

United States Department of Agriculture,

DIVISION OF ENTOMOLOGY.

THE LARGER APPLE-TREE BORERS.

Among the most troublesome of the insect pests with which the fruit-growers of the United States have to deal are two species of boring beetles known, from the appearance of their larvæ, as the round-headed and flat-headed apple-tree borers. In addition, there is another species called the spotted apple-tree borer, after the adult form, and to distinguish it from the round-headed borer, which it closely resembles. The two species first mentioned are common and injurious throughout a wide extent of country—the former to seed fruit trees, the latter also to stone fruit, as well as to a great variety of forest and ornamental trees; the third is a comparatively rare insect and rather exceptionally injurious so far as known.

THE ROUND-HEADED APPLE-TREE BORER.

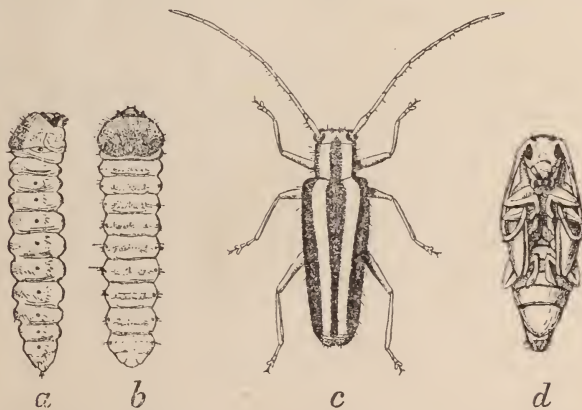
(*Saperda candida* Fab.)

FIG. 1.—*Saperda candida*: a, larva, from side; b, from above; c, female beetle; d, pupa—all enlarged one-third (original).

INTRODUCTORY REMARKS AND DESCRIPTION.

The round-headed apple-tree borer is next after the codling moth, the worst enemy to apple culture in America.

The first intimation that the grower may have of the presence of this borer in his trees, unless he be forewarned, is in their retarded growth and the sawdust-like castings, consisting of excrementitious

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matter and gnawings of woody fiber, which the larvæ extrude from openings into their burrows. This manifestation is usually accompanied by more or less evident discoloration of the bark, and, in early spring, particularly, slight exudation of sap.

The parent of this borer is a beautiful beetle, measuring from three-fourths to nearly an inch in length, the male being perceptibly narrower than the female. The antennæ are long, stout, and many-jointed, being somewhat shorter than the body of the insect itself. These organs and the legs are gray, the under surface of the body and the head are silvery white, and the upper surface is light yellowish brown with two longitudinal white stripes extending through the thorax and elytra or wing-covers to the tip, as shown in the accompanying illustration (fig. 1, c).

The larva when mature measures from three-fourths to a little over an inch in length (22-26 mm). It is fleshy and somewhat grub-like in appearance, cylindrical in form, and light yellow in color. The head is darker, particularly about the mandibles, which are nearly black. The first thoracic segment is large and broad and bears on its summit numerous small tubercles, placed closely together. The remaining joints of the body are narrower, the constrictions between them being deep and conspicuous. The first seven abdominal segments bear on the upper surface of each a peculiar elevated process, as shown at figure 1, b. It is destitute of organs of locomotion.

The pupa, illustrated at *d*, is nearly as long as the adult insect, which it resembles in a superficial manner, the head being bent down toward the breast, and the legs and long antennæ folded upon the ventral surface. Its color is similar to that of the larva.

Saperda candida was given its specific name by Fabricius in the year 1787, and was again described as new by Thomas Say, in 1824, under the name of *S. bivittata*, who remarked at the time upon its being injurious to the apple tree by boring into the wood.

DISTRIBUTION.

This species is native to this country and present in injurious numbers in practically every State of the apple-growing region east of the Rocky Mountains. It inhabits, like so many other injurious insects, the upper austral and transition life zones, comprising the better agricultural portion of all, except the extreme southern States. It has been reported to occur in one locality, Agricultural College, Miss., which lies in what is considered the lower austral zone. As with many other injurious species again, it is in the older States, particularly New England and New York, where orchards have been long established, that injuries are most pronounced. Until recently this

species was not known as especially injurious about the District of Columbia, but at the present time it has become very abundant and destructive, whole orchards of both young and mature trees having succumbed to its ravages.

