

MR. FERNALD: A word of explanation is perhaps due to account for my presenting this paper. The work on this subject was done in Massachusetts by Dr. Franklin before he went to Minnesota, and, through the kindness of Professor Washburn, it has been sent to me, simply because I represent the state where the work was done.

NOTES ON CRANBERRY PESTS

By HENRY J. FRANKLIN, *Saint Anthony Park, Minn.*

In studying the life histories of various cranberry bog insects on Cape Cod during the season of 1907, certain interesting points were discovered concerning the life history of *Peronea minuta* (Robinson) which do not appear to have been published. This insect is two-brooded in Massachusetts and three-brooded in New Jersey. The winter brood of moths in Massachusetts are slate gray in color, but the summer brood are orange red. In New Jersey also, the winter brood is slate gray, but the two summer broods are both orange red in color.

The fact that the species is dimorphic in the adult state has been long recognized, and Prof. J. B. Smith has recorded (Farmers' Bul. No. 178, U. S. Dept. Agric., p. 13) a marked dimorphism on the part of the larvae. Speaking of the last brood of worms in New Jersey he says: "Eggs laid by these moths" (those of the last summer brood) "do not hatch until in August or even early September, and the worms that come out of them grow slowly as compared with the earlier broods. Few of them spin up more than a single shoot, and few of them eat into any but the smallest berries. They also tend to become reddish in color and even striped, so that at one time they were believed to form a distinct species, described as the 'red-striped cranberry worm.'" In this we find a difference not only in color, but also in habit, as the worms of the other two broods are pale yellow in color and those of at least one of these broods usually draw together a number of shoots in a single web and eat into the fruit voraciously. In Massachusetts as well as in New Jersey this last brood of worms, which later changes into the winter brood of moths, has a tendency to "become reddish and even striped" and grows slowly as compared with the caterpillars of the other brood. In Massachusetts, however, this brood of worms is the one which is often very injurious to the vines and the berries. This difference in habit between Massachusetts and New Jersey is doubtless due to the fact that the cranberry

vines are not in the same condition in both regions during the time that this brood of worms is at work.

In Massachusetts, the second brood of worms all have yellow heads in all stages of their development, and when they first hatch from the egg they do not burrow into the tissues of the leaves on which they feed, but they leave the egg-shell through a circular exit-hole and go at once into the higher portions of the vines and commence to spin up the tips. The first brood, on the other hand, have considerably darkened heads in their early stages and may readily be mistaken for young larvæ of the Blackhead Cranberry Worm (*Eudemis vacciniana*). Like the young caterpillars of that species they bore straight into the tissues of the leaves on which they hatch, destroying the egg-shells in the operation and leaving a pile of frass over their entrance holes. They work around within the tissues of the leaves for some time before they leave them to go in to the tips of the vines. Some of the worms of this brood continue to have somewhat darkened heads until they become full grown. It would be interesting to know if the first brood of the worms of this species in New Jersey present the same peculiarities of habit and appearance that they do on Cape Cod and also if the second brood agrees with the first one in these respects.

A comparison of the pupation habits of the fire worm (*Eudemis vacciniana*) on Cape Cod and in Wisconsin is interesting. On Cape Cod the worms of both broods of this species go down out of the vines on to the surface of the bog to pupate on the sand and among the fallen leaves. In Wisconsin, on the other hand, (Cf. C. B. Hardenberg, Bul. No. 159 of the Wisconsin Experiment Station, page 7), these worms usually pupate in the spun up tips of the vines, only a small percentage passing the pupa stage on the surface of the bog under the vines. The bogs of Cape Cod are as a rule well drained, while those of Wisconsin are not, and it is probable that the dampness of the bog surfaces in Wisconsin makes them unsuitable localities for the insect to pupate in. It would be interesting to know, however, if this difference in pupation is a real inherent difference of habit or a difference forced upon the insect by the surrounding conditions.

