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The Pecan Case-Bearer.

BY GLENN W. HERRICK.

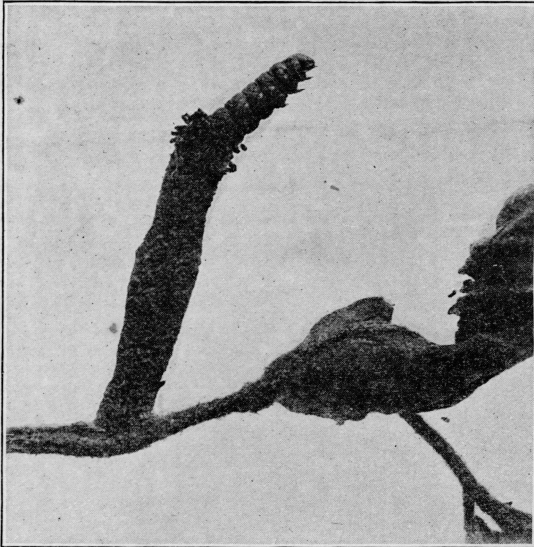


Fig. 1.—Case with larva partly exposed. Enlarged (original).

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THE PECAN CASE-BEARER.

Acrobasis nebulella Riley.

The pecan tree, in Texas, is subject to attacks from at least two species of so-called bud worms, of which *Acrobasis nebulella*, the case-bearer, has been very forcibly called to my attention during the past season. Evidently this species has been causing considerable loss in the State for several years and without doubt is the most serious pest attacking the pecan. Professor Gossard, in speaking of the work of this insect in Florida, says "no other insect in Florida is more destructive to the pecan."

During the spring of 1909 it was very abundant in the vicinity of Cuero, Texas, and did a great deal of injury to pecan orchards in that locality. In one orchard from which the crop of nuts netted nearly \$2000 in 1908 the owner thought his crop in 1909 would hardly pay to gather owing to the injuries by this insect.

This pest is evidently widely distributed in the vicinity mentioned and has been the cause of serious loss to many pecan growers.

History.—Up to 1908 this moth had been considered a variety of *Mineola indigineila* and is so listed in Dyar's Catalogue of the Lepidoptera. It was first described by Riley in his Fourth Missouri Report. He says a single specimen was bred from wild crab (*Crataegus*). Dr. Riley also makes note of the fact that the same species was found by him in the cabinet of M. J. Lichtenstein, Montpelier, France, it having been taken in that vicinity. In the tenth volume of the Proceedings of the Entomological Society of Washington, 1898, Dr. H. G. Dyar describes this pest as a distinct species, *Acrobasis nebulella* Riley.

Distribution.—The insect seems to be quite widely distributed and has more than one food plant, although the hickories seem to be preferred. It is recorded by Riley from Missouri; by Scott from Atlanta, Ga.; by Boll from Texas; by Pratt from Kerrville, Texas; by the Bureau of Entomology from Blackshear, Ga.; by H. G. Dyar from Rhinebeck, N. Y.; by Gossard from Florida, and by myself from Cuero and College Station, Texas. It will be noted that Dr. Riley found it in France, but "whether indigenous or imported from this country is a question yet to be solved." It is probably widely distributed all over the South wherever the pecan or hickory grows.

Food plants.—Dr. Riley bred a single specimen from wild crab and several specimens from hickory and walnut. Gossard bred it in abundance from the pecan in Florida, and I reared many specimens from the pecan from Cuero, Texas, where it was very abundant and doing serious damage. High found it on wild hickory near College Station.

Nature and extent of injury.—The larvæ injure the leaf buds principally as the leaves begin to appear in the spring. The over-wintering young larvæ congregate at the ends of the young branches and begin eating the young leaves as fast as they come forth. In other cases where

the young leaves get a start the larvæ tie them together with silk and form their cases inside of this blackened, ragged mass made up of cases, silk, excrement, and wilted and dried leaves. Often a tree will struggle along for some time trying to put forth its leaves. On March 31st, an infested orchard at Cuero was visited and the larvæ were found in large numbers. Hardly a branch or a twig was found without from one to a half dozen or more of these minute larvæ, some concealed in their cases while others were feeding, mostly down the center of the tender leaf stems, and in some instances had actually bored their way into the wood of the twigs. This caused the twig to die back at the ends as though blighted. From one to twenty of the little cases were found upon the distal end of a single branch, thus making possible hundreds upon the larger branch. The young trees, that is, those four or five years of age,



