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PAPERS ON CEREAL AND FORAGE INSECTS.

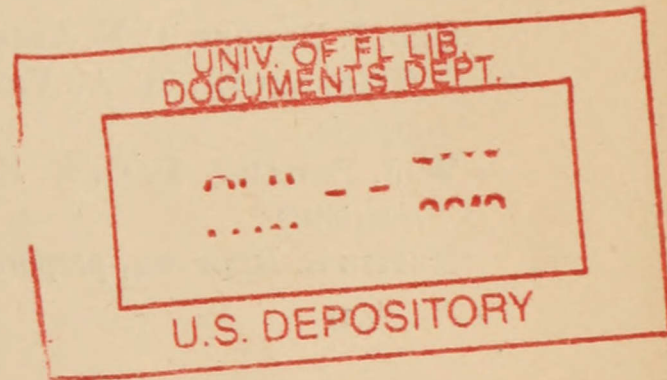
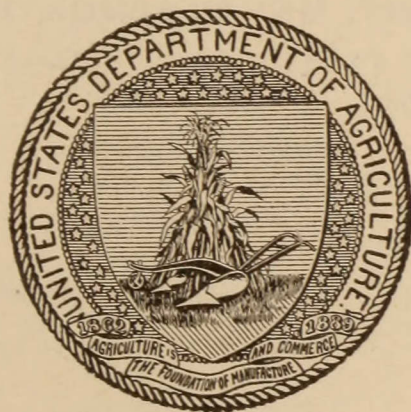
THE TIMOTHY STEM-BORER,

A NEW TIMOTHY INSECT.

BY

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PAPERS ON CEREAL AND FORAGE INSECTS.

THE TIMOTHY STEM-BORER, A NEW TIMOTHY INSECT.

(*Mordellistena ustulata* Lec.)

By W. J. PHILLIPS,
Entomological Assistant.

INTRODUCTION.

The writer's attention was first attracted, in 1904, to the interesting little insect which is the subject of this paper. On November 29 of that year, at Rives, Tenn., while examining timothy for joint-worms (*Isosoma*), a curious little larva, unknown at that time to the writer, was found tunneling the stems. In many cases it had traversed the entire length of the stem, from the top joint to the bulb. Although nothing was reared from this material it served to arouse interest. Since that time, however, it has been reared and some interesting facts learned concerning its habits and manner of living.

Thus far it has not proved a serious pest, having been found only in small numbers at any given point. In large numbers it would scarcely do any perceptible injury to the hay crop, although it could probably very materially lessen seed production. For this, as well as other reasons, it deserves more than passing notice.

HISTORY.

The adult (fig. 1) was described by Le Conte in 1862, but there is no reference in literature to its larval habits, although as early as 1877 it was known that larvæ of other species of this genus inhabited plant stems of different kinds.

During the early part of November, 1904, Mr. Geo. I. Reeves, of this Bureau, found larvæ tunneling timothy stems at Richmond and Evansville, Ind., and at Nicholasville, Ohio, but none was reared. In the latter part of the month the writer found a larva working in timothy stems at Rives, Tenn. Nothing could be reared, but in the light of recent observations it is very probable that they were *Mordellistena ustulata* in each instance.

In 1905 the writer found numbers of larvæ inhabiting timothy at Richmond, Ind. Some time in the fall infested stems were collected and sent to the Department for rearing, but it was the same story—nothing issued.

Early in the spring of 1906 observations were begun with a view to rearing the adult. Infested stems were collected in May, and on June 8 the first adult appeared. Specimens were later submitted to the Department and were found to belong to the above species. Since that time they have been reared repeatedly.