Its known distribution as shown by published and unpublished records, in the possession of this office, includes Canada, all of New England, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, District of Columbia, Ohio, Illinois, Michigan, Iowa, Missouri, Kansas and restricted localities in Texas, Alabama, and Mississippi.

FOOD PLANTS AND NATURE OF INFESTATION.

This borer is practically limited in its food supply to the apple and kindred woody plants. It is most injurious to quince and apple, and somewhat less troublesome to pear. It also infests crab apple and thorns of different species, choke-berry and June-berry, in short practically all except one or two kinds of trees and shrubs belonging to the genera now included in the restricted family of Pomaceæ. The wild plants are its natural food and certain varieties at least, although often inhabited by this insect, are for some reason not so susceptible to injury by it as our cultivated trees.

This species inhabits more particularly the base of the trunk of trees, often being found below the surface of the earth, especially in young nursery stock. It is to such trees that it is most injurious as it soon works around the tree, separating the wood from the bark, interfering with the flow of sap and producing the effect of girdling, a result which is very apt to be produced even when no more than two or three larvæ occur upon the same tree. Very frequently four or five larvæ dwell together in a single small tree and in a short time injure it entirely beyond recovery. In older trees larvæ occur somewhat higher up the trunk, in exceptional cases at a distance of several feet from the base or even, still more rarely, in the lower limbs; but as a rule they are seldom found except within a foot or two of the base. Trees of all sizes are frequently killed or so weakened that they are unable to mature a full crop of fruit.

The experience of many years shows that injury follows where grasses, weeds, or other rank vegetable growth are permitted to accumulate about the trunks of the trees, since the beetle, like all nocturnal insects, naturally seeks concealment, and the conditions thus afforded are most favorable for its attack on cultivated plants.

LIFE HISTORY.

The beetles make their first appearance of the season late in May and in June, according to locality, coming forth from the trunks of the trees in which they have bred during the night, at which time

the species, being nocturnal, may be seen in flight. During the day the beetles hide away in some secluded place under leaves or in similar situations on the trees which they inhabit.

Soon after their first appearance the sexes mate and eggs are deposited. The female first makes an incision in the bark, whether by means of her mandibles or ovipositor is not plain, causing it to split slightly, then turning, head upward, places an egg under the bark nearly a quarter of an inch from the incision, accompanying the deposition by the extrusion of "a gummy fluid which covers and secures it to its place and usually fills up the aperture. In young trees with tender bark the egg is usually thoroughly hidden while in older trees it is sometimes so shallowly imbedded as to be readily seen."

"The egg is pale rust-brown in color, one-eighth of an inch long, one-third as wide at the middle, flattened so as to have a depth of about one-third the width." Its shell is fairly tough and resistant, not sculptured and sufficiently plastic, when laid, to receive impressions from the woody fibers between which it is forced. Oviposition has been observed from June to September in a single locality (Lawrence, Kansas) but June is the month in which most of the eggs are laid.¹ Fitch and others observed the beetles in the trees, near Albany, N. Y., as early as April.

The period of the egg from the time it is laid until it hatches rests upon the statement of Mr. E. W. Junkins that a young borer larva was observed July 7 from eggs² that were deposited June 15, which would give a period of twenty-two days.

The larvæ soon after hatching tunnel under the bark and feed upon the sap-wood, gradually working their way upward and afterward downward, usually, particularly in young trees, remaining within a short distance of, or below the surface of, the ground. By the beginning of the second year the larvæ, according to recent observations conducted by the writer, attain an average growth of about five-eighths of an inch. The larval growth will naturally vary according to temperature, moisture, and quantity of food available for consumption, and other conditions. With the approach of cold weather the larvæ cease feeding, but with the beginning of warm spring weather—in the District of Columbia as early as the latter days of March—they again commence, forcing their excrement and castings consisting of gnawed particles of wood out through holes which they make in their burrows. By the end of the second year the larvæ have increased considerably in size and have now penetrated deeper into the solid heart-wood, their burrows being closely

¹ Above quotations from account by Riley in New York Weekly Tribune, Feb. 20, 1878; Kans. Hort. Rept. for 1879, pp. 196-201.

