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United States Department of Agriculture,
DIVISION OF ENTOMOLOGY.

THE FRUIT-TREE BARK-BEETLE.
(*Scolytus rugulosus* Ratz.)

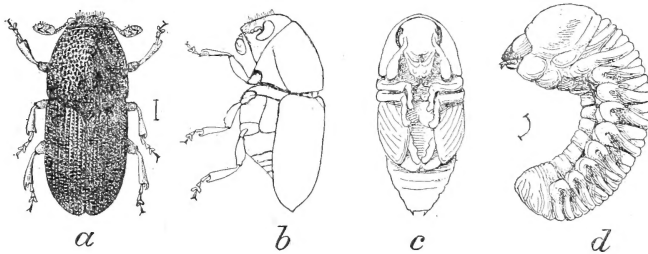


FIG. 1.—*Scolytus rugulosus*: *a*, adult beetle; *b*, same in profile; *c*, pupa; *d*, larva—all magnified about 10 times (original.)

GENERAL CHARACTERISTICS AND METHOD OF WORK.

Fruit 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 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 insects' 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 mined in their larval stages and developed under the bark. Holes are also made by the adult insects, probably chiefly males, according to Mr. E. A. Schwarz, 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 at 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 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 are illustrated in the figure, and at *b* the peculiar form of the short abdomen is shown. This insect is sometimes known as the shot-borer and orchard scolytus, but has more frequently been mentioned as the fruit bark-beetle. The name of fruit-tree bark-beetle is now suggested as more appropriate.

In Europe this insect 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, and quince trees are known to have harbored this species. Of trees other than those of the orchard that serve as food for this borer, none are known in America, but in Europe mountain ash has been recorded by Döbner, and hawthorn and elm by Eichhoff.

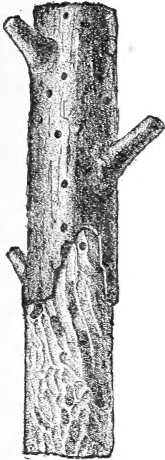


FIG. 2.—Work of *Scolytus rugulosus* in twig of apple—natural size (original).

Two important factors have operated in the past two or three years that 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 species, such as the San Jose scale (*Aspidiotus perniciosus* Comst.), 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) the severe windstorms that have swept through portions of the same region and which have caused extensive destruction of fruit as well as shade and forest 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 fruit-grower is in permitting trees to remain after they are badly injured and useless for any practical purpose except as firewood.

Dr. E. F. Smith, of this Department, informs the writer that on several occasions he has noticed infested orchards in the vicinity of wood yards or of brush or remnants of abandoned orchards. Three such instances are recorded by him.* 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."

*Bulletin 4, Division of Vegetable Pathology, U. S. Department of Agriculture, p. 30.

There is a difference of opinion as to whether or not this species is able to breed in vigorous trees, some writers going so far as to assert that the beetles will attack only devitalized growth.*

The weight of testimony is that, as a rule, only diseased trees or such as may already be suffering from the attacks of other borers or of scale insects are permanently injured by this bark-beetle. 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.

Different observers have noticed that this insect, in common with most diurnal species, is found more abundantly on the exposed sunny side of living trees. The sunny side being drier would exude less sap, and for that reason is more available as food for the beetles.

DISTRIBUTION AND SPREAD OF THE SPECIES.

From the 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 this time. In 1888 it was brought to the attention of Dr. Forbes by its depredations in the State of Illinois, and as a conse-

*During the season of 1897 the writer and others, on several occasions, saw 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. One of our correspondents, Mr. Peder Pedersen, who has carefully observed this species in Montgomery County, Pa., where it is very troublesome, writes that he has noticed a precisely similar condition of affairs at Huntingdon Valley. Mr. W. P. Corsa, of the Division of Pomology, states that he has witnessed the same at Milford, Del.

quence the species was given special study in that State, resulting in the publication of a very full account,* which has been of considerable value in the preparation of the present circular.

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. 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 eighteen States and one Territory in which it has been reported to occur in one or more known localities in injurious abundance. In addition it has been observed in Delaware in three different localities but not, as far as reported, in troublesome numbers.

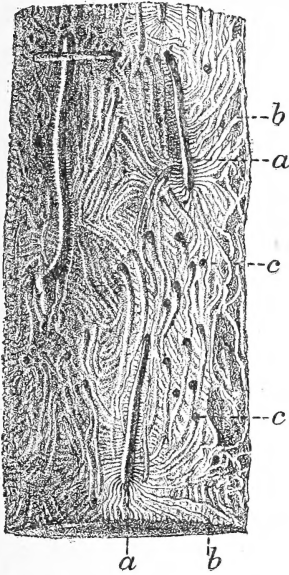


FIG. 3.—Galleries of *Scolytus rugulosus* on twig under bark: a, a, main galleries; b, b, side or larval galleries; c, c, pupal cells—natural size (after Ratzeburg).

