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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY—BULLETIN No. 95, Part II.

L. O. HOWARD, Entomologist and Chief of Bureau.

PAPERS ON CEREAL AND FORAGE INSECTS.

THE MAIZE BILLBUG.

BY

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ISSUED APRIL 22, 1911.

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PAPERS ON CEREAL AND FORAGE INSECTS.

THE MAIZE BILLBUG.

(*Sphenophorus maidis* Chittn.)

By E. O. G. Kelly,
Entomological Assistant.

INTRODUCTION.

There are several species of the genus Sphenophorus that have been reported as being enemies to young corn in early spring. Heretofore these reports have always been made in connection with fields of grass, timothy sod, or lands recently reclaimed by drainage, and the depredations were on the first cultivated crop following these conditions.

Dr. S. A. Forbes [a] records eight species of Sphenophorus the adults of which are known to attack young corn. Dr. C. V. Riley, in the report of the Commissioner of Agriculture for 1881 and 1882, records Dr. L. O. Howard's observations on the habits and natural history of *S. robustus* and gives a description of the imago, larva, and pupa, Dr. Howard having found and reared these from specimens taken from young corn plants at Columbia, S. C. Dr. F. H. Chittenden, however, in a paper entitled "On the species of Sphenophorus related to *pertinax* Oliv., with descriptions of other forms," [b] with reference to *S. robustus*, says:

> This species ranges from Indiana and Michigan through Wisconsin, Minnesota, and western Kansas to California. It is a northern form, not occurring in the East. Nothing appears to be known of its habits, reference to *robustus* and its injuries to corn being due to a distinct species, my *S. maidis*.

Dr. Chittenden had before him, while describing *S. maidis*, among numerous other specimens, the one specimen from Columbia, S. C., reared by Dr. Howard. According to his statement *maidis* is a valid species and quite distinct from *S. robustus*.

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[a] Twenty-third Report of the State Entomologist of Illinois, 1905.
[b] Proc. Ent. Soc. Wash., vol. 7, p. 57, 1905.

Dr. Chittenden informs the writer that since 1895 complaints have been made every few years in localities in Kansas, South Carolina, Georgia, and Alabama of injuries to corn by what he believes to be this species of billbug. The species has been quite generally confused with *Sphenophorus pertinax* Oliv. and *S. robustus* Horn, by both of which names it has been mentioned in economic literature, more especially by the latter. It is, however, quite distinct from either, in fact, different from any billbug known to inhabit the United States, and has only recently been described as new to science, although Dr. Chittenden states that it is by no means new as an agricultural foe.

The observations on the maize billbug (*Sphenophorus maidis* Chttn.) given herein were made by the writer between June and December, 1910.

HISTORY OF THE SPECIES.

The history of this species, the writer is informed by Dr. Chittenden, is, in brief, that it first attracted attention in Alabama as early as in 1854; again in the same State in 1880; in South Carolina in 1881; in Kansas in 1895; in 1901 it again did injury in Kansas, and in 1903 in Georgia. The fact that the insect is injurious to corn in both of the active stages, larva and beetle, indicates that it is a more or less permanent pest, whereas several of our equally common corn billbugs will eventually disappear with the reclamation by draining and the cultivation of the soil and the consequent destruction of their breeding places.

In the opinion of Dr. Chittenden, this is the species described and figured by Townend Glover in 1855 [a] as the "billbug" or 'corn borer (Sphenophorus ?)," since both description and figure do not apply to any other billbug known to breed in corn. Glover describes the beetle as from four-tenths to six-tenths of an inch in length, and of a reddish-brown or reddish-black color, and the rostrum or snout in the figure can not belong to any other Sphenophorus. None of the specimens which served as models of the drawing remains in the Government collections. The billbug was reported as very destructive to corn in many parts of the South and Southwest, more particularly along the Pedee River. Injuries were reported by Senator Evans, Gen. Fitzpatrick, and Col. Pitchlynn. Senator Evans's report is as follows:

> The perfect insect eats into the stalk of the corn, either below or just at the surface of the ground, where it deposits its egg. After changing into a grub, the insect remains in the stalk, devouring the substance, until it transforms into the pupa state, which occurs in the same cavity in the stalk occupied by the grub. It makes its appearance the following spring in the perfect state, again to deposit its eggs at the foot of the young corn plants. These

[a] Agricultural Report of the Patent Office for 1854 (1855), p. 67, pl. 4.

insects destroy the main stem, or shoots, thus causing suckers to spring up, which usually produce no grain, or, if any, of very inferior quality to that of the general yield. Swamp lands or low grounds are the places most generally attacked.

Senator Evans thus is, according to Chittenden, to be credited with the discovery that the larva develops in the stalk of corn below the ground, and not in decaying wood, as contended by Messrs. Walsh and Riley in later years. The insect was said to be very destructive in Alabama, from which State the specimens chosen for illustration doubtless came, and on the Red River in Arkansas. With little doubt it was the same insect operating in Arkansas, as it is now known that this species ranges between South Carolina and Missouri.

This insect was observed in the spring of 1881 by Dr. L. O. Howard, at that time assistant to Dr. C. V. Riley, Entomologist of the Department of Agriculture. Dr. Howard was at once sent to Columbia, S. C., to investigate the injury being done to corn by "billbugs," and the following account of these investigations is taken from the report of his observations:[a]

The species found near Columbia, S. C., is *S. robustus* [now *S. maidis*]. In the plantations along the bottom lands of the Congaree River much damage is done by the adult beetle every year, and the corn not infrequently has to be replanted several times, as the earlier plantings are destroyed. The beetles are first noticed in the spring after the corn is well up. Stationing themselves at the base of the stalk, and also burrowing under the surface of the earth slightly, they pierce the stalk and kill many plants outright, others living to grow up stunted and dwarfed.

