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COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

Agricultural Experiment Station.

BULLETIN NO. 44.

- I. The Fruit-Tree Bark-Beetle.**
II. The Common Apple-Tree and Peach-Tree Borers.
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The Fruit-Tree Bark-Beetle.

Scolytus rugulosus Ratz.

BY J. M. STEDMAN, Entomologist.

SUMMARY OF RESULTS.

From the observations and experiments conducted by this station during the past two years on the fruit-tree bark-beetle, the following results are briefly summarized:

I. The fruit-tree bark-beetle is increasing rapidly in Missouri, and is annually doing more and more damage and attracting the attention of fruit growers. It infests the plum, cherry, apricot, nectarine, peach, apple, pear, and quince.

II. The adult insects perish each fall, the winter being passed by the larvae within the infested tree; and these transform to adults which emerge from the tree usually about the latter part of March.

III. The adult beetles make minute holes through the bark, and they and their larvae mine or burrow just beneath the bark thus destroying the cambium layer and killing the limb above.

IV. While the fruit-tree bark-beetle is almost sure to attack first of all unhealthy, injured or dying trees or parts of trees, they will attack and injure apparently perfectly healthy trees.

V. This bark-beetle is much more difficult to control than other fruit-tree borers, but may be successfully held in check by careful attention to the following:

First. Clean culture is of first importance; every tree or part of a tree that is badly infested or is dying from any cause

whatsoever should be removed and burned at once. If from any cause this be neglected during the summer, it must be done in the winter before March.

Second. The trees should be kept in as healthy and vigorous a condition as possible by cultivation and fertilization.

Third. The trunks and large limbs, and as many of the smaller limbs and twigs as possible, should be kept covered with a repellent wash which should be applied just before the beetles emerge in early spring by means of a force pump, and as often as necessary thereafter until the leaves appear, after which it should be applied by means of a white-wash brush to the trunks and larger limbs.

VI. We have found the best wash to be the following: Dissolve as much common washing soda as possible in six gallons of soft water, then dissolve one gallon of ordinary soft soap in the above and add one pint of crude carbolic acid and mix thoroughly; two pounds of lime is then slaked in two gallons of water and filtered so as to remove all dirt and small lumps; this is now added to the above and mixed; while to all is added one-half pound of paris green or one-fourth pound of white arsenic, and thoroughly mixed.

VII. The above wash, made thicker by the addition of lime, we have found to be as good as any, and much better than most, washes to apply to the trunks and large limbs of apple and peach trees in order to prevent the attack of the common peach-tree and apple-tree borers.

GENERAL REMARKS.

Two years ago our attention was called to the importance of the fruit-tree bark-beetle by the numerous letters this office received from fruit growers in various parts of this state. Many of these letters were accompanied by specimens of the beetles and their work, while those that were not were usually explicit enough to enable me to place the cause of the trouble. At that time we believed, as most entomologists still do, that these beetles attack only diseased, injured, devitalized, or dying

trees, and advised our correspondents accordingly. The great number of the enquiries, however, led us to make investigations and experiments in order to determine whether or not this insect was really doing the damage it was reported to be causing, and, if possible, to find some method to obtain relief.

DISTRIBUTION.

This pest is another example of an imported insect, it having been introduced into the United States from Europe, where it has been known for some time; but appears to be held in check by parasitic insects, and is not there regarded as especially destructive. It was first noticed in this country near Elmira, New York, in 1877, where it was doing injury to the peach. It has spread until it is now found in damaging quantities in the eastern half of the United States from Massachusetts in the east to Kansas in the west, and from Michigan in the north to Alabama in the south.

ITS FOOD HABITS.