Fig. 2.—Ends of branches showing work of larvæ (original).

had great masses of these little cases upon almost every branch. Many of these larvæ were burrowing into the ends of the twigs. The larvæ were in such numbers that practically all the twigs infested were leafless and showed little vitality, with nothing but the blackened masses of cases and debris at the ends of the branches (Fig. 2). A few larvæ are often found scattered among the well-developed leaves where they will tie three or four together with their web and build their individual cases in between the tied up leaves. The injury is not wholly confined to the youngest leaves, for the older, well-developed leaves are often eaten full of irregular holes.

Moreover, the flower buds are often attacked and seriously injured.

On the 7th of June I received a small box of young nuts just set, each of which had been bored into near its base. Among the nuts which had

been partly webbed together was a full-grown larva of *A. nebulella*. Within each of two other nuts I found a dead larva. The kernels were completely eaten out, leaving only the hollow shells. I am convinced that

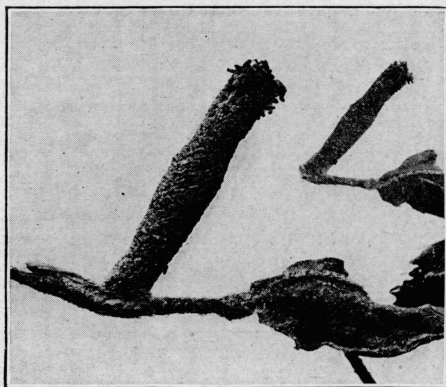


Fig. 3.—Case enlarged and natural size (original).

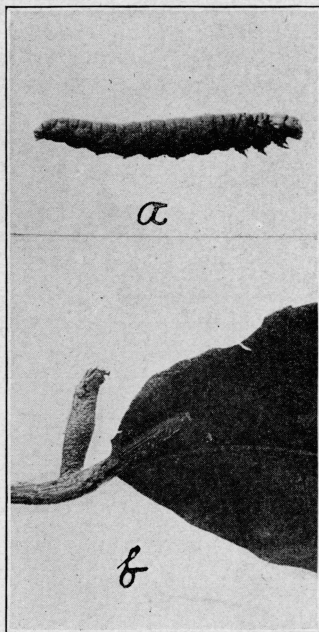


Fig 4.—A, larva; b, case fastened to petiole of leaf (original).

A. nebulella was the cause of this injury, although the larvæ doing the work were considerably later in reaching maturity than those we had reared from Cuero, Texas. However, it is likely that the majority of the larvæ mature later than those did in our laboratory.

The case.—The cases are made of frass or pellets of excrement tied together with silk and lined inside with silk. The cases of the immature larvæ are often curved, reminding one strongly of the cases of *Mineola indiginella*. As the larva increases in size and nears maturity the case becomes straight and always noticeably enlarged in the middle (Figs. 1 and 3).

The distal or unattached end of the case is usually slightly larger than the fixed end, but not conspicuously so. The larva when feeding protrudes its body through the open end of the case (Fig. 1), but holds to it most tenaciously with the prolegs when any attempt is made at removal. When a young larva is removed from its case and transferred to another position it first of all begins the construction of a new habita-

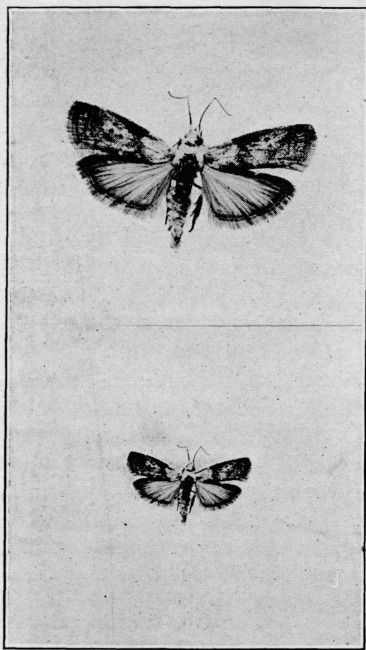


Fig. 5.—Moth twice enlarged and natural size (original).

tion. The case is exceedingly tough and very difficult to tear apart. When the larva is full grown its case averages from 16 mm. to 20 mm. in length.