With *S. sculptilis* [*zeæ*], in spite of the damage it has done, the earlier stages remain unknown, Walsh surmising that the larva breeds on rotten wood, so situated that it is continually washed by water. With this statement in my mind I was prepared to doubt the statement of Mr. W. P. Spigener, of Columbia, who informed me that the "grub form of the billbug" was to be found in the corn, but a couple of hours in the field convinced me that he was right, my previous idea having been that he had mistaken the larva of *Chilo saccharalis* for the weevil grub. I searched a field on Mr. Spigener's plantation, which was said to be the worst point in the whole neighborhood for bugs, for some time before finding a trace of the beetle in any stage, but at last, in a deformed stalk, I found in a large burrow, about at the surface of the ground, a full-grown larva. After I had learned to recognize the peculiar appearance of the infested stalks I was enabled to collect the larvæ quite rapidly.

They were present at this date (Aug. 20) in all stages of larval development, but far more abundantly as full-grown larvæ. A few were preserved in alcohol and the remainder forwarded alive to the department, but all died on the way. Two pupæ were found at the same time; one was preserved in alcohol and the other forwarded to the department. The beetle issued on the way, and from this specimen we have been able to determine the species. From an examination of a large number of injured stalks it seems evident that the egg is laid in the

[a] Report of the Entomologist, Department of Agriculture, for 1881 and 1882, pp. 139–140.

stalk just at the surface of the ground, preferably and occasionally a little below. The young larvæ, hatching, work usually downward, and may be found at almost any age in that part of the stalk from which the roots are given out. A few specimens were found which had worked upward for a few inches into the first section of the stalk above ground, but these were all very large individuals, and I conclude that the larva only bores into the stalk proper after having consumed all available pith below ground.

The pupæ were both found in cavities opposite the first suckers, surrounded by excrement compactly pressed, so as to form a sort of cell.

Wherever the larva had reached its full size, the pith of the stalk was found completely eaten out for at least 5 inches. Below ground even the hard external portions of the stalk were eaten through, and in one instance everything except the rootlets had disappeared and the stalk had fallen to the ground.

In a great majority of instances but a single larva was found in a stalk, but a few cases were found where two larvæ were at work. In no case had an ear filled on a stalk bored by this larva. The stalk was often stunted and twisted, and the lower leaves were invariably brown and withered.

In one field, which had been completely under water for six days in January, the beetles were apparently as healthy as in fields which had remained above water.

INJURIES SINCE 1895.

The records of reports of injury which follow, received by Dr. Chittenden during the past decade, substantiate the observations of Dr. Howard made in 1881, and add as well to our knowledge of the life economy of the species.

In 1895 this billbug was destructive in three localities in Kansas, complaints all being made during the first week of May. At Cedar Vale immense damage was done, the insect "taking whole fields of corn, hill by hill." Similar injury was observed at Dexter and Leon, these reports having been made by Mr. Hugo Kahl in a letter dated July 27, 1898.

The following year Prof. F. S. Earle reported, June 6, injury by this species at Wetumpka, Ala., on the Coosa River, where there was great complaint of it as a destructive enemy of corn, especially on low-lying bottom lands. The insect was well known there as a billbug, and was not found on hilly land. It worked below ground, and when the stalks were not killed outright they put out an immense number of suckers. The beetles were most destructive to early plantings, corn planted after the middle of May being usually little injured.

In 1901 Mr. J. E. Williams, Augusta, Butler County, Kans., wrote, August 28, of injury to corn. Attack commenced as soon as the corn came through the ground, and the billbugs ate and dug down to the kernel and devoured that. In larger corn they bored into the stalk and wintered over in the old stalks, usually below ground. Whole fields were destroyed, the beetles remaining to continue their work on second plantings. The insect was known locally as the "elephant bug." September 6 Mr. Williams sent larvæ and adults and their

work in the root-stalks of corn. He had observed that the eggs were deposited in the stalks, and that these serve for the winter quarters of the adults; that the beetles began work when the corn was about 4 or 5 inches high by inserting their beaks in the young stalks just above ground. By taking hold of the center of the corn and pulling it it came out, as it was nearly severed as from cutworm attack. Stalks that had been preyed upon by the billbug did not yield any amount of seed. No injury was observed to crops other than corn. Injury was only in lowlands, and the principal damage was accomplished before the woody outer shell of the stalk was formed. The beetles were active chiefly after dark, when they traveled, though slowly, from one place to another. They burrowed in the ground during the day. They were described as "cleaning up everything as they go, rendering the crop entirely worthless." September 17 another sending of larvæ, pupæ, and imagos were received from the same source. Out of 100 stalks examined by our correspondent only 10 were free from the ravages of this billbug. At this date of writing the beetles were deserting the corn.

In 1903 a report was received of injury by what was with little doubt this species at Griffin, Ga., although no specimens were received, as in all preceding instances cited.

DISTRIBUTION.

