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THE CONTROL OF THE BOLLWEEVIL

By Fred Reinlein

PORTLAND, OREGON

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BOTTLEWELL

By Fred Reinlein

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The Control of the Bollweevil

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Circular No. 152.

February 4, 1918

The Bureau of Entomology, in getting out Farmers' Bulletin No. 848 in August, 1917, has defined what the men in charge profess to know to be the best means of controlling the bollweevil. The means described are nothing but the old rotten stuff that had been dished up for many years, and which has been fully dissected by me during years past, the evidence I thus gave having shown the inadequacy and often utter impracticability of the means advocated by the Bureau, and means were shown by me that gave the result desired. The Bureau has never discussed these means, although they have often told Members of Congress they had done so. The responsibility for this rests upon the Chairmen of the Congressional Committees on Agriculture, who never did anything to force the Bureau to show why the means shown by me should not be satisfactory.

As the chief means of control is given the early destruction of all cotton plants in the fall. This is a correct idea, provided, first, no one can show you a way by which you can make the plants bear till frost, which I shall show can be done and, second, that this does not cause the bollweevil to adapt itself to feed on plants related to cotton or cause it to accustom itself to live without food during this period. That the weevil is adapting itself to an absence of all cotton in the fall, there is much evidence, and for this reason I shall show how I had modified, during the past two years, my original system of control to meet the requirements of the case.

In his zeal to convince you of the profitableness of the early destruction of all the cotton plants in the fall, Dr. W. D. Hunter, in charge of the work, tells you on page 18 that 410 acres were thus cleared in Calhoun County, Texas, and the profit was \$14.56 an acre. "This was 29 times the cost of uprooting and burning the plants." Thus the work cost \$14.56 divided by 29, or 50 1-5 cents per acre. Can you have this work done at this rate? Dr. Hunter does not tell you that the work was done in 1906 in a section having low-priced labor. Even there the work could not be done now at this cost. But the big little end of the humbug comes in by Dr. Hunter not telling you, with the approval of his worthy chief, what the conditions were. As pointed out as far back as 1908 in my Circulars No. 84 and 85, and carried out more in detail in my Circulars No. 115, 129, 139 and 141, these fields were near the sea, hence weevils hunting in search of food in that direction had not even as much chance of survival as on land devoid of cotton. The nearest cotton was 15 miles away, This seemed to have been but a small patch, for the fields used for checks were 30 miles away. Figuring at a distance of only 15 miles, the 410 acres cleared represented only about the one three thousandth part of the area included in the circle having a radius of 15 miles; hence the weevils deprived of food and scattered over this area in search of it, had in the spring only one chance in three thousand to find food, as compared with usual conditions, where one acre in five is given to cotton, where, therefore, on the average, the hibernated weevil finds food on every fifth acre. Thus under usual conditions the chances of infection in the spring are 600 times greater. If you can plow out the stalks and burn them under usual conditions for 50 cents, there, the benefit will be \$14.50 divided by 600, which gives you a return of $2\frac{1}{2}$ cents for an outlay of 50 cents. This assumes that you can destroy cotton over a territory large enough to make your place safe; and this includes destruction of all volunteer cotton. The tests were made about 75 miles southwest of Galveston. To get anywhere the same results in Tennessee the work would have to be done about September 1st. This

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shows the need of a better method, especially in the northern half of the belt.

"Other methods are applicable to different conditions" says Dr. Hunter on page 20, but what those methods are he does not say. But he says. "...The difficulty in one method of removing the plants—that of cutting them off near the surface of the ground with a stalk cutter or ax, is that during mild seasons many sprouts soon make their appearance to furnish food for weevils that would otherwise starve during the fall and winter.. The great objection is that innumerable weevils in the bolls and squares will be allowed to develop." This is correct, but Dr. Hunter is not correct when he continues: "Nothing but uprooting and burning will fully meet the exigencies caused by the weevil, but the burning must be looked upon as an emergency measure especially necessary in regions recently invaded by the weevil and to be replaced by burying after a few years."

As far back as 1913 I had shown in my Circular No. 134 a way that fully met the exigencies of the case, if we assume that the boll weevil cannot adapt itself to feed and breed upon plants other than cotton. If it can— and you will be left to judge whether or not it can—the method in its original form will not answer any more than will destruction of all cotton by uprooting and burning even if done by magic at no cost. The method consisted in showing how the plants can be cut off with the V stalk cutter without giving rise to sprouts.

The V stalk cutter, used as originally advocated by cotton planters left well developed eyes above the surface, about the base of many if not most plants, resulting in sprouts if there was enough moisture. As these sprouts do not offer ovipositing material, the female has to hunt for cotton elsewhere, or else for related plants that give a reasonable promise of successfully serving as breeding material, hence the danger from sprouts consists in that feeding upon sprouts might reduce the rate of mortality existing. There is no conclusive evidence that such is

the case to any appreciable extent, chiefly because the adults, when starved, can fly for many miles to find cotton. However, I had not only shown how these sprouts can be avoided, but also how the field can be turned into pasture within a few weeks after the plants were cut off and burned. Since then, in my Circular No. 151, p. 5, I have shown that the necessity for burning can be removed, as will be shown.

The plan consists in slightly throwing the earth towards the plants at the last 2 or 3 cultivations and sowing a crop of vetches or other legume at the last cultivation. This causes the eyes that do develop near the base of the plant to develop 2 to 4 inches higher up than they would otherwise do. When the V stalk cutter is then used the weight of the tool rests upon 3 points, the nose, and where each arm rests upon the row. The stalks are thus cut off much more evenly and also several inches below the lowest developed eyes, hence no sprouts can appear. The nose of course, must ride upon a shoe of some sort, to avoid injuring the young forage plants. Neither Dr. Hunter nor his Chief, nor any of the members of Congress directly charged by law to guard the farming interests could be made to talk on this point. Yet the Entomologist, as shown throughout my Circular No. 151, has repeatedly told Members of Congress I am wrong all around. Of course it is a disgrace to them to swallow such gab without being shown. Only once with Hon. John E. Raker, as explained in detail on pages 15 to 21 of my Circular No. 151, did the Entomologist go into any details at all upon the various issues he is wanted to talk on, and immediately stopped this upon finding that Mr. Raker gave me a chance at defense by giving me a copy of the reply he got.

If an insect is attacked by a more or less complete, systematic and unseasonable destruction of its exclusive food plant year after year, it will try to adapt itself to survive without this food. That the boll weevil has a strong capacity along this line you can see from a case where in a cage started September 28, 1908

at Mansura, La., by the Louisiana Crop Pest Commission, there survived a weevil which lived till June 9. 1909. This weevil had to survive a temperature that caused the weevils for weeks to crawl on the screen hoping to get away; had no access to water or dew as it would have had outside; had no access to cool shaded places as the weevils have outside; had food removed at once, whereas outside this is impossible, since even if all plants could be uprooted in one day, they would still offer food for several days, making the change to no food gradual. And the rainfall for October was only 0.28 inch.

Again: a cage started October 26, 1908 by the Louisiana Crop Pest commission, with a mean temperature of 51.9 degrees for the week following the caging, gave a survival of 25.12 per cent; while a cage started November 23, with a mean temperature of 70.36 degrees for the week following the caging, gave only a survival of 12.67 per cent. As far back as 1912 I had shown in my Circular No. 128 from the results secured in all of these test cages, by figuring out the mean temperature for the days following immediately the caging, that, at any given time, the high or low survival was regulated by the high or low temperature prevailing immediately at caging time. Since in the open a weevil deprived of food can secrete itself in the woods where the mean temperature is by October 1st somewhere around 55 degrees, early destruction of stalks is beneficial as a means of weevil control chiefly by stopping further breeding.

Plowing out and burning the stalks cannot be carried out in a general way quick enough, if it be done at all, hence under this plan little good results can be expected to follow on the whole. Fields that are cleared, turn off their weevils to fields not cleared, and fields cleared by good management can then produce "a profitable crop through proper methods" as Dr. Hunter shows on page 1, but with all fields cleared and all located alike, infestation of all in the spring will be about the same.

