

United States Department of Agriculture,
 DIVISION OF ENTOMOLOGY,
 L. O. HOWARD, Entomologist.

THE FRUIT-TREE BARK-BEETLE.

(*Scolytus rugulosus* Ratz.)

By F. H. CHITTENDEN,

Entomologist in Charge of Breeding Experiments.

GENERAL CHARACTERISTICS AND METHOD OF WORK.

Orchard trees are subject to the attack of a small boring insect, the fruit-tree bark-beetle (*Scolytus rugulosus* Ratz.), its presence being manifested by what are called "worm-holes," minute round openings

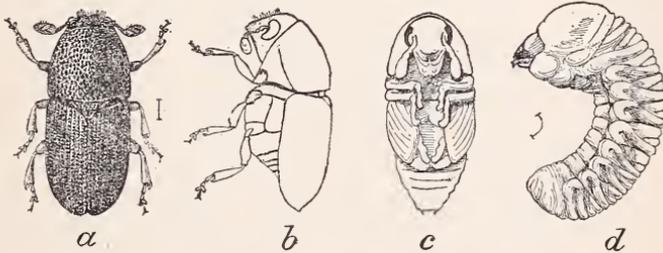


FIG. 1.—*Scolytus rugulosus*: a, beetle; b, same, in profile; c, pupa; d, larva—all magnified about 10 times (author's illustration).

in the outer bark scarcely a sixteenth of an inch in diameter, accompanied by wilting of the leaves and shriveling of the bark, and, in the case of stone-fruit trees, by more or less copious exudations of gum. The first appearing holes are made by the parent beetles in entering the bark to deposit their eggs, but later, if no effort is made to check the insect's work, the bark will be found thickly "peppered" with holes as though by fine bird shot. These are the exit holes of beetles that have in their larval stage mined and developed under the bark. Holes are also made by the mature insects, probably chiefly males, in the latter days of a season after midsummer, evidently for no other purpose than for food. A piece of twig, showing exit holes in the bark and the galleries of the insects beneath it, is reproduced in figure 2.

The insect which causes this injury is a member of the Scolytidæ, a family of cylindrical bark-and-wood-boring beetles. The adult or beetle is shown at figure 1, a. It is about one-tenth of an inch in length and three times as long as wide; uniform black in color, except the tips of the elytra or wing-covers and a portion of the legs, which are dull red. The punctuation of the thorax and of the elytra is also illustrated and at b the peculiar form of the short abdomen is shown. This insect is a European introduction and is sometimes known as the shot-borer, orchard scolytus, and fruit bark-beetle.

In Europe the species first attracted attention by its occurrence on young apple trees in 1834; in the United States it was noticed for the first time in 1877 through its injury to peach. Available data indicate that plum is more susceptible to attack than other trees, while peach, cherry, and apple are attacked about equally. Pear is also quite subject to infestation, and apricot, nectarine, quince, mountain ash, and Juneberry trees also harbor this species. In Europe mountain ash has been recorded by Döbner, and hawthorn and elm by Eichhoff.

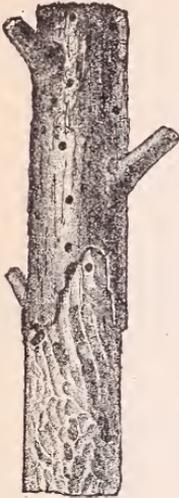


FIG. 2.—Work of *Scolytus rugulosus* in twig of apple—natural size (author's illustration).

Two important factors that have operated in the past have had a marked effect in increasing the numbers and consequent injury by this as well as other fruit-tree borers: (1) The introduction of other destructive insects and diseases into many of the districts which this insect inhabits, which has undoubtedly, by weakening the trees, afforded opportunities that would not otherwise have existed for the multiplication of these borers; (2) severe windstorms that often sweep through portions of the same region and which cause extensive destruction of fruit and other trees.

The presence of the injured and dying trees that are permitted to remain is a standing menace to the culture of stone fruits, apples, and pears.