This insect has been reported, according to Chittenden,[a] from Augusta, Kans. (E. L. Williams); Riley County, Kans. (P. J. Parrott); Florence, Kans.; Dadeville, Ala. (S. M. Robertson); Wetumpka, Ala. (F. S. Earle); Columbia, S. C. (L. O. Howard); Ballentine, S. C. (J. Duncan); Texas (Ulke, 1 ex.); Michigan (Knaus). It has also been reported from Texas (T. D. Urbahns), and the writer found it at several points in Oklahoma and Kansas. Owing to the fact that representatives of the species have been taken in such widely separated localities, it is very probable that it occurs over the entire territory between South Carolina and Texas and northward to Kansas and Missouri.

FOOD PLANTS.

The adults attack young corn plants and probably some of the coarser grasses. Dr. Howard, and later the writer, found both adults and larvæ feeding on young corn. Mr. Urbahns found adults at base of swamp grass (*Tripsacum dactyloides*) in considerable numbers, and probably larvæ and pupæ of the species in this same grass (fig. 8). Mr. Urbahns found several Sphenophorus larvæ

[a] Proc. Ent. Soc. Wash., vol 7, No. 1, pp. 59–61, 1905.

in burrows in this swamp grass and two pupæ, but failed to rear them. Dr. Chittenden determined these pupæ as having adult characters of *S. maidis*.

DESCRIPTION AND LIFE HISTORY.

THE EGG.

(Fig. 5.)

Eggs were found by the writer in southern Kansas during June in punctures made especially for them (fig. 7, *b*) in young corn plants. These egg punctures, which the female makes with her beak, are scarcely visible on the outer surface of the stalk, being only a slit in the sheath of the plant, through which the beak, and later the ovipositor, are thrust, the sheath closing readily when the egg is deposited and the ovipositor withdrawn. The eggs are about 3 mm. long and 1 mm. thick, creamy white in color, elongate, and somewhat kidney-shaped, with obtusely rounded ends, being slightly more rounded at one end than at the other; the surface is smooth, without punctures.

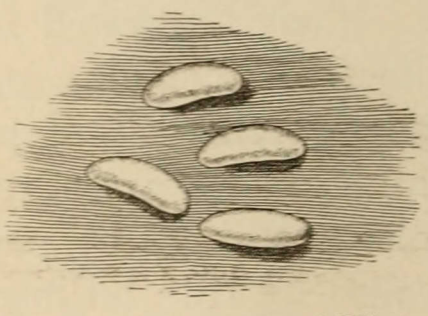


FIG. 5.—The maize billbug (*Sphenophorus maidis*): Eggs. Enlarged three times. (Original.)

In the latitude of southern Kansas eggs were laid in the corn plants during the month of June, where they hatched in from 7 to 12 days, the young, footless grub thus finding itself surrounded with the choicest food.

THE LARVA.

(Fig. 6.)

The newly hatched larvæ are white, with a light-brown head, the head changing to darker brown within a few days. The color remains white in the full-grown larvæ, with the head chestnut brown. The length of full-grown living larvæ ranges from 15 to 20 mm. and the width from 4 to 5 mm.

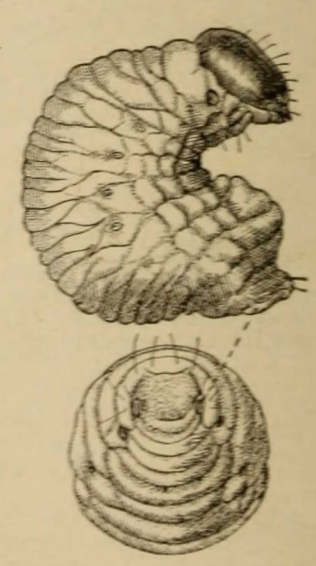


FIG. 6.—The maize billbug: Larva. Twice natural size. (Original.)

The following description of the full-grown larva was made by Mr. E. A. Schwarz under the name of *S. robustus*, from the few alcoholic specimens collected by Dr. Howard at Columbia, S. C.:[a]

Length 12 mm.; color dingy white; head chestnut brown, with four vittæ of paler color, two upon the occiput, converging toward the base, and one along each lateral margin; trophi very dark, clypeus paler; body fusiform, strongly

[a] Report of the Entomologist, Department of Agriculture, for 1881 and 1882, p. 141.

curved, swelling ventrally from the third abdominal joint posteriorly, slightly recurved and rounded at anal extremity. Head large, oblong, obtusely angulate at base, sinuately narrowed anteriorly; frontal margin with a shallow emargination between the mandibles; upper surface with a median channel, the occipital portion deeply incised, with raised edges, continuing as a shallow impressed line to the middle of the front; on either side an engraved line, commencing upon the vertex, becoming deeper after crossing the branches of the Y suture, and terminating at the frontal margin in a bristle-bearing depression; sides and vertex with several long bristles arising in depressions; antennæ rudimentary, occupying minute pits on the frontal margin at the middle of the base of mandibles; ocelli a single pair, visible only as translucent spots upon the anterior face of the thickened frontal margin, outside of and closely contiguous to the antennæ from which they are separated by the branches of the Y suture, a few pigment cells obscurely visible beneath the surface; clypeus free, transverse, trapezoidal, with faint impressions along the base and at the sides; labrum small, elliptical, bearing spines and bristles, a furrow each side of the middle, forming three ridges, so that the organ, when deflected, appears three-lobed; mandibles stout, triangular, unarmed, with an obsolete longitudinal furrow on the outer face; maxillæ stout, cardinal piece transverse, basal piece elongate, bearing a palpus of two short joints, and a small rounded lobe, furnished at tip with a brush of spiny hairs, the lobe concealed by the labium; labium consisting of a large triangular mentum, excavate beneath, and a hastate palpiger, with a deep median channel; labial palpi divergent, separated by the ligula, of two joints subequal in length; ligula represented by a prominent rounded lobe, densely ciliate on the under surface. Thoracic joints separated above by transverse folds; the first wider, covered above by a transverse, thinly chitinous plate; the two following similar to the abdominal joints; abdominal joints forming on the dorsum narrow transverse folds, separated by two wider folds, the anterior fold attaining the ventral surface, the second fold confined to the dorsum, eighth and ninth abdominal joints longer, excavate above, without dorsal folds; beneath, the first three joints contracted, the succeeding joints enlarged, the terminal joint broadly rounded, with anal opening upon a fold at its base; sides of each joint presenting numerous longitudinal folds; stigmata very large, nine pairs; the first on the anterior margin of the prothorax, low down upon the sides; the remainder upon the sides of the first eight abdominal joints, above the lateral prominences, beginning upon the first joint at the middle of the side and gradually rising to a dorsal position upon the eighth joint; thoracic and last abdominal pairs large, oval; the intermediate pairs smaller, elliptical; all with chitinous margins of dark-brown color. The noticeable features of this larva are its cephalic vittæ, and conspicuous spiracles.