In this country the fruit-tree bark-beetle attacks various varieties of the plum, cherry, apricot, nectarine, peach, apple, pear, and quince. In Europe it not only infests the above fruit trees, but also works on the elm, mountain ash and hawthorn. Although it has apparently never been recorded as attacking these trees in the United States, nevertheless it may possibly do so later. The stone fruits seem to be more especially subject to the attacks of this beetle, the plum perhaps most of all; but since our orchards are principally peach and apple, it is with these trees, that the greatest amount of damage is done if we consider the state at large. Fully three-fourths of the complaints from this beetle have been from its work on these two fruits.

From what we have observed during the past two years, it is evident that the beetles prefer and will attack first of all those trees or parts of trees that are injured, weakened or dying from any cause whatever; still we have seen many trees infested with this insect that were apparently as healthy and

sound as any tree, and for that reason it appears this insect is capable of doing more damage than was at first supposed.

It is very largely a matter of opinion when one pronounces a tree perfectly healthy that has become infested with this pest, but no doubt one should regard a tree as healthy when there is absolutely no reason to suspect anything different except that it has now become attacked by this insect. Those who still entertain the opinion that this beetle will attack only devitalized trees, would surely have trouble in detecting all such cases of devitalization in our orchards, were no fruit-tree bark-beetle present to lead the way. Looking at the subject from another point of view, it may be a question whether any of our apple trees, for instance, are not devitalized that are found in the southern half of this state where it is practically impossible to find them free from the wooly-aphis. Nevertheless it seems plausible to regard the greater bulk of these trees as healthy.

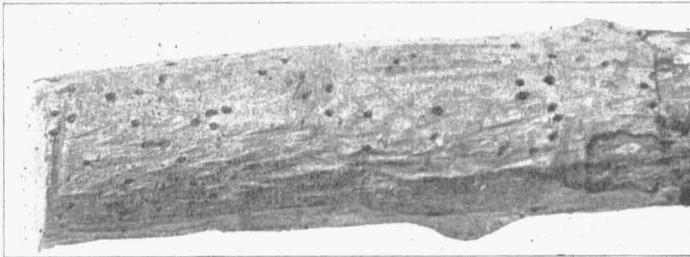


Fig. 1.—Photograph of a portion of an apple-tree twig infested with the fruit-tree bark-beetle, showing the "pin holes" or "shot holes" and the shriveled bark. Natural size. (Original.)

No doubt one of the greatest agencies at work to assist in the multiplication of this beetle in Missouri is the wooly-aphis, which has so devitalized and killed such a large number of the apple trees in southern orchards, that it has made the conditions most favorable to the development of this bark-beetle in those trees. The greater number of peach trees that are attacked by this bark-beetle owe such an attack to the fact that they are also suffering in our orchards from the work of the

peach-tree borer, which is weakening and killing many, and from the winds and overbearing, which are breaking large limbs and forming the best of breeding places for this pest. It is sure to attack such trees first. Trees that have just been transplanted, as in setting out a young orchard, are also frequently attacked by these beetles, but this may be largely due to the checked vigor resulting from such a change. A perfectly healthy and vigorous tree will frequently repel the attack of the fruit-tree bark-beetle by the copious flow and exudation of sap. This is especially the case with the stone fruits, where the beetles appear to be driven away by this means, and are unable to burrow to any considerable distance below the bark and are unable to deposit their eggs.

When the beetles attack a comparatively small limb, perhaps the first indication will be a withering of the leaves, while a closer examination will show the bark to be more or less shriveled, as can be seen by referring to the photograph in figure 1; and later, when the adult beetles emerge, the small "shot holes" will be conspicuous. If the beetles attack a large limb or trunk, the work may go on for some time before it is observed; but usually one will detect the flow of sap, especially if it be a stone-fruit tree, where the exudation of drops of gum will be sure to attract attention, and may even be very conspicuous and run down the tree to the ground.

HABITS AND LIFE HISTORY.