One source of injury that is too often disregarded by the fruitgrower is in permitting trees to remain after they are badly injured and useless for any practical purpose except as firewood.¹

Until recently there was a difference of opinion as to whether or not this species was able to breed in vigorous trees, some writers going so far as to assert that the beetles will attack only devitalized growth.² As a rule, only diseased trees or such as may already be suffering from

¹Dr. E. F. Smith, of this Department, has on several occasions noticed infested orchards in the vicinity of wood yards or of brush or remnants of abandoned orchards; three such instances are recorded by him (Bulletin 4, Division of Vegetable Pathology, U. S. Dept. Agr., p. 30). In two cases cited, "peach brush from diseased trees had been cut in the spring and piled near an orchard, and in both the only attacked trees were in the vicinity of these piles, and those most seriously attacked were nearest to them."

²The writer and others have on several occasions seen peach trees that were apparently free from disease and from insects other than the fruit-tree bark-beetle. In one peach orchard, where the beetles were just commencing attack in September, nearly all the infested trees were, to every appearance, perfectly healthy; in fact, one tree that looked feeble was scarcely at all affected, while a neighboring tree that looked absolutely sound was well covered with the beetles and their burrows. Mr. Peder Pedersen, who has carefully observed this species in Montgomery County, Pa., has noticed a precisely similar condition of affairs at Huntingdon Valley, and Mr. W. P. Corsa, of the Division of Pomology, has witnessed the same at Milford, Del., and Prof. E. A. Popenoe the same in Kansas. See Bul. 19, n. s., Div. Ent., p. 96; also Lowe, Bul. 180, N. Y. Agl. (Geneva) Exp. Sta., pp. 122-128.

the attacks of other insects are permanently injured, but apparently normal trees are also attacked and sometimes completely recover without assistance. Stone-fruit trees, especially peach, if in condition, exude such quantities of gum that the beetles are repelled and abandon their burrows without mining to any extent under the bark or depositing their eggs. As long as there is a vigorous flow of sap there is little danger of serious injury, but after frequent attempts to obtain lodgment the beetles may so "bleed" a tree that, in course of time, they are able to attain their purpose, when the death of the tree is assured.

Another form of injury is the destruction, at the beginning of spring, of small twigs together with the leaves which they bear. The beetles are also reported to destroy leaves by boring into the base of the buds at their axils.

Injury, then, is mainly due to beetles of the first generation working upon the terminal twigs in spring and afterwards of later generations on the trunks and larger limbs of trees.

In common with most diurnal species this insect is found more abundantly on the exposed sunny side of living trees, which being drier would exude less sap, and for that reason be more available as food.

DISTRIBUTION AND SPREAD OF THE SPECIES.

From its first center of introduction in the United States, whether central New York or elsewhere, this species had spread, presumably in the main by the distribution of nursery stock, from infested to uninfested districts until, three years after its first observed occurrence in 1877, it was reported as injurious in localities in New Jersey, Pennsylvania, Missouri, Maryland, and the District of Columbia. In the succeeding five years it was reported successively from Massachusetts, Virginia, Georgia, and South Carolina, indicating a wide distribution at that time. In 1888 it was brought to the attention of Dr. S. A. Forbes by its depredations in the State of Illinois, and as a consequence was given special study in that State.¹

A perusal of the list of localities in which this species is known to occur in the United States shows that it is an inhabitant of the Upper Austral life zone, and that it is now resident in nearly every State of the Carolinian division, as well as in a few that lie within the Transition zone. This includes territory from Massachusetts, New York, and Michigan in the North to Alabama and Georgia in the South, and Missouri and Arkansas in the West, a total of nineteen States and one Territory in which it has been reported to occur in injurious abundance in one or more known localities.

LIFE HISTORY.