Upon issuing from the eggshell the young larvæ are about 5 mm. long and 2 mm. thick. They at once begin feeding on the tissues of the young corn at the bottom of the egg puncture (fig. 7, *b*), directing their burrowing inward and downward into the taproot. When they finish eating the tender parts of the taproot they direct their feeding upward, continuing until full grown, allowing the lower portion of the burrow to catch the frass and excrement (fig. 7, *a*). This burrowing of the taproot of the young growing corn plant is disastrous to the root system (Pl. I, figs. 1, 2); the roots, first dying at the tips, soon become of little use to the plant, allowing it to die or to become more or less dwarfed (Pl. II). The corn plants shown

in Plate I were collected in Kansas and forwarded, in moist paper, to Washington, D. C., and photographed by the official photographer, Mr. L. S. Williams, and show the injuries more clearly, while Plate II, photographed in the field, illustrates the effect on the standing corn. Small plants, even those of less than one-half inch in diameter, are often recipients of eggs from which the larvæ, on hatching, burrow into the heart of the plant and cut off the growing bud, thus killing the top; they then direct the burrowing downward only to

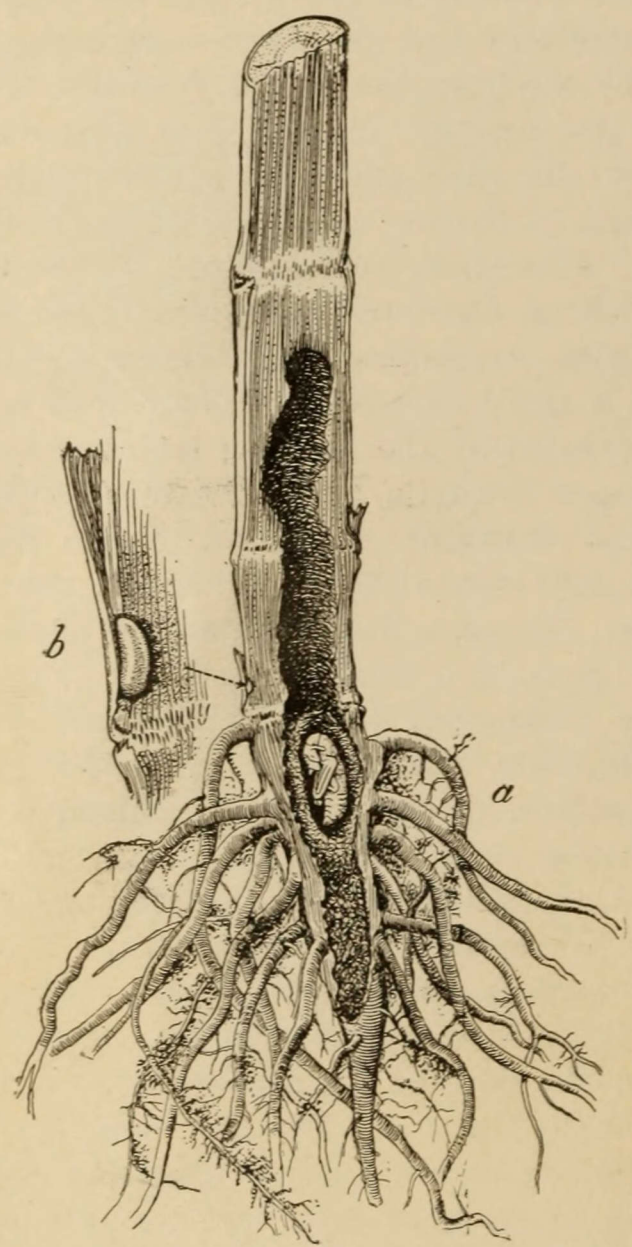


FIG. 7.—Corn plant showing result of attack by the maize billbug: *a*, Larval burrow containing pupa in natural position; *b*, egg puncture containing eggs. *a*, Reduced two-thirds; *b*, enlarged. (Original.)

