On The Control of Sugar-Cane Insects.

Circular No. 155. May 16, 1919

The world's increasing demand for sugar is resulting in increased areas being devoted to sugarcane. At the same time this increased area tends to increased injuriousness by insects and plant diseases. Very little in the way of securing efficient means of controlling either insects or plant diseases on sugarcane has as yet been accomplished. I propose to point out better means of control. As the sugarcane insects of Hawaii are pretty exhaustively treated in U. S. Dept Agri. Bulletin No. 93, I will begin with a discussion of these.

The most important sugarcane insect in Hawaii is the sugarcane leafhopper. It has been introduced from Australia. It has also been recorded from Java. With the lively commerce through the Panama Canal this exposes the canefields of the Southern States to continual danger of infestation. In addition as far back as 1841 a related species feeding on sugarcane was recorded from the West Indies (p. 34). This "insect lives in company with its larva in large numbers behind leafsheaths, which it punctures to imbibe the sap of the plant. When mature it is exceedingly active in its habits, springing with suddenness from its resting place at the least disturbance..." [p. 12]. "..The leafhopper, during heavy infestation will continue to puncture the midribs of the leaves as rapidly as the leaves unfold... Ordinarily when disturbed the adult leafhopper does not fly, but moves off in an odd sidewise fashion to another part of the leaf, or springs suddenly to another portion of the plant..."(p. 16).

As to means of control officially advocated we have to consider direct measures, indirect measures and natural control.

The direct measures are: Insecticides, collection by nets, cutting and burning the infested centers, stripping the leaves, and burning of trash after harvesting (p. 22). In practice, admittedly, none of these things are of any value. Of insecticides no tangible results could be secured. Collecting by nets "was also discarded." Cutting and burning showed "that the adults were able to take flight from the burning cane and escape to adjoining fields." Stripping the leaves "...showed... that in heavy infestation the internodes of the stalk of stripped cane contained hundreds of punctures from egg laying..." Burning of trash "...is the most effective method practiced for the control of the insects of sugar cane." But on page 33 Dr. Perkins is quoted as saying that "on the Colonial Sugar Refining Company's estate in Australia no such burning off is allowed. If this" (supposition that this increases the number of natural enemies) "is correct, it may help to account for the insignificant numbers of our cane leafhoppers here..."

One of the indirect measures consists in selection of varieties of cane for planting As to resistance "...the Yellow Caledonia made the best showing." But as to sugar production—ton for ton—it seems to be inferior to other varieties, for, as usual, everything the Bureau hands out must be taken with a grain of salt—"it is for the planter to decide whether or not the advantage of one variety over another are offset by the ravages of the leafhopper..." (p. 24).

Another indirect measure "natural methods," consisting in intensive cultivation, fertilization and irrigation, resulted in a lower rate of loss than fields not so treated. Naturally, keeping the field clear of weeds early in the season tends to drive hoppers to places not so clear. Whether with all fields so treated this would result in a decrease in number, taking the fields as a whole, is not at all proved. Another indirect means, diversification of crops, is recommended. This means a decrease in acreage. Of course, if no cane were grown at all, and other possible food plants were kept down, it would be possible to starve the hopper out.

Another indirect means claimed is "the control of the rind disease of sugar cane." But the control is merely declared to be desirable, for no means of control does exist.

The natural control consists in the fostering of natural enemies of the hopper. These are chiefly parasitic and predaceous insects, and certain fungus diseases. The burning of the trash is conceded to be inimical to the development and perpetuation of the parasitic and predaceous insects. And with burning of the trash, now officially considered to be imperative for the control of cane insects in general, it is now proposed, as far as control of the leafhopper is concerned, to propagate and distribute the natural enemies artificially.

Parasites are liable to be decimated at any time by hyperparasites. "Several species of ants were very active about the leafhopper in the canefields, the honeydew being an attraction to them" (p. 28). That means that these ants will work towards the increase of the leafhopper by attacking as far as possible the parasitic and predaceous insects that pray upon the leafhopper. And altogether there is reason to believe that most of what natural control there is, comes through the working of the two fungus diseases that are present, "which long previously known to kill the native leafhoppers, have become transferred to the introduced pest..."(p.32).

As this leafhopper lives behind the leafsheaths, there is just one thing that will work there and that is the hot airblast torch. This insect hides similarily to the chinchbug. I had shown as far back as 21 years that the blast from a common plumber's torch makes the chinchbugs and other insects capable of locomotion hidden behind the leafsheaths come out in a hurry and tumble to the ground where they can be killed by the blast at close range. I had shown that the best time for this is the cool part of the day, or spells of cool or wet weather. The higher the temperature the more readily will adult leafhoppers be able to jump or fly out of range. But during hot weather work against the adults with a torch can be kept up from the cool of the evening during all of the night and most of the forenoon, say 16

hours out of 24. During the remaining 8 hours the work can be kept up, but the blast should approach the bugs in a backward stroke. In this way the bugs will not become restless enough to get away before the blast is upon them.

The Hawaiian sugarcane borer is second in importance in Hawaii and this insect also hides, during the day, within the lower leaf sheaths as do many other injurious insects of less importance. The use of a torch will cause them to come out, most, if not all, will fall to the ground, there to be killed by the blast. The present official way consists in collecting the adult weevils by hand, either hidden behind the leafsheaths or hidden under split pieces of cane distributed through the field.

Again, there is the sugarcane mealy bug "congregating for the most part behind the older leaves near the ground" (p, 44). An occasional licking will keep them down. The official means of control consists in "Selection of seed cane" and "Burning of trash" and, of course, "Natural enemies." Most if not all ants present protect and foster the mealy bug, incidentally defending it against its natural enemies. Hence you see a need of a means control applicable to the growing cane, as furnished by a torch. This not only kills the ants it hits in licking of the bugs, but the ants can be traced to their nests and a blast blowing about it will bring the colony out so it can be destroyed.