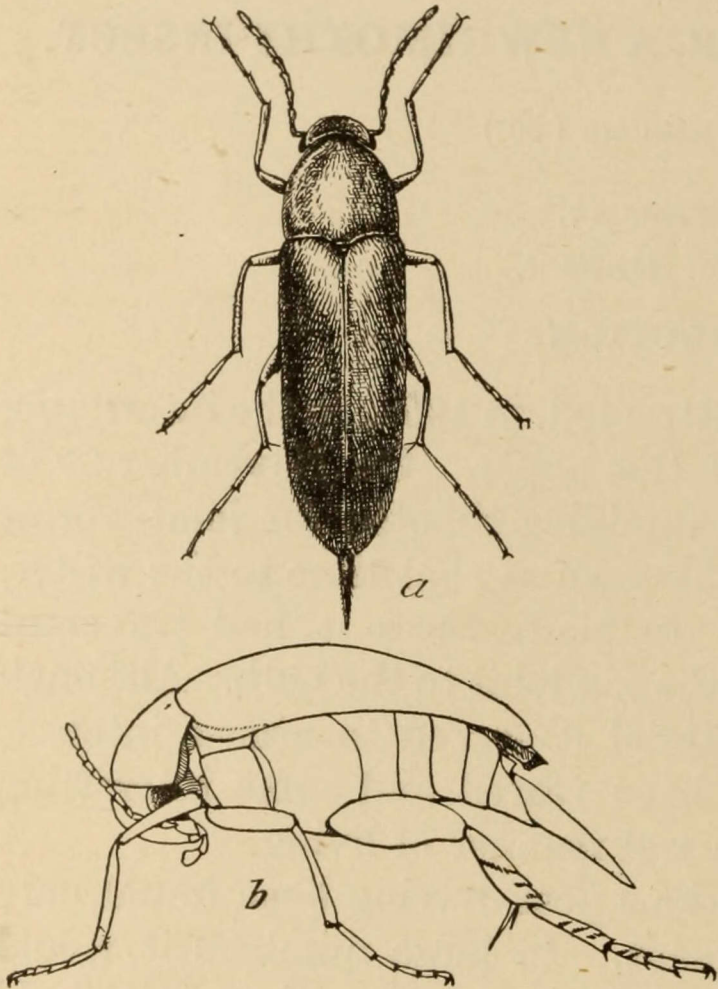


FIG. 1.—The timothy stem-borer (*Mordellistena ustulata*): *a*, Adult or beetle, dorsal view; *b*, same, lateral view. Greatly enlarged. (Original).

DISTRIBUTION.

The habitat of this insect has been given as the middle and southern United States. Adults have been captured as far east as Pennsylvania, and they have been reared from material collected in Indiana, Ohio, and Virginia. Timothy stems containing mordellid larvæ that were not identified, but which were probably *Mordellistena ustulata*, were found in Kentucky, Tennessee, Illinois, and, this year, Mr. T. H. Parks, of the Bureau of Entomology, found them at Chillicothe, Mo.

CHARACTER OF ATTACK.

As a rule the egg is deposited at or slightly below the center of the first or second joint in timothy, but much farther down the stem in other grasses. From here the larva bores into the center of the stem and then begins its downward journey to the bulb or root. It feeds upon the pith and the walls of the stem as it passes downward, and when it encounters a joint it tunnels completely through it, leaving a mass of detritus behind. Plate I is an illustration of its workmanship.

HOST PLANTS.

This species has been reared from timothy, orchard grass (*Dactylis glomerata*), quack grass (*Agropyron* sp.), and *Agrostis alba*, while larvæ that were supposedly this species have been found in bluegrass (*Poa* spp.) and cheat (*Bromus secalinus*).

DESCRIPTION OF THE DIFFERENT STAGES.

THE EGG.

(Fig. 2.)

Length 0.65 mm., diameter near center 0.16 mm. Color milky white. Acuminate-ovate, apparently smooth; one side convex and the other slightly concave; large end broadly rounded, small end acutely rounded.

Described from specimens dissected from gravid females.

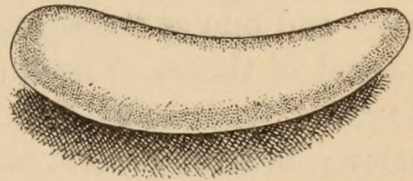


FIG. 2.—The timothy stem-borer: Egg. Highly magnified. (Original.)

THE LARVA.

(Fig. 3, a.)

Length 6 mm., diameter 0.875 mm. Color varying from creamy to white, shading into a very faint tinge of salmon near center. None of the segments appears to be corneous, although each bears a number of setæ; last segment feebly bifid, ending in a two-pointed spear, and covered with stout bristles. Dorsal surface of abdomen with six pairs of fleshy tubercles which will be described later.