On page 22 Dr. Hunter warms up the old story about a neglected peach orchard across a narrow lane on one side of the

experimental cotton field of 40 acres. "Every season the first weevil infestation in the cotton was found in the immediate vicinity of the orchard."

According to Dr. Hunter to eliminate the hibernating quarters across the lane meant only the prevention of the growth of weeds. But the rough bark of the trees might have been the chief attraction, as was shown to him as far back as 1909, in my Circular No. 102. If the weeds do attract the weevils, I was offering a pretty good means of control when I, previous to 1913, suggested to plant corn around the cotton fields, letting the cotton stalks stand till hibernation has taken place. What weevils then would go outside would mostly go to hibernate in the corn. But then Dr. Hunter violently declared they would go to the woods, So they would, provided the woods are not too far off. Of course both corn and cotton stalks were then to be destroyed by plowing down before emergence could begin, Plowing down cotton stalks was also condemned as utterly impracticable, but now he recommends it himself, that too in the early fall, when the soil is apt to be dry and hard, With the proper use of a heavy chain these stalks can be easily completely plowed in.

Suppose instead of an orchard there had been woodland, what would Dr. Hunter have recommended then? Well, nothing but planting as far as possible away. And as for what numbers of weevils there are out of reach in the woods you gain an idea from page 168 of State Crop Pest Commission of Louisiana Circular No. 31. "...From an elm tree located in the swamp, $\frac{1}{4}$ of a mile from the nearest field, (Spanish) moss was gathered from the limbs at a height of 15 feet. The ground in the swamp was covered with water and a dense growth of cane, 12 to 15 ft. high, occurred all about the tree. In this moss was found 3,158 weevils to the ton..."

But now as to the tendency of the weevil to feed and breed in plants other than cotton; "In laboratory experiments performed by B. R. Coad, a weevil developed in the bud of a wild plant related to cotton. Under natural conditions it has not been

found developing in that plant, but the experiments may indicate a tendency for the insect to acquire a new food plant..” (p. 11)

“May indicate,” you see. And if it does? Dr. Hunter offers not the slightest suggestion. “In the adult stage the boll weevil frequently has been found in okra blooms, but repeated observations and experiments have failed to show that it places its eggs in the pods or can develop in them.” This apparently while cotton was available. “When confined in bottles the adult weevil will feed upon various substances such as apples and bananas, but this is only under stress of starvation.” All this shows that the weevil does possess a tendency to acquire new food plant.

Mr. Coad writes on this point as follows in U. S. Department of Agriculture Bulletin, No. 231, page 3, issued Aug. 2, 1915: “During the summer of 1913, following the discovery of a boll weevil feeding on cultivated *Hibiscus syriacus* at Victoria, Texas. the writer succeeded in rearing the species on buds of this plant, fed them for some time, and noted the partially completed development in buds of *Callirrhoe involucrata* and *C. pedata*, and kept them alive on *Sphacralcea lindheimcri* buds for a short period.”

“In the above series of experiments, by alternating foods it was found that the weevils have a wide range of hitherto unsuspected adaptability. This discovery makes the presence of malvaceous plants in the vicinity of cotton a possibly important factor in the ultimate control of the species....”

Of course, as long as there is cotton, the weevil wants nothing better. But with the food supply cut off more or less every fall, the weevil has the choice to learn to starve along, or to feed and breed in related plants. As there is a good supply of related plants available, destruction of cotton becomes yearly more and more harmless to the weevil. Thus in this event what Dr. Hunter now offers as the chief means of control loses its value.

Were once the weevil accustomed to breeding in plants related to cotton, this would be likely to extend the period of

breeding both in the fall and in the spring. All this shows the need of a method of control that will make it possible to actually kill the weevils and without scattering the weevils to plants other than cotton. Dr. Hunter has absolutely nothing of this kind. I shall describe such a way evolved by me during the last three years.

In the case of infestation from the peach orchard above referred to, Dr. Hunter says: "...the infestation always started at that point and radiated into the field..." This brings up the question of what might be done to reduce the number of hibernated weevils in the spring.

Woods, or even only vegetation of scrubby growth, or a strong stand of grass would all have the effect of enabling large numbers of weevils to survive the winter. Pastures and meadows should not be closely cropped for several very good reasons, the chief ones being to avoid erosion and enable them to withstand the effects of winter. All such make good hibernating quarters for weevils and other insects, injurious, beneficial and neutral ones. What is the use to talk about the benefit to be derived from beneficial insects, or birds, if you give them no chance to survive?

How these and other places, such as sorghum stubble, can be cleared of weevil better than by any other way except perhaps burning, which is highly injurious and causes erosion, will be shown later.

On page 22 Dr. Hunter calls attention to sorghum stubble as highly favorable for hibernating places. "A little work in the fall or winter will result in the destruction of practically all of the weevils found there." Wherein this "little work" does consist he is careful not to say. If there is any little work that approximates such results other than striking a match while the stubble is dry, I do not know of it,

Slopes and river banks must be protected by rough vegetation to prevent erosion and provide protection against damage

by floods. For details see Yearbook Separate No. 688: Farms, Forests and Erosion.

I had shown as far back as my Circular No. 117, in 1910, carrying it out minutely in my Circular No. 127, 1912, from the results of tests made by Dr. Hunter, that the weevils as they arrive settle at the edge of the field. I showed that as long as there are no squares they stay at the edge. Thus in case infestation starts at a point, or at a side near timber or a fence row, the weevils will be practically all at this point or side, clustering to the outer rows as long as there are no squares. It has been shown that 50 per cent of these might be killed by an application of poison. But when squares are set the use of poison ceases since the weevils begin to feed within the squares. The females as a result become fit to oviposit. With the squares few and far between, they at once scatter all over the field. I showed from this at that time that the only economical means of controlling hibernated weevils would consist in picking the weevils off the edge of the field beginning with the setting of squares, every day, at least while there is warm weather. This has to be kept up till emergence is about over, which usually takes 3 to 4 weeks. Thus, if a female is caught on the edge, it saves hunting for her offspring, represented by about 139* infested squares, later on, scattered all over the field. This latter way, however, is the now officially approved way, approved as far as you can carry it out—it is all up to you. The scientists in charge are foxey. The correctness of the statements made by me was never disputed by them. Nor has any member of Congress insisted to be shown why I should be wrong.

In 1915 I realized that the problem of how to control the New Mexico range caterpillar can be solved by the judicious use of poultry, explained in detail in my Circular No. 151.

This in turn led me to realize that while the plan of securing hibernated weevils as just described was a good one, it would often be difficult to secure the proper help to get the desired results, and that poultry could be used to advantage, this the more as poultry could be used the year around. Take the

*This is the average number actually found in tests

case of the weedy peach orchard, for instance. If the weevils hibernate in the weeds, and poultry had the range of the orchard during fall and winter, the poultry will secure most of the weevils before emergence. Again, given access to the orchard and across the lane during spring, they could easily see the emerged weevils feeding on the young cotton. Further, as squares begin to fall it is natural for poultry to pick on these, since they suggest a juicy grub within; they thus attack the adult, the larva and the pupa. This naturally keeps down the weevil and results in increased production. This the more as poultry also controls other cotton insects. This includes the bollworm, as will be shown. Moreover, it will be shown how poultry can be assisted by the use of trap-plants, and how this enables the field to produce fully up till frost.

The Bureau's way is quite the opposite. They emphasize the need of securing an early crop. "What is needed is a variety which will mature quickly and set a crop by a date not later than the middle of July. In humid regions with heavy infestation the most productive varieties have been found to be King and its principle derivatives, namely, Simpkins and Broadwell. In recommending these varieties the Department reminds the planter that they produce lint of a very short staple... The varieties may safely be replaced by large-boll varieties in other regions." What other regions? Well regions not humid. This means chiefly West Texas, Oklahoma and North Arkansas. Thus all the rich lands in the humid regions are to grow the King type. What you want is a means of control that makes possible the growing of long-staple and Sea-Island cotton where it was grown before the advent of the weevil. As long as you have not done this you have not solved the problem. If you have a variety that sets a crop by the middle of June, you would simply cut the season that much shorter. By clearing the fields in the fall, driving the weevils away to other fields not cleared, and then racing along for an early crop by all means known, such as selecting a perfectly drained field, best of cultivation, proper fertilizer and especially an early strain of seed, you can easily out-

run your neighbor, as shown by me as long as 13 years ago in my Circular No. 31, but such a course means simply winning at the expense of the neighbors, because as soon as the earliest field becomes at all well infested, there starts an exodus of weevils bred there for nearby fields having as yet a lower infestation of squares. As not all lands are alike and cannot be made equally early, the men with 'proper methods' comes out first at the expense of the man riding a slower horse.