As early as the middle of March, first of April or later in May, according to locality and season, the parent beetles make their first appearance

¹Seventeenth Rept. State Ent. Illinois for 1889 and 1890 (1891), pp. 1-20.

of the year, and may be seen crawling about orchard trees and beginning to burrow through the bark. After penetrating to the sapwood, feeding as she goes, the female constructs, partly within the bark and partly in the wood next to it, a vertical gallery or brood chamber, and along the sides of this at very short intervals gnaws little pockets in which she deposits her eggs. The minute, whitish, grub-like larvæ hatching from

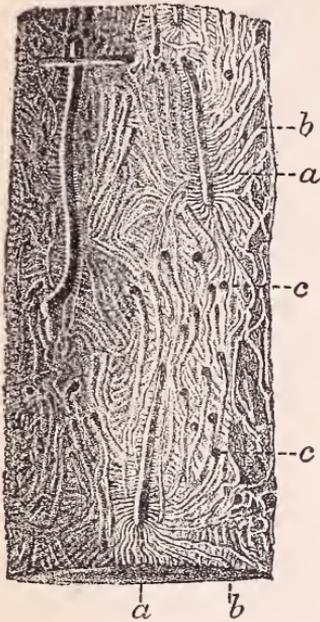


FIG. 3.—Galleries of *Scolytus rugulosus* on twig under bark; a, a, main galleries; b, b, side or larval galleries; c, c, pupal cells—natural size (after Ratzeburg).

these eggs excavate little side galleries, which start out at right angles to the brood chamber but soon diverge and widen with the increase in size of the growing larva. Much more frequently this insect lives in such numbers, with its galleries so closely packed together under the bark of a tree, that it is with difficulty that individual galleries can be distinguished. A specimen of the insects' work on the wood, shown at figure 3, illustrates the crossing and recrossing of the galleries of different larvæ. Completed main galleries measure from one-half to two inches in length, and the average number of eggs deposited in each by a single female is said to be about eighty.

The parent beetle, according to the studies of Dr. J. B. Smith at New Brunswick, N. J., occupies less than a week in the construction of the brood chamber, the eggs hatch within three days, and the larva is about twenty days in attaining maturity. The full-grown larva, shown in natural curved position at figure 1, *d*, is white in color, with a small yellowish head and brown mandibles, and its surface is much wrinkled. When about to transform, the larva forms at the large end of its gallery an oval chamber, usually in the wood, but sometimes partly in the bark, and here the pupal stage is assumed. The period of the pupa state as observed in moderate weather, at Washington, D. C., is seven days; in cooler weather of spring or autumn this may be extended to ten days. Allowing for both the shorter and longer periods in the development of the preparatory stages, which must exist in the different temperatures of midsummer, autumn, and spring, we have approximately a life cycle of four to six or perhaps more weeks.

THE NUMBER OF GENERATIONS.

The earlier writers on the fruit-tree bark-beetle took little account of its development, evidently being of the opinion that it required a year to attain maturity. Thus, Schmidberger, writing in 1837, states that in

trunks of young apple trees the larvæ fed till late in autumn and the beetles were seen (in confinement) about the end of February at rest in their passages, which they left in April and May. Goureau, writing in 1861, says that larvæ get their growth by the middle of winter, pupate the last of May, and mature in June. It will be seen that these two authors had no conception of more than a single generation annually. Later writers have assumed the probability of a second generation. Prof. F. M. Webster, speaking of its occurrence in central Ohio, says "the species is double-brooded."¹

Observations conducted in the vicinity of the District of Columbia have led the writer to the belief that there may be a third generation produced in this latitude.² While the life cycle may be passed in as short a space as four weeks, it would appear that the beetle is some time in escaping from the wood and in feeding before completing the primary galleries and laying its eggs.

In the extreme South, according to Mr. C. F. Baker, who has observed this species at Auburn, Ala., it is almost impossible to trace any broods, owing to an apparent continuous breeding through the spring, summer, and fall. As late as December females were found in newly formed brood chambers. Larvæ were also observed at this time and the opinion was expressed that "the insect must pass the winter in both egg and larval stages."

PARASITIC AND OTHER ENEMIES.