² New England Homestead, January 3, 1885.

packed behind them with castings. The third year the larvæ gnaw outwards to the bark, form a pupal cell with the assistance of their castings and, with their heads pointing toward the bark, transform to pupæ. With the approach of May and June they cut their way out by means of their powerful mandibles and issue through a round hole as mature beetles. The period of the pupal stage does not appear to have come under observation hitherto. A larva was observed by the writer at the Department of Agriculture that pupated May 11, and appeared as adult May 30, which gives nineteen days for this period; weather seasonable.

NATURAL ENEMIES.

Concealed as this insect is during its three years of existence in its preparatory stages it is nevertheless a prey to natural enemies which seek and devour it in its haunts under the bark. Of this number are woodpeckers and hymenopterous parasites. Of the latter only a single species is known to the writer, *Cenocælius populator* Say.¹

METHODS OF CONTROL.

After borers have once entered a tree there is no better remedy known than to cut them out with a knife or other sharp instrument. In the treatment of this insect an ounce of prevention is worth several pounds of cure. Cutting the borers out, unless practiced with the greatest care, is apt to result in injury, and it is far better to prevent the parent insects from depositing their eggs upon the tree. This is not difficult of accomplishment, as oviposition is practically confined to two months in a single locality, usually during June and July. The best preventives are impenetrable substances placed about the trunk and various washes of a repellent nature.

Cutting out by hand.—Little has been gained in the line of direct remedies for this borer until very recent years. The early writers had nothing better to advise than cutting out the larva, either with a knife or gouge, or killing them by the insertion of a wire into their burrows. These remedies were in use early in the present century and are still the ones most often practiced. It is no uncommon thing to find four or more larvæ in a single small trunk and the cutting out of all of them, if not practiced with the greatest caution, is apt to result in the girdling of the tree, if, indeed, this has not already been accomplished by the combined attack of the borers themselves. It would seem superfluous to add that it is best to cut the borers out as soon as detected. Their presence may be known by a little experience, some persons, the writer is informed, being so expert in detecting their exact location as to be able to kill them with a knife thrust

¹ Mentioned in *Insect Life*, Vol. III, p. 59, as *Promachus saperdæ* Riley MS

or by the puncture of an awl or other sharp instrument. The fruit-grower should institute a practice of inspection that the borers may be removed as often as found.

To assist the tree to recuperate after it has been girdled a bridge or two should be made by splitting a piece of apple twig (say, of an inch or two in thickness), cutting it diagonally on the inside, and applying to the surface at the base of the tree. It should then be tied on and grafting wax applied to each end, after which a fertilizer, preferably fresh cow manure, should be applied and the whole banked over with earth. It is also well to keep the tree watered for a few weeks after treatment whenever this is practicable without too great inconvenience.

Mechanical preventives.—This is one of the borers that can readily be controlled by different sorts of mechanical barriers placed about the base of the tree. For this a few thicknesses of newspaper wrapped rather loosely about the trunk and extending about two feet from the base are all that is necessary. This covering should be tied, by preference with cord, which will readily yield or break with the natural expansion of the tree in its growth, and also be tightly fastened at top and bottom and hilled up with earth so that the beetles can not obtain access to the tree from below. From the top of this covering upward it is best to use some deterrent alkaline or carbolated wash. Instead of newspapers, wire gauze or mosquito netting may be used, and should be put in place, so as to loosely encircle the tree, that the beetles may be unable to successfully deposit their eggs between its meshes and that the growth of the tree may not be hindered. Both have been successfully employed for a long period of years, and there is abundant testimony to their value. If the netting or paper be put in place early in May, it will not only prevent the beetles from ovipositing during the next two months but will also keep the insects which might be present in the trunk from issuing and they will die in their burrows without being able to lay fertilized eggs. The paper wrapping must be removed each season, but the wire netting will last for several years. It is safe to remove either, ordinarily, after the first of September.

Hydraulic cement mixed with skim milk, recently advised by Dr. J. B. Smith as a remedy for the peach-tree borer, should prove equally effective against this apple-tree borer. It could be applied with less trouble than paper bands.