The fruit-tree bark-beetle is a small cylindrical beetle about one-tenth of an inch in length and one-third as wide as it is long; nearly or quite black in color, with the very tips of the elytra or wing covers and portions of the legs reddish brown. Under a hand lense one can make out the peculiar markings on the back—thorax and elytra—and the short hairs on the head and wing covers. A fair idea of the general appearance of these beetles as seen under a lense can be had by observing the drawing of one magnified in figure 2, a, while a side view in outline is shown in figure 2, b. This beetle belongs to the family *Scolytidae*, which includes a number of similar, small bark

and wood boring beetles that the ordinary observer will not be able to separate from the one under discussion except by a close observation of its habits and work.

The adult beetles begin to emerge about the last of March in most seasons, and may soon begin to feed by eating small round holes through the bark of the tree. These holes are usually made near the base of the larger limbs, and about forks and old scars or lateral spurs, but are also common on the smaller limbs and even on the small twigs; while in badly infested trees they may occur on the trunk as far down as to be within a short distance of the ground. The holes through the bark are small, not much larger than the cross section of a large pin, or about

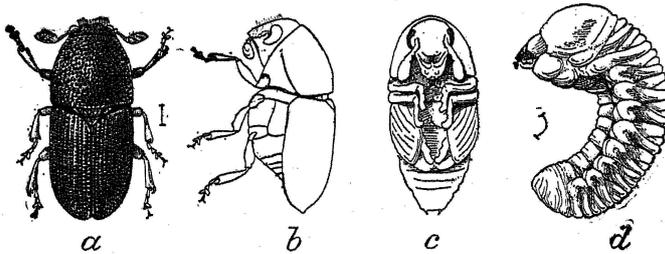


Fig. 2.—The Fruit-Tree Bark-Beetle, *Scolytus rugulosus* Ratz. a, adult beetle; b, same in profile; c, pupa; d, larva. All magnified about ten times. (From Chittenden, Circular 29, SS. Div. Entomology, U. S. Dept. of Agriculture.)

one-eighteenth of an inch in diameter; and for this reason are frequently spoken of as “pin holes,” and the beetles as the “pin hole beetle.” Where these holes are very numerous they give the limb the appearance of having been shot or peppered full of holes with fine bird shot; and this again has led to another common name for the beetles—“shot hole borers.” Figure 1, shows the appearance of a twig, natural size, infested with these beetles; and the holes and shriveling of the bark can be seen fairly well.

The first holes are made by the adult beetles that eat directly through the bark until they reach the wood, then they tunnel between the bark and the wood making a hole from an inch to an inch and a half in length, and slightly larger than the

insect. This burrow is almost invariably in the direction of the long axis of the limb or very slightly oblique, and is made in the cambium layer including a little of the wood on the one side and a little of the bark on the other. As the females make this burrow, which is known as the brood chamber, they deposit their eggs to the right and left along its course. The minute grubs hatching from these eggs eat little tunnels or side galleries at right angles to the brood chamber, likewise keeping in the cambium layer and including a little of the wood and a little of the bark. As they increase in size they make the burrows larger in diameter accordingly, and soon begin to turn the tunnels in the direction of the long axis of the limb and parallel to the brood chamber. These side galleries are lengthened as the larvae feed until they are about as long as the brood chamber, or possibly longer, by which time the grubs have become full grown larvae. They are small white, footless grubs with brown heads, one of which is represented magnified in figure 2, d. They then eat a little deeper into the wood and thus make a small chamber, known as the pupal chamber, stopping up the entrance with pieces of the wood, and there change to pupae. A pupa is represented magnified in figure 2, c.

When the adult beetles emerge they simply eat through the bark to the exterior and escape. Thus it is that the limb becomes so full of the small holes through the bark; and as each female deposits about eighty eggs, as can be readily determined by counting the side galleries of the brood chambers, one can readily imagine the result when the adults emerge. From a short section of a small limb, one half of which is photographed in figure 1, there emerged in the laboratory one hundred and sixty-seven adult beetles of one brood.