The planters in a section might agree to not plant before a certain date, for all now realize that the earliest fields serve as a weevil nursery, but not all fields could be rushed along at the same rate.

If the fields are kept patrolled by poultry while young, the weevils cannot get plentiful enough to do any appreciable damage. That poultry can secure this result, is known from what poultry did in at least one very similar case, the alfalfa weevil. Details are given on page 10 of my Circular No. 151. The Bureau of Entomology had now two years in which to make all the tests they wanted to satisfy themselves if benefiting the public is what they are after.

After considerable fruit has set, squares become scarcer and, if the weevils are sufficiently numerous, as they are under the present official methods, infestation of bolls begins. But squares are preferred, because the female knows a new generation can be produced in them quicker than in bolls. The scarcity of squares thus naturally causes a constant movement in search of them. It is all theory what I say, is what Chief Howard tells members of Congress that make an honest attempt to get at the truth. First let him point out what is theoretical here or anywhere else.

Inasmuch as we do know that destruction of all cotton in the fall, following the law of self preservation, does develop a tendency of the weevil to subsist on and breed in plants related to cotton, which is easier to acquire than the ability to go without feeding and breeding during the absence of cotton, I had shown in my Circular No. 148, page 13, that, provided poultry

is not able, through lack of numbers or any other cause, to so keep down the weevil as to make the cotton bear till frost. it will be unwise to cut off all of the plants when they are no longer producing profitably and that a small part should not be cut off. These plants then are to serve as traps. These plants, it was shown, could be rolled down so that poultry could have access to the tops and keep on picking the weevils off.

Using trap-plants is the more necessary as destruction of all cotton plants includes also the destruction of volunteer cotton scattered all over the country, work that is no one's particular business. Unless destroyed these plants can, and will, in the absence of all other cotton, attract and sustain vast numbers of weevils. Then again since the boll weevil has been actually bred on *Hibiscus syriacus*, and this plant occurs there plentifully, and there are numerous related plants, destruction of all of the plants in the field would have lost its value as a means of control anyway, and a supply of trap-plants tends to keep them to cotton, their original and preferred food.

A better way of concentrating the weevils was pointed out, however, in my Circular No. 149. This consisted in planting a small patch of cotton very late, say in July, for no other purpose than providing an abundance of squares in the fall. Any kind of seed, except a late variety, will do. Weeds in the rows are kept down by one or more harrowings before, and possibly immediately after, the plants are up: there is no thinning or hand weeding of the rows: the patch is cultivated as usual and should be sown as a crop of vetches at the last cultivation. Thus there is very little expense. This patch will then attract the weevils, since the females then do a great deal of flying in an attempt to place their 139 eggs on the average, to as good advantage as possible. And poultry can easily find them there. Feeding a little grain there daily would cause poultry to stay there by preference. Where practicable these patches might be located within a poultry-tight fence. Doing this will give positive evidence what value there is to these trap patches. This then results in the cotton-field keeping on bearing till frost. Thus there is

done away with the danger of complicating matters by having the boll weevil become accustomed to other food plants besides cotton.

In an exceptionally dry season, cotton planted thus late might not sprout. In that case some rows of the old plants might be cut back so as to produce a abundance of squares. These plants would have to be rolled down to bring the weevils within reach of poultry.

Such trap-plants, it was pointed out, would of course be preferred to the older plants by many other insects, and it was shown this is of special importance in the case of the boll worm.

In my Circular No. 150, p. 9, I quoted the Bureau from Farmers' Bulletin No. 290, p. 30 as saying: "Several instances have come under the writer's observation in which cotton adjacent to barns, where chickens, turkeys and guineas were kept was practically free from bollworms, while at some distance out in the fields the injury was quite severe."

In the cases in question poultry, apparently, was not present in sufficient numbers, or was not used to proper advantage. A little grain scattered over the parts not kept clear would probably have induced the poultry to extend its range of feeding to these points.

Such trappatches of cotton with an abundance of squares make the most favorable oviposition material then available for the bollworm. What specimens finally succeed in entering hibernation do so by pupating about 2 inches below the surface of the ground. As stated these patches should have been sown to vetches at the last cultivation. There is no hurry to destroy these plants after having been killed by frost. Besides bollworm pupa, this patch is apt to harbor boll weevils, and other insects. Because of this variety of insects, the patch should be plowed down when emergence of weevils begins.

In the North a little patch of corn sown in August offers the very finest oviposition material for the hibernating brood. This corn need not go to waste. It may be pastured off, or hogged

down at the approach of frost. This patch must be plowed down in the North early in May to prevent any pupa in the ground to escape as adults.

It will readily be seen that by providing a trappatch of young cotton to concentrate the last generation of the boll weevils, and also of the bollworm and many other cotton insects, and having poultry at work, there is no good reason why the cottonfields should not produce up till frost. In any case the plants in the field are to be cut off with the V stalk cutter as soon as production is practically at an end. There is no need to burn these plants, since most if not all weevils that may yet emerge from squares and bolls on the cut off plants would find their way to the trappatch of late planted cotton. The cotton field thus is turned into a pasture within a few weeks after the cutting off of the plants. These plants left to rot, become overgrown by the vetches, and are buried in the early spring evenly and completely by the use of a heavy chain in connection with the plow.

After there is no more cotton, poultry can hunt for weevils and insect in general in the many places that may serve as hibernating quarters. None of these should be burned over.

There has recently appeared U. S. Dept. of Agr. Bulletin No. 564, giving the results of tests on the collection of weevils and infested squares as a means of control of the cotton boll weevil in the Mississippi Delta. In substance, as there given, the result comes to this: "...It seems to the writers that in a year of light infestation a slight degree of benefit may be secured from the picking operations, but that in a year of average or heavy infestation this benefit is completely lost..." (p. 44). It is shown there at length how utterly impossible it is on the average to secure the labor necessary to do the picking, or, to put it another way, if other crops are neglected because of this picking, the loss to the crop per day per man is given as amounting to \$5.11. Thus we now have radically different figures from what the U. S. Entomologist has dished up some years ago when he claimed, tests had shown a profit of \$3.22 per acre, implying

then that labor and conditions could be generally secured to get such results.

Moreover, "The discovery of the injurious effect of the use of bag and hoop (collection of weevils and infested squares) on the plant is of great importance....the studies...have shown definitely that the use of this semi-mechanical picker cannot be recommended," (p. 50).

As to mechanical pickers: "The failure of the mechanical picker to give satisfactory results is very discouraging...This picker was so injurious to the plants that it actually reduced the crop considerably," (p. 51).

Then why not make a judicious use of poultry? Under date of Feb. 28, 1917 the Secretary of Agriculture wrote to Hon. John E. Raker, who made an attempt to get at the truth, as follows as regards the use of poultry and a trappatch, described in this Circular, and originally presented to him in my Circulars No. 147 to 150: "...Mr. Reinlein's suggestion is that chickens be provided in sufficient numbers to destroy all or most of the weevils as soon as they make their way into the fields."

The fact is, when in my Circular No. 147, 1915, I pointed to the use of poultry as a means of controlling the boll weevil for the first time, I showed its use to be possible not only during the period of emergence, but also on fallen squares, and as for control after the plants were cut off, I stated on page 23: "...the plants cut off with the stalk cutter furnish subsistence for weevils till dry, and the weevils can be picked off meanwhile by the use of poultry."

This method was improved by showing in my Circular No. 148 that a few rows might be left standing as this then will hold the weevils to their original and preferred food plant, These trap rows, by being rolled down, would then attract weevils till killed by frost, and at the same time would carry the weevils low enough to be reached by poultry. Finally, in my Circular No. 150 I showed that by growing a trappatch of late planted cotton, the weevils are concentrated there during all of late summer and fall.

