

# OAK SAPLING BORER, GOES TESSELATUS HALDEMAN<sup>1</sup>

By FRED E. BROOKS<sup>2</sup>

*Entomologist, Fruit Insect Investigations, Bureau of Entomology, United States Department of Agriculture*

## NATURE OF INJURY

During the last 10 years the writer has observed in several localities of central West Virginia rather extensive injury to young oak and chestnut trees by cerambycid larvæ of the species *Goes tessellatus* Haldeman. The injury done consists of wide irregular burrows in the wood at the base of the trunks. Trees from half an inch to 2 inches in diameter suffer most. (Pl. 1, D, E, F; Pl. 2, A.) Approximately 25 per cent of the infested trees die, either directly from the injury inflicted by the larvæ or from breaking a few inches above the ground (Pl. 3, A, B) at the large exit holes made by the escaping beetles. In the woods the insects show a distinct tendency to colonize, some apparently favorable growths of saplings being almost free from injury and others with practically every young tree showing fresh or ancient wounds.

The burrows are most extensive a few inches above the surface of the ground but they extend also a short distance below. The larvæ hatch and begin feeding about midsummer, and during the remainder of the first season they burrow in the outer wood, both above and below the oviposition scar in the bark. As cold weather approaches they work downward and pass the winter near the ground level. The second season they bore deeper into the wood and their galleries thereafter are in and around the heart. The burrows are so large that often a considerable portion of the trunk at the place of attack is involved (Pl. 1, D). When 4 or 5 inches above the ground, the burrow is enlarged at the upper end to form a pupal chamber.

## LIFE HISTORY

### BEETLE AND EGG

The beetle (Pl. 2, C, D) is elongate, cylindrical, with a ground color of grayish brown. The body is covered throughout with short, yellowish, prostrate hairs, these hairs on the elytra varying locally in abundance, and by their density in places forming small, scattering, yellowish spots. The antenna is much longer than the body in the male and slightly longer than the body in the female. The female is somewhat larger and stouter than the male. Numerous reared specimens ranged from 20 to 27 mm. in length and from 7 to 9 mm. in width.

After attaining the adult stage the beetle remains in the pupal chamber from 5 to 7 days and then escapes through a circular hole gnawed through the bark at the upper end of the chamber (Pl. 2, C). This hole is from 7 to 9 mm. in diameter, and the smaller trees sometimes break at the hole as a result of the severing of so much of the wood (Pl. 3, B).

<sup>1</sup> Accepted for publication Aug. 11, 1923.

<sup>2</sup> The investigations described in this paper were authorized by Dr. A. D. Hopkins, Forest Entomologist.

The beetles are somewhat sluggish and evidently do not move about a great deal under natural conditions. In color they resemble the bark of the trees upon which they rest, and they are hard to find in the woods. The writer has never been able to obtain an adult specimen except by rearing. When confined in cages the beetles gnaw the bark freely from white oak twigs, and when supplied with sufficient of this kind of food they live from three to five weeks.

The beetles issue from the wood late in May and early in June. At French Creek, W. Va., where beetles have been reared for several successive seasons, the first emergence record is May 25 and the last June 1. Within a week or ten days after emergence the beetles begin ovipositing. In preparing a place for her egg the female gnaws a circular concavity from 6 to 12 mm. in diameter in the bark (Pl. 1, A). In the center of this rather conspicuous scar she inserts her ovipositor and deposits a single egg between the bark and wood. Of about twenty eggs observed in their natural positions, all were placed with the long axis parallel to the grain of the wood and were directly above the oviposition scar in the bark (Pl. 1 B, C). The distance from the entrance hole to the near end of the egg was uniformly about 1 mm. The space between the egg and the hole is filled with a brownish, glue-like substance which becomes hard when dry.

The egg (Pl. 1, B, C) of the oak sapling borer is elongate, yellowish white, parchmentlike, and wrinkled. The dimensions average 6 mm. long by 2 mm. wide. When the egg is removed from its position in the tree the impress of the wood grains usually shows distinctly on its surface.