A much greater amount of damage from this bark-beetle would result were it not held in check by a host of natural enemies. In Europe two hymenopterous parasites³ destroy it in great numbers. In the United

¹ An. Rept. Ohio St. Hort. Soc. 1895-96, pp. 94-98.

² From a twig of apple containing larvæ and procured by the writer in the vicinity of the District of Columbia in September the earliest individuals of the first generation were obtained May 1 of the year following. What we may consider the second generation was issuing from the bark of plum the first week of July. Larvæ were then present in greater abundance than at any other stage. By the close of the month all but an extremely small percentage had issued as beetles, a few straggling pupæ and still fewer larvæ being present under the bark, which was then honeycombed by the multitudes of this insect which it had harbored. Subsequently all the beetles escaped, as the wood was quite dry and no longer in condition for their maintenance. A third generation, if previous surmises are correct, was reared the first two weeks of September from a different lot of plum branches and was observed at the same period in a peach orchard in another locality. In the latter place the beetles had evidently been at work several days, having made holes sufficiently deep in the tree for their complete concealment. Indications were that this hypothetical third generation made no attempt to breed but merely entered the peach trees for food and shelter. Beetles could still be seen projecting from their burrows as late as the first week of November, but no galleries of any kind were to be found.

³ *Blacus fuscipes* Gour., and *Pteromalus bimaculatus* Nees.

States several other parasites have been reared from or with it.¹ In addition, three or four predaceous insects² have been detected under circumstances to indicate that they lived upon the bark-beetle larvæ.

Some idea of the value of these parasites in helping to restrain the excessive multiplication of their host may be had when it is stated that in a case that recently came under the writer's observation at Washington, 92 parasites were reared from infested twigs, against 72 beetles. All but two individuals of the parasites were *Chiropachys colon* (fig. 4).

REMEDIES.

Borers are among the most troublesome insects with which the fruit-tree grower has to deal, and the present species is, perhaps, the most difficult one to control by ordinary measures. The time-worn remedy of cutting borers from the tree, valuable for large forms, and still practiced against many species, is useless against the fruit-tree bark-beetle. Preventive measures that may be successfully used against other boring species are also ineffectual. The main difficulties in the way of treating this species are its minute size, its extreme abundance, and the fact that it is not restricted to any portion of a tree, and that oviposition occurs practically throughout the entire season.

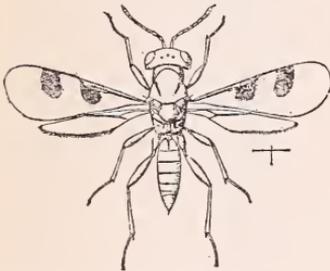


FIG. 4.—*Chiropachys colon*—much enlarged (author's illustration).

Clean culture as a prime requisite.—Foremost among the requisites is clean cultural practice; in fact, little of really substantial benefit can be accomplished without it. Brushwood and other remnants of orchards, as has already been shown, are too frequently left to serve as centers of infestation to sound trees. As soon as infested trees are seen to be actually dying, it is practically useless to do anything to save them. Trees may recover from slight attacks, and the fruit-grower must use judgment in discriminating between what will recuperate and what are beyond hope of recovery, and should cut out and burn the dying and dead growth as often as detected.

For the perfect protection of one kind of fruit tree all other kinds which are permanently injured must be destroyed. If, for any reason, such measures be neglected during the summer, the injured growth should at least be burned before the following spring, as by such means all the hibernating insects will be destroyed.

¹ *Chiropachys colon* Linn., *Raphitelus maculatus* Walk., *Eurytoma bicolor* Walsh, *Eurytoma crassineum* Ashm., *Heydenia unica* Cook, *Hemiteles scolyti* Ashm., *Platygerrhus* (?) *scolyi* Ashm., *Tetrastichus scolyti* Ashm. (secondary), and two or more new species of *Eupelmus*.

² *Phyllobacnus dislocatus* Say, *Clerus ichneumoneus* Fab., *Thanasimus* sp., unknown clerid larva, *Rhizophagus bipunctatus* Say. The American species have mostly been reported by Dr. A. D. Hopkins and the writer.