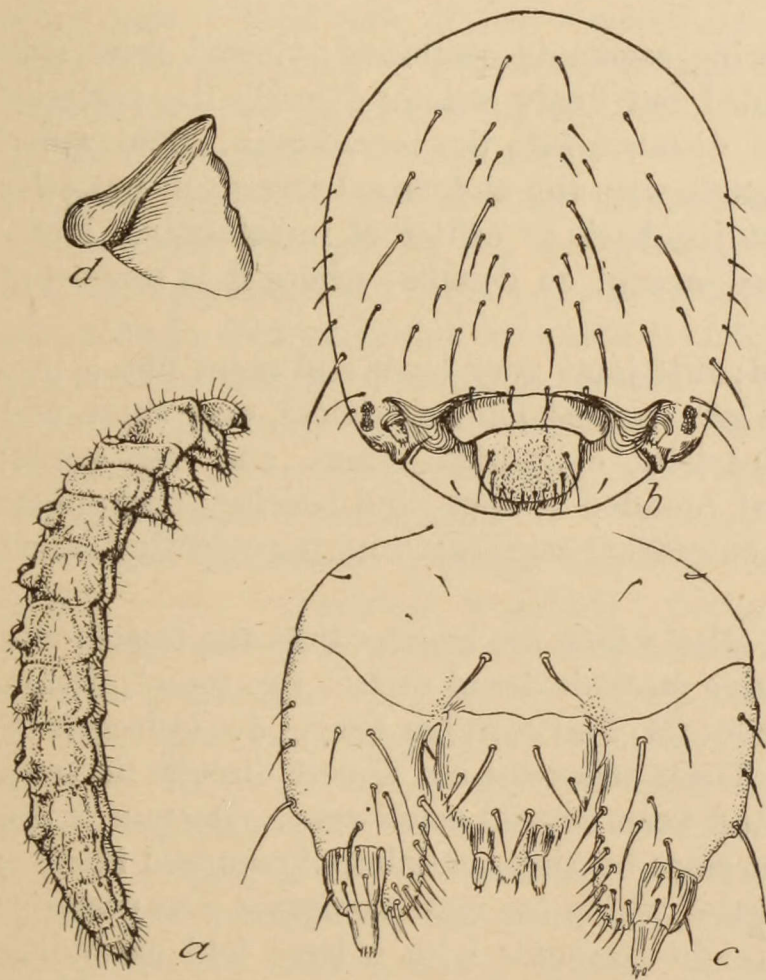


FIG. 3.—The timothy stem-borer: *a*, Larva, lateral view; *b*, head of same, dorsal view; *c*, maxillæ and labium of same; *d*, mandible of same. *a*, Greatly enlarged; *b*, *d*, more enlarged; *c*, still more enlarged. (Original.)

Labrum tonguelike, lying directly over the mandibles, rectangular, longer than broad; distal margin rounded and densely fringed with setæ or bristles; upper surface pappose; two large setæ near center and two on each lateral margin; six smaller ones on distal margin.

Head (fig. 3, *b*) narrower than thorax and arranged almost vertically with reference to it; ovoid, smooth, and bearing a number of large and small setæ, a very faint suture extending from the occipital area almost to the epistomal area.

Antennæ represented by two fleshy tubercles, situated laterad of and near insertion of mandibles; somewhat cone-shaped and bearing several small setæ on their summits.

Eyes represented by two tiny, slightly fused black dots situated slightly ventro-laterad of the antennæ.

Epistoma sublunate; anterior margin concave and posterior convex; about twice as broad as long and apparently inclosed by base of mandibles and a chitinous ridge extending from insertion of mandibles almost entirely across the face; ridge amber-colored.

Mandible (fig. 3, *d*) short, very broad at base, almost as broad as long, tapering abruptly to a sharp point; outer face convex and smooth, with a small seta near center; ferruginous at base and black at extremity, strongly curved; inner face concave, with two small notches midway of superior margin and one small notch near extremity of inferior margin.

Maxillæ (fig. 3, *c*) inserted far to the rear, large, fleshy, curving considerably, thus inclosing the labium; extending considerably beyond tips of mandibles; distal extremity bearing the two-jointed palpus and the lacinia. Each maxilla bears a number of setæ, one large and two small ones occurring on outer face, a large one at outer and one at inner angle of base of palpus, and two small ones and one large one caudad of these. The lacinia is a brushlike organ bearing a fringe of stout bristles. Maxillary palpi (fig. 3, *c*) two-jointed; first joint slightly obconical, about as thick as long, bearing several setæ on the outer face; the second joint is a slightly truncated cone, and much smaller than the first joint, and bears a number of minute setæ at the apex.

The *labium* (fig. 3, *c*) is a very simple organ inserted between bases of maxillæ, fleshy, rectangular; distal extremity sharply rounded and fringed with minute setæ, with two larger setæ at tip; four setæ forming a semicircle near center, the two in the center much the largest; a large seta at inner angle of base of each palpus. Labial palpi (fig. 3, *c*) very minute, two-jointed; first joint cylindrical; second joint almost cylindrical but much smaller than the first and slightly rounded at tip, bearing several minute setæ.