Beetles confined in the insectary oviposited freely in sections cut from the trunks of young white oak saplings and also in white oak bushes in the woods when confined over them. In one young white oak over which females were caged, 12 egg punctures were made. Of these punctures, 11 were within 4 inches of the ground and 1 was 15 inches above the ground. One lot of 5 females laid a total of 30 eggs, or 6 per individual. No definite data were obtained as to the time required by the egg for hatching, but general observations indicated an incubation period of about three weeks.

#### LARVA

Immediately after hatching the larva begins to feed in the bark and soon after that to eject sawdustlike castings through the oviposition wound and other small openings which it eats to the surface. During the second season of feeding these castings are thrown out near the ground and often form small, conspicuous heaps at the base of the tree. The larval period covers three years, and, in some cases, probably four or five years.

Individuals of various sizes may be found in the trees at any season of the year. The smaller specimens are usually located just beneath the bark, while the larger ones are deeper in the wood. At all stages of their growth the larvæ are slow of movement, but they show great strength in burrowing through the hard wood and in tearing off loose strings of wood for bedding their pupal quarters.

During its last summer in the tree the larva excavates a gallery extending several inches up the trunk and forms a roomy pupal chamber at the upper end (Pl. 1, D). This is entirely within the hard wood of the tree. The gallery below the chamber is packed with excelsiorlike wood fiber (Pl. 1, D; 2, A) through which moisture may drain. At the upper

end of the chamber an extension of the gallery turns abruptly outward, reaching almost to the inner bark. In this chamber the full-grown larva passes the winter and pupates early in the spring.

#### DESCRIPTION<sup>3</sup>

The full-grown larva is from 25 to 30 mm. long, the width of the prothorax is between 5 and 6 mm., and the head is about 4 mm. wide.

The Goes larva belongs to the general type of longicorn larvæ, which are specialized for a typical wood-boring life. The body, robust, fleshy, and yellowish, is almost cylindrical but slightly flattened dorsally and ventrally and somewhat broader anteriorly. The abdomen is extended and the segments readily telescope. The head is invaginated into the prothorax, with the exception of its minor anterior part, which carries the movable labrum and large membranous clypeus, the forceful mouth parts, and the different sensory organs. As in all members of the subfamily Lamiinae, to which Goes belongs, the shape of the head is very characteristic; it appears oblong when liberated and has almost parallel sides and a long unpaired suture along the dorsal middle line. It penetrates the entire length of the prothorax and its posterior foramen is located more ventrally than in the longicorn larvæ of the other groups, thus making the movements of the head and especially the up-and-down movements more free than in these larvæ.

In Goes the sides of the head narrow gradually to the base, while in closely related genera they suddenly constrict behind the middle of the head; the anterior chitinized and dark margin of the head capsule is without particular limitation posteriorly, not especially thick, and not projecting; the eyes are small, only one ocellus is present on each side; the antennæ are very small, and the chitinous rings of the head capsule from which they extend are closed behind, not bisected by the frontal sutures, as is the case in related genera. The mandibles are strong and heavily chitinized, as in all longicorn larvæ, but they have a rather unusual shape, being elongate, with a short, oblique cutting edge, and therefore they produce very characteristic scars or marks in the surfaces of the galleries which they gnaw. As in all the genera of the subfamily to which it belongs, Goes is completely legless, and its locomotion is therefore entirely dependent on the large warts or "ampullæ" of the abdomen. These warts are present in all longicorn larvæ, usually developed on the dorsal and ventral sides of the posterior thoracic and the first seven abdominal segments, and their surfaces are subdivided in different ways by small furrows or wrinkles and often set with minute chitinous asperities.

It has been noticed that a striking correlation exists between the development of the surfaces of the ampullæ and the different environments in which the longicorn larvæ live. Thus the chitinous asperities are characteristic of the forms in living trees and glabrous ampullæ in the forms in dead wood. Therefore the presence or absence of these asperities offers good classifying characters, especially for the distinction of species. Applied to the genus Goes, it is found that in five of its six known species the dorsal warts of the abdominal segments carry four transverse rows of small tubercles set with rather coarse asperities, and all of these species, among which is *Goes tessellatus*, attack living trees; the sixth species has glabrous ampullæ and has only been found in dead wood, feeding beneath the bark.

In many longicorn larvæ the dorsal surface of the ninth segment is provided with one or two chitinous plates or terminates with an unpaired median thorn or carries small hooks or chitinous granules; in Goes it is covered with a single smooth shield, shaped like a nail, posteriorly rounded and of a light yellowish color.

The spiracles are lateral, oval, with two lips and a narrow linear opening. Nine pairs are present; the mesothoracic is twice as large as the abdominal ones and is pushed somewhat forward into the prothorax.

Very remarkable but easily overlooked structures are two minute chitinous pits or pores, one at each end of an oval, obliquely transverse tubercle, on the sides of the first eight abdominal segments. These pits represent the external ends of a sensorial organ which is concealed in the pleural tubercles and probably is some sort of ear or so-called "chordo-tonal" apparatus. The shape of these pleural tubercles, the number of the setæ which they carry, and the more or less distinct development of the pits offer good generic characters in the subfamily to which Goes belongs. In Goes each tubercle is broadly oval; it carries two setæ, and the pits are darkly chitinized and comparatively distinct.

<sup>3</sup> By Adam G. Böving, Forest Insect Investigations, Bureau of Entomology, United States Department of Agriculture.

The structure of the integument of the body and the development of the hairs vary, like the asperities of the locomotory warts, according to the environment. In *Goes tessellatus* the texture of the integument is tough, shining, and sparsely clothed with hairs; but these hairs are long, rather coarse, and distinctly colored brownish yellow.

Anteriorly the dorsal side of the prothorax is smooth, and the hairs on its front margin do not form a continuous band as they do in closely related forms; posteriorly it is finely asperate. On the ventral side the posterior area of the prothoracic sternum carries a band of asperities which in this species is broken for a short distance in the middle.

#### PUPA

In West Virginia pupation has been observed to take place from April 9 to April 15. The pupa is yellowish white and is capable of only feeble movement. With four individuals the pupal stage lasted 39, 41, 43, and 44 days, respectively.

#### DESCRIPTION <sup>4</sup>

The pupa measures about 25 mm. in length. As in all the longicorns, it bears considerable resemblance to the adult, and many characters are identically developed in the two stages. However, special pupal characters are found in the striking way in which the posterior half of the long antennæ is rolled into a spiral below the abdomen and also in the shape, number, and arrangement of hairs or spines on many parts of the body. The hairs are yellowish brown and more coarse and well colored than in other species of *Goes*; they are rather numerous on the prothorax and are along the back of the first six abdominal segments set in two conspicuous longitudinal series of large blotches; each of the two blotches on the first abdominal segment contains about twice as many hairs as on the sixth segment. Finally, the last abdominal segment is armed with a well-developed, single, median process, which is conical, recurved, and mostly fleshy, but at the tip hardened into an acute and dark spine which laterally carries several minute teeth.

#### DISTRIBUTION

According to Blatchley,<sup>5</sup> this species is known from New York, Indiana, Louisiana, and Georgia. Its presence in West Virginia, which is central in the quadrangle of States mentioned, indicates that it may occur, locally at least, throughout much of the eastern portion of the United States where oak and chestnut trees grow. Notes in the files of the Bureau of Entomology show that the species has been observed in Virginia and North Carolina.

#### FOOD PLANTS

By far the most extensive injury caused by the oak sapling borer is to white oak, *Quercus alba*, although the adult insects have been reared from chestnut oak, *Q. prinus*, and injury probably attributable to this species has been noticed in other oaks. More rarely it attacks young chestnut trees, *Castania dentata*. In 1915 the writer obtained one beetle of this species among individuals of the roundheaded apple-tree borer, *Saperda candida* Fab., reared from wood of young service trees, *Amelanchier canadensis*, collected in the woods. It seems that the insect is a general feeder, but with a decided preference for white oak.

<sup>4</sup> By Adam G. Böving, Forest Insect Investigations, Bureau of Entomology.

<sup>5</sup> BLATCHLEY, W. S. AN ILLUSTRATED DESCRIPTIVE CATALOGUE OF THE COLEOPTERA OR BEETLES (EXCLUSIVE OF THE RHYNCHOPHORA) KNOWN TO OCCUR IN INDIANA. Bul. 1, Ind. Dept. Geol. and Nat. Resources, p. 1068. 1910.

## NATURAL ENEMIES

No insects predacious or parasitic upon the oak sapling borer have been discovered. Woodpeckers destroy many of the larvæ and pupæ by drilling through the wood and removing them from their burrows (Pl. 3, C). The species of bird responsible for the destruction of the borers was not determined, but the marks made in removing the insects were noticed frequently in woods where both the hairy woodpecker, *Dryobates villosus villosus* (L.), and the downy woodpecker, *Dryobates pubescens medianus* (Swains.), were abundant.

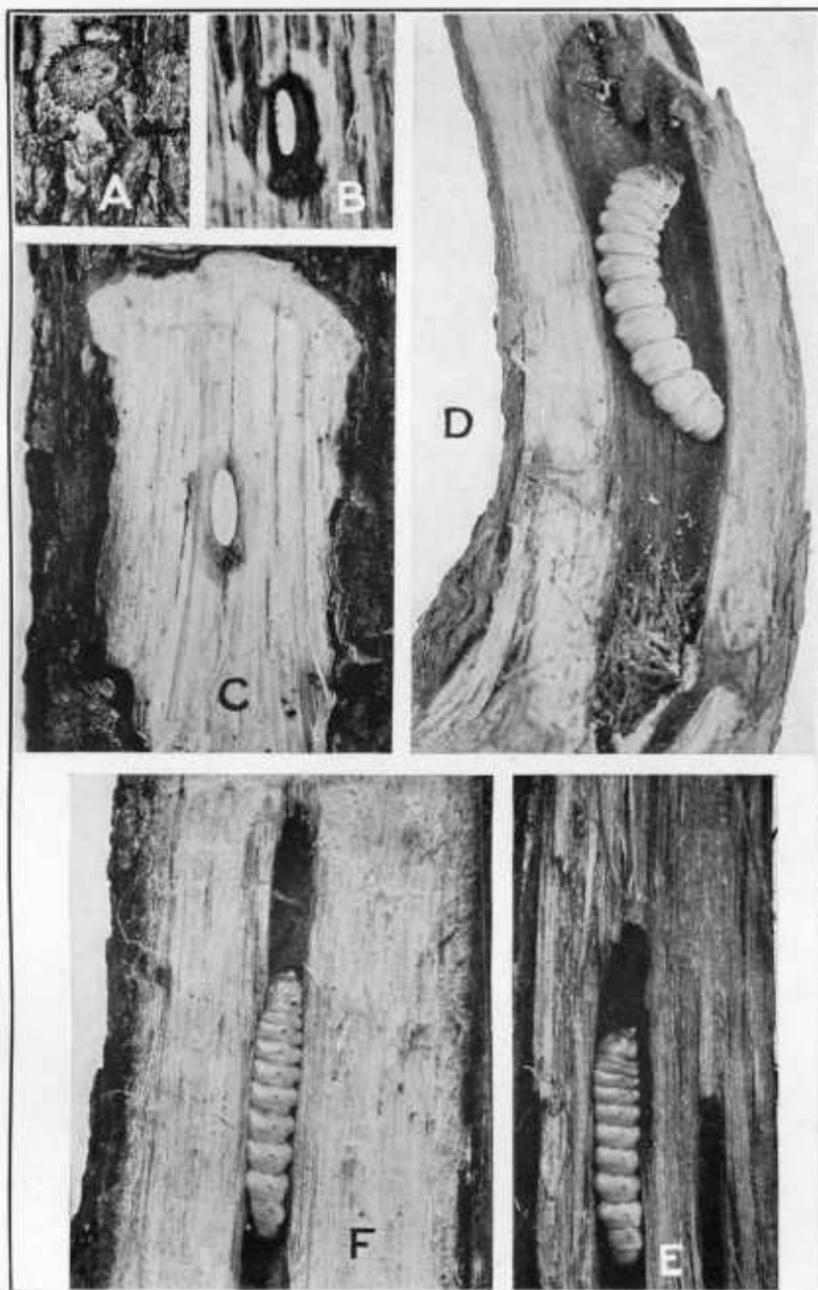
## CONTROL

Control measures against this insect will occasionally be called for where chestnut trees planted for nut production and oak and chestnut trees planted for shade, park, and reforestation purposes are attacked. Fortunately the borer in the tree makes its presence known by ejecting castings from its burrow before great injury has been done. Wherever fresh castings are being thrown out the borers can be located and killed without much difficulty by the use of a knife or chisel and a short piece of wire. A little cutting of the bark and outer wood is usually sufficient to expose the burrow so that the wire can be inserted and the borer killed.