As the great bulk of the young beetles soon attack the same tree from which they emerged, and eat holes through the bark and burrow in order to deposit their eggs for another brood, it can readily be understood that it does not require much time before these insects have completely undermined the bark, and

by destroying the cambium layer, have killed the limb above the infested place.

By removing the bark from an infested limb one can readily see the shape of the burrows engraved upon the wood and upon the bark, and, where the limb is badly infested, one will find the galleries so close together and so interwoven that it is difficult to trace the work of a single family. Figure 3, shows an enlarged picture of such a limb with the bark removed.

In Missouri, this beetle has sometimes three and sometimes

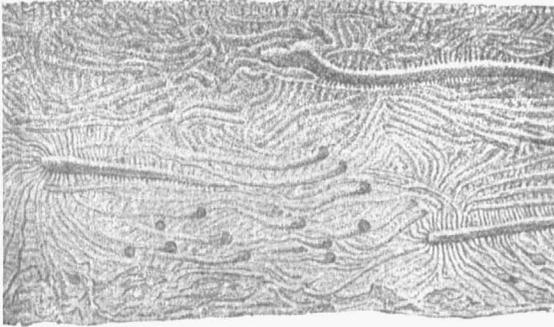


Fig. 3.—Enlarged view of the galleries of the fruit-tree bark-beetle as seen on an infested limb from which the bark has been removed. (After Ratzburg.)

four broods during a season, each brood requiring on an average five weeks for its completion; but as the beetles do not all emerge at once, and vary considerably in a single tree, the result is the different broods tend to overlap somewhat, and we have found it very difficult to exactly trace the broods for a certainty. However, this is not of as much importance as the fact that the adult beetles all perish in the fall, the winter being passed by the larval stage within the infested trees; and this, no doubt, is the key to the situation of successfully combatting this pest.

REMEDIES.

The fruit-tree bark-beetle is attacked in its larval form while within the infested tree by a number of small hymenopterous parasites, perhaps the most common of which is *Chiro-pachys colon*, represented much enlarged in figure 4. These insects are capable of doing considerable good in holding the beetles in check, but our experience has been that they are not yet numerous enough in Missouri to materially lessen the damage from the borers. They may some day, however, multiply so as to hold the bark beetle in check.

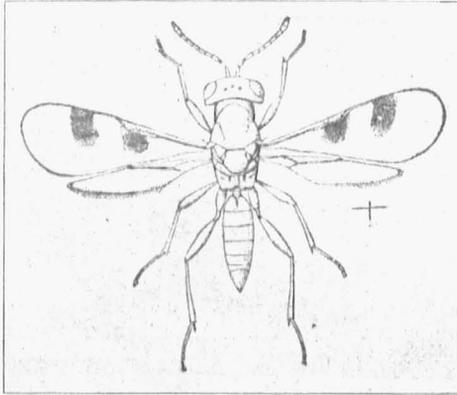


Fig. 4.—*Chiro-pachys colon*—much enlarged.
(After Howard.)

While all fruit-tree borers are difficult insects to combat, the fruit-tree bark-beetle is by far the most troublesome, owing to the fact that it is so small and occurs in such large numbers, while it deposits its eggs practically all summer and infests all parts of the tree above ground except the leaves and fruit.

From the habits of the insect one can readily see that the most essential thing to be done is to keep the trees in a perfectly healthy and vigorous condition, and free from any injury or weakness, or from injured, weakened or dying parts. This can be done by careful cultivation and fertilization, and by clean

culture. Although this pest will infest perfectly healthy trees, it is so much more liable to attack weakened or dying trees that it becomes important that clean culture be practiced, at least in so far as to remove from the orchard and to burn all dead and dying trees or portions of trees. The sooner this can be done the better. If for any reason it has not been done during the summer, it must be done during the winter, and all such trees and limbs burned before March, thereby destroying the insects before they emerge. When a tree or portion of a tree is seen to be dying, it is useless to try and save it, and it should be removed and burned at once. Of course a fruit grower must use his own judgment in discriminating between those that will recover and those that will not; but it is safe to say that if it be attacked to any considerable extent by this pest, it is better to remove and burn it.