Protective washes.—Any one of several washes in general use against boring insects may be used as deterrents. A good alkaline wash is prepared of soft soap reduced to the consistency of thick paint by the addition of caustic potash or washing soda in solution. A good fish-oil, or whale-oil, soap or common soft soap are often used, and in some cases any one of these is sufficient to deter the insects

from depositing their eggs. The alkaline wash may be carbolated, if desired, by the addition of crude carbolic acid, at the rate of 1 pint to every 10 gallons of the wash. Such a wash, it should be borne in mind, not only affords protection against this and other borers, but against scale and fungous diseases at these points, and is, moreover, of positive benefit to the tree. Caustic potash fish-oil soaps are among the best for insecticides.

Whatever wash is used should be applied thoroughly, and in localities where apple-tree borers are unusually troublesome the larger branches should also be covered as far as possible. The wash may be best applied with a whitewash brush and should be renewed at intervals of two to four weeks, as found necessary, the first application being made before the appearance of the insects in May or June and again during July.

It is well to scrape old trees to remove the dead bark scales, care being taken not to cause any abrasion which would injure them. Scraping is best done some time before the application of the wash that the wounds that might be made shall have opportunity to heal before the appearance of the beetles.

Destroying the adult insects.—The mature beetles are shy, and so seldom seen on this account, that it is doubtful if any method of destroying them is feasible. They are attracted to lights at night to some extent, and some meet their end in this way. Very early in the morning, immediately after daybreak, the beetles may be found upon the trees, if sought for in their season, and may then be beaten off into an inverted umbrella by striking the branches with a stout stick.

Kerosene as a remedy.—A great variety of substances have been recommended to kill the borers in the trees, but up to the present time only a few have given satisfaction. For the benefit of those who have not had experience with this borer it may be necessary to state that it is of no avail whatever to inject kerosene or any other insecticide into the round holes made by the beetles in their escape from the trees. A correspondent of this Division, Mr. T. B. Ashton, who has had many years' experience with this borer, states that there is no better way of effectually putting a stop to the depredations of this and similar borers than in the use of kerosene applied freely wherever the castings of the larvæ are to be seen protruding through the bark. The kerosene is absorbed by the castings and, carried by capillary attraction, permeates the entire burrow where it comes in contact with the larva, which soon succumbs. The amount of kerosene which it is necessary to use is so small that it does not endanger the health of the tree.

Clean cultural methods.—Finally, clean culture, the best preventive for insect injury of whatever kind, should not be neglected. The nursery should not be started in new localities where crabs, thorns, June-berry, and other wild food plants of this species grow in great profusion nor in the vicinity of neglected orchards, nor should rank growths of weeds, grasses, bushes, and briars be permitted to accumulate about the trunks of the trees. When a tree is seen to be injured beyond recovery it should be taken out and destroyed by burning before the following spring, that the larvæ which it contains may not have an opportunity to develop and reinfest healthy growth.

THE SPOTTED APPLE-TREE BORER.

(*Saperda cretata* Newm.)

A very similar insect to the preceding both in appearance and in habits is the spotted apple-tree borer (*Saperda cretata* Newm.). The adult beetle is of nearly the same size and form as the round-headed borer, differing superficially by having two white spots on each elytron



FIG. 2.—*Saperda cretata*: female beetle—enlarged one-third (original).

instead of the longitudinal white lines which distinguish the latter. (See fig. 2.) The larva and pupa are so similar that no description need be made of them. Although the species has a fairly wide distribution, corresponding somewhat closely to that of the common species, specific injury by it has only been noted in two States, in Michigan by Prof. A. J. Cook and in Iowa by Prof. H. Osborn. In the former State this borer is reported as quite as common and destructive as *Saperda candida*. Its occur-

rence is also recorded in Canada, New York, Pennsylvania, New Jersey, and Ohio, and there are specimens in the National Museum also from Northern Illinois and Texas. It has only been observed injuring apple and wild crab, but its occurrence has also been noted on June-berry and thorn. According to Osborn the "eggs are evidently laid in pairs, half an inch or more apart, along the branch, the larvæ of each pair upon hatching working in opposite directions around the branch, at first just beneath the bark, afterward (probably after the first year) entering the hard wood."