All this the Secretary's humbugologist deliberately ignores, and specifically claims all this and certain other matters relating to the range caterpillar and the Argentine ant, discussed on pages 15 to 22 of my Circular No. 151 to be impractical, but, as always in the past, carefully refrains from making any attempt to show why this should be so.

As far back as my Circular No. 127, 1912, I had shown that once you fail to secure the weevils at the edge of the field as they emerge from hibernating quarters outside of the field, and before they begin to breed, control becomes impossible, because not only will each female infest on the average 139 squares, but these squares will also be scattered all over the field, and moreover before you can find any infested squares you have to stand by for two weeks or more allowing the weevils unhindered entrance, thus increasing the work hopelessly.

It will thus be seen the Bureau of Etomology has really no tangible means of controlling the boll weevil, first, because destruction of the plants in the fall by plowing out is too slow and the weevil is learning to adapt itself to absence of cotton, both by learning to go without any food, and by learning to feed and breed in plants other than cotton, and, second, because collecting weevils and fallen squares has been shown to be entirely impracticable. Early planting and use of early varieties can make a good showing only in individual cases, because if universally practiced it will enable the weevils in all of the fields to start breeding that much earlier. That is, many females that would otherwise die before they could oviposit, will thus become enabled to oviposit, and later emerging ones will find an abundance of squares, where otherwise they would find a scarcity; this then accelerates ovoposition.

The Chairmen of the Congressional Committees on Agriculture, Senator Thomas P. Gore and Representative Asbury F. Lever, are to blame for permitting the Bureau to dodge the issue from year to year.

Because of this, upon the issuance of my Circular No. 151, I undertook to see what could be done to interest the officials in

charge of agriculture in the States that are chiefly affected by the control of the insects there discussed.

In Circular No. 151 I purposely went minutely into detail in regard to the use of poultry as a means of controlling the New Mexico range caterpillar, because there is nothing complicated either about the problem or the means of control advocated by me, I made every effort to get Representative W. B. Walton of New Mexico to ask the U. S. Entomologist to define his position. Mr. Walton took no action of any kind. Both of the U. S. Senators were posted. Senator A. B. Fall made no reply. Senator A. A. Jones twice promised to look into this matter.

I had tried to interest the State Officials as early as I had worked out the system of control in my Circular No. 146, 1915, and they were wanted to render an opinion on it and test it out to their own satisfaction.

This insect as egg, larva, pupa and moth is accessible to poultry the year around, and is fit food for poultry except as more than half grown caterpillar. The Bureau of Entomology on the other hand has no means of control, except what may be possible by fostering parasitic and predaceous insects. As this insect is now also attacking cultivated grasses and grains, it is obvious that control by parasitic and predaceous insects alone is entirely inadequate, even when the pest is comparatively scarce on the range.

In New Mexico the Director of the Experiment Station is in charge of agricultural matters. When addressed he expressed himself favorably toward having the matter fully discussed by the State Entomologist. As this was not done, however, I called his attention to it. There then came a reply by the State Entomologist, at least touching upon a few things connected with the matter and the sum of all was this: "I regard the government's method of investigation" [relying on parasites] "as more natural and more productive of permanent results than is your method."

Yes, that method must be regarded as more natural and more productive of permanent results, just as the moon is more natural and more productive of permanent results as a lantern than is any other means of lighting during the night, but men find it necessary to employ other means in addition to get light when and where it is wanted.

The natural enemies often fail, in fact, the Government gives it as its belief that this is what caused the insect to become prominent as a pest; and for this very reason, since the Government wants to humbug the people by telling the people lies, claiming my plan consists in having the caterpillars eaten by turkeys, the State Entomologist can be expected to state his side. As it is, if a rancher or farmer has his ranch or farm threatened by the caterpillars, as far as the State Entomologist is concerned, there is no help: whereas if poultry had had the run about the range, they would have minimized the eggs, and minimized the young caterpillars. Further, they would the fall before have minimized the pupae and minimized the moths. Thus the pest could not become greatly injurious to crops. That this is so was shown at length in my Circular No. 151 from official evidence referring to feeding habits of wild birds and of poultry in regard to insects in general, and the gipsy- and browntail-moths, in their various stages, in particular.

These last two pests, it is shown there at length, when taken as forest pests, are beyond any control as far as means advocated by the Bureau of Entomology are concerned. The proposed plan of changing the deciduous woods as far as practicable to conifers encounters, admittedly, a serious difficulty because of probable attacks by the white-pine blister rust: and then I had shown on pages 35 to 38 of my Circular No. 151, there is now present the European pine shoot moth, which destroys the apical bud, causing crooked pines. The remedy the Bureau advocates is 140 years old, and consists in removing the infested apical shoots. The remedy I pointed out as far back as in 1915 consists in protecting the apical bud by an application of semi-liquid clay before the beginning of the ovipositing period. The U. S. En-

tomologist was all along urged to show what might be wrong or impracticable about this method, but he all along maintained absolute silence.

There has recently appeared Farmers' Bulletin No. 845: The gipsy moth and the browntail moth, and their control. On page 1 are shown about 50 female gipsy moths depositing eggs on a tree trunk. Thus here you see moths and eggs in quantity where they would be within reach of poultry. Probably 12½% of all the eggs are thus oviposited. Add to this other places within reach of poultry. such as stone walls and low vegetation, and we have probably a total of 25% within reach of poultry, although a fourth of these are apt to be deposited out of sight.

On page 24 you read: "...planting of white pine might be done to advantage, but... the question... must be decided by the owner..." and "The presence of.. white pine blicterr rust.. should receive due consideration..." The presence of the European pineshoot moth is ignored. Thus all the Bureau's advice just comes to this: You pay your money and take your choice.

On page 31 of my Circular No. 151 I had shown from Year-book Separated No. 700 that turkeys greatly relish acorns and that where these are plentiful but little grain need be used for fattening them in the fall. This probably also holds good with chickens. Now, oaks are very plentiful in the territory infested by the gipsy- and browntail moth, and as they are officially admitted to eat moths in common with many birds much smaller, they can be profitably used to at least help to control the gipsy moth.

Mr. S. A. Weiant, Scientific Assistant in Poultry Husbandry, who wrote Separate No. 100 under date of January 9, in regard to my inquiry, mentions in addition as available nuts, beechnuts, chestnuts and pine nuts, thus showing that the woods offer rich feeding ground.

Elimination of oak, scrubapple and wild cherry is specifically recommended on page 24 of No. 845 as greatly assisting in reducing the number of browntail moths. But the insect can subsist admittedly on almost anything except conifers.

The Bureau of Biological Survey publishes literature on how to attract birds, and lays special stress on the value of fruit bearing shrubs and trees, while the Bureau of Entomology urges their eradication, for they are host-plants to practically all the insects and fungi that attack the cultivated trees and shrubs. Wild birds cannot be strictly controlled, nor can they be owned, but poultry can be controlled and owned. Nutbearing trees and shrubs, wild, and planted and grafted, are one of the very best plants to use to clothe sidehills with to prevent erosion. These nutbearing trees, in common with other vegetation, are affected by insects and fungi, their greatest enemies being weevils. All these weevils pass the winter as larva in the ground. These larvae in the fall and spring are near the surface and can be found by poultry. Hogs can admittedly be fattened by being given access to eat up the nuts that are not gathered or are wormy,

It cannot be denied that it is in accordance with the law of nature that all lands not fit for agricultural purposes should be kept in timber of whatever kind best succeeds, in a given locality, and that the steeper the slopes the more necessary it is that the undergrowth and ground covering should be interfered with as little as possible. Thus the woods will harbor many plants that would, for instance, sustain the apple maggot. These plants would include haws, crab-apples, huckleberries and blueberries. Under primitive conditions the fruits of these plants are eaten by bovines and other animals. and to avoid having them serve as sources of infestation to cultivated plants, it is clear that cattle, horses, hogs and sheep should have access to eat the fruits. Poultry will be of benefit chiefly by securing larva and pupa from the ground, the period extends for about nine months in the year.