Mechanical barriers such as wrappers are of little value in preventing the attack of this insect, except to keep them away from the trunk and, perhaps, the large limbs; and on this account it is better to rely upon some wash that can be applied over a larger part of the tree.

We have used a wash made by dissolving one pound of potash whale-oil soap in two gallons of water, and applied about the middle of March by means of a spray pump, and again about the first of April, and have observed good results in repelling the attack of this beetle as long as the rains allowed the soap to remain on the trees to any considerable extent; but this spray is too strong to be used when the trees begin to leave out, and on that account, it is better to use other washes.

While we have used with more or less success a number of different washes, we have found the following one to give the best results: Dissolve as much common washing soda as possible in six gallons of soft water, then dissolve one gallon of ordinary soft soap in the above and add one pint of crude carbolic acid and mix thoroughly; two pounds of lime is then slaked in two gallons of water and filtered so as to remove all dirt and small lumps; this is now added to the above and mixed,

while to all is added one-half pound of paris green or one-fourth pound of white arsenic, and all thoroughly mixed together. While the lime may be omitted, we have found it of value in helping to hold the other substances on the tree and in being of itself disagreeable to the beetles, but use it principally to enable one to tell exactly where and to what extent, or in other words, how thoroughly, the spraying has been done. The paris green or white arsenic may be omitted, and the wash will still act as a repellent; but the addition of the poison has advantages in that it will kill the beetles that try to effect an entrance. It is, perhaps, needless to say that all washes should be applied as thoroughly as possible in order to cover all portions of the tree that it is intended to protect. We have applied the above wash on the trees by means of a spray pump with perfect success, and have reached and covered the entire tree when not leaved out. When the trees are leaved out, it is not practicable to apply the wash by means of a spray pump, since the leaves catch the bulk of the spray and prevent the wash from thoroughly covering the small limbs and twigs where the benefit is to be derived.

The above wash should be applied to the trees by means of a spray pump just as soon as the adult beetles begin to emerge, which is about the last of March as a rule, and other applications should be similarly made as often as needed until the trees leave out, after which any further application should be made by means of a white-wash brush to the trunks and large limbs. The above amount of paris green or white arsenic is too strong to apply to the foliage of fruit trees, and for that reason should be omitted entirely *if spraying* the peach or plum after they are in leaf, and should be reduced if spraying other fruit trees while in leaf. When the trees are leaved out, however, the wash should be applied to the trunks and larger limbs only, and by means of a brush, and in that case the presence of the large amount of poison will do no harm.

The above wash, while very effectual in preventing the beetles from attacking a tree, will not kill the insects when they

are once within the tree. Should one discover that the beetles have just attacked a tree where one can get at it, they may be killed by touching their entrances with a sponge or rag on the end of a stick and saturated with a mixture of creosote oil one part, turpentine two parts. After the insects have been killed, it is necessary to apply the wash in order to prevent others from entering.

THE COMMON APPLE-TREE AND PEACH-TREE BORERS.

There are few apple orchards in this state that are not suffering more or less from either the round or the flat-headed apple-tree borers or both. While in a few small and isolated localities orchardists claim they have never seen the one or the other of these borers in their orchards, the vast majority of orchardists have these pests to contend with; and frequently both of them in the same orchard, although many orchards are apparently exempt from one or the other species, and a very few from both at present.

Probably all the peach orchards of Missouri are more or less infested with the peach-tree borer; and in the great majority of cases this pest is the most serious one with which the peach orchardist has to contend.

As common and as universal as these three borers are in Missouri orchards, it is surprising that so many fruit growers do not understand the methods of combatting them, and that so few know the adults of these insects. Letters are continually being received at this office making inquiry in regard to the best washes and methods of combatting these borers, and of the appearance of the adults.