When the larva is ready to pupate it moves out among the well-developed leaves and fastens its case securely to the petiole by a foot-stalk of strong gray silk (Fig. 4, b). They also cover the case on the outside with a layer of silk, thus giving it a grayish appearance, and then close up the free end, later changing to a pupa within.

On April 1st, I opened a case that had just been closed and almost immediately the disturbed larva began industriously spinning up the opening. By the morning of April 2nd the case had been completely closed and made ready again for pupation.

The moth.—The moth has a wing expanse of about 15 to 18 mm. and, in general, is grayish in color (Fig. 5). The head between the eyes, the thorax, the patagia, and the proximal third of the wings are dirty white. On the front margin of each front wing about one-third of the distance from the proximal ends is a triangular patch of dark scales, purple in some lights, and just beyond this patch, in a lighter area, are two dark spots one behind the other (Fig. 5).

When the moth alights the wings lie roof-like along the abdomen with the anal margins slightly overlapping. In this position, the head, thorax, and forward part of the body are conspicuously light gray with this area sharply defined posteriorly by the meeting of the dark patch of scales on each wing. They frequent the weeds in the orchard and the debris around the bases of the trees, among which they hide and elude one when pursued.

The larva.—The full-grown larva measures 12 to 15 mm. in length. The body is dark green and the head dark brown. The prothoracic shield is lighter in color while the mesothorax has a pair of shiny black tubercles, one on each side. The second, third, fourth, fifth and last abdominal segments each bears a pair of prolegs (Fig. 4, a). Each proleg ends with a circle of minute hooks which enable the larva to cling tenaciously to its case. The thoracic legs are black.

The pupa.—It has no characteristic or conspicuous markings, but is shiny brown in color and varies considerably in size, measuring from 7 to 10 or 11 mm. in length.

Life history.—Unfortunately, I was obliged to leave Texas before the egg-laying period of the moth occurred and hence have not seen the eggs, and, so far as I can find, no one has described them. Very likely they are laid on the leaves. Gossard says "Its summer history agrees well with that of its twin relative, the leaf crumbler of the apple and other orchard trees, *Mineola indiginella*, the eggs soon hatching after which the young caterpillars commence feeding on the younger leaves, especially those just opened at the terminal ends of branches." We made very careful search for the eggs up to the 10th of June, but as only a few of the moths had appeared in the field by this time it was probable that the eggs had not yet been deposited. The young larvæ live upon the trees all summer, but do not attain a very great size nor commit conspicuous injury owing to the large amount of well-developed foliage. As already stated, the cases of the immature larvæ are more or less curved. Probably the larvæ attach their cases to the trees before the leaves fall in the autumn and remain in this situation all winter. The fact that they appear in such numbers and with such suddenness in the spring just as the buds begin to put forth shows that they must winter over in great abundance. They must be quite inconspicuous on the tree, and I regret that opportunity was not afforded me for observing them during this phase of their life history. In the vicinity of Cuero the larvæ become active in March and by the middle of this month their depredations are noticeable and serious. It was on the 24th of March that I received the first large batch of larvæ. It was on April 1st that I found the first larva closing up its case for the formation of a cocoon. The pupa was not formed, however, until after April 8th, and the moth did not appear until May 2nd. Very likely this larva was hastened into pupation by

the lack of a food supply. Other moths appeared as follows: May 10th, May 11th, May 7th and May 9th. All of these were in the laboratory, however, and their food supplies were rather irregularly and scantily furnished. Gossard says that "the moths appear from the 1st of May until the 1st of July, the bulk of them coming as a general rule during the first half of June." It is quite probable that they appear in Texas also over so long a period. The larvæ among the young nuts received by me on June 7th would indicate this. It is quite likely, too, that the larvæ kept by us in the laboratory were hastened into pupation earlier than they would have been in the field.

Natural enemies.—In my rearings of the larvæ no parasites were bred and no natural enemies were observed in the field with the possible exception of one species of spider which Mr. High observed apparently sucking the juices of a young larva. Gossard says that "a Tachinid fly, two or three ichneumon flies and a very minute hymenopteran" emerged from the cages in which he was breeding the larvæ and pupæ. Of these he identified surely only *Pimpla conquisitor* and *Spilochalcis vittata*. He further says that "the cumulative benefits of parasitic attack were illustrated by a few trees on the Station grounds, which during April and May, three years ago, were well-nigh unable to get into foliage; for the past two years they have been in much better condition, due almost wholly to parasites."

Control by spraying with arsenate of lead.—A small orchard of pecan trees at Cuero which was very badly infested with the *Acrobasis* offered a splendid opportunity for trying the effect of a thorough spraying with arsenate of lead. This orchard consisted of probably two acres of trees, and around the outskirts of the main body were thirteen trees varying in height from six to ten feet. Since these trees were distributed in such a manner that a few of them were standing on each side and end of the main body of trees, and since they were all badly infested and of medium height they were selected for spraying, while the main body of trees in the middle was left as a check.

On the 5th of April Mr. M. M. High sprayed these trees with Disparene, 3 pounds to 50 gallons of water, using a common barrel pump with one lead of hose. It was raining while the first two trees were being sprayed, but these were gone over again after the rain had ceased. All of the thirteen trees were carefully and probably more thoroughly sprayed than would ordinarily be done.

On April 27th the trees were carefully examined to note results. Pains were taken to examine the highest branches, using a ladder when necessary. On tree No. 1 two living larvæ were found and many shriveled and dead ones. No more living larvæ or pupæ were found until tree No. 10 was reached. This was the tallest tree and difficulty was experienced in reaching the highest branches when it was sprayed. On this tree one living larva and two pupæ were found on the extreme end of a tall branch which was probably not reached with the poison.

The trees were in uniform leaf and in no way resembled the picture that they presented on April 5th. The trees looked healthy and vigorous with their new crop of leaves. It will be recalled that these trees were very badly infested on April 5th, and presented a most discouraging appearance.

The owners considered the experiment a complete success.

Recommendations.—One application of the arsenate of lead should be made considerably earlier than the foregoing. It should be applied as soon as the buds burst through the bud-scales. Another application later may be necessary.

An experiment against the pecan bud moth, Proteopteryx deludana, and its bearing on the control of the case-bearer.—From an experiment made in a large young pecan orchard at Jacksonville, Texas, to control the bud moth it would seem that this pest, at least, may be held in check by a winter spraying with the lime-sulphur mixture. The minute larvæ of this moth winter over in their tiny cases snugly hidden away behind the buds. That is, usually between the buds and the branch. This pest was present in the orchard during the spring and summer of 1908 and caused serious injury. I found the cases containing the larvæ present in considerable numbers on the trees in February, 1909. Early in February we sprayed every other row of this orchard very thoroughly with the lime-sulphur mixture (20-15-50 boiled forty-five minutes). Later on, the owner fearing an outbreak of the pest in the spring dared not leave our check rows and sprayed those also. Fortunately, he left several hickory trees at the side of the orchard which he had budded with pecans. These, he writes, were badly injured by the bud worm in the spring. His main orchard, however, was free from any injury of this pest up to April 4th, and he writes as follows: "I am freely persuaded that the lime and sulphur spray last winter was a perfect success in destroying the pecan bud worm on my farm.

"I have carefully examined twenty trees three times a week for my bud worm, and never saw any sign of them until the 19th of March, and that was on my hickory-pecan budded trees where I never sprayed at all all winter. I believe I shall have to spray these trees every two to four weeks all summer.

"There has been no sign of bud worm on any of my sprayed pecan trees."

From these results obtained with the lime-sulphur wash for the bud worm, I am of the opinion that the case-bearer *A. nebulella* might also be controlled in the same way. If these two most serious pests of the pecan could be controlled by the same material applied at the same time for both pests it would be a distinct advantage. Besides, the lime-sulphur wash is a splendid fungicide and may also prove of aid in the fight against the pecan *Phylloxera*, another pest of this tree.

Acknowledgments.—I wish to acknowledge my indebtedness to Mr. M. M. High, a student in the Entomological Laboratory, for his observations made in the field and for his enthusiastic aid in carrying out the spraying experiments at Cuero under my direction.