Prothorax as large as the two following segments combined; viewed from side triangular in form; not wrinkled or folded but finely striate; dorsally the posterior margin extends back for a considerable distance into the mesothorax. The mesothorax and metathorax lie at quite an angle with the abdominal segments; posterior margin of dorsum of mesothorax extending back to center of metathorax. Metathorax about same width as mesothorax, except on dorsum, where it is somewhat narrower.

Legs fleshy, cone-shaped, four-jointed; first joint very large and more like a projection of the thorax than a joint of the leg; second joint obconical, very short, and very much smaller than the first; third joint cylindrical, short, and very small; fourth joint the smallest of all, obconical, rounded at apex, and bearing three spines at tip; a whorl of spines at each joint on outer face; segments very imperfectly defined in most cases.

Abdomen composed of nine segments, all of which are broader than the mesothorax or metathorax. First six segments bearing on their dorsal surface two round, fleshy, somewhat retractile elevations or tubercles (M. Perris, in his *Larves des Coléoptères*, calls them "ampoule ambulatoire.") These tubercles are almost circular in form and the apex is crumpled and folded and bears several small setæ. Dorsum of the seventh segment with a slight transverse ridge bearing a number of recurved bristles; eighth segment bearing a number of bristles, which are more numerous near posterior margin, all directed backward. First eight segments with a large fold extending their full length on each lateral face, most prominent near center of segments, at which points there are a number of bristles directed slightly to the rear. Ninth segment somewhat cone-shaped, densely covered with stout bristles, ending posteriorly in a two-pointed, chitinous projection; just below this, dorsally, are two chitinous spurs or tubercles.

Stigmata: Nine pairs of stigmata, one pair in mesothoracic region just above and slightly in front of insertion of legs and a pair to each of the first eight abdominal segments, very near the anterior margin and just above the lateral fold. They are circular in form, the thoracic being slightly the larger.

THE PUPA.

(Fig. 4.)

From the lateral aspect: Length 5 mm., diameter in thoracic region 1.125 mm. Pale cream color, somewhat acuminate-ovate, broadly rounded at head and thorax. Prothorax, from the lateral view, triangular, the dorsal surface being the base of the triangle, which is very broad and convex. Antenna passing upward at side of eye, between margin of prothorax and front femora, thence to dorsum, curving backward over base of wings. Wing-pads long and narrow, covering posterior legs, with the exception of the last three tarsal joints; front wings nearly covering hind ones.

From the ventral aspect (fig. 4): The front of head is in almost direct line with the body; mandibles small and not closed; palpi widely separated and extending beyond front tibiae. Femora of first pair of legs directed dorsally, tibiae resting on middle femora; first tarsal joints resting under tip of palpus; tarsal joints then extending caudad, almost parallel, except last two joints, which slightly diverge. Femora of second pair of legs parallel to femora of first pair, second tibiae, however, forming a greater angle with their femora than tibiae of first pair of legs; second femora and tibiae resting upon wings for a part of their length; tarsal joints gradually converging until the last two, which nearly touch between wing pads. Third pair of legs covered by wing pads, with exception of last two joints and a part of third; last two parallel, touching, and extending to middle of sixth abdominal segment.

Dorsal surface of the first six abdominal segments almost flat, and in the third, fourth, fifth, and sixth segments the surface produced laterally into a fleshy fold projecting over side of abdomen, the anterior margin of which is rounded and the posterior square, giving the abdomen a notched appearance; in center of each projection laterally is a group of recurved bristles.

Seventh abdominal segment (fig. 4), from a lateral view, cylindrical anteriorly; posteriorly the dorsal surface is drawn out into a long cone-shaped projection, the tip of which extends beyond the last abdominal segment, resting between its two chitinous spurs; ventral surface extending backward into a fleshy fold or lip, beyond insertion of following segment.

Eighth segment (fig. 4) somewhat cylindrical anteriorly, telescoping into seventh; dorsal surface extending backward into a large fleshy projection or lip, almost filling space between cone-shaped projection of preceding segment and Y-like chitinous projection of following segment; a deep lateral notch or incision, but ventral projection much shorter than dorsal.

Ninth segment (fig. 4) smallest, telescoping into eighth, and extending posteriorly into a Y-like projection, the tips of which, inclining forward, are amber-colored, chitinous, and spinelike.