LIFE HISTORY.

As early as the middle of March, the first of April or later in May, according to locality and season, the parent beetles make their first appearance 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 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 work of this species on the wood is shown at figure 3, which well 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.

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

The parent beetle, according to Dr. J. B. Smith, who has studied this species recently 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 its 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, which is usually in the wood, but sometimes partly in the bark, and here the pupal stage is assumed. The pupa, which is of the same white color as the larva, is illustrated at figure 1, *c*. The period of the pupa state as observed in moderate weather, at Washington, D. C., is seven days; in cooler weather in 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 from 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 the species required a year to attain maturity. Thus, Schmidberger, who wrote of this insect in 1837 states that in pieces of the trunks of young apple trees infested by this bark-beetle 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 readily be seen that these two authors had no conception of more than a single generation annually. Later writers who gave the matter any thought assumed the probability of a second generation.

Observations conducted during the year 1897 in the vicinity of the District of Columbia lead the writer to the belief that there are at least three generations produced in this latitude each year. Farther northward in the transition zone, perhaps no more than two generations develop annually, while, in exceptional years at least, we may expect four generations in the southernmost range of the species. On this head Dr. Smith remarks that "there may be four or five" generations produced each year (in New Jersey). 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.

From a twig of apple containing larvæ and procured in the vicinity of the District of Columbia in September the earliest individuals of the first generation were obtained the first day of May 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 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 now 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 trees 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.

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, as the insects seem to breed continuously 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 beetle would result were it not held in check by a host of natural enemies. In Europe two hymenopterous parasites* are said to destroy it in great numbers. In the United States several other parasites have been reared from or with it.† In addition, three or four predaceous insects ‡ have been detected under the bark of trees under circumstances to indicate that they lived upon the bark-beetle larvæ.

* *Blaeus fuscipes* Gour., and *Pteromalus bimaculatus* Nees.

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

‡ *Phyllobenus dislocatus*, *Thanasimus* sp., unknown clerid larvæ, *Rhizophagus bipunctatus* Say.

A number of the American species have been reported by Dr. A. D. Hopkins and others; other species have been observed by the writer.

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 observation at Washington, 92 parasites were reared from infested twigs, against 72 individuals of the beetle. All but two individuals of the parasites were *Chirpachys colon*. This species was first captured and recognized in this country by Dr. Howard in 1879, and the accompanying illustration was drawn under his supervision soon afterwards.

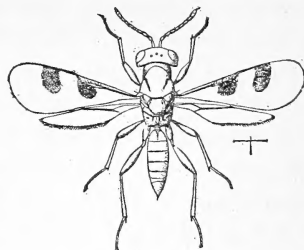


FIG. 4.—*Chirpachys colon*—much enlarged.

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 with this insect. The main difficulties in the way of treating this species are its minute size, its great abundance, and the fact that it is not restricted to any portion of a tree, and that oviposition occurs practically throughout the entire season.

Clean culture 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 often 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, of course, may recover from slight attacks, and the fruit-grower must use his own judgment in discriminating between what will recuperate and what is beyond all hope of recovery, and should cut out and burn the dying and dead growth as soon as detected.

For the perfect protection of one kind of fruit tree all other kinds which may be injured beyond recovery must be destroyed. If, for any reason, such measure 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.

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 similar 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 advised for this species, and in successful use against the peach-tree borer (*Sannina exiti-*

osa), 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 of the branches as possible.

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, as has been conclusively proven in recent experience.

Raupenleim and dendrolene, as well as coal tar, are sometimes used to prevent borer attack, but must be applied only with great caution, particularly upon young fruit stock, since, if applied too thickly, they are apt to retard the growth and eventually kill the trees.

These washes, it should be remembered, are simply preventive and do not kill the borers or afford any protection from injury by them once these insects have entered the tree.

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 infested portions.

Girdling.—It is probable that the European custom of girdling 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.

Kerosene emulsion; creosote oil.—The beetles may be killed and much consequent damage prevented, if they are detected at the outset of their attack, by touching lightly the infested spots, from which the gum or sap has begun to ooze, with a small sponge saturated with kerosene emulsion, or creosote oil and 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, and by heavy applications of fertilizer, preferably fresh cow manure, to the base of the trunk.

Whatever wash or other 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, before 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.

Hydrocyanic-acid gas suggests itself as a possible remedy for this insect but no opportunity has offered for experiment with it.

F. H. CHITTENDEN,
Assistant Entomologist.

Approved:
JAMES WILSON,
Secretary.

WASHINGTON, D. C., *March 25, 1898.*

NOTE.—Correspondence is solicited from fruit-growers who have had experience with this borer and particularly with such as have had opportunities for thoroughly testing remedies.