In connection with these measures, if orchard trees be kept in vigorous health—with the aid of manure or mineral fertilizers, if necessary—they will more readily be able to withstand borer attack.

Mechanical barriers.—Newspapers, tarred paper, burlap, or straw wrapped about trunks and limbs deter boring insects from laying their eggs upon the trees at these points; but mechanical preventives can not well be applied except to the trunks and largest branches, hence poisonous washes and like substances are preferable.

Deterrent washes and other remedies.—Several washes are in use against borers of this nature. One of these is an alkaline wash prepared of soft soap reduced to the consistency of thick paint by adding washing soda in water. Another is prepared of one pint of crude carbolic acid, one gallon of soft soap, and diluted with eight gallons of soft water. These washes should be applied thoroughly, preferably with a brush, care being taken to cover all portions of the trunk and as many branches as possible. It should be remembered that they are simply preventive and do not kill the borers or afford any protection from injury by them if once the insects have entered the tree.

Some grades of fish-oil and whale-oil soap are valuable as deterrents, but do not entirely prevent the insects from issuing from the trees.

With any local application that may be made against this bark-beetle there is always this difficulty, that the twigs and smaller limbs can not be completely covered and the beetles readily enter them, hence the necessity of the most careful inspection during the season and the cutting out of the badly infested portions.

Whatever deterrent is used should be applied just before the first warm days of spring; in the Gulf States, before the first of March; in the latitude of Pennsylvania and New Jersey, by the first of April.

Owing to the development of so many generations of this insect it is necessary that applications be renewed during the season.

Girdling.—It is probable that the European custom of girdling, or "ringing," a few trees in an orchard as traps for such beetles as may not have been destroyed with their host trees might prove effective, but, although the remedy has frequently been recommended, we have no knowledge of its successful use in this country.

Trap trees and branches.—After the issuance of the first edition of the present circular (March 25, 1898) it occurred to the writer that much injury might be avoided by the judicious use of dead wood to decoy the beetles for oviposition. This remedy has already been advised for the flat-headed apple-tree borer, but, so far as the writer knows, it has not been given a fair test as to its usefulness. Freshly-killed host trees, branches of smaller limbs of the same, such as



FIG. 5.—*Raphitelus maculatus*: adult fly, much enlarged, with femur at left giving lateral view (original).

ordinary prunings, should be placed about the orchard where infestation is most feared. Apple and pear would probably prove most useful for the purpose because apparently most favored by the borer. In the application of this remedy it is essential that the operator shall know the dates of the first appearance of the different broods of the bark-beetle in his particular locality.

Left about the orchard as previously described, the decoy material will attract the beetles, appearing (in the District of Columbia) in late March and April, and after they have deposited the bulk of their eggs it should be destroyed by burning, say, four or five weeks after the beetles first appear, to prevent the developing of other generations, and a new lot of branches should be provided by pruning injured or superfluous material to attract the next generation of beetles, which appears about the first of July. The last-appearing beetles, which are active about the first of September, must be trapped again in the same manner. The greatest care should be used in all cases to destroy trap and other infested material before the issuance of the beetles.

Considering the efficacy of parasites in the control of this insect, it might be found valuable to inclose pieces of infested branches in boxes or barrels covered with wire netting of a mesh sufficiently fine to prevent the beetles from issuing, but to allow the parasites to make their exit and thus to keep up their good work in the control of the pest.

Kerosene; creosote oil.—The beetles may be killed and much consequent damage prevented if they are detected at the outset of attack, by touching lightly the infested spots, from which the gum or sap has begun to ooze, with a small sponge saturated with kerosene, creosote oil, or turpentine, and fastened at the end of a stick or pole. After destroying the beetles in this manner upon a tree, it may be protected from further attack by paper wrappings, and, should it show signs of serious injury, this might be averted, if the tree be too dry, by frequent waterings, where this can conveniently be done, to the base of the trunk.

Approved :

JAMES WILSON,
Secretary.

WASHINGTON, D. C., *March 25, 1903.*