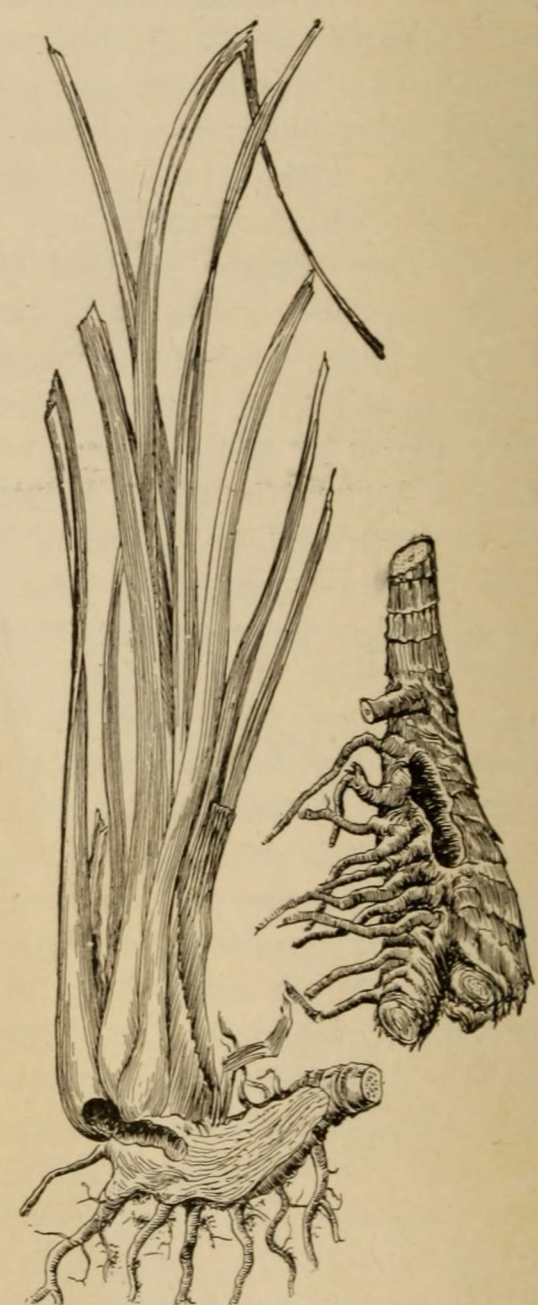
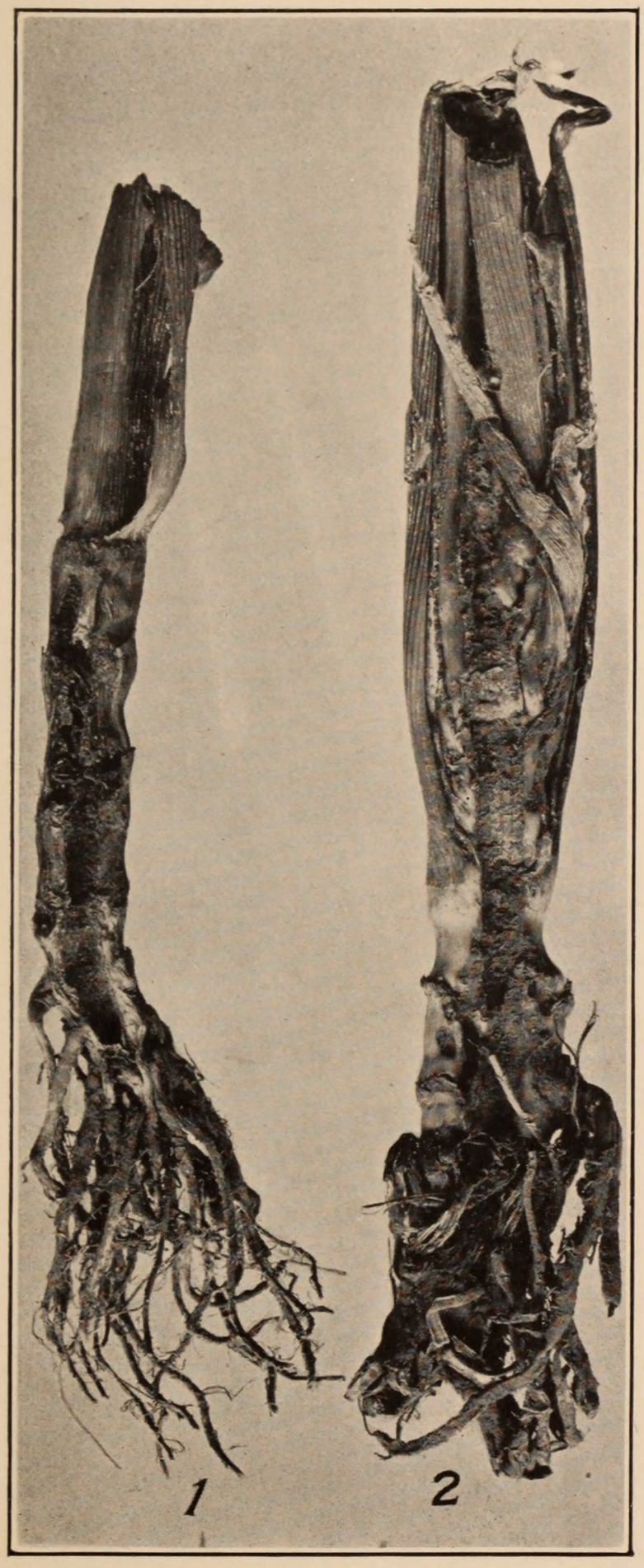