For the benefit of those who do not know the adults of the three common borers, the following very brief statement of the life-histories of each, together with figures will serve to enable them to recognize these pests.

THE PEACH-TREE BORER.—*Sannina exitiosa* Say.

The adult peach-tree borer is a moth that differs from most moths in that its wings are more or less transparent and shaped somewhat like the wings of wasps; in fact the casual

observer is very apt to mistake these moths for wasps as they are flying about in the sunshine and depositing their eggs. The male measures about one inch from tip to tip of the expanded wings and the female about one and one-half inches; and the two sexes differ so much in general appearance that one would scarcely believe them to be the same species. The general color of these moths is a deep steel-blue, while the fe-

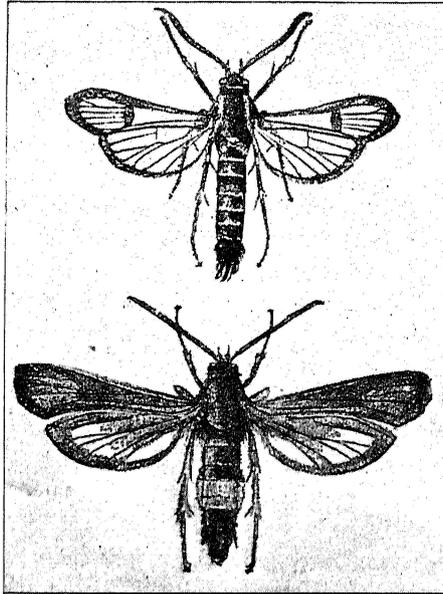


Fig. 5.—Adult Peach-Tree Borer, *Sannina exitiosa* Say.; the upper one is the male; the lower one is the female. (After Lintner.)

male has a conspicuous orange band across the abdomen. One may obtain a fairly good idea of the general appearance of these adults by observing figure 5, which represents them enlarged; the upper figure being the male and the lower figure the female.

The adult moths begin to emerge in the spring, usually in May, and continue to emerge until well into July, for un-

fortunately they do not all reach maturity together. Hence it is that they are found depositing eggs for so long a time. There is but one brood each year, however. The eggs are deposited as a rule on the bark at or near the surface of the ground, although they will sometimes deposit them up the trunk and even on the larger limbs. The young larvae or borers are active and soon eat their way through the bark to the sapwood, usually entering where there is a crack or crevice. They feed there and thus enlarge their tunnels, and if the tree be a small one, or if there be several larvae in the same tree, they may girdle and kill the tree or greatly weaken and injure it. When cold weather appears they hibernate and in the spring, after they have become full grown, they make an oblong cocoon by fastening their excrement and gnawings of wood or bark together by means of a little silken thread and gum. This cocoon is usually near the surface of the bark and more or less surrounded by the gummy exudation from the tree. Within this cocoon the larva or borer transforms to the pupa stage, and shortly emerges as an adult moth.

As is well known to all, the presence of the borer within a tree is easily detected by the gummy exudations, usually mixed with more or less excrement and borings; but as this may be just below the surface of the ground, it may escape notice for some time unless the earth be removed from about the trunk down to the large roots.

The peach-tree borer will also attack the plum tree.

As the methods of combatting this borer are the same as those for the apple-tree borers, the reader is referred to them on the last pages of this bulletin.

THE ROUND-HEADED APPLE-TREE BORER.—*Saperda candida* Fab.

The adult of the round-headed apple-tree borer is a beautiful long-horned beetle. It is from three-fourths to nearly an inch in length, and with the antennae or feelers nearly as long as the body. The under surface of the body is silvery-white,

while the upper surface is light brown with two white stripes running from the head to the tip of the wing covers; the legs and antennae are gray. A picture of one of these adult beetles is shown in figure 6, *c*, natural size.

The adult beetles emerge about the last of May as a rule, but vary a month or so in emerging, and as a result they are nearly two months in depositing their eggs. The eggs are deposited at night, usually in the bark of the trunk near the base, but may sometimes be deposited higher up and even in the large limbs. The larvae or borers on hatching burrow in the

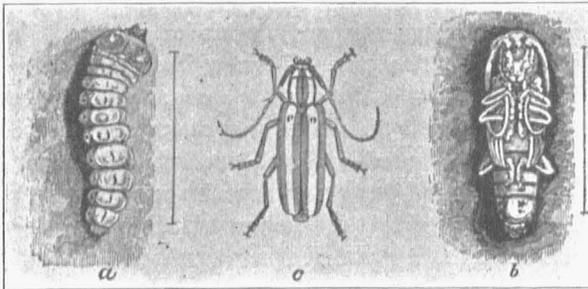


Fig. 6.—Round-Headed Apple-tree borer, *Saperda candida* Fab.: *a*, larva; *b*, pupa; *c*, adult. (After Smith.)

sapwood for the first season and, if the tree be young or there be several within the tree, may girdle it. The second year the borers usually work more or less into the heart wood; and the third season they gnaw out toward the bark, where a cocoon is made within the tunnel out of their excrement and gnawings, and within this the pupal stage is passed. The adults on hatching eat their way out and escape. Thus it will be seen that it requires three years from the time the egg is deposited until the adult appears, the borer being within the tree all this time. Figure 6, *a*, shows a picture of the larva or round-headed borer, and figure 6, *b*, a picture of the pupa.

The presence of these borers in a tree is indicated by the lack of growth, and frequently by the presence of the saw-dust

like gnawings and excrement that are pushed out from their holes.

This round-headed apple-tree borer also works in the pear and quince, and in fact in nearly all the members of the family Pomaceae.

The means of combatting this borer are discussed under the general head of remedies at the end of this bulletin.

THE FLAT-HEADED APPLE-TREE BORER.—*Chrysobothris femorata* Fab.

The adult of the flat-headed apple-tree borer is a beetle measuring about one-half inch in length, the upper surface of a dark metallic-brown color and the under surface of a coppery bronze color. A picture of one of these adult beetles is shown in figure 7, *d*; at *a*, the larva or borer; and at *b*, the pupa.

The adults appear in the spring at practically the same time as those of the round-headed borer, but differ much from them in their habits. The beetles deposit their eggs during the day time upon the bark of the trunk and limbs of the trees; the larvae or borers mining and feeding usually in the sapwood. They hibernate on the approach of cold weather, and the next spring make their pupae within the infested tree, and ultimately

emerge by eating their way out. Thus the flat-headed borer lives only one year within the tree. It is usually not as destructive an insect as the round-headed borer, and is largely found in the limbs, sometimes in considerable numbers, but is more apt to attack injured or dying than perfectly healthy trees. Its range of food plants is quite large including besides the apple, the peach, plum and pear, oak, hickory, chestnut, maple, box-elder, sycamore, linden, and willow.

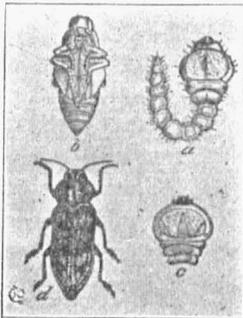


Fig. 7.—Flat-Headed Apple-Tree Borer, *Chrysobothris femorata* Fab.; *a*, larva or borer; *b*, pupa; *d*, adult, natural size. (After Riley.)

GENERAL REMEDIES FOR THE THREE BORERS.

Since the methods of combatting these three borers is practically the same for each, it will suffice to treat them together, stating any special case of difference whenever it is needed.

The methods of combatting the common apple-tree and peach-tree borers may be divided into three classes, namely: destroying the borers, mechanical barriers, protective washes. In no case should one rely upon any one of these methods, and especially where the borers are very troublesome, all three methods should be resorted to.