Setæ: Numerous setæ on ventral surface of abdomen, on head, and on prothorax. First abdominal segments bearing a few setæ on dorsal surface; there is a small transverse ridge on dorsum of second segment, bearing a row of setæ; following four segments

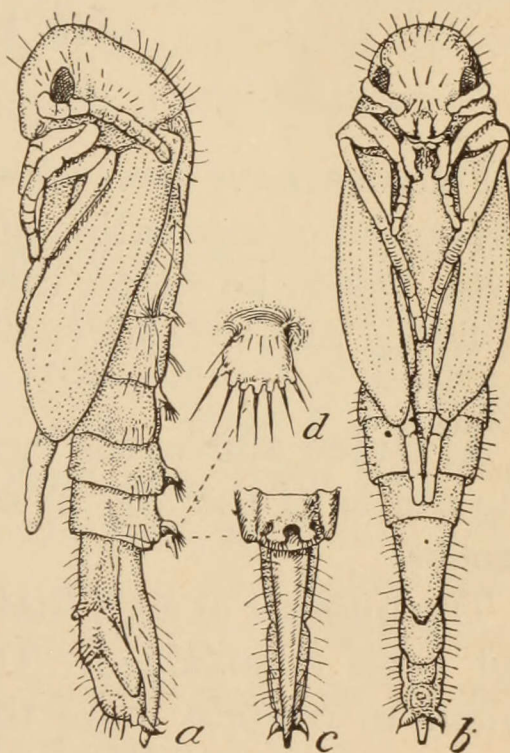


FIG. 4.—The timothy stem-borer: *a*, Pupa, lateral view; *b*, ventral view of same; *c*, ninth segment of same; *d*, setigerous tubercle of sixth segment. *a*, *b*, *c*, Greatly enlarged; *d*, more enlarged. (Original.)

bearing each two recurved, fan-shaped, fleshy elevations or tubercles, increasing in size with each successive segment (fig. 4, *d*); each elevation simple and bearing a fringe of bristles directed to the rear.

Last three segments bearing a number of bristles; cone-shaped projection of seventh rather thickly studded and last segment densely covered with stout bristles, all directed to the rear.

THE ADULT.

(Fig. 1.)

The description by Le Conte is as follows:

Hind tibia with two oblique ridges on the outer face; ridges parallel, the anterior one extending almost across the outer face of the tibia; first joint of the hind tarsi with three, second with two oblique ridges; elytra ferruginous, with the suture and margin blackish; ferruginous, black limb of the elytra very narrow; abdomen, and sometimes the hind coxæ and pectus, blackish. 9-11.

LIFE HISTORY AND HABITS.

THE EGG.

Females have never been observed in the act of oviposition and the period of incubation of the eggs has never been determined. The latter would be rather difficult to obtain, as eggs that are deposited in living plant tissue rarely hatch after they have been exposed to the air.

As stated above, the egg is usually deposited at and slightly below the center of the first or second joint from the top, within the plant tissues.

The number of eggs that one individual is capable of depositing has not been ascertained. Upon dissection females have never been found to contain more than four fully developed eggs and several immature ones, but they probably deposit a much greater number than this.

THE LARVA.

Upon hatching, the young larva apparently destroys the tissue immediately surrounding it, thus forming a minute cell or cavity. It then eats its way into the center of the stem and starts downward, tunneling the joints as it reaches them, and at harvest time the earlier ones are below the fourth joint, where they will be out of danger of the mower. By fall they have reached a point just above the bulb.

THE MOVEMENTS OF THE LARVA IN THE STEM.

The manner in which the larva propels itself up and down the stem is very interesting. It can ascend or descend the stem, forward or backward, apparently with equal facility. The maxillæ, which extend beyond the mandibles, the true legs, the dorsal tubercles or feet, and the anal segment all play a part in its movements. In going forward the abdomen is advanced by means of the dorsal tubercles, which act

as feet; the body is then braced by fixing the spines of the anal segment against the opposite wall of the stem; the maxillæ and true feet then advance the thorax and head. By executing these movements almost simultaneously the larvæ can move quite rapidly. In going backward the movements are reversed. The dorsal feet or tubercles and the anal spines enable the larva to support itself in the stem.

THE MOVEMENTS OF THE LARVA OUTSIDE THE STEM.