FIG. 8.—Swamp grass (*Tripsacum dactyloides*), attacked by the maize billbug. Reduced two-thirds. (Original.)

devour the stub, leaving themselves without food, and, being footless grubs, they of course perish. Plants of more than one-half inch diameter which become infested with larvæ make very poor growth, being very slender, rarely reaching a height of more than 2 or 3 feet before tasseling (Pl. II), and do not produce shoots or ears. Those that do not become infested until they are half grown may produce small ears. Each larva inhabits only the one burrow, and if, owing to any mishap, it becomes dislodged from it, it is powerless to reestablish itself. The larva does not become dislodged from the burrow



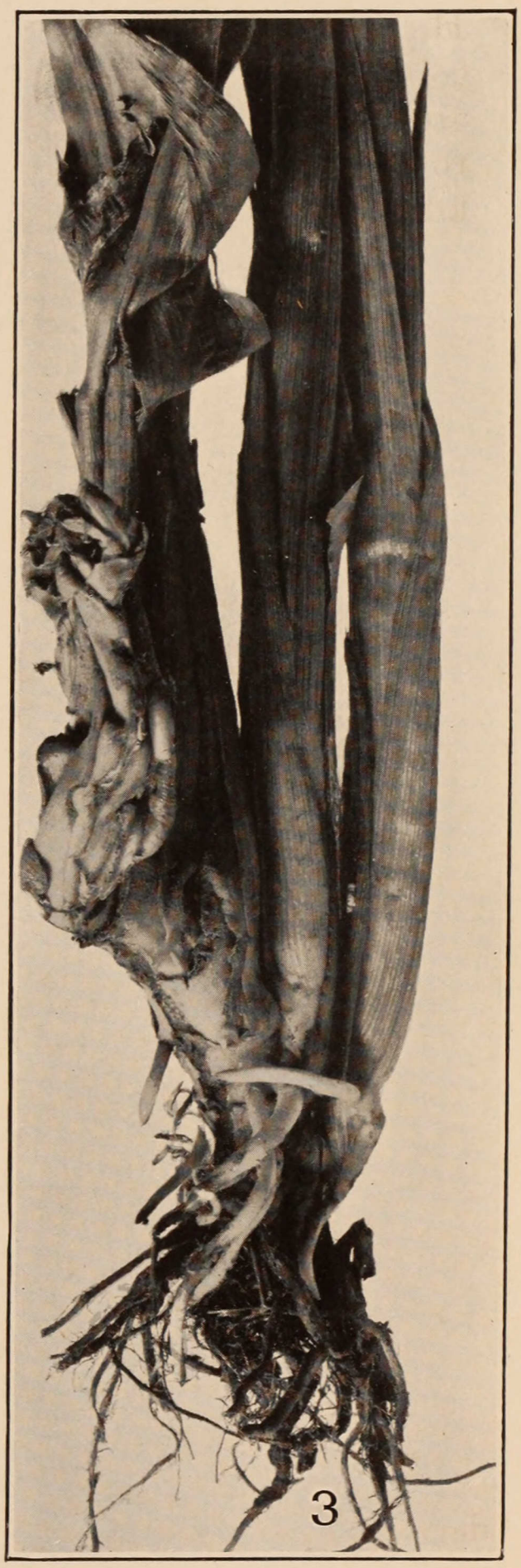


FIG. 1.—CORN PLANT INJURED BY THE ADULT OF THE MAIZE BILLBUG (SPHENOPHORUS MAIDIS), AFTERWARD ATTACKED BY THE LARVA. FIG. 2.—CORN PLANT SHOWING ON STALK THE EFFECTS OF FEEDING BY ADULT MAIZE BILLBUGS, AND EFFECTS ON ROOTS OF FEEDING BY THE LARVÆ. FIG. 3.—CORN PLANT, MUCH DISTORTED, SHOWING SUCKERS; FINAL EFFECTS OF FEEDING OF ADULT MAIZE BILLBUGS.

All figures about natural size. (Original.)

CORN PLANTS SHOWING EFFECTS OF FEEDING OF MAIZE BILLBUG IN THE FIELD.

Plant at left not attacked, the two at right attacked by larvæ. Reduced. (Original.)

of its own accord. Sometimes there are three or four larvæ in the same plant, their burrows often running into each other, but this does not appear to discommode them in the least, as they can, and usually do, all mature. In badly infested fields two larvæ are quite often in the same plant, although one is the usual number and is sufficient to ruin the plant. The larvæ are easily managed in the laboratory; upon issuing from the eggshell they can be readily handled with a soft camel's-hair brush and placed inside a section of a cornstalk, where they will feed as readily as upon the growing plant. As soon as the section of plant is fairly eaten, and before decay sets in, the larvæ must be removed to fresh sections; keeping them thus supplied with fresh food they can be reared to maturity.

The length of the larval life ranges from 40 to 50 days, as indicated by laboratory observations and checked by collections in the field. They begin maturing and pupating by the 1st of August, pupation reaching the maximum by the 20th, and with the exception of a few stragglers all are mature and changed to pupæ by the 1st of September.