In Hawaii "an aphis... is occasionally injurious to cane" (p. 45). Remedy: The use of a hot airblast torch. Of course the use of a common plumber's torch is not advocated, some such type as is shown on last page should be used.

"In some districts... a mole cricket... is sometimes abundant enough to be injurious. Another species... is a most important pest of sugarcane in the island of Porto Rico... wherever the Hawaiian mole crickets were numerous almost all of the seed cane was destroyed..."(p. 46). No official remedy. Free use of poultry will probably keep them under control.

One of the most important sugarcane insects in Hawaii is the leafroller. An official means of control employed at times is "to send laborers through the fields to pinch the caterpillars in

their retreat between the folded cane leaves." (p. 42). As this insect is sometimes so plentiful as to entirely strip the canefields, this remedy will not do. When abundant patroling the young cane with poultry will be the means of getting rid of many of the moths. These apparently hide about the plant during the day and fly during the night.

It is similar with various adults of army worms and cut worms and probably with a bud moth, mentioned on page 46. Most every year one or the other is more or less plentiful. Generally speaking the best thing that can be done is to use the torch as a trap-light at night. How to use the torch shown on last page as the most successful trap-light in existence is explained in detail on pages 25 and 26 of my Circular No. 153. It is done, in corn or cane, in substance by suspending the torch on a tripod made out of 3 pieces of light clear lumber 12 to 16 or more feet long. The tank is hooked up in the apex; hose and pipe are allowed to drop. A cord is used to give the hose some slack, removing the strain. On the burner is hooked a pail. This pail is fitted up similar to a spittoon by having a funnel-shaped cover with a hole in the center. And over the burner is placed a piece of tin of the shape of a lampshade. A circle of light of about 1½ inches width is allowed to shine forth between the lower edge of the upper cone-shaped fitting and the rim of the pail. This allows the insects to fly in, there to bump against the red-hot burner, get stunned, and drop through the hole below into the pail. Or, if not so easily conquered, as happens with strongbodied insects, they will, in trying to get out bump in nearly all cases against the upper or lower cone-shaped fitting, and because of the narrow space, the intense heat and the poisonous air be quickly disabled to roll into the pail below. The poisonous air blowing downward through the hole soon puts a stop to all attempts to escape through this only possible outlet. I had shown in my Circular No. 153 that if sweet-smelling sweets. such as water and molasses were put into the pail, this would make the torch especially attractive to insects in general.

This torch does not make a bright light. This in some re-

spects is an advantage, as the insects attracked cannot gauge the distance correctly and are knocked silly and trapped before they know what has happened. "...The Hawaiian sugarcane leafhopper is an insect readily attracted to light at night..."(p. 14) The weevil borer, most likely. is also attracted to light. If so, this will be of very considerable value, since this insect attacks, in Hawaii, also the banana, coconut palm, sago palm, royal palm, winepalm and papaia. "Dying coconut palms were examined and in the tender heart of the palm were found great numbers of the insects (borers), in all stages" (p. 37). Of course an insect attacking tall trees, and living within in all stages, if attracted to light can be handled in no easier way than by the use of a trap that is capable of trapping in vast numbers. The leafroller moth, in all probability, can thus also be trapped. Poultry in cane fields would probably be able to secure a fair share of the weevils.

As explained on pages 26 and 27 of my Circular No. 154 the Bureau of Entomology has no system of trapping that is worth anything. Being created to promote entomological knowledge in its broadest sense, the Bureau has persistently to hinder all progress along the line shown by me by refusing to make check tests and give the results. Moreover the Bureau repeatedly told Members of Congress that were trying to get at the truth I am wrong on every point. The chairmen of the Congressional Committees on Agriculture, Senator Thomas P. Gore and Representative Asbury F Lever have never seen to it that the Entomologist gives his reasons for making such a statement.

A torch used as a trap works automatically. A quantity of gasoline, enough to run about the time desired, say four hours, is put in, air is pumped in, and the gasoline will use itself clear up without any attention.

The mothborer of the Southern States can in all probality also be trapped, along with the weevil borers, now established since nine years in some places, together with the sugarcane beetle and other insects amenable to this method.

The chief reliance for the control of the mothborer, howev-

er, is to be found in the use of corn for attracting the last two broods, described in detail in my Circular No. 154, pp. 9 to 12, the original description being given pages 31 to 35 of my Circular No. 151. As the moths prefer tender corn to cane for oviposition, by providing patches of late planted corn in succession and using it for fodder, stover or silage, and finally trapping the borer to hibernating quarters, the borers there to be destroyed by plowing before emergence begins in the spring, the moth-borer is readily and cheaply controlled. Poultry, if present to keep down other injurious insects, such as ants, is also helpful by securing part of the moths.

Meanwhile the Bureau, instead of passing on the merits or de-merits of this method, is nosing around for a natural enemy that secures the same result. One thing in this connection the Bureau refuses to make clear to the public. It is that while under primitive conditions natural enemies do usually effectively control injurious insects, under modern methods of agriculture food plants such as cane, corn, wheat are grown in vast tracts, enormously favoring multiplication of injurious insects, while safe hibernating places for parasitic insects are far less plentiful than under primitive condition, in fact would be almost absent if the Bureau's recommendation of destroying hibernating places for injurious insects were followed. Besides the injurious insects often can breed at a mean average temperature too low for the parasites to breed.