Destroying the borers.—Every year, about the last of August or during September, one should go through the orchard and by means of a sharp knife dig out and kill the borers before they have mined too far or done much damage; sometimes a wire will be useful. Kerosene gradually turned in their holes is sometimes successful, especially with the round-headed apple-tree borer, where capillary attraction will carry the oil through the castings which fill up the burrows, and thereby reach the larva and kill it. Hot water has been used with more or less success in the case of the peach-tree borer by turning it about the base and large roots after removing the soil.

Mechanical preventives.—Wire gauze or mosquito netting, or thin wooden wrappers are of value, and should be placed about the base of the trunk in the early spring before the adults emerge. The wooden wrappers are satisfactory and, as they can be purchased for about three dollars per thousand from box and basket makers, they are now the most economical. They should be pushed down into the ground so the adults can not crawl under to deposit their eggs, and the tops should be stopped up with cotton wool in order to prevent them from entering there. Young trees especially should be thus protected. These wrappers are of value also in preventing "sun scald" during summer, and in the winter they will keep rabbits away.

Protective washes.—For the past three years we have been testing the efficiency of all the different washes for apple-tree and peach-tree borers that we could hear of or devise, both patent and otherwise. While some are of little or no account, the great bulk of them are good, and a few excellent. It is not necessary to enter into detail or give all of them; a few of the best will suffice.

It must be understood that these washes have no effect on the borers once they are under the bark; they act as repellents and either prevent the adults from depositing their eggs or kill the larvae in attempting to enter. These washes must be applied in the spring before the adults appear and again in about three weeks, or oftener if necessary. The dirt should be removed a little from about the base of the tree, and the wash applied thoroughly by means of a white-wash brush to the tops of the roots and up the trunk and main limbs. Of course the dirt is immediately replaced about the base. It is well in trees with a scaly bark to first remove as much of this as possible without injuring the bark, and in no case to cause the sap to flow later. All cracks and crevices must be filled and the bark thoroughly and completely covered.

A simple wash that is more or less effectual is made by dissolving as much common washing soda as possible in water, and then dissolving in this enough soft soap to make a thick paint. This wash is improved by the addition of one pint of crude carbolic acid to every ten gallons of the wash. This again is improved by the addition of one-half pound of paris green or one-fourth pound of powdered white arsenic to every ten gallons of the wash. And this is again improved by the addition of enough lime to make it a thick wash.

The best wash for borers, all considered, that we have seen or tested is made by the union of all the above ingredients in the following way: Dissolve as much common washing soda as possible in six gallons of water, then dissolve one gallon of ordinary soft soap in the above and add one pint of crude carbolic acid and thoroughly mix; slake a quantity of lime in

four gallons of water so that when it is added to the above, the whole will make a thick white-wash; add this to the above and mix thoroughly, and finally add one-half pound of paris green or one-fourth pound of powdered white arsenic and mix it thoroughly in the above.

We have taken the soda water and soap as a basis, and also the lime as a basis, and have added the other ingredients in various combinations in order to make different washes, and have found them all to be of service; but from our experiments, we would advise the use of all in one wash. If expense is a great item the poison may be omitted, but we believe it is cheaper in the end to put it in. All the other ingredients are very cheap. We have had good success with the soap omitted, but it is better to use it when possible. We have also added powdered tobacco to the washes with good results. The facts are, that by using the soda water and soap as a basis, and adding one or more of the other named ingredients, a good wash is produced, and a better one, if all are added. Likewise, we have found the same to be true if a thick white-wash of lime in water be used as a basis, and one or more of the other ingredients added, preferably all of them.

We have never found powdered sulphur to be of any use in washes for borers.

To sum up our experiments with the various washes: we have found the best results from and advise the use of the wash above described, made of water saturated with washing soda, soft soap, lime, crude carbolic acid, and paris green or powdered white arsenic.