Take another case: The larch sawfly does often very great damage in north-eastern New England, The Bureau of Entomology has no means of control to offer. The insect passes the winter as pupa inside of a cocoon in the rubbish beneath the trees, during 10 months out of 12. I had shown in my Circular No.

149, pp 16 and 17, that poultry in large numbers, and giving them the run under supervision of man over the tracts thus affected, solves the problem. Besides when plentiful these caterpillars crawl in great numbers on the ground, and make fit food for poultry, being devoid of poisonous hairs.

A similar case of importance: The grape berry moth passes the winter as pupa in a cocoon, usually spun on a grape leaf during October. These leaves, normally, are blown together during the winter in sheets, and there hibernation takes place. What is needed, clearly, is to give poultry access to these leaves.

Preserving as far as practicable the natural undergrowth everywhere is necessary to secure the more nearly even flow of rivers, through holding the rainfall instead of having the water rush off to the sea, filling up the rivers with sediment at one time, and failing to have the rivers give the flow they are normally capable of at other times.

Further: The more vegetable matter is thus allowed to accumulate on non-agricultural lands, the less will there be vegetation that will dry up during the late summer and fall, consequently the less will be the danger from fire.

Still another thing: Some insects are held more in check by fungus diseases than by parasites. These fungi do not develop in the absence of moisture. There is good reason to believe that the range caterpillar is normally kept in check more by fungus disease than by parasites, for as it feeds on or near the ground, fungus disease developing during a spell of hot, moist, weather, has a specially good chance to get a hold. However it is well known that the range has been kept overstocked for years. Thus it is easy to see that absence of enough vegetation to hold as near as feasible what precipitation there occurs—and it occurs there mostly in the form of sudden heavy local downpours—failed to provide the conditions necessary for the developement of the fungus. These conditions require the presence of a certain amount of humus. Thus it is highly probable that the Entomologist and his trained scientific Staff, and also the New Mexi-

co State Entomologist, are altogether watching the wrong hole as far as natural agencies of control are concerned.

What can be done? On the open range nothing can be done, unless laws are enacted to enable the stockmen to fence the land popularly considered to be each man's range—the land half the distance from each man's watering place to that of his neighbor's. This matter is very ably discussed in U. S. Dept. Agr. Bulletin No. 211: Factors affecting range management in New Mexico. The greatest stress is laid on the necessity of avoiding erosion, and the chief remedy pointed out is avoiding close grazing.

Just for contrast how is this: "Under certain favorable circumstances the winter burning of restricted areas has proved of great benefit in destroying the over-wintering egg clusters. Cultivated areas usually may be protected by winter-burning the surrounding egg-bearing grass, weeds or other vegetation. However such burning destroys the grass crop for that year..." (U. S. Dept. of Agr. Bulletin No. 443, p. 11.)

Avoiding close grazing, then, produces conditions more suitable for the development of fungus disease in summers of more than normal rainfall. Overstocking has been going on for many years. If the range caterpillar has become plentiful because of the absence of insect parasites, as is officially claimed, overstocking would seem to have been the cause. If so, there then is no good reason to expect that breeding parasites would be of benefit as long as close grazing is not avoided.

Of the introduced natural enemies 3 kinds of large ground beetles (calosomas) are considered to be among the most important. As far back as 1915 in my Circular No. 147, p. 16, I had quoted evidence from U. S. Dept. of Agr. Bulletin No. 250, The *Calosoma sycophanta* in New England, and showed that skunks, raccoons and foxes destroy large numbers of the beetles before they can emerge from the ground and climb up the trees and that, because of this, they are kept rather scarce even in woodlands, where after emergence they are out of reach of ground

inhabiting vertebrates. On the range this is not the case, hence this beetle has there not the slightest chance to become a factor in keeping down the range caterpillar,

Because of this, it was shown that in making systematic use of poultry for control the thing to do is to trap or shoot the skunks and other predatory animals, bringing in at the big prices paid for good furs considerable money, and at the same time this serves to protect the larger stock, especially sheep. This can be easily done because the poultry is to be corralled at night within a moveable woven wire fence, and the predatory animals will nose around outside.

Copies of my Circular No. 151 were sent to the State Entomologist of four of the New England states most affected. I also made other efforts to get officials of these states to act. Only one of them made any reply. He said: "The possible benefit that might arise from the use of poultry for a means of destroying gipsy moth eggs is problematical..." Exactly. The attention of the Bureau of Entomology was called to this in 1915, and instead of carrying on tests, they now claim I am wrong on this and everything else. Since about 20% of the eggs are within reach and about 75% of these are within plain view of poultry, and these are present at a time, during the late fall, winter and early spring, while animal food is scarce, poultry will naturally feed heavily on these. Then since the caterpillars, especially while young, frequently lower themselves it was shown, they thus also often come within reach of poultry. To what extent they then thus can destroy the pest is thus also left to be problematical, this while Congress is appropriating special funds for just this purpose.

The gipsy moth caterpillar exists in six stages, since it molts five times. The several lengths are $\frac{3}{8}$, $\frac{1}{4}$, $\frac{5}{8}$, $1\frac{1}{4}$, $1\frac{1}{2}$, $2\frac{5}{16}$ inches. It takes about 50 of the third stage caterpillars to equal the bulk of one specimen of the sixth stage. The New Mexico range caterpillar passes through the same stages, but length

and bulk is materially greater. Chickens having the run of woods can thus destroy vast numbers of young gipsy moth caterpillars without even feeling satisfied, and that, too, without any injurious effect on their health. It is the same with the range caterpillar.

On pages 32 to 35 of my Circular No. 151 I described what is an easy and sure means of controlling the sugar cane borer moth. Since the Bureau of Entomology would not speak I tried to get the Louisiana Sugar Experiment Station to state its position. They did nothing of the kind.

The means outlined rests upon the fact that the borer prefers young corn for breeding, and also takes advantage of the fact that the moths hang on the plants during the day, thus enabling poultry to secure at least part of them. Trap patches of young corn are provided during the whole season especially in late summer and fall to attract and hold the last brood, which upon going to hibernate in the ground is then destroyed by plowing. This plan not only protects the cane, but also makes possible the growing of an adequate supply of corn on a sugar cane plantation.

As cane supports the mealy bug, and as the presence of the Argentine ant results in an estimated five-fold increase of the pest, I had asked also the Station what they think of my plan of using poultry to control this pest by scratching up the shallow nests, as discussed on pages 19 and 20 of my Circular No. 151. They did not reply.

With the boll weevil now covering most of the South Atlantic States, territory that used to grow much long staple and Sea Island cotton, and the Argentine ant getting a good foot-hold there also, I wanted to see what the State Officials of the Gulf and South Atlantic States would do when shown the facts as given in my Circular No. 151. Only two made any reply at all. While the two replies in question did not go into any details, they at least showed that the offices they emanated from are oc-

cupied by men and not by scared rats.

How is this for a straightforward reply: "November 8, 1917 will state that it has never been the policy of this department to participate in controversies that do not concern us. We are not in any way interested in your controversy with the U. S. Bureau of Entomology. The men who have conducted experiments on the boll weevil and other insects, for the Bureau, are among the most able men in this line of work to be found in this country, and we have no reason to disagree with them in recommendations which they have made as results of their investigations, State Entomologist."

This man is at least candid. But have his Commissioner of Agriculture ask him whether the U. S. Bureau of Entomology has made any recommendations satisfactory or otherwise, to control the Argentine ant at large, and he has to admit they have nothing of the kind, a matter discussed on pages 19 and 20 of my Circular No. 151. Ask this man whether the means of controlling the boll weevil as advocated by the Bureau are all that can be desired and he has to admit that a really satisfactory means of control must make it easily practicable to utilize the whole season all over a given region. The people of his state are manifestly agreed that he should be interested in these things. His ability to serve his people is at present confined to stating his view of the merits or demerits of the case, so that the representatives of the people of his State in Congress may know the reason. Claiming to have no reason to disagree with the Bureau implies a condemnation of my method, and an endorsement of the Bureau's method, and calls for an explanation why my method should be condemned. And failure to make such an explanation in the first place, implies he cannot make any.