Naturally enough, as the larva seems peculiarly adapted for movement in a small hollow stem, when it is placed on a flat surface it appears wholly at a loss how to proceed. It arches its body and turns on its side, going through the same movements as though it were in a stem, but it moves very slowly. It then turns on its back and tries to walk on its dorsal feet. By bringing all of its knowledge of the different ways of walking to bear on the problem, it moves slowly, in a drunken way, to a protecting object, if any be near.

THE PUPA.

When ready to pupate, the larva (Plate I, *a*) reverses its position in the stem and ascends to a point anywhere between the first joint from the root and the first or second joint from the top, depending upon whether the timothy has been cut or not. Plate I, *b*, shows a larva ready to pupate, just below the second joint from the root. It probably locates most often just above the first or second joint from the root. It then seals up the stem above and below with detritus, making a cell of from 1 to 2 inches in length. It will reseal a stem if interfered with, but if its burrow be molested many times it will live for weeks and not pupate, finally dying.

After inclosing itself within this cell the larva becomes sluggish, contracts slightly, and thickens perceptibly in the thoracic region. It soon casts its larval skin and becomes a fully developed pupa. In Plate I, *c*, is seen a pupa in its cell just above the second joint from the root. After pupation it is a pale cream color, gradually changing to a brownish tint.

THE MOVEMENTS OF THE PUPA IN THE STEM.

The movements of the pupa in ascending and descending the stem are fully as complicated and interesting as in the case of the larva. In moving up the stem, the spurs of the last segment are planted firmly in the wall; the body is then bowed ventrally and the spines of the dorsal tubercles are brought forward and fixed in the wall; then by quickly releasing the anal spines, with the long pointed pygidium of the eighth segment, they and the dorsal tubercles act as levers and thus propel it up the stem. By executing these evolutions quickly they can move with considerable rapidity.

They can, apparently, descend with equal rapidity. By releasing the anal and dorsal spines they are lowered by gravity. If the stem be placed in a horizontal position, the pupa makes slow progress backward. The organs of locomotion are apparently not so well fitted for moving backward on a horizontal plane.

THE MOVEMENTS OF THE PUPA OUTSIDE THE STEM.

When removed from the stem and placed upon a flat surface, the pupa moves as uncertainly as the larva in the same position. It wriggles constantly, trying in vain to fix its "climbers" into something firm, whereby it can gain leverage and propel itself forward. It will fix the anal spines into the surface upon which it rests, but as there is no surface opposite and near it moves very slowly and uncertainly.

THE ADULT.

When ready to issue, the pupa is quite brown. The thin pupal envelope is ruptured along the dorsum of the thoracic region and the insect gradually forces its way out, after which it gnaws an irregular opening at some point in the stem and emerges.

The adult beetles are about 5 mm. in length, of a brownish color, and have pointed abdomens. From the lateral aspect they are somewhat crescent shaped. They are abroad from the latter part of May to the latter part of June, depending upon temperature conditions in early spring.

There is but one brood or generation during the year.

LIFE CYCLE.

LENGTH OF THE SEVERAL STAGES.

The larval stage covers a period of about 11 months. Nothing could be learned about the number of molts, as the larvæ will not develop if their galleries are disturbed.

The pupal stage varies from 11 to 16 days, depending, apparently, upon the temperature.

The adult beetles will live from 5 to 6 days in confinement, but they will probably survive a much longer period in the open.

HIBERNATION.

The insect hibernates in the larval stage. About the time freezing begins in the fall the larvæ are down to the bulb or crown of the root, where they are well protected from cold. They are nearly full grown by this time. Whenever a few warm days come, they apparently start feeding again. In the spring they burrow down into the juicy bulb, where they continue feeding until they become full grown.



THE TIMOTHY STEM-BORER (*MORDELLISTENA USTULATA*): LARVÆ AND PUPA IN STEMS.

PARASITIC ENEMIES.

This insect is apparently a very attractive host. Three species of parasitic Hymenoptera have been reared from it, all of them new, representing three genera—two braconids and one a chalcidid.

Messrs. H. L. Viereck^a and J. C. Crawford^b have kindly described these parasites, giving them the following names: *Heterospilus mordellistenæ* Vier., *Schizoprymnus phillipsi* Vier., and *Merisus mordellistenæ* Crawf. The descriptions appear elsewhere over the names of their respective authors.