In the Southern States the use of poultry becomes imperative in cane through the presence of the Argentine ant, which fosters the development of the mealy bug and also of aphids. These ants unless kept down by poultry, would have to be kept down by the use of a torch. This use of a torch I had shown as far back as four years ago in my Circular No. 147 is the best thing to enable poultry to gain a start at a given place. The summer nests of this ant are very shallow and letting a blast blow about them brings the whole outfit out to be killed with the greatest ease. This then gives poultry roosting—and breeding places free of ants and enables them to bring the pests under

control. The Bureau for the use of these ants in general recommends the use of poisoned ant syrup. You will readily see that in canefields or other vegetation supporting aphids or coccids this fails to work, if carried out, because the ants then prefer the excretions of these insects to all other food. Moreover all kinds of waste places make a natural home for these ants. To use poultry for control simply means to use a domesticated form of natural enemy. Further, ant syrup will poison the beneficial insects attracted to it.

Froghoppers or spittle insects have also been found as far back as 1911 in Louisiana and, like the borer, may at any time attract big attention. They are sucking insects and respond to the use of a torch same as the mealy bug. "...if they get established in sugarcane there is no knowing what may happen.." (Ent. Circ. No. 165, p. 4). No official means of control is suggested. Also "leafhoppers in very small numbers were observed (in 1912) several times during the season on sugarcane. but no injury due to them could be detected." (Ent. Circ. No, 171, p. 6). There also is "no knowing what may happen."

Another moth borer. *Castnia licus*, exists in the West Indies. Its range extends northward to Mexico. "Collecting the moths by means of nets in the hands of children has given better results than any other direct means.." Ent. Circ. No. 165, p 3. The adult is a day flying moth. Poultry might be able to secure some when ovipositing. "...The pupal stage is passed in the cane or in the soil near the underground portion..." (p. 2) Hence poultry might be expected to secure some pupae. "Its original food plants were species of the orchid family and of the family of plants to which the pineapple belongs (Bromeliaceae)... in Trinidad it is known to attack sugarcane and bananas..." This would make it appear likely that, if introduced into the United States, it could be controlled by trapping it to corn same as the mothborer we now have.

The recent publication of Farmers' Bulletin No. 944: Controlling the Garden Web Worm in Alfalfa Fields, through point-

ing out the danger of serious damage by this species, and through failing to offer a satisfactory means of control makes the evidence given there suitable for showing the need for developing poultry raising to a scale large enough to enable the farmers to cope with such pests when affecting cereal and forage crops, and also for pointing out the advantage that can be gained by trapping with light-traps certain insects, that are attracted to light, hence amenable to trapping, but which insects are not, because of poisonous hairs they carry while in the larval stage, or for other reasons, such as being out of reach, amenable to attack by poultry.

"The garden web worm... has caused extensive damage to alfalfa in California, Nebraska, Iowa, Missouri, New Mexico, Kansas, Oklahoma and Texas. In infested localities of the last three states it is not uncommon for second or third annual cuttings to be entirely destroyed by the pest" (p. 3).

The food plants are given as corn and garden crops, beets, potatoes and other plants., "various crops," alfalfa and cotton, and several kinds of weeds, showing it to be capable of existing upon most any garden and forage plant and weed. The moth appears in the alfalfa fields about May 1st. After mating they deposit their eggs, usually in clusters of 40 or 50, upon the lower surface of the leaves, usually on those near the top. "Individual females may deposit as many as 300 to 400 eggs. The eggs are laid on the alfalfa plants or on adjacent weeds... In the latitude of Kansas and Oklahoma there are, apparently, four generations annually... The form or stage in which the insect overwinters in that latitude has not been definitely determined" [p 6] Thus a female emerging in the spring from a pupa, mating and producing only 100 females enables these, at the same low estimate to produce 10,000 females in the second generation, these to produce 1,000,000 females in the third generation and these cause, at 300 eggs each hatching, 300,000,000 of worms in the fourth generation, showing the enormous potential capacity for damage. "The moths are most active at night and are strongly attracted to light..-"(p. 6).

For remedies the Bureau advises: Timely cuttings, brush drags, and clean cultivation. These means are absolutely inadequate as will be shown.

Both timely and untimely cuttings will naturally kill many larvae in the field, the "timely cuttings being given at an earlier date" than is customary. They are given at any time before damage gets too serious. It is simply a matter of cutting while there is yet something to cut. This, of course, is a set back to increase; but with the capacity of the insect for increase, its large range of food plants and large number of this insect present as pupa in the ground even then and with the adults capable, if need be, of flying for miles for suitable oviposition material, an alfalfa field necessarily becomes readily re-infested, in fact probably offers the most favorable breeding material available on a large scale in the latter part of the season, especially if irrigated. A brush drag does not, under the circumstances, offer enough of a set back to amount to anything.

"Clean cultivation methods are also of much value... Since pig weed and lamb's quarter are its favorite natural food plants, it is important that fields, fencerows and near-by waste ground be cleared of these and other weeds. The pest often breeds upon such weeds and imigrates later to near-by alfalfa, which would escape injury if these weeds were not present" (p. 7). As the pest is omnivorous, if its preferred food plants were to be removed, nearly every green thing would have to be kept down for miles around, since the adults are capable of flying long distances if no suitable plant be close by. This destroys the natural grazing ground and ruins the land by erosion, affecting, in turn, the capacity for navigation of rivers and harbors, the maintainance of power plants and the production of fish, for the same plan is advocated by the Bureau in the case of many other insects infesting field- and forage crops, and for insects in general. However, even if the "weeds" were "thus cleared off" for miles around, the pest would then simply feed and breed that much more severely on cultivated crops other than alfalfa when such is not available immediately following a cutting.

"In loose sandy soil" (the cocoons harboring the pupae) "are often slightly more than 1½ inches long, but in heavydry soil they usually are not more than one-half to three-fourths of an inch long... They extend downward in a nearly vertical position, the top end even with the surface of the soil. After about 10 days... the tiny adult or moth issues..." (p. 5). Thus, as at cutting time the soil is more or less stocked with pupae, if every larva be killed at cutting time, this set back with the enormous capacity for reproduction does not bring tangible results.

The pupa is thus exposed to attack by poultry as is the caterpillar and the moth. It is reasonably certain that the insect hibernates mostly as pupa. The moths evidently emerge in the spring irregularly and at the time of any 'timely cutting' are present in any stage and can readily recover, even if the proportion of pupae then in the ground compared with the number of larvae then present be small. Thus, poultry given the run of the fields and waste places, the pest would be kept down. In addition, for quick and immediate effect, the adults can be trapped, as described on pages 5 and 6 of this Circular.

The alfalfa fields might at the same time be affected by the alfalfa caterpillar. The adult is a butterfly. The caterpillar eats of the leaves and when grown spins up as a crysalis on alfalfa- or other stems. The insect hibernates as butterfly, larva and pupa, chiefly as the latter in the cooler sections of its range, hidden away in trash in the ground, chiefly outside of the field. Poultry thus can attack the insect the year around and keep the pest easily down to harmless numbers In a way this is conceded in U. S. A. Bulletin No. 124, p. 28: "...Domestic fowls... play an important part in the history of this insect..." However the idea of using poultry on a vastly larger scale than is now done by merely employing the usual little farm flock is lacking, for the writer says on page 29: "From these observations it is seen that chickens may be utilized in small fields to keep down the numbers of alfalfa caterpillars and that turkeys, because of their roving nature, can be used to ad-

vantage in larger fields. Mr. Charles Springer, of Cimarron, New Mexico, informs the writer that he hires a boy to herd an immense flock of turkeys on the range, so that they may feed upon the grasshoppers destroying the grama grass and other range grasses It seems that the same method could be imployed in outbreaks of the alfalfa caterpillar ..".

This is taking too narrow a view of the matter. Cimarron. New Mex. is in the heart of the New Mexico range caterpillar territory. I had shown in 1915 in my Circular No. 146 that poultry could be used there to keep down the range caterpillar, attacking the grama grasses and other range vegetation, and also now invading cultivated crops, not by eating any of the growing caterpillars, but by attacking the insect during the seven months of cool season while it is in the egg stage in clusters on grass, and weed stems slightly above the ground; also by eating of the young caterpillers before they acquire poisonous spines, and by eating of the pupae found in clusters on grass- and weed stems, and further by eating of the moths hanging during daytime quietly in plain view on—and weed stems during fall. All efforts to have the Bureau of Entomology admit that this idea is sound were futile. Now Mr. Springer demonstrates in practice that it can be done to keep down grass hoppers. As the grasshoppers hibernate as eggs in the ground, his turkeys have been feeding all along on pupae, adults, eggs and larvae of the range caterpillar without his knowing it. What the Bureau knew in this connection was that the turkeys do not eat of the larvae after they have poisonous hairs, but such is the case only about two months out of the twelve. And if the matter were looked into closely, it would probably be found that Mr. Springer does it at a profit of several hundred per cent. However, even if the poultry raising itself did not pay. it would pay indirectly big by preventing heavy loss to the ranch grasses and thus to the stock. As a matter of fact poultry thus given the run of vast tracts of low priced lands in large flocks in the care of a herder offers the most favorable conditions for producing poultry and eggs free of disease. The flock, it was pointed out by me, can be protected

by a movable wire fence at night. This enables the herder to trap or shoot wild animals trying to prey upon the poultry at night. At the high prices of furs, this goes a long way to keep him paid.

As a matter of fact, as explained on pages 7 to 9 of my Circular No. 154, the New Mexico Biologist Entomologist utterly condemned this plan. It must be obvious that the more the country is cleared and given over to cultivation or to pasture, the less can birds maintain themselves in sufficient numbers to cope with the injurious insects stimulated to increase by an abundant supply of food, and that the natural remedy consists in using poultry under the control of man. If the Bureau's plan of 'clearing weeds' were carried through, this would remove the natural feeding ground for poultry while the fields offer little or no picking. This renders the carrying through the winter of flocks of any great size impracticable, which is necessary to deal with outbreaks.

Alfalfa might also be attacked by the clover root curculio or by the clover root borer. The adults of both species are probably attracted to light and might be trapped. But the most practical means of control all around is the use of poultry to secure the adults as they are about laying their eggs on the neck of the roots. Poultry also may be able to secure some of the larvae. Naturally the adults prefer to hibernate in nearby rank vegetation, woods probably being the most favorable. This same course I had shown for several years keeps the alfalfa weevil under control.

In the case of the bean- and peaweevils, discussed in Farmers' Bulletin No. 983, there is at present no official means known of affecting them in the field. Poultry, if admitted after the plants have become well established, can be expected to secure many of the adults. When grown in quantity what damage poultry might do to peas and beans will be far offset by the number of adult weevils they secure. It is likely these weevils are attracted to light and, if so, can be trapped in vast numbers by the use of a torch as described on page 5 of this Circular.

Treating the seeds after harvesting with fumigants or other means to destroy the grubs within is not going far enough, for many adults emerge in late summer and fall and escape before harvest or before treatment can be given. Also many adults escape from fallen seeds and scattered pods. These then re-infest the young crop next spring and call for an efficient means of control in the field. As some of the bean-infesting weevils have as many as 6–7 generations in the latitude of Washington, D. C., it is plain that with no means of control in the field available, a small number of weevils surviving the winter is capable of destroying the crop. The use of a trap and the use of poultry offer the only chance of effective reduction during the growing seasons.

In using such a trap, of course, many other insects are caught, the catch showing just what insects, of those that are attracted to light, are becoming plentiful. Grain and forage crops on low lands are often infested by insects that normally live in rank grasses growing in wet places. Some of these are the billbugs, certain wireworms, and the rough headed cornstalk beetle, while there are other pests, having similar effect, living on dry ground. No satisfactory official remedy is known. As might be expected the Bureau advocates under these conditions the destruction of the wild food plants, but these are needed, in lowland as soilbinders and as protection to creek and river banks especially if there are no timber fringes, and on higher lands they, or other rank growth, are needed to prevent erosion. Waste is contrary to the laws of nature. What the Bureau of Entomology calls wastelands is natural feeding ground for stock and under modern methods of agriculture offers the best means of carrying poultry in the cheapest manner through the winter.

Where grassland is to be plowed up for corn, often many cutworms, white grubs, billbugs and wire worms are present. The Bureau's general remedy is to plow the land in that case as early as the late summer or early in the fall before. The aim is to starve the grub out. In the first place, a trap used the previous summer would show the rate of infestation and would re-

duce it. The most convenient time for plowing is late fall and early spring. Sod then turned down gives in a large measure support to the grubs and worms within while the corn is making a stand. In fact, it often happens that damage does not become apparent till the second year. These grubs and worms naturally want to eat of the fresh growth above ground or of the roots or tubers in the ground. In the case of corn when sprouting there is but little to eat for some weeks. hence the damage often very heavy. This can be easily remedied by drilling in for every few rows of corn a row of some quickgrowing plant alongside the corn. Anything quickgrowing and succulent will do. Of grasses rye is probably best, and turnips or rankgrowing radishes ought to be splendid. The latter might be broadcasted immediately after the plowing. Or some of these seeds may be added from time to time to the seed corn in the hopper at planting time. After the corn is strong enough these protecting plants can be removed. Poultry should have access to corn as soon as it is safe to admit it.

The Entomologist's report for the fiscal year ended June 30 1918, makes reference to several newly introduced insect pests that are capable of doing very great damage unless better means of control than are now officially advocated are made to come into play.

Among deciduous-fruit insects the so-called oriental peach moth easily ranks first. This insect was originally found in the District of Columbia and adjacent counties of Maryland, and has been described in Bulletin No. 209 of the Maryland Experiment Station, issued December, 1919. It belongs to the same family of moths the codling moth belongs to. This family. the Tortricides, is very difficult to control. The codling moth, compared with the rest, is comparatively easy to control in sections where it has only a brood and a half, as it usually has in the northeastern United States; for the reason that it has less generations than most of the rest, and because it has been found possible to destroy most of the first brood by the proper use of arsnicals.

Where the codlingmoth has two or three broods it is difficult and expensive to control it under present methods. Here is a sample of official utterances on this point: "...Spraying experiments ..,in the Grand Valley of Colorado have indicated that a skedule of six applications of arsenate of lead at the rate of four pounds of the poudered product to 200 gallons of water, with the addition of four pounds of fish-oil soap, will make a very effective treatment..." (Ent. Rep. for 1918, p. 1). The warmer the climate, the more difficult becomos control.

The oriental peachmoth, in part, differs from the codling moth in that it has four generations in Maryland in seasons when the codlingmoth has only two or, at most, a partial third: also the first two generations do not develop on the fruit, but on the young growing tips, causing a shrubby stunted growth, and cannot as readily be poisoned as can the first brood of worms of the codlingmoth. "It is impossible to keep the young twigs coated with arsenical poison, though it is possible to prevent the larvae from entering the fruit (of peach) by a thorough application .." (Maryland Exp. Station Bull. No. 209, p. 8). The insect attacks the twigs of peach, plumb, apricots and cherries. As the twigs harden, the third and fourth generations more and more attack the fruits of apple, quince, peach and probably others. "...Our most successful combination of insecticides during 1917 was a mixture of self-boiled lime, sulphur, calcium arsenate and tobacco, preceded by a winter application of concentrated lime sulphur. Applications were made on April 30, May 24, June 15, and July 13, the concentrated lime sulphur having been applied previous to April 30. This application gave a reduction of 31 per cent to twig injury.. ". To protect the fruits after July it would be necessary to apply poison 2 or 3 times more. It will thus be seen that the control of this insect, and of the torticide in general, leaves much to be desired. "The occurence of the (oriental peach) pest has been definitely established (in December 1917) by the U. S. Department of Agriculture in Virginia, New Jersey, New York and Connecticut" (Md. Exp. Sta. Bull. No. 209, p. 8). This is doing pretty well for a

recently established pest and, in common with other pests yet to be discussed, shows how little can really be done to prevent the introduction of injurious pests and it also vividly shows that efforts to control them made by people other than those holding federal offices should be officially encouraged and not opposed, and that an official that opposes such efforts is a traitor to his country for purely selfish reasons.

On pages 24 to 26 of my Circular No. 153 I described a method of trapping the codlingmoth and other insects attracted to light by the use of a torch in connection with sweetsmelling fruitjuices. On pages 8 to 11 of my Circular No. 139 I pointed out in detail that while tests have shown that the codlingmoth is not attracted to light to any extent if let loose in a room that is diffused with light as would be the case in a room lighted by a large Rochester lamp, probably fitted with an opaque globe, which was the kind of lamp used to make the test the claim chiefly rests on, my own accidental experience was, that a codlingmoth flew in through an open window of my room in May and repeatedly violently flew against the chimney of a common lamp that had a stiff paper lampshade and which lamp drew all its light upon a few square feet of desk surface, the rest of the room being practically dark. All efforts to have the U. S, Entomologist test this point out to his own satisfaction and thus be in a position to act as judge, were futile.

Further, I quote from Bulletin No. 142, p. 35, Cornell University Experiment Station: "The codlingmoth has a slender, pointed tongue with which it sometimes sips or sucks up sweet substances. Le Baron saw the moths feed freely upon lumps of moist sugar and slices of sweet apple which he placed in their cage. McMillan records that they willingly fed upon sweetened water and that he 'has seen those of the second brood feeding upon the yellow flowers of an autumnal composite (*Grindelia squarrosa*) in the dusk of the evening," in Nebraska."

Strange enough, in spite of this evidence, the author, the late M. V. Slingerland, continues: "The weight of evidence from careful experiments indicate that the moths are not easily

attracted to alluring baits of any kind." And, more strange, he follows this statement up with this record: "A Connecticut correspondent states in the *Rural New Yorker* for Feb. 9th, 1897 that 'happening to pass a sweet bough apple-tree one evening in August, where a number of apples, half eaten by chickens, were lying scattered about, I noticed a kitten busily trying to catch some small object. On investigation I discovered that the half-eaten apples were covered with codlingmoths. There were thousands of them, apparently feeding on the fruit. They were very active when disturbed. I procured a lot of old newspapers and for half an hour or more I kept several fires burning brightly, while the kitten and I stirred them up. I don't think I succeeded in burning as many as the kitten caught. They carefully avoided the fires."

It is evident that these sweet apples had concentrated the codlingmoths from over a considerable area of pome fruits, and if it had been possible to kill them from time to time that area could have been thus protected against the second brood of worms. Naturally the moths avoid the fire. It cannot be reasonably assumed that even an insect strongly attracted to light, as are for instance most cutworm moths, would expose itself deliberately to injury. That, however, light loving insects do get rather frequently inadvertently injured when flying about lights was proved as stated on page 10 of my Circular No. 139, in a record given in Cornell Bulletin No. 202, by Mr. Slingerland, where a mothcatcher, "while making rather a poorer showing than a traplantern" caught about 3000 more of lace winged insects than did the traplantern. I pointed there out that the only tenable explanation for this can be found in the fact that the "mothcatcher" had an open flame, affecting lace wings, when a "traplantern" would not.

In the case of using the torch for a trap, there is no bright fire to speak of anyway. What fire there is is yellowish red and is concentrated within a narrow chamber. The insects, from the lack of light outside, cannot at all readily gauge the distance and bump against the redhot burner before they know what

has happened. The conditions given in the record could have been improved for trapping by removing the sweet apples from the ground and putting into the pail hanging on the burner of torch as part of the outfit, some of these sweet apples, crushed, with some water added. This would give off a most inviting scent. For all around use, if no cheap suitable fruit is available, molasses is apt to be best. Under this plan there is no kerosene smell to act as a repellant. Mr. Slingerland's trap-light tests carried on with the use of kerosene as a killing agent, given in Cornell Bulletin No. 202, show that, in this case, the insects caught are mostly males, and what little females are caught have mostly laid their eggs. Tests made by others corroborate this.

On page 43 of Bulletin No. 142, issued in 1898, Mr. Slingerland makes this note: "The use of baits has recently received considerable attention in Germany and in *Der Practische Ratgeber* for 1895, is recorded an account of an experiment with glasses of apple jelly hung in the trees. We glean from the report that quite a number of codlingmoths were thus captured, about half of them being females. Which shows that no matter how bone-dry things may get, the farmer, might, for industrial purposes, such as trapping codlingmoths and grape insects, put in a claim for a barrel each of hard cider and wine. The smell thus given off through this liquid being kept hot by the blast blowing down upon it, with the windfalls kept eaten up by hogs, will make this the chief source of attraction for the codlingmoth, other torticids and a host of other insects, injurious, beneficial and neutral.

On page 18 of my Circular No. 153 I stated from D. A. Bulletin No. 491, p. 23, that tests in the case of the melonfly showed that access of newly emerged females to juices of cucumbers greatly stimulated bodily forces, sexual activity and egg-maturation. Corresponding juices in the case of other injurious insects, applejuices of some sort in the case of the codlingmoth for instance, used in connection with a trap, can then be assumed to offer the most effective means for their destruction. Also since this then concentrates the insects within a certain area,

bats and nightflying birds can thus catch a hundred where otherwise they might catch one.

In the case of the codlingmoth emergence of the adults in the spring is very irregular, but in the case of the oriental peachmoth "the first two broods are very distinct, the third and fourth more or less confused" (Maryland Agr. Exp. Stat. Bull. 209, p. 3). Hence a torch, supplied with some suitable sweet-smelling attractant, and used from time to time as needed during warm dark nights up till fall, holds out a far better promise of success in controlling this new pest than anything that has yet been devised.

The torch does not make a bright light. This in some ways is a disadvantage and in other respects an advantage. In the great majority of cases it is a decided advantage, for as the range of attraction extends, say, for 1000 feet in each direction, this about covers the area of the average farm. The farmer does not want to draw injurious insect away from his neighbors upon his farm. The brighter the light and the smaller the farm the less benefit does the farmer using a trap get and the more benefit, free of charge, do get the other farmers within the range of attraction of his trap.

Inasmuch as any means of controlling injurious insects, destruction of hibernating quarters for instance, always also more or less injures beneficial and neutral ones, it is necessary that the public be sufficiently educated in using a trap to know what they are mostly catching. The Bureau of Entomology was created to promote entomological knowledge in its broadest sense. For the U. S. Entomologist to deliberately lie by telling Members of Congress wishing to get at the truth I am wrong on every point means to humbug the people with their own good money, and the Chairmen of the Congressional Committees of Agriculture, Senator Thomas P. Gore and Representative Ashbury F. Lever, full well know this.

An insect might be highly injurious with no official satisfactory means of control known, might be nightflying but be repelled by bright light and even avoid diffused light. Naturally

electric lights and even lanterns giving forth a mild clear light are out of question as traps in this case. To a lesser extent this then holds good also of a dull reddish-yellow light such as is given forth by a torch. If for a killing agent kerosene in an open pail be used then there is little chance, because of the offensive smell, that any such insect would be attracted. but if instead there were emanating from the pail an inviting sweet smell suggesting attractive food to be found only somewhere near the light given forth by such torch, this might alter the case radically, and may often offer the only feasible means of control.

An insect that, as far as official means of control are concerned, meets these conditions is the lesser cornstalkborer, described in Department Bulletin No. 539. This insect has a very wide range of food plants. These include corn, cowpeas, crabgrass, Johnson grass, Milomaize, sugar cane, Japanse cane, sorghum, beans, peanuts, chufa, turnips, and wheat. The infested territory covers a quadrangle marked by Southern California, Florida, Massachusetts and Iowa. It has in this territory an average of four generations a year, and the average number of eggs deposited by the females in 190. In substance the Bureau of Entomology has nothing to suggest in the way of control than "cleaning up" and the plowing of fields. "The borders and the terraces of the field should be gone over with a harrow to stir up the ground," This breaks up the winter quarters of pupae and causes them to perish" (p. 24). The insect breeds and hibernates to a very large extent in what the Bureau habitually calls waste land. To "clean up", these "waste places" is certainly some job,

The Bureau of Public Roads, in one of its more recent publications, Farmers' Bulletin No. 997: Terracing farm lands, points out at length the need of terracing sloping farm lands, by which is meant lands under the plow, while the U. S. Entomologist and his unlearned learned assistants never loose a chance to talk from the top of the bughouse of how to unterrace them. Even where the land is practically level it is necessary to keep the ditches In grass, and the creek- and river banks in

grass and trees to prevent the banks from becoming undermined and thus, from this source alone. very largely fill up the creek- and river beds. Much other details on this very important subject is found in Year Book Separate No. 688: Farm, Forests and Erosion.

Of course, during all of the growing season there can be no such thing as cleaning up. Thus, evidently, the Bureau's system of control is worthless, since while this plan would destroy a small part of this and other injurious insects present during the hibernating period, it does not effect the insect during the period of growth to any great extent, and the policy of "cleaning up" also cleans up the hibernating and breeding places of beneficial insects.

In the case of the lesser cornstalkborer, moreover, we are not at all dependent upon a torch used as a trap. This insect is amendable to control by the free use of poultry. I have been showing for four years past that it is feasible to thus control a great variety of injurious insects. Why use a torch to trap adults, or a harrow to kill pupae over a limited space, when it is possible to use poultry the year around to keep the pest in check and when poultry in doing so secures a large part of its sustenance? "It is seldom that larvae are found in the tunnels of the plants upon which they feed, but more often in specially constructed tubes which lead away from the entrance to the tunnels in the stalk, lying even with or slightly beneath the surface of the ground or sometimes curved around the stem.,," Thus you see this insect, as larva, is simply waiting to be picked off by poultry. The moths can also partly be secured by poultry.

However, there are highly injurious insects where the use of a torch used as a trap offers the only feasible means of reducing the number of the species. The European pineshoot moth is a case in point. In this case the adult moths lay their eggs singly into the terminal buds of pine trees, choosing preferably the apical cluster of buds, and in turn cause the leading shoot of the pines affected to become very badly crooked "...each one of these insects does very considerable damage...

These injured shoots bend downward and outward and afterwards grow upward again in a curve.." (Dep. Bull. No. 170, p. 6). The insect shows preference for young trees. In my Circular No. 145, published in 1915, and in subsequent Circulars, I had pointed out that the simplest means of control consists in pouring, at the approach of the egglaying season in summer, some semi-liquid clay into the apical whorl of buds. This then leaves all the rest of the terminals untreated and thus in normal condition for oviposition. This protection is, of course, feasible only in the case of the smaller trees—unless the Bureau can devise a profitable system of using aeroplanes for this work, and for the reduction of the number of the adults the use of a trap as described—or a better one—is the only thing that holds out hope of success. A trap as described, in this case preferably used with a sweetened decoction of pine twigs, would in all probability, give very good results. The moths might be adverse to light, but the presence of a scent resulting from the evaporation of a sweetened decoction of pine twigs within the pail would be likely to cause them to be trapped. While it does not seem feasible that poisoned sweets, suggested by the Bureau for the control of certain fruitflies, could be used, if they were used, it would have to be found out what other insects, beneficial, injurious or neutral, are thus also destroyed. As the moths prefer nurseries, a trap located there would largely protect more distant, larger trees. All the Bureau has to suggest in the way of control is to first let the insect infest the shoots, then send men through the woods, supposedly fitted with wings or extension rubber necks, and have them remove the grubs and affected buds and burn them, so that other buds left uninfested may make as near a straight growth as possible under the circumstances. This treatment has to be given every year. Moreover there is danger that the moth, in this country, can develop two broods. Fancy what it would cost to examine a square mile of pines even once effectively this way. Yet the Bureau says I am wrong on every point, and the chairman of the Congressional Committee

on Agriculture approve of this course by doing nothing to force them to make any definite statements.

In his report for 1918 the Entomologist on page 5 mentions the introduction of the European cornborer. This insect is highly destructive and is similar in habits to the lesser cornstalkborer, and also to the larger cornstalkborer, described in Farmers' Bulletin No. 1025. For the latter insect the Bureau's chief recommendation as to control is rotation of crops, nothing more direct being officially known. It belongs to the same genius as does the sugarcane borermoth. There are 3 or 4 generations a year.

"Fortunately the insect passes the winter in the stalks of its host plants and winter destruction is therefore possible, although winter extermination of its host plants throughout its present range, on account of its numerous food plants, would be a matter of great difficulty and expense"... "Among the cultivated crops attacked in Europe are corn, hemp, hops, millet, several wild grasses and many common weeds. In this country corn is the principal crop seriously injured, but the damage to that crop is so serious as to cause the gravest apprehension should this insect spread into the great corn belt of the Middle West. The caterpillars, of which there are at least two generations annually, bore into the stalk, ear and tassel of the plant. Thirty or more individuals often are to be found in one stalk during the latter part of the summer. ...At present the area known to be infested (located in eastern Massachusetts) amounts to something more than 300 square miles..."

Thus here you have a new pest breeding till it has covered 300 square miles before it is even discovered. How many other, smaller infestations must then be expected to exist elsewhere?

Chief Howard is reported in the press to have told the American Philosophical Society at Philadelphia on April 25 that this pest also got a strong foothold in New York "If this borer reaches the cornfields of the West." he is reported to have said, "I do not see what is going to save them..." The answer is easy. A rope around the little man's hind leg so that he cannot,

as usual, crawfish away before he has made an answer in regard to the method of control I shall describe will save them. And moreover this will lead to a discussion that will save lots of other crops from serious injury, affecting such important insects as the bollweevil and the pink bollworm. The method is essentially the same as described by me for the control of the sugar cane borer moth on pages 32 to 35 of my Circular No. 151 two years ago, in regard to which Chief Howard has not seen fit to make any statement, good, bad or indifferent.

When in 1914 the European pineshoot moth was discovered on Long Island, investigations up to Feb. 9. 1915, showed the insect to be present in nine states with "indications very strong that the pest has become established in several other widely distributed localities." Yet all the while since the Bureau talked about exterminating this insect. It was no trouble at all for the Entomologist thus far to work the public for a sucker. The public sends men to Congress to guard its interests, and if these do not do so, an official of the Executive Department can dish up to a trusting public any old humbug while the dishing up is good.

Of course, in the case of the European cornborer, it is, because of the large range of food plants and the large area even now admitted to be infested, absurd to talk about extermination. Nor can the pest be kept from spreading. Rigid quarantines will impede its progress at great cost. But a sound system of control will make it possible to do away with at least the more onerous provisions of quarantine, and incidentally keep the U. S. Entomologist from lying awake of nights.

Apparently neither the larva nor the pupa in this case is amenable to attack by poultry. Hence the use of a trap as shown, if possible, might be resorted to, if there were nothing better. But undoubtedly the best means of all consists in the judicious use of trapcrops, properly managed, exactly the opposite to what the Entomologist proposes to use. He proposes the elimination of food plants—in this and many similar cases.

In the early spring while all vegetation is succulent the in-

sect is apt to oviposit on any suitable plant near by. Naturally it will prefer sweet corn to common corn, and common corn to most other plants and weeds. Hence the first generation of moths is not likely to be especially destructive to corn. However, since early sweet corn is apt to show a heavy infestation, the stalks should be fed, cut for stover or for silage as soon as the ears are gathered. The bulk of the damage is evidently done through the moths of the second brood congregating upon field-corn. This field corn is apt to have then passed the tassel stage since several weeks and a small planting of corn and, especially sweet corn, just coming into tassel as the second brood of moths appear, would most likely attract the moths very largely away from the main crop grown for ears The trap crop, if field corn, will not mature properly and should be sown thinly for fodder to allow of the forming of a good many tassels. If sweet corn be used, being smaller and quicker in maturing, it is to be sown correspondingly later. This corn, used for traps, will then very largely concentrate the hibernating larvae, and, by being carefully utilized for feeding, will effectively check the pest.

A pest similarly affecting corn is the pink cornworm, described in U. S. Dept. Agr. Bulletin No. 363. This insect has about 4 generations a year. Nothing in the way of official control is available except early harvesting, early husking and fumigation of infested ears, calling for work at a time when work on the southern farm is most pressing: besides fumigation greatly adds to the cost. Thus the insect is admittedly beyond all official means of control during the period of increase. It occurs only in the cornbelt in injurious numbers, Mississippi having suffered worst thus far. Inquiry in Mississippi, however, shows upon information furnished by State Entomologist R. W. Harned that his State after two years of severe damage is no longer noticably affected. But serious outbreaks may have been occurring elsewhere right along. It is thought that the decrease in cotton growing, or, what is more likely, the destruction of the bolls in the fall by plowing-in, may have forced this

insect to attack corn with corresponding severity. "...In the young squares (of cotton) ...the active little reddish larva of this Batrachedra is very often found as unquestionably an original inhabitant and it undoubtedly frequently causes quite an extensive shedding of the squares. This however, only occurs in the spring... later in the season the Batrachedra larva is found boring in the unopened flowerheads of various weeds" (p. 131).

While it is likely that the adult, a moth, can be trapped as described, the fact that the adult oviposits very readily upon young cottonsquares can be taken advantage of to control this pest most easily. When the infested squares fall and poultry has the run of the field, they will attack these and other infested fallen squares for the grubs within. I had explained at length in my Circular No. 152, and as far back as my Circulars No. 147 to 151, that the correct method of controlling the boll weevil consists in the use of poultry in connection with a trappatch of late planted cotton. This system of control I evolved to cope with the officially admitted tendency of the bollweevil to feed and breed in plants other than cotton, or to go without food and reproduction for long periods by secluding itself in the absence of acceptable food for feeding and breeding, in cool places well protected against heat and cold, thus conserving its vitality. I had shown from official evidence in my Circulars No. 110 to 154 that the conditions in the cage tests the Bureau of Entomology carried on in an attempt to prove what results would happen in case stalks are destroyed in the field at a given date were not normal, and have also shown that where the conditions furnished in the cage did approach normal conditions the survival was much greater than was officially claimed, this work dating back nine years.

Under my plan poultry is to be given the run during the winter of the surroundings of the fields to be planted to cotton, lessening thus the number of the successfully hibernating weevils. When cotton comes up poultry given the run of the field and the surroundings will pick off most of the weevils and many other insects that feed in the tips of the young cottonplants and al-

so pick off many other insects on nearby "wasteplaces" where they aim to complete their first generation to go to cotton in the second generation. As squares form and become infested poultry will attack the fallen squares for grubs. It will readily be seen that this is a continuous check to the multiplication of the bollweevil and permits of the setