental plantings is less severe, although balm-of-Gileads, when grown as specimen trees, are sometimes attacked.

**Injury**—The adult beetle lays her eggs either singly or in groups of three or four in the inner bark of wood at least two years old. Where there is an injured place in the bark, the eggs are placed along the edges of the scar, otherwise the female uses her mouthparts to drill an opening through the outer bark for the reception of the eggs. These are often placed in the lenticels or in the thickened bark at the bases of twigs or buds. The young, on hatching, feed in the inner bark and the cambium. The injury is usually inconspicuous in the fall,

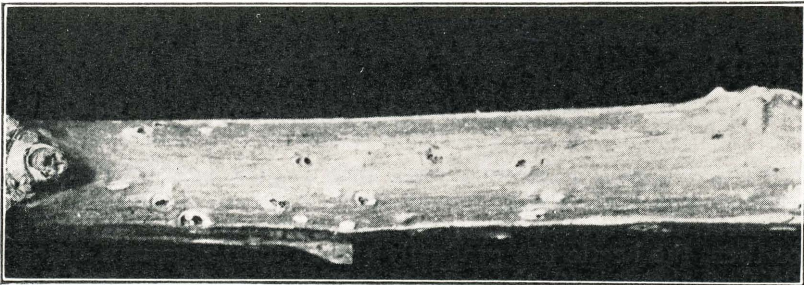


Fig. 22.—Feeding punctures of Mottled Willow Borer.

but can be detected by the discoloration of the bark caused by the dark, wet frass which accumulates in the old egg cavity. In the spring, development is more rapid and the injury is often more spectacular because of the abundance of dark-brown frass which is pushed out from openings in the bark. When the larva completes its development and starts its pupal tunnel in the wood proper, the chewings become coarser, more abundant, and are light in color. The direction taken by the larval tunnel is apparently accidental but frequently it extends around the infested branch; and, if attacked by several larvae, the

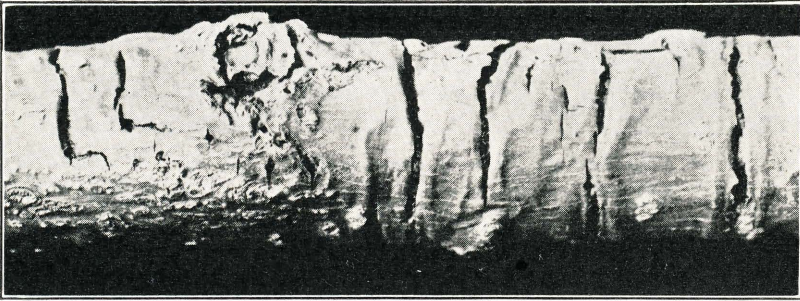


Fig. 23.—External evidence of injury by Mottled Willow Borer.

branch may be completely girdled in one season. The pupal chamber usually extends upward and is hollowed out in the center of the limb, and the bark over the tunnel may crack open, exposing the wood beneath.

**Description**—The adults are snout-beetles, one-third of an inch or more in length. They are dark-brown, mottled with grey, but the posterior portion of the wing-covers, the under side of the thorax and parts of the legs are pink, yellow, or light-grey. The curved beak is as long as the head and thorax and, when not in use it rests on the underside of the thorax. The beetles are sluggish and drop to the ground and feign death when disturbed. The wings are apparently normal, but, so far as known, the adult has never been taken on the wing. The mature larvae are white, footless grubs about one-half an inch long.

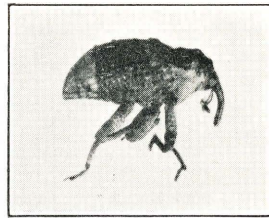


Fig. 24.—Mottled Willow Borer enlarged.

**Life History**—There is one annual generation. The brood is considerably scattered, for it is not unusual to find all stages of development in a badly infested tree at any season. Winter is usually passed under the bark as a partially developed larva, which starts feeding early in the spring. Development is rapid; and, in Michigan, an examination of infested trees shows that the majority of the brood pupates late in June. Three or four weeks are required to complete the pupal development, and adults are plentiful by the last of July. The adults feed for a time on the cambium of tender

young shoots before they lay any eggs. After feeding for a week or 10 days they return to the older wood and select places to oviposit, showing a decided preference for wood from two to four years old. The adults are present in numbers through August and September, in fact, egg-laying takes place well along in October. As far as observations in Michigan go, the adults do not hibernate over winter.

**Control**—Cut and burn infested limbs or trees before the beetles emerge. Do not plant nursery poplars or willows near old plantations or near trees growing along river banks. The use of paradichlorobenzene and cottonseed oil (p. 4), when painted over the opening in their tunnels, kills both larvae and adults. This method of control is practical on nursery stock and on prize ornamental trees.

Schoene\* was successful in killing adults just after they emerged by spraying the tops of the trees with a bordeaux arsenical spray made up as follows:

Bordeaux mixture .....	50 gallons
Lead arsenate .....	2½ pounds

### Bark Weevils

#### *Magdalis* spp.

There are several species of weevils, belonging to the genus *Magdalis*, known to infest shade trees. Both the trunks and larger limbs are attacked. Small trees recently transplanted, which might otherwise survive, are often girdled at their bases and on larger trees the dead branches appear here and there throughout the top. Weak trees are always attacked first and it is a question whether the beetles are capable of maintaining themselves in healthy trees. The larvae engrave their tunnels in both the cambium and in the bark. One year

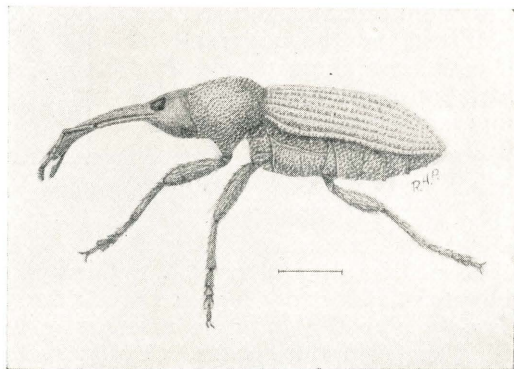


Fig. 25.—Adult of Elm *Magdalis*. Enlarged.

\*1907. Schoene, W. J. Poplar and Willow Borer, N. Y. Agr. Exp. Sta. Bul. 286, Geneva.



Fig. 26.—Work of adult *Magdalis* sp. on elm.

is sufficient to complete a life-cycle and winter is passed in the larval stage. Pupation occurs in the spring and adults appear in late May or early June. The beetles vary in length from one-eighth to one-fourth of an inch and there is a decided difference in the appearance of the two sexes.

The reddish elm snout-beetle, *Magdalis armicollis*, and the black snout-beetle, *M. barbata*, confine their activities to elm and are especially destructive to newly-set trees. *Magdalis olya* has been bred from hickory. Infestation is apparently confined to the thin bark on the trunk and limbs. Hordes of *M. olya* emerge from dead or dying trees the season after they have been weakened or killed by the hickory bark beetle, *Scolytus quadrispinosus*.



Fig. 27.—Work of *Magdalis* in elm.



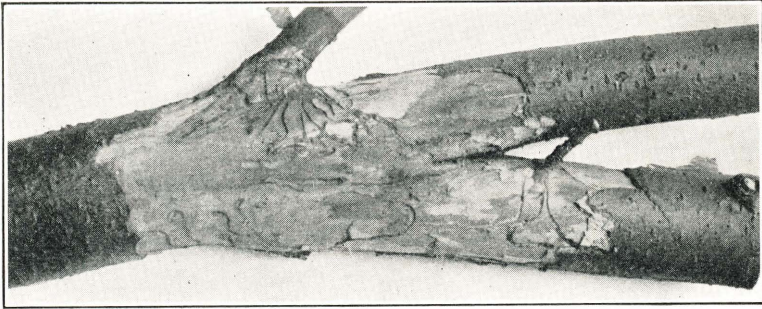


Fig. 28.—Work of *Magdalis* sp. larvae in elm.

**Control**—The most satisfactory control measure against the *Magdalis* group is prevention. They do not survive in healthy trees. The trunks of young trees which have been recently transplanted should be protected either by mechanical barriers such as fine wire screen, by wrapping the trunk in paper, or by the use of borer repellent, (p. 4).

### Clear Winged Moths

#### *Aegeriidae*

There are a number of moths belonging to the family *Aegeriidae* (clear wings) destructive to trees and shrubs. Of these, the species infesting fruit trees naturally have received the most attention; however, many forms common to fruit trees also infest certain trees and shrubs commonly used in ornamental plantings.

The adult moths are wasp-like insects, many species being brilliantly colored in reds or blues. There is frequently considerable difference in the appearance of the two sexes of the same species. The adults, like the wasps and bees which they simulate, are active and abroad during the heat of the day. The larvae are borers and tunnel in vegetation, infesting the stems, often working in the inner bark or the cambium.

### Peach Tree Borer

#### *Aegeria exitiosa*

Probably the most widely known member of the family is *Aegeria exitiosa*. It is widely distributed throughout the United States and Canada east of the Rocky Mountains and has killed many trees. It infests peach, plum, cherry, prune, nectarine, and apricot, besides occurring in various ornamental shrubs, particularly those belonging to the genus *Prunus*. The peach tree borer passes the winter as a larva or a pupa and some few hibernate as adults. The adults lay their eggs

in early June in the rough bark near the ground level. The larvae pass through the bark and tunnel in the cambium layer where they later pupate. The work of the larvae underneath the bark, near the ground level in peach, often causes large masses of gum to exude; this gum covers the workings of the pest.

**Control**—Today the accepted control measure for this insect is by the use of paradichlorobenzene during August or September. Cut the weeds and grass at the base of the tree without disturbing the soil and remove the gum from the wounds. Place the crystals of paradichlorobenzene in a ring about the tree, not closer than one inch or more than two inches from the trunk. On mature trees, it is safe to use an ounce of crystals. Smaller amounts should be applied on younger trees. It is usually inadvisable to use crystals on trees less than six years old. On young trees, it is probably best to remove the larvae with a wire or by means of a sterilized knife. The same methods employed for the control of the borer on peach will be found equally useful in controlling this pest when it infests shrubs.

### Lesser Peach Borer

*Aegeria pictipes*

The lesser peach tree borer confines its attack to the upper part of the trunk and to the larger branches. This species is common throughout the eastern part of the United States. It is smaller than the common peach borer and is recorded as attacking peach, plum, cherry, service berry, chestnut, and viburnum.

**Control**—This species can be effectively controlled with the paradichlorobenzene and cottonseed oil treatment applied to the injured areas when the tree is dormant, see p. 4.

### Lilac Borer

*Podosesia syringae*

The lilac borer is so called because the specimens originally described were bred from lilac. It is primarily a pest of ash, and is known to infest the mountain ash, as well as the green, white, and English ash. In some localities, it is quite destructive to lilac. The eggs are deposited on roughened areas or on scars caused by mechanical injury to the trunk or larger limbs. The larvae, on hatching, feed for a time in the inner sapwood, tunneling under the bark and when mature they enter the heartwood, often excavating irregular mines in the branches. They hibernate as larvae in tunnels deep in the heartwood. Pupation takes place in the spring and the adults are abroad in May.

**Injury**—The adults lay their eggs on roughened places on the bark. Apparently, a number of eggs are laid on each scar. Repeated infestations year after year cause such areas to develop into irregular, en-

larged, gall-like swellings. During the period while the larvae are mining, considerable frass and chewings are eventually in evidence outside the injured area. Plants are frequently so weakened that they break at the point of attack.

**Control**—Severely infested trees and shrubs should be cut and burned before the adults emerge in the spring. Where the infestation is light, the borers may be eradicated by painting the infested areas with paradichlorobenzene and cottonseed oil (p. 4) before growth starts in the spring or after it has been completed in the fall. During the growing season, it is possible to remove the larvae with a wire or knife. Where the larvae are out of reach, they can be killed by injecting carbon disulphide into the tunnel and plugging the opening. Keep the bark smooth and free from mechanical injuries, since the moths prefer roughened areas for egg-laying.

### Maple Clear Wing

#### *Sesia acerni*

The maple borer, or "callus borer", as it is sometimes called, is perhaps the best known of the clear-winged moths infesting shade trees. It attacks both hard and soft maples throughout the northeastern part of the United States. The injury caused by this species is quite characteristic, occurring both on the trunk and limbs. The females prefer to lay their eggs on rough areas of the bark, on mechanical injuries, or on soft tissues about healing wounds. The larvae tunnel in the soft tissues of the wounded areas or work in the inner bark and the sapwood. Wounds thus aggravated fail to heal, developing instead into enlarged galls or canker like growths. During the period when the larvae are active, the infested area is festooned with quantities of brown frass and chewings pushed out from the tunnels. Small trees are occasionally girdled. Trees in ornamental plantings lose their aesthetic value because of the gall-like swellings, and limbs so weakened break readily in the wind.

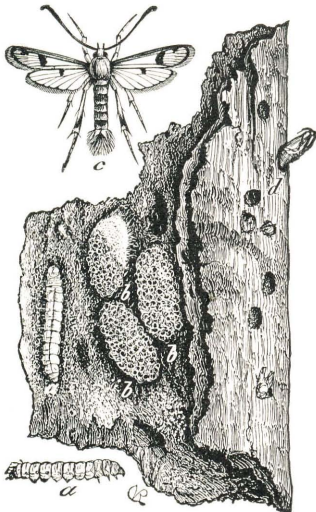


Fig. 29.—Larva, pupa and adult of Maple Clear Wing. From U. S. D. A.

**Life History**—There is one annual generation. Winter is passed in the larval stage in the inner bark, the adults appearing late in May or by the middle of June. The eggs hatch in a short time and the young larvae enter the inner bark. They practically complete their growth by September, although they remain as larvae throughout the winter, pupation taking place in the spring. When the adults emerge, they leave their empty pupal cases protruding from the larval tunnels.

**Appearance**—The adult moths are wasp-like insects, the females measure about an inch across the expanded wings, but the males are slightly smaller. The thin, transparent wings are practically free from scales. The head and the fan-like tuft at the caudal end of the abdomen are bright red. The legs and thorax are yellowish. The mature larva is one-half inch or more long and is white with a reddish-brown head.

**Control**—Keep the bark entirely free from mechanical injuries. When the borer once becomes established, it can be controlled by the paradichlorobenzene and cottonseed oil treatment (p. 4) applied either in the spring before growth starts or in the fall after it stops.

### Carpenter Worm

#### *Prionoxystus robiniae*

The carpenter worm is a native insect and is widely distributed throughout the United States. In Michigan, it has been most destructive to mature trees. Oak, maple, and black locust seem to be the preferred host-plants in Michigan, although chestnut, ash, elm, willow, and cottonwood are also said to be infested.

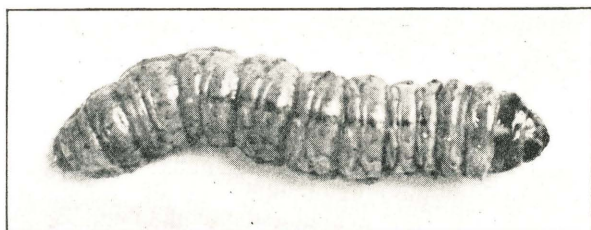


Fig. 30.—Larva of Carpenter Moth. Nat. size.

**Life History**—Three years are required to complete a life-cycle and the broods overlap, larvae of all three ages working together. The adults appear in May and June and deposit their eggs in wounds or crevices in the bark. The young larvae mine for a time in the cambium; later they enter the heartwood, extending their broad tunnels in all directions.

**Injury**—The injury caused by the larvae is largely confined to the heartwood of mature trees. The same trees are infested year after year. Some oak trees on the campus of Michigan State College have been infested by so many generations of moths that the heartwood for the first four or five feet of the trunk from the ground level up has been reduced to powder, leaving a mere shell. Trees infested to this degree readily break in wind storms. At times, they are numerous enough in fallen shade trees to materially detract from the value of the tree for firewood. Where young trees are attacked by a number

of larvae at the same time, the terminals may wilt as if the tree needed water. It is not unusual for small trees to be girdled by the carpenter moth in one season.

**Description**—The adult moths vary in size from two to three inches across the expanded wings, the abdomen of the female being large and densely covered with greyish-brown, sprinkled with occasional white scales. The mature larvae are nearly three inches in length. They vary in color through greenish-white tinged with pink to a delicate rose color, all larvae taking on a dull, olive-greenish cast just before pupation.

**Control**—The moth lays her eggs in scars on the trunk and main limbs. Therefore, protect the trunk from mechanical injury. Where such injuries occur, tree surgery is advisable. Borers may be killed by injecting carbon disulphide into the tunnels and plugging the opening. Doubtless, the paradichlorobenzene and cottonseed oil applied to openings of the tunnels will be as effective against this species as any other, although we have not had the opportunity to try it out.

### Pigeon Tremex

*Tremex columba*

The pigeon tremex differs from all its near relatives in that it attacks dead and dying trees. It gets the credit for being a killer of trees because it seeks out weak, dying specimens in which to deposit its eggs.

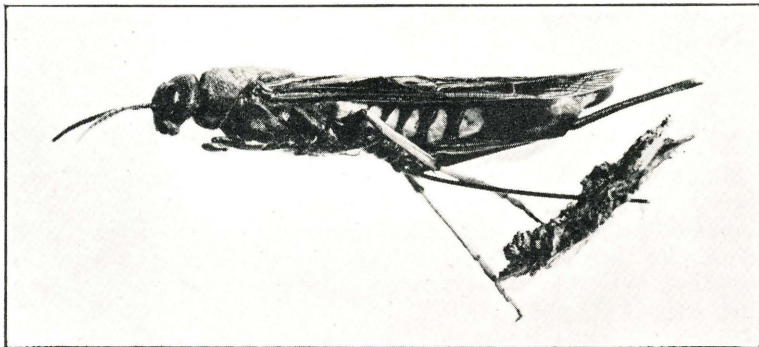


Fig. 31.—Pigeon Tremex. Enlarged about twice.

**Distribution**—The species is common at least throughout the northeastern United States and southern Canada. It probably infests a number of deciduous trees. In Michigan, it is most prevalent in oak and maple. It is also recorded as attacking sycamore, elm, hickory, beech, apple, and pear.

**Life History**—The life history of this species has never been completely worked out. At least two years must be required to complete a life-cycle in Michigan, since adults are more abundant every alternate year. Either there is an overlapping of generations or else certain adults live for three years, because all stages of development may be found in the same piece of wood. Each larva prepares its pupal chamber in the sapwood and the adults emerge through holes about one-fourth inch in diameter in the bark. The adult female drills holes through the bark and deposits eggs into the wood. The larvae tunnel in the sapwood and heartwood. This tunnel is just the size of the larva and is packed with partially digested wood fibre which has passed through the larvae.

**Description**—The adult of the pigeon tremex is about one and one-half inches in length. It is a thick-waisted, hymenopterous insect, brown in color, with the abdomen ornamented with yellow bands. The wings are transparent. The abdomen of the female is equipped with a short, blunt ovipositor, used to drill openings through the bark into the wood for egg-laying. The mature larvae are creamy-white and measure about two inches in length.

No discussion of the pigeon tremex would be complete without mention of its parasite, *Thalessa lunator*. This alarming-appearing insect is brown, ornamented with yellow. The body is about one and one-half inches in length and the abdomen of the female is ornamented at the tip with a flexible, thread-like ovipositor three or four inches long. As soon as the female locates the tremex, she elevates the ovipositor over her back and begins drilling through the bark to the larvae of her victim, in whose tunnel she deposits her egg. From this egg of the parasite, there comes a grub which attacks the larva of the pigeon tremex. The *Thalessa* may, therefore, be regarded as a true friend instead of being mistaken for an enemy, as so often happens.

The pigeon tremex prefers dead and dying trees for its operations, although it does not confine itself altogether to such trees. Unfortunately, there is no really effective remedy known for this pest.

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