PLATE 1

*Goes tessellatus*

- A.—Oviposition scar in bark of oak. About natural size.  
B and C.—Eggs exposed by removing bark. Slightly enlarged.  
D, E, and F.—Larvæ in their burrows. About natural size.



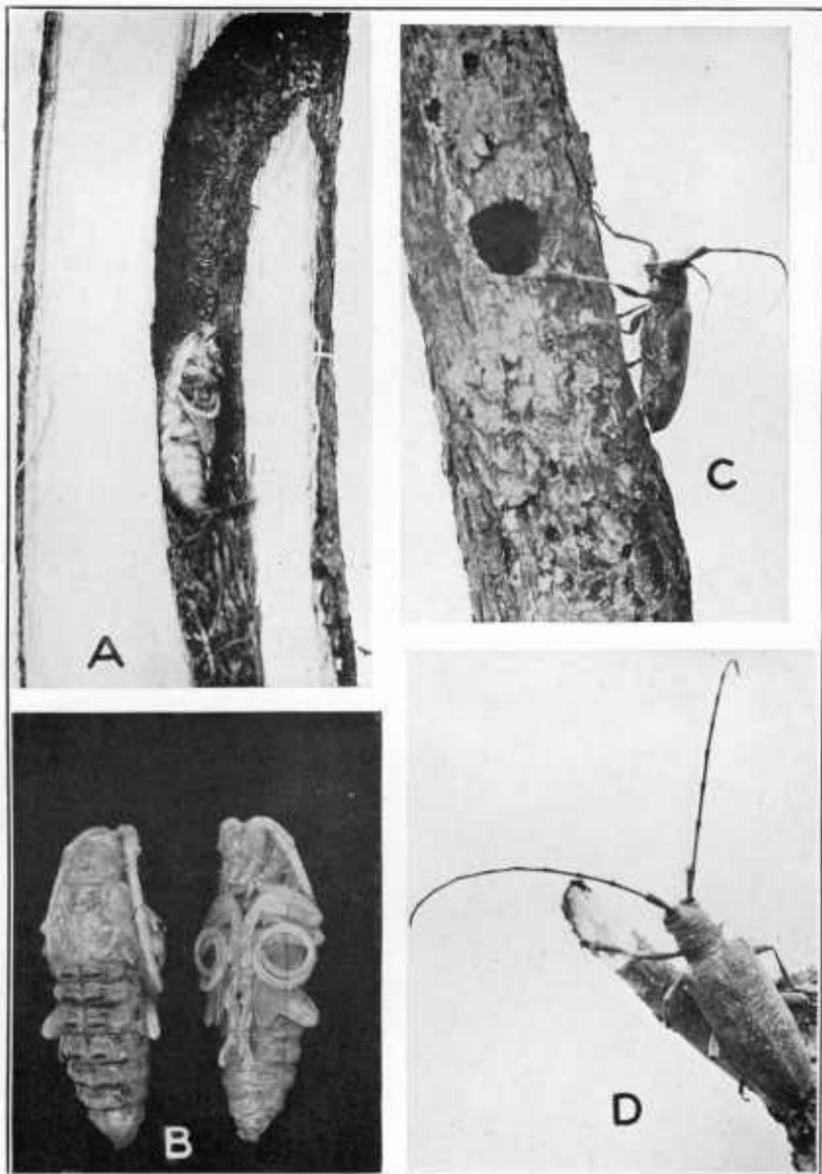


PLATE 2

*Goes tessellatus:*

- A.—Pupa in natural position in tree. About natural size.
- B.—Pupæ. Enlarged.
- C.—Beetle just after emerging from wood. About natural size.
- D.—Beetle. Slightly enlarged.

PLATE 3

*Goes tessellatus:*

- A.—Trunks of saplings showing large exit holes of the sapling borer.
- B.—Young oak tree broken by wind at exit hole of sapling borer. About natural size.
- C.—Drill mark of woodpecker made in removing a borer from its burrow. About natural size.