The other reply came from the State Horticulturist of an adjoining state. He stated after having a copy of my Circular No. 151 for a day, that he finds it very interesting, but is unable to get the proper view point, because he does not know who I am and why I write these circulars. Thus here, for once, you have

an unspoiled, guileless soul to start with.

He was told, in essence, that the U. S. Bureau of Entomology does not hold a corner on brains, that to present my case and protect myself I have to use copyrighted books; that as long as I do not get fair play the matter keeps out of general circulation; thus that, for instance, the cotton planters have to use the method of controlling the boll weevil the Bureau describes and claims to be good, when it is actually worthless, and when there can be made available one that is good, and that to get fair play I want to find out whether the State Entomologists are willing to do the right thing by their states and define their position. He was told his State Entomologist, through his former connection with the Bureau of Entomology in boll weevil investigations, knows me well enough for all practical purposes, and is an ideal man to point out any sore spots that might exist on the method of boll weevil control, as described in my Circular No. 151. There was no further reply. Evidently his State Entomologist succeeded in prevailing upon him to do nothing in the way of stepping on Chief Howard's corns.

What is known as white pine blister rust has been described in Farmer's Bulletin No. 742, issued June 9, 1916. It is claimed there that the pines suffer from a rust, and that to prevent that rust upon pines, it is necessary to destroy all currants and gooseberries—wild and cultivated.

I shall show that the pines suffer from a cankerous disease, and that what is known as rust on the pines is the hibernating form of a fungus disease affecting currants and gooseberries, and this rust, on pines, affects merely decaying tissue, and does, therefore, no damage to pines, and destruction of the currants and gooseberries would not in any way stop the cankerous disease; shall show it all, too, from the statements of the author, Mr. Perley Spaulding, Forest Pathologist.

According to Mr. Spaulding infection of the pines takes place through what is known as teliospores, produced in late summer and fall upon currants and gooseberries. These "...fal-

ing upon bark of suitable age on white pine, may in turn germinate, penetrate the bark and grow in the inner layers during the incubation period..."

I shall show that the "suitable age" has nothing to do with the germination of these teliospores, but that the cankerous disease requires for development the parts on pines that are of suitable age, and that these teliospores cannot germinate upon, and penetrate, the bark of healthy pine that is suitable for the development of the cankerous disease.

"A period of incubation follows the infection of white pines. This period may vary from less than one year to six or more years. [p. 11]Then the bark begins to swell at the point of infection...,the parasite pushes forth, through tiny openings in the bark, small drops of a clear, sweet tasting fluid. This is not pitch. In it, if examined by a microscope, immense numbers of tiny spore bodies. These may be found early in the spring before the formation of the blisters described below, or they may occur apparently at almost any season in late summer and fall. What the function of these tiny spore bodies may be, nobody knows. They occur in a considerable number of closely related parasites, but they are not known to reproduce the disease in any way. They are simply indicators of the disease. They are known as pycnosporos. Shortly after the pycnosporos are produced, from the latter part of April until the middle of June, the real fruiting bodies push their way through the swollen tissues of the bark... known as aeciosporos or *Peridermium* spores....If one of these falls upon a leaf of a currant or gooseberry it is able to attack that leaf....These new spores...are called uredosporos....a new generation of uredosporos being produced every two weeks:... From the latter part of July until the fall of the leaves. Still another form of fruiting body and of spores is produced...These are known as teliosporos...,in order to carry on the disease they must attack the bark of young white pine or young parts of old white pine.... This infection of the pine bark must take place in the late summer and fall. If the parasite finds conditions very fa-

vorable, it may produce the sweetish drops of liquid with the pycnosporos early the next spring and shortly after that it may produce the blisters containing the Peridermium spores....Because of the fact that the peridermium spores produced upon pine cannot infect pine and that the teliosporos produced upon currants cannot infect currants, we immediately perceive that if the two sets of host plants are separated widely enough so that the spores produced upon one cannot reach the other, the disease cannot spread." (p. 14).

Wrong. The teliosporos germinate only on parts of pines previously diseased, and which are producing the pycnidial drops. These teleosporos penetrate the diseased bark and in the spring produce the Peridermium spores, and nothing else. That they do not produce the pycnosporos is proven by the fact that the pycnidial drops "may occur apparently at almost any season in late summer and fall," because there are then no teliosporos to produce them. To claim that the pycnidial drops containing the pycnosporos are simply indicators of the disease, is little short of absurd. We know that in the case of the pearblight there are similar exudations and the disease is spread by insects feeding on them and infecting other trees.

We have to do in this case with a disease of pines, very much what pearblight is to pears. The disease is spread by insects—wasps, bees, flies etc., in the case of the pearblight—carrying the so called pycnosporos to parts of pines susceptible to attack. If all the currants and gooseberries were eradicated—and this is the means of control proposed—there would be no uredosporos to produce teliosporos to germinate on diseased parts of pines and produce peridermium spores in the spring, but the disease that is really killing the pines is then there as before.

What can be done? The fungus disease on currants can easiest be kept down by an occasional slight licking of the under side of the leaves with a hot air blast torch, a suitable type of which is shown on last page. This was pointed out by me as far back as 1898, but the Bureau of Plant Industry never made any tests to satisfy themselves.

What actually kills the pines is a bacterial or cankerous disease, similar to pearblight. As far back as 1903 I had called the attention of the Bureau of Plant Industry to the possible use of heat from a hot airblast torch, through repeated slight lickings, upon these exudations. They said, it might be of some value, but nothing was done to test it out.

These pycnospores are not spores at all, but are microbes, and the sweet tasting fluid they are in serves to attract animal life to carry the disease to other plants, same as in the case of the pearblight, as will be shown.

On page 25 of my Circular No. 139, 1913, I described what I considered a much better method, in fact, I propose to show that it is far the best thing that can be used of anything now known. I give the original description in full.

"If the use of a torch should be shown to be of no value in this case, I would consider that smearing the exudations over with some such matter as air slacked lime, or a mixture of it with clay, carbonated or otherwise, made strongly disinfecting, or not, as tests may prove to be best, applied dry, or probably more successfully in paste form with a plasterer's trowel, would permit the tree to throw off matter it wants to throw off, but would not permit the insects to have access to it. Of course, this paste, after getting dry, is quite liable to crack, due to evaporation as well as due to the growth of the tree, but these cracks it should be easy to fill up by dashing with a paste brush or a suitable broom some more of the same stuff, in more liquid form, over the stuff already on. To thus prevent pear blight, or what is also called fire blight, and control diseases of similar nature, work on covering up the exudations or the spots where they are breaking out must naturally be prompt for best results. Possibly a semi-liquid smear, applied with a paste brush, will prove to be best."

According to the Secretary of Agriculture, that, with all else I have pointed out, is theory and all wrong. Let them examine the evidence following and show what is wrong: Pear blight "attacks and rapidly kills the blossoms, young fruit, and new twig growth, and runs down in the living bark to the large limbs and

thence to the trunk...." (Yearbook U. S. A, 1905, p. 295.) "Pear blight varies in severity...the microbes travel about... notwithstanding the fact that they are surrounded and held together and to the tree by sticky and gummy substances..." (p. 296) The pear blight microbe is a very delicate organism and cannot withstand drying for any length of time..." (p. 297) In early spring....it spreads rapidly and the gum is exuded copiously from various points in the bark and runs down the tree in a long line. Bees, wasps and flies are attracted to this gum and undoubtedly carry the microbes to the blossoms..., (p. 298) The key to the whole situation is found in those cases of active blight [comparatively few] which hold over winter. If they can be found and destroyed the pear blight question will be solved.." [p 298] "The only really satisfactory method of controlling pear blight.. is... by cutting out and burning every particle of blight when the trees are dormant, [p. 299].. in the orchard or within a half mile or so from it. Every tree of the pome family [apple, pear, quince, crabapple, mountain ash, serviceberry and haws] should be examined for this purpose, the blight being the same in all..." [p. 300.]

This cutting out is too severe a measure. The cases of blight that hold over winter are usually found on big limbs or on the trunk of the tree. To cut them out there involves making a dangerous wound, inviting attack by fungi and by insects. In addition this work of cutting and burning is very slow. If cutting be practiced, the health of the tree requires that the great wounds thus caused be protected, involving much time and expense.