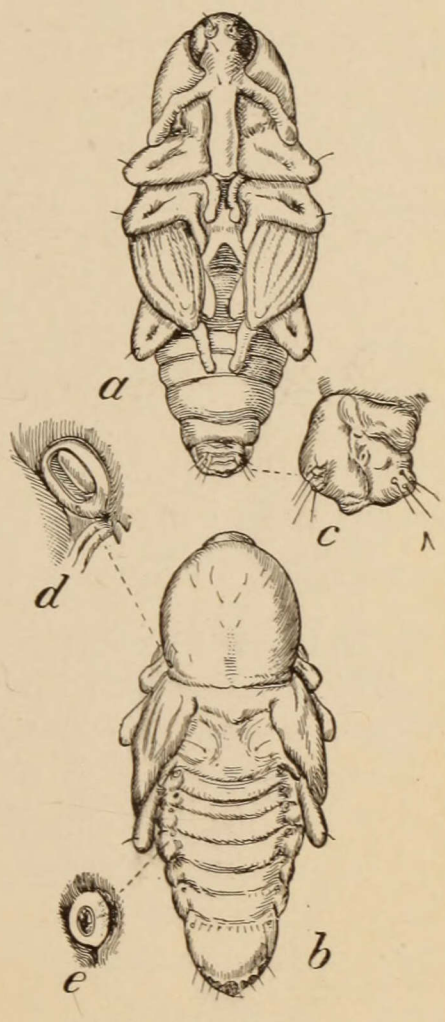


FIG. 9—The maize billbug: Pupa: *a*, ventral view; *b*, dorsal, view; *c*, anal segment; *d*, thoracic spiracle; *e*, abdominal spiracle. *a*, *b*, Twice natural size; *c*, *d*, *e*, greatly enlarged. (Original.)

THE PUPA.

(Fig. 9.)

The larvæ, on finishing their growth, descend to the lower part of the burrow, to the crown of the taproot, cutting the pith of the cornstalk into fine shreds with which they construct a cell where they inclose themselves for pupation.

The newly issued pupæ are white, becoming darker after the fourth or fifth day, and continue to darken until just before the adults issue. The adults are reddish black in color. The length of living pupæ ranges from 16 to 20 mm.

The following description of the pupa was made by Mr. E. A. Schwarz, of the Bureau of Entomology, under the name of *S. robustus*, from the single individual collected by Dr. Howard at Columbia, S. C.:[a]

Average length, 17 millimeters. Stout, rostrum reaching between first pair of tarsi. Antennæ but slightly elbowed and reaching not quite to bend of

[a] Loc. cit., p. 142.

anterior femora and tibiæ. Eyes scarcely discernible. Face with three pairs of shallow tubercles, the basal pair the largest, and each giving rise to a stiff, brown hair. Other minute piliferous tubercles, especially near the posterior dorsal border of the abdominal joints, being very stout on the preanal joint, or pygidium, where they form two series of quadridentate ridges.

To Mr. Schwarz's description the following may be added:

Lateral view: Body oblong, thickest at middle; thorax depressed anteriorly; abdomen cylindrical, tapering from seventh segment; thoracic pair of spiracles very prominent (fig. 9, *d*), first five pairs of abdominal spiracles prominent (fig. 9, *c*), the three on the rear segments not prominent. Elytra short, curving ventrally between middle and hind legs, reaching tarsi of hind leg, covering upper half of femur of hind leg; middle leg resting on elytra.

The pupæ occur mostly during the latter part of August and first part of September and are always to be found in their cells in the larval burrows near the crown of the taproot and nearly always below the surface. The pupal period is from 10 to 12 days.

THE ADULT.

(Fig. 10.)

The adults are very large, robust, and reddish black when newly issued, changing to black when older. The original description by Chittenden[a] is given here:

Body two-fifths as wide as long, of robust appearance because of the subquadrate thorax, which is nearly as wide as the elytra; general color black or piceous, moderately shining; alutaceous deposit on unelevated surfaces inconspicuous, appearing to be normally dark rufous or piceous velvety when the extraneous argillaceous covering does not persist.

Rostrum three-fifths the length of the thorax, considerably arcuate, strongly subequally compressed, apex prolonged at the posterior angle with an acute spine, producing the appearance of greater curvature of the inner surface, base feebly protuberant, moderately dilated; anterior face of apex broadly deeply concave; surface minutely punctate, more distinctly and densely at base, base moderately deeply channeled with distinct deep interocular puncture and short impressed line.

Thorax longer than wide, fully three-fourths as long as the elytra, sides usually widest just in front of middle, anterior third suddenly and very strongly arcuate and constricted at apex, posterior two-thirds or three-fourths subparallel, or gradually narrowing to the base which is feebly bisinuate. Vittæ feebly elevated, tending toward obsolescence, moderately finely but distinctly and sparsely punctate, more coarsely and densely at the ends; median vitta extending from a fine line and rapidly widening to a point just in front of the middle where it is broadly dilated, then more abruptly narrowed, extending in a narrower line to near the base; lateral vittæ sinuous with a tendency to become confluent with the median in the apical half, generally a little wider in basal half but narrower than the median, branch wide but ill-defined; interspaces and surface at sides coarsely foveate-punctate, punctures becoming confluent, especially posteriorly at sides. Scutellum deeply broadly concave.

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[a] Proc. Ent. Soc. Wash., vol. 7, No. 1, p. 59, 1905.

Elytra little wider than the thorax; striæ usually deep and well defined, distinctly closely punctate; intervals with first, third and fifth elevated, with two or more series of rows of fine punctulation; first or sutural with basal third triseriately, posterior two-thirds biseriately punctulate; third widest and most elevated, with four or five rows of fine punctulations; fifth biseriately punctulate; seventh little or not at all more elevated than the remaining intervals; intervals 2, 4, 6, 8, as also 7, more coarsely and closely uniseriately punctulate. Pygidium deeply, coarsely and rather sparsely punctate, with sparse golden yellow hairs proceeding from the punctures and forming a short tuft each side, frequently abraded.

Lower surface coarsely and rather densely punctate, scarcely less strongly at the middle than at the sides, punctures largest at the middle of the metathorax. Punctures of the metepisterna (side pieces) more or less confluent. Second, third and fourth abdominal segments nearly uniformly punctured throughout, like the legs.

♂.—First abdominal segment very concave; pygidium truncate at apex.

♀.—First ventral scarcely different; pygidium narrowed and rounded at apex.

Aside from the differently shaped pygidium and the slightly shorter and less compressed rostrum there is little difference between the sexes.

Length, 10–15 mm., width, 4.5–6.0 mm.

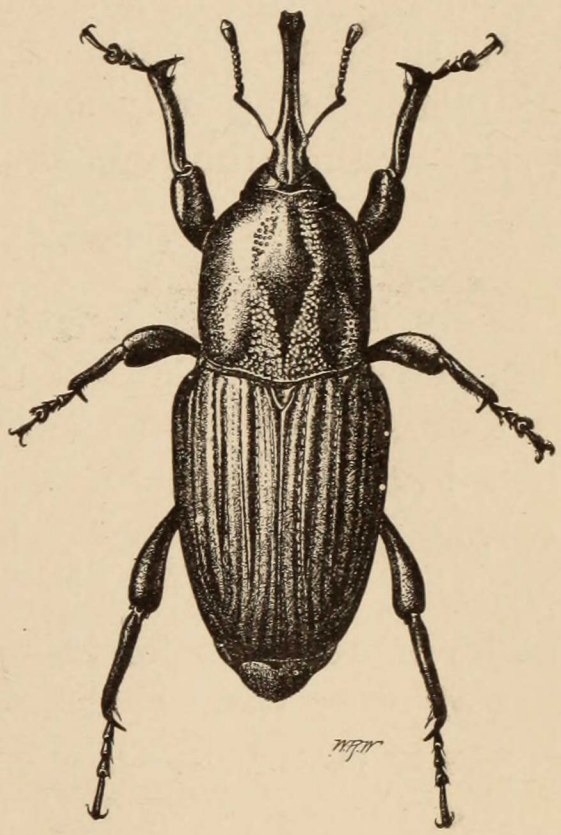

FIG. 10.—The maize billbug: Adult. Four times natural size. (Original.)

The adults begin to issue about the middle of August and continue to do so until the middle of September. Some of them leave the pupal cell, but most of them remain there for hibernation. The adults that leave the pupal cell in the late summer disappear; continued search in every situation until December failed to reveal a single individual. It is evident that they left the cornfield in which they developed, and it is very probable that they found their way to some dense, coarse grass (*T. dactyloides*), which is abundant in the locality, The adults hibernating in the pupal cells issue from them in late spring, about the time young corn is sprouting. The beetles are rarely observed on account of their quiet habits and because they are covered with mud—a condition which is more or less common among several species of this genus and is caused by a waxy exudation of the elytra, to which the soil adheres. The presence of the adults of this species in a cornfield is made evident by the withering of the top leaves of very young corn plants, the plants having been severely gouged. The adults kill the small plants outright and injure the larger ones beyond repair. After the plants grow 10 to 15 inches tall they do not kill them, but gouge out such large cavities in the stalks that they become twisted into all sorts of shapes (Pl. I,

fig. 3). The attacked plants sucker profusely, affording young, tender growth for the beetles to feed upon, even for many days after the noninfested plants have become hard. The corn plants injured by *S. maidis* resemble somewhat corn plants injured by the lesser corn stalk-borer (*Diatræa saccharalis*), and are easily distinguished from plants injured by the smaller species of Sphenophorus owing to the fact that the punctures of the smaller species are not always fatal to the plants, which, however, in unfolding their leaves, show a row or series of rows of round or oblong holes in them.

The females issuing from hibernation feed on young corn for a few days before beginning to deposit their eggs. The egg punctures are made by the female in the side of the cornstalk (fig. 7, *b*) beneath the outer sheath. These egg punctures are not injurious to the plants, being only small grooves, about 5 mm. long and 3 mm. deep, in which the eggs snugly fit.

NUMBER OF GENERATIONS.

There is only one generation a year. The eggs occur throughout June, larvæ from early June until September, pupæ from the first part of August until the last part of September, and adults from the middle of August until the first part of August of the following year.

RECORDS OF DEPREDATIONS.

The depredations of this species have probably been confused with that of other species, the first and only known record of its attack on young corn being that made by Dr. Howard, at Columbia, S. C. During the season of 1910 both adults and larvæ were numerous in cornfields in lowlands in southern Kansas and northern Oklahoma, doing serious damage in some instances. They were frequently found in uplands, but not in injurious numbers.

REMEDIAL MEASURES.

The knowledge of the hibernating habits of the insect suggests an effective remedy in the pulling up and burning of the stubble, which is also the most practical means of destroying the lesser corn stalk-borer (*Diatræa saccharalis*). The beetles remain in the taproot of the corn plants until spring, allowing the farmer abundant time to destroy them. Care must be taken, however, in pulling up the infested stalks or else they will break off above the beetle, leaving the pest in the ground. The infested stalks, having a very poor root system, are easily pulled. Spraying the young corn plants with arsenical fluids at the time the beetles are making their attack is a very laborious procedure and not very effective.

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