In May of this year, *Mordellistena ustulata* was found to be very abundant at Wilmington, Ohio, in timothy; material was collected and sent in to the laboratory at La Fayette, Ind., for rearing. Two species of parasites were reared from it, *Heterospilus mordellistenæ* and *Merisus mordellistenæ*. *Schizoprymnus phillipsi* and *Heterospilus mordellistenæ* were reared from material collected at Richmond, Ind., in 1906 and 1908, respectively. The latter species and *Merisus mordellistenæ* were reared at La Fayette, Ind., in 1910.

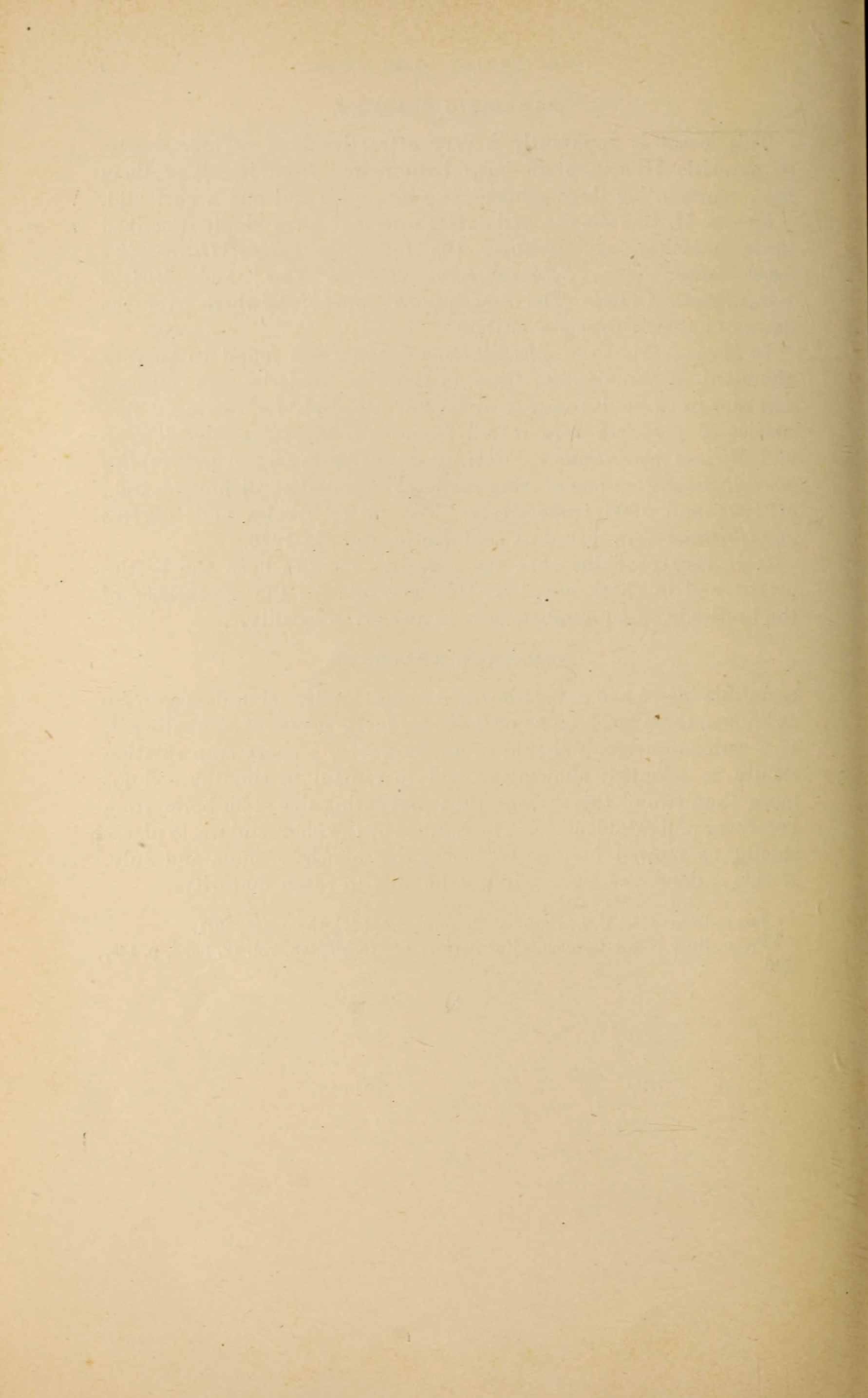
It is very probable that the parasitic enemies keep the beetles pretty well in check and that this accounts for the appearance of the beetles in small numbers only in any given locality.

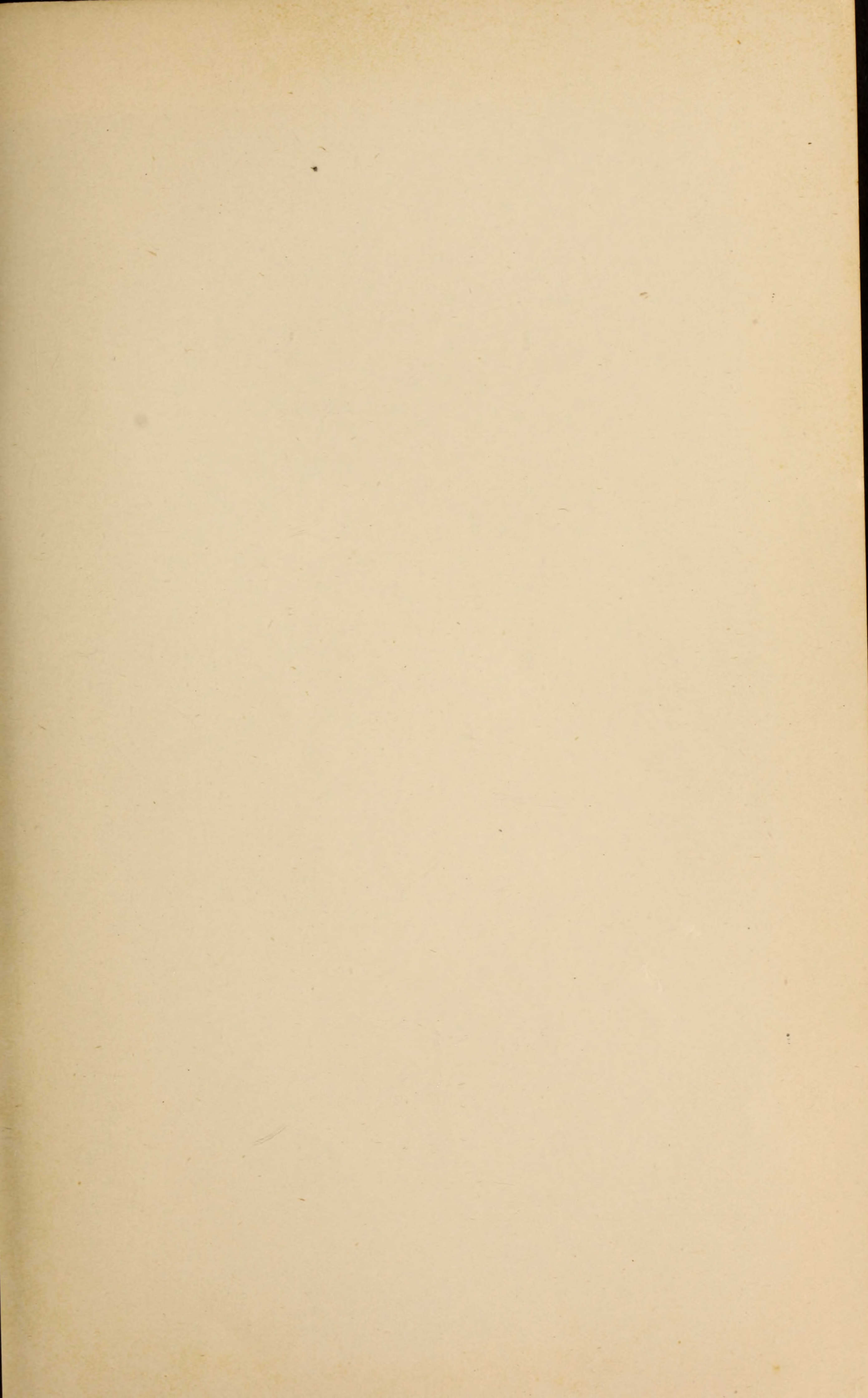
REMEDIAL MEASURES.

As this insect has never appeared in destructive abundance, so far as known, there has been no occasion to devise means of combating it. If a serious outbreak should occur, however, a short crop rotation should be adopted, allowing a field to remain in timothy sod not more than two or three years, thus preventing this stem-borer from becoming well established. The borders of the fields and waste places should be mowed frequently during the months of June and July. If this is done, the larvæ will not be able to reach maturity.

^a Proceedings of the U. S. National Museum, vol. 39, pp. 401-408, 1911.

^b Proceedings of the Entomological Society of Washington, vol. 12, no. 3, p. 145, 1910.





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