It is obvious that it is as safe to say that the key to control consists in rendering the exudations in the spring harmless, since they, admittedly, contain the microbes. In an orchard the

plan shown by me would consist in covering the exudations with some suitable smear to absorb the moisture, thus both killing the microbes and keeping off the carriers of the disease. Merely digging up some soil or a clump of grass and rubbing over the places where the exudations occur, beginning when they are about to occur, and going over the trees every few days, to supplement this where necessary should be all that is needed. This course will then enable the tree to heal the canker over and incidentally to keep out insects and fungi. This would seem to be the only feasible course on wild trees. These moreover are usually not on the orchardist's land.

It will be seen that this course would also fit a similar bacterial disease of the plum and related stone fruits.

I do not consider that this course is feasible on white pine trees, covering forest lands. I consider that the most feasible course consists in taking a little white pine or other handy evergreen branch and slap this about the infested parts of pines and do this while the pycnidial drops are produced, especially in the spring. It would seem certain that this causes the pycnidial drops to dry up, thus killing the microbes they contain. About the best thing to do is for the operator to carry a brush hook, since he may have to hew his way to where he wants to go. He thus also has a weapon in case he encounters a dangerous animal.

In 1916 this disease was known to be present in New Hampshire, Vermont, Massachusetts, Connecticut, New York and Pennsylvania. It had also been found previously in New Jersey, Ohio and Indiana. Probably the trees known to be infected were there destroyed and the disease was considered to have been exterminated. "Imported white pines of suspicious origin are known to have been shipped as far west as Illinois and Minnesota, but not beyond the natural range of the eastern white pine." What a nice little job it would be to grub out all the currants and gooseberries west to Minnesota as a matter of supposed insurance and precaution! "The white pine, in many sections

at least, is much the most valuable tree now available for future forests. Its loss would be a real catastrophe, for no other tree can take its place." (Bull. No. 742, p. 6)

Which shows that public interest requires that I be given a square deal, have the Department of Agriculture admit that I am right, or else show what is wrong.

Using a hot air blast torch to control rust on currants and gooseberries is only one of the many uses to which heat thus generated can be put, described at length in my Circulars No. 130 to 147. For instance, the Eastern States are now becoming heavily infested by the pearthrips. I had shown to the Bureau of Entomology in my Circular No. 147 that torches of any type needed can be readily constructed, and that heat applied while the pearthrips are in the larval stage will cause them to drop, and they can then be killed by applying more heat to the ground. Where the insects do not drop, as is the case with scales and lice, repeated slight swift lickings will keep them down, and at far less cost than any other known means. This also always destroys the spores of fungi that are present. I had also shown in my Circulars No. 139 to 147 how insects can be trapped in large numbers with the type of torch shown, properly fitted up. For instance, while nutweevils spend the winter in the ground, and should be kept down by poultry and hogs, adults might appear in alarming numbers. Practically all these fly to lights and could be trapped. The pine weevil, which eats out the apical shoot, is a similar case

In my Circulars No. 148 to 151 purposely very little has been said about this use of a torch as a trap, or about a still better and much needed system of trapping I could describe. There is nothing for me in any mechanical device as long as the the U. S. Entomologist is permitted to claim I am wrong on every point without being compelled to show where the wrong comes in.

So beginning with Circular No. 148 I began to work out a detailed system of control for insects where no apparatus is needed. These include the range caterpillar, the boll weevil,

the bollworm, the Argentine ant and the gipsy- and browntail moths, taken as farm and forest pests.

The range caterpillar, for instance, does most of its damage within North-Eastern New Mexico. Thus here we have a more or less localized trouble. If it is not feasible to interest the State Authorities, the Members of Congress and the People, I simply bide my time. I tried to get Mr. Wildermuth, who wrote U. S. D. A. Bullentin No. 443, treating on the range caterpillar, to state his side. There was no reply.

Texas is now up against a similar proposition. Newspaper reports have announced the discovery of the pink bollworm in 5 counties about Galveston, claimed to have come from the Laguna district in Mexico. "Congress appropriated \$250,000 for the fight and the State of Texas also put up money. The next step will probably be the creation of a wide zone in Texas where cultivation of cotton will be forbidden for a number of years."

Under date of Aug. 7, 1914, the Department of Agriculture issued a Circular giving general information about the pink boll worm, but refrained from suggesting any means of control. According to that Circular the pink bollworm cannot be starved out through failure to plant cotton. On page five of it you can read: "Occasionally the pink bollworm appears to attack other plants" (than cotton)...

I tried to learn through the Bureau of Plant Industry what plants we might have in this country closely related to these food plants. My request was referred to the Bureau of Entomology and Chief Howard stated: "The records which you mention of other food plants of the pink bollworm have been proven by recent investigation to be erroneous. The only normal food of the worm is cotton."

That is, cotton, as far as is known. If so, it is theoretically possible to stamp the insect out by growing no cotton in the infested area. Anyway, adopting the use of poultry and of trap-patches for the control of the boll weevil and the bollworm outside of this area is the best precautionary measure now known

against the spread of this insect should it occur beyond what is believed to be the infested area.

From what has been published on the life history of this insect it may be assumed it has at least three generations a year. "First a considerable number of squares and bolls are so injured that they fall to the ground. In case of heavy infestation 50 per cent of the crop may be destroyed in this way... A single lock of a boll may be infested. In such a case the remaining locks develop, but the boll opens prematurely and the fibre is short and kinky... Moreover the work of the insect leaves stains in the fibre... Mills ordinarily obtain from 19 to 20% of oil, the amount...was found...reduced to from 16 to 17%... In many cases the infestation must be so high that at least double the usual quantity of cotton seed must be used to secure a stand." (p. 4)

The insect seems to pass the winter as larva and pupa in cotton seed exclusively, although "pupa have sometimes been found in the lint." (p. 6) Thus the insect can be attacked by utilizing the seed not wanted for planting before emergence takes place, or else, the seed has to be sacked or kept in a screened room to avoid the escape of the moths. There seems to be difficulty to separate the infested seed from the uninfested.

All in all the means of control described by me for the control of the boll weevil seem to fit this new comer to a dot. The fallen squares and young bolls, of course, can be attacked in no other way than by poultry. Given the choice, there is every reason to believe that later in the season they would forsake the old plants to oviposit on the trap-patch advocated for the control of the boll weevil and the bollworm.

There is a strong suspicion that if it were attempted to control the insects by early destruction of the plants, it would readily learn to feed and breed in plants other than cotton. The adults during the whole season will during the day time be hiding about the plants, and many will be found by poultry. In addition, if further means of control were necessary, it is highly

probable that this insect can be easily trapped by the use of a torch fitted as a trap, as described by me in short on pages 7 & 8 of my Circular No. 151.

In my Circular No. 139 and subsequent Circulars, I had shown from official tests and tests made by myself that the codling moth is but little attracted by light, if the light is diffused through an opaque globe and is thus diffused pretty evenly all over a room, and that on the other hand the codling moth is strongly attracted to light that is thrown upon spots, as happens in case a common lamp has a stiff paper shade and throws its light upon a table and leaves the rest of the room in darkness. Spiders, flies and mosquitoes cannot be said to be attracted to light, yet I have repeatedly known them to make their way to light under the latter conditions. The Entomologist was wanted for five years past to test this point out to his heart's content. Having done nothing, he now wants to claim I am wrong.

In using a torch for a trap the insects are originally in darkness without, and can only come to the light by entering between two corresponding cone-shaped attachments about an inch and a half apart and encircling the red hot burner. The narrow quarters within causes the insect to bump against the red hot burner and against the cone-shaped attachments, becoming thus temporarily disabled. This causes them to drop and thus fall through a hole in the center of the lower attachment into a pail below, to get killed by the downward blast from the torch.