The remedies for this species are the same as for the preceding with the extra precaution that the larger branches also be protected by the wash applied.

NOTE.—A third species of *Saperda*, *fayi* Bland, has similar habits and is likely to attack apple and similar cultivated pomaceous trees, but is thus far known only on thorns. A very full account of this species was published by the late Dr. Hamilton (Can. Ent., Vol. XX, pp. 6-8).

THE FLAT-HEADED APPLE-TREE BORER.

(*Chrysobothris femorata* Fab.)

GENERAL APPEARANCE AND NATURE OF INJURY.

A much less dangerous, though more abundant, insect than any of the preceding, is the flat-headed apple-tree borer. It belongs to a different family of Coleoptera, the short-horned wood-borers or metallic beetles of the family Buprestidæ, and differs remarkably from the preceding in all its stages as well as in its habits and life history.

The adult insect (represented at *b*, fig. 3) measures from a little less to a little more than a half inch in length. It is flattened above, resembling somewhat a snapping beetle, but it is not provided with jumping organs like the Elateridæ. The antennæ are short and serrate, the eyes large and conspicuous, and the forelegs are armed in front with a conspicuous tooth. The upper surface of the body is dark metallic brown and fresh specimens are coated here and there with a powdery gray substance, which is easily rubbed off. The wing-covers are ornamented as shown in the illustration, and underneath, as may be seen when the insect is in flight, the body is a bright metallic greenish blue. The under surface is coppery bronze. The males are smaller and may further be distinguished from the females by their green heads as well as by other characters (see fig. 3, *c*).

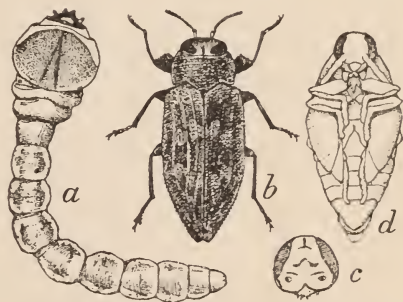


FIG. 3.—*Chrysobothris femorata*: *a*, larva; *b*, beetle; *c*, head of male; *d*, pupa—twice natural size (original).

Unlike the round-headed borer the present species is diurnal in habit, being most active in the heat of the day and commonly found on prostrate trees and logs or on injured trunks basking in the sunlight. The beetles are active creatures, running rapidly and flying readily.

This species attacks by preference diseased or dying trees, inhabits all parts of a tree from the base of the trunk to the limbs, and is not restricted in its ravages to fruit trees, but attacks also a variety of deciduous trees.

In all these respects it differs from the round-headed borer, but agrees with the latter in that it is injurious chiefly to young trees, its injuries being practically confined to newly transplanted nursery stock and to trees which have been weakened through any cause, such as careless pruning, or insufficient nourishment due to poor soil or drouth. There is a difference of opinion as to the nature of damage, some writers taking the stand that healthy trees are not injured at

all. It is a well-known fact that many forms of boring insects prefer injured plants but when this is wanting do not hesitate to attack perfectly sound growth, and records show conclusively that the present species is included in this category. The general opinion is that trees suffering from "sun scald" are most subject to attack, and the opinion has been expressed that injury known under this name is in reality due to the work of this species of borer. The beetle is essentially a sun-loving species and deposits its eggs practically exclusively on the southern or southwestern sides of standing trees or on recently felled logs that are exposed to direct sunlight. Observation shows that it is doubtful if the young larvæ would be able to withstand the strong flowing sap of vigorous trees.

Infestation may be detected by the discoloration of the bark.

A list of its recorded food plants includes, among orchard trees, apple, pear, peach; and of shade and forest trees, mountain ash, oak, maple, box-elder, hickory, chestnut, sycamore, horse-chestnut, linden and willow. To this list should be added plum and cultivated redbud (*Cercis japonica*), from which the species has been reared by the writer, and currant.¹

Cherry, beech, and white birch are probably food plants although the beetle has not been reared from them, and elm, tulip, and cottonwood have been mentioned as such, but on what authority is not clear. Oak is without doubt the favorite natural host tree.