It was found to be a common thing, on the strictly dry bogs of Cape Cod, for certain undetermined species of ants to collect both yellow-headed cranberry worms and fruit worms in large numbers and take them to their nests, presumably as food. I several times saw as many as fifty such worms, all at one time and within a radius of twelve feet, being dragged along by these ants, the ants as a rule

working singly. It is certainly advisable that the nests of these valuable allies of man should not be disturbed by the cranberry grower, and these observations suggest the possibility of developing the use of ants as a means of combating these pests on dry bogs, either by encouraging the species already present, possibly by the use of artificial nests, or if possible, by the introduction of some closely allied but more prolific species.

PRESIDENT FORBES: Any discussion of this paper?

MR. R. L. WEBSTER: Mr. President, I was very much interested in the remarks on the cranberry worm, inasmuch as I have just finished some experiments on its life history in Iowa, where the insect is a pest on apple stock in the nursery. In southern Iowa, and as far north as Des Moines, this species is three-brooded, and there was no indication of the difference in the color, either in the head or in the general color of the larvæ. I found no larvæ on apple, which I could call red-striped, in any sense of the word. The three broods, as far as I could see, all had the same appearance.

Early in the spring, I found eggs only on the lower part of the apple trees in the nursery. They seemed to be deposited before the leaves had come out very far on the trees, all on the lower part of the trees, perhaps within a foot or six inches from the ground. In this way, only the lower limbs on the trees were infested. The leaves higher up did not have any larvæ at all. The remaining two broods deposited eggs, as far as I could determine, on the leaves. I saw none at all on the limbs, as in the case with the first brood. In the second and third broods the larvæ seemed to be feeding all over the trees, principally in the tips of the young growing leaves. The first and second broods of moths were the orange form, and the last brood the slate form as in New Jersey.

PRESIDENT FORBES: Anything further on this subject?

MR. HOPKINS: Mr. President, I think the matter has come up before this Society before, and while we are considering the matter of nomenclature, we ought to settle on the use of the terms "brood" and "generation." Sometimes it is necessary to refer to the particular brood. It seems to me there ought to be a certain uniformity.

PRESIDENT FORBES: The following paper will now be presented: "An Example of Forest Insect Control at a Profit," by Mr. A. D. Hopkins.

A. D. HOPKINS: Mr. President, I did not expect to present this paper, but, owing to the fact that a rather striking example was

reported recently, I took these extracts from manuscripts already prepared in order to call attention to the fact that some of our most destructive forest insects can be controlled without cost, and often at a profit.

AN EXAMPLE OF FOREST INSECT CONTROL AT A PROFIT

By A. D. HOPKINS, *Washington, D. C.*

In May, 1907, Mr. W. D. Edmonston, a forest ranger, detailed from the forest service to the Bureau of Entomology, to work under our instructions in the location of evidences of beetle infestation in the National Forests of Colorado and adjoining states, reported that the pine timber was dying on a large estate not far from Idaho Springs, Colorado, and in the adjoining Pikes Peak National Forest. Mr. Edmonston was then instructed to make more detailed examinations, after which he reported that some 63,000 feet of standing timber on the estate was infested by the Black Hills beetle and that unless the ravages were checked at once it would kill the timber not only on this estate, but that on the adjoining estates and National Forest. The owner of the property was advised by the Bureau of Entomology to take radical action according to a special recommendation and detailed instructions relating to a necessary control policy. No action was taken, however, before the first of the following July, and therefore not in time to prevent the broods of beetles from swarming from the infested trees and extending their ravages. In December, 1907, Mr. Edmonston was instructed to make another examination of the timber, when he found that his prediction was being fulfilled, and that instead of 65,000 feet of timber in the old infestation, there was nearly four times as much timber involved in the new, or over 250,000 feet. The owner was again notified of the serious character of the outbreak, and the further suggestion made that if the logs from the infested trees were converted into lumber and the slabs burned before May, 1908, it would result in the protection of the remaining living timber. Immediate steps were then taken by the owners to carry out the original recommendations. Mr. Edmonston gave instructions to the manager of the estate in locating and marking the infested trees and in the essential features in the methods of utilization to destroy the necessary number of beetles. He also marked the infested timber on an adjoining estate and on the National Forest. Five months later, in May, 1908, Mr. Edmonston reported that the larger clumps of infested trees on the estate had been converted into lumber and the slabs burned, and that the