The entomologist's idea of trapping consists in placing pans with water and kerosene near electric lights. Utterly impracticable as this was shown to be on page 7 of my Circular No. 151 a catch of any kind would thus be quite accidental. In a cotton field for the bollworm moth a large pan with a lantern set on bricks is the method that has been used in tests by Entomologists. A few moths were thus caught. The wonder is that any were caught. In the first place the light in this case is diffused over too great an area offering no special inducement to come

close by or to sit down on the water and kerosene. Then again, if a bollworm moth accidentally sits down upon the water, being a strong bodied moth, it is liable to get away. This holds good especially with the hard bodied kinds which are not immediately affected by the kerosene.

There is urgent need for the introduction of a trap that traps. The female of the European pine shoot moth for instance lays her 100 eggs singly in the top buds of the shoots, selecting as far as practicable the apical cluster of buds on young trees. I had shown that on young trees these apical buds can be protected by pouring some semi-liquid clay over them before the period of ovipositing begins. This of course, is purely a repellent measure. To secure material reduction of the insect the only feasible means is the use of a trap that traps, such as described by me. In this case there is utilized for a trap an apparatus intended to be used during the day for other work.

The European pine-shoot moth was introduced during the same period and through the same importation which brought in the disease known as white pine blister rust. Naturally it is spread over much the same territory.

As to natural enemies of the pine shoot moth "As early as 1838 Hartig recorded 14 ichneumonid wasps and a tachined fly.. to promote the good work of these parasites specially constructed rearing houses have been created in Europe during bad outbreaks..." (U. S. D. A. Bull. No. 170, p. 9.) This shows that to encourage the increase of parasites is nothing new. In spite of this work, however, and of collecting infested shoots as a regular measure, "75 acres of young pines planted in 1878 became infested to such an extent that hardly a shoot was spared, and in 1884 the entire plantation presented a pitiful, crippled appearance." (p. 3.) "The species attacks mainly young trees between 6 and 15 years of age, but it is often excessively destructive to younger plantings and seedlings and injures also the other trees. (page 3.)

Thus it will be seen that protection of the apical bud by an application of semi-liquid clay is quite feasible in a very large part of cases. Since these same trees are even then preferred for oviposition, by operating a satisfactory trap in such plantings the number of moths can be greatly reduced. All this and more was described originally in my Circular No. 145, in 1915.

Farmers' Bulletin No. 856 has recently appeared. It treats on the diseases and insect enemies of the home vegetable garden. On page 35, relative to the control of the harlequin cabbage bug you read: "...The plumber's torch is effective for this pest, destroying all the insects with which the flame comes in contact... These torches are not practical against many other insects and their use should be restricted to this species and a few others.."

I was first, in 1898 to point out the use of a plumber's torch against this insect. I also at that same time showed that the adults congregate upon tassels of sweet corn, hence can be picked off there, with the torch, or by hand. I also then showed that the flame and heat generated by the torch is the most practical means of control in many other cases. For instance I showed it to be of great value against the chinch bug. According to Entomology Bulletin No. 95, part 3, page 38, the Bureau now claims: "The flaming torch is not altogether satisfactory on account of the liability of damaging the plants..." Ask them what other means they have and they tell you: "The burning of grasses and rubbish about the farm to destroy chinch bugs has been often recommended and is doubtless the most effective measure to be taken against future ravages of the pest." (p. 36)

Any one familiar with chinch bug emergence in the spring knows of the countless billions of winged adults that drift about during warm spells in April and May. They come not only from "grasses and rubbish about the farm," but from woodlands as well, nothing to say about buildings. Such burning, in a few years, destroys most of the fertility and ruins the farm by erosion. Moreover this burning may bring no practical results, because the next spring and summer might be warm and moist

and thus reduce the pest through the developement of parasitic fungi.

Other means of combating chinch bugs, as given by the Bureau, are dust barriers, coal tar barriers and kerosene emulsion. All of these admittedly, have their drawbacks. Two points, called attention to by me as early as 1898, have been entirely ignored. They refer to the habit of the chinch bug to go into the ground during cool nights and cold days. Also that the torch should be used preferably during the cool parts of the day, especially in the cool part of the morning while the dew is on. In the case of chinch bugs traveling from harvested small-grain fields to corn, and there clustering on the outer rows, there is nothing to prevent the use of the torch during all of the night, this the more as at this period the nights are usually warm enough to prevent any great number of bugs to seek the protection of clods about the plants. During a cold spell all the bugs will be hidden under the clods and a torch approaching and playing about the base of the plant gets them all without any injury whatever to the plant.

I showed in 1898 that this holds good with many other insects and pronouncedly so with most of the cucurbit insects, showing that by carefully lifting a vine, especially in the early morning and letting a blast blow on the ground about the plant, the ground becomes usually at once fairly alive with insects.

Later I showed that by mulching all or part of the plants with half-rotted manure especially inviting hiding places are furnished. I also showed that the foliage of cucurbits sustains a surprising amount of heat without injury, facilitating greatly the destruction of insects on the leaves, such as young squash-bugs or lice, located on the under side of the leaves. I also as early as that showed that such use of flame and heat destroys the spores of fungi with equal facility on the upper and lower side.

Later, in my Circular No. 139 and subsequent Circulars I showed specifically that flea beetles are best attacked by taking advantage of their habit to spend the night under clods on the

ground, laying special emphasis on the need of making use of this feature in the control of the hopflea beetle on the Pacific coast.

In Entomology Bulletin No. 82, part IV, p. 42 you read: "The (hop flea) beetles go into the bud scales or down under the clods at the base of the vine on cold nights, but when mild weather approaches they remain on the leaves..." And in No. 66, part VI, p. 74 the manager of a large hop yard in British Columbia says: "...In the middle of July the beetles were so numerous that the ground was fairly alive with them. They go into the ground in the evening and come out again in the morning..."

There are two broods in British Columbia, the first emerging during the end of April and first half of May. Naturally the thing to do is to go after this brood, since the nights are then cool and the pest can be cleaned out with the torch with the greatest ease, if necessary doing part of the work during the night.

Compared with this the Bureau has nothing to offer that in any way approaches these results. And the same holds good in a general way, in the case of all other flea beetles, with all lice and mealy bugs on growing crops, in fact with any insect requiring a contact insecticide or not readily amendable to the use of poison, such as is the cabbage worm and potato beetle (bug).

In the case of the harlequin bug I had since shown that since the harlequin bug lays her eggs on a variety of cruciferous plants, wild and cultivated, and selects the underside of the leaves, the immature insects can usually not be seen without turning the leaves by hand, and I showed that far the easiest way of control consists in seeing to it to have during all the season some cruciferous in bloom. The pollen then attracts the adults and being in plain sight, they can be picked off by hand, with a torch, or by the use of poultry.

Of course the plumbers torch is not by any means the most practical kind of torch that can be used. A torch of the knap-

sack type as shown on last page is the best thing all around. The onion thrips for instance is very destructive to onions, cabbage and many other crops, the insect being capable of 6 or more generations in a season. It can best be attacked by having a blast blow along the row upon the ground, The insects while in the nymphal stage are very susceptible and unable to get away except by dropping to the ground, which however makes it possible to destroy the pest without applying much heat to the plant itself.

An insect of greatest importance where the use of heat is far the best means in sight is the pear thrips. In my Circular No. 147, and elsewhere, I went into details showing that there is no difficulty to construct torches to treat big orchard trees. I showed on page 12 that the practicability of this system rests upon the fact that five gallons of gasoline will keep four burners going 20 hours under a pressure of 30 to 40 pounds. There is nothing in the way of a spray, except where poison can be used to advantage, that approaches heat thus generated and applied, as an insect killing agent for cheapness, where a contact insecticide is required. Canker worms or brown tail moth caterpillars, for instance, might be present. These are practically immune to poison, while the use of a torch settles both these and the pear thrips. A slight licking makes them fall to the ground where they are killed by further application of heat. This insect has a wide range of food plants, wild and cultivated, and because of this requires an easy means of control to be successfully combated.

Hooverize! Hooverize is the cry! Hooverize is the official cry! We have the meatless day and the wheatless day, but why can we not have the humbugless day seven days in the week? Have the Congressional Committee on Agriculture take up the issues at question and you increase output of food by more than a ship load a week, by avoiding waste caused by insects and fungi, representing a value of more than a billion dollars a year.

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