The larva differs greatly from that of the round-headed borer. Its name of flat-headed borer is derived from the peculiar flat expansion of the second thoracic segment, the one just behind the head. In color it is light yellow and in length it measures nearly twice that of the mature insect. It habitually rests in a curved position, more bent usually than shown in the illustration (fig. 3, a). The pupa (d) shows the form of the future beetle and is of the same yellow color as the larva.

This species inhabits practically the entire United States and the southern portion of Canada, being like the preceding, a native of North America and injurious year after year.

NATURAL HISTORY AND HABITS.

The beetles make their appearance about the same time as the round-headed borer, in regions infested by both species, in the principal apple-growing regions of the northern States after the middle of May, and continue through the month of July, and, it is said, even into September, the female depositing her eggs upon

¹ F. H. Hillman, Nevada Experiment Station, Bull. 36, p. 18.

the trunks or branches of trees destined to be the future food of the larva, in cracks and grooves or under bark scales. Several eggs are most frequently found together. The eggs are yellow in color, irregularly ribbed, and about one-fiftieth of an inch in length.¹ The larva differs from the round-headed borer in that it requires only a single year for its development, pupation occurring in the spring shortly after the appearance of the beetles. It differs also in its manner of work, living for the most part just beneath the bark, where it excavates broad, flat, and very irregular channels, but sometimes entering more deeply into the sap-wood. Like many other borers it often girdles a small tree, a single individual being capable of killing a small tree in this manner. As it approaches maturity it generally eats deeper into the solid heart-wood, but in spring time, just before transformation, it works back again into the bark, and there constructs its pupal chamber. In the pupa state it is said to remain for about three weeks,¹ when the beetle cuts its way out, leaving an elliptical exit hole in the bark, which distinguishes its work from that of the round-headed borers, which make round holes in their exit, these holes corresponding to a cross-section of the beetle which makes them. In the North the winter months are passed as larvæ, but farther south, in the District of Columbia, according to recent observations, pupation may take place as early as November the first year.¹

NATURAL ENEMIES.

Among natural enemies, woodpeckers are effective destroyers of this species, as are also ants, which devour larvæ and pupæ under the bark. A number of parasitic insects also prey upon it and assist greatly in restricting its too great abundance.²

REMEDIES.

The remedies advised for the round-headed borer are also of value and are generally employed against the present species. It is necessary, however, that deterrent coverings and washes should be applied farther up the trunk and to as many branches as can be conveniently reached. As this, however, necessitates additional labor and extra expense, other preventive measures are recommended.

¹C. V. Riley, Proc. Ent. Soc. Wash., Vol. III, p. 92.

²The list includes the Braconids, *Bracon charus* Riley and *B. pectinator* Say, *Spathius pallidus* Ashm., and the Ichneumonids, *Labena apicalis* Cr. and *L. grallator* Say, and one or more species of Chalcididæ, noticed by Fitch, as occurring in New York, and by Riley, in Missouri.



Trap wood for the beetles.—For this purpose any sort of tree known to be freely attacked by this borer, *e. g.*, oak, maple, or any fruit tree, may be used. If a few limbs or trunks of newly felled trees be placed at intervals, say, of thirty or forty feet, on the outskirts of orchards, where they would be freely exposed to the sun, the beetles would be attracted for the deposition of their eggs, and all that would then be necessary would be to destroy the trap wood by burning before April or May of the following year. This plan has not been practically tested, but the writer has no doubt that it would prove useful in securing immunity from this pest in the orchard, provided that no diseased fruit trees be left for food.

Cultural carefulness.—Careful, clean methods of cultivation are essential as a measure of protection, and involve the cutting out of dead, dying and injured deciduous forest and shade trees known to be chosen as food by this beetle, as well as orchard trees. Care should be exercised in transplanting, and especially in pruning, and the use of fertilizers should not be neglected that the trees may be thrifty and better able to withstand attack. Proper regard for these measures should give practical exemption from injury.

F. H. CHITTENDEN,
Assistant Entomologist.

Approved:

JAMES WILSON,
Secretary.

WASHINGTON, D. C., *July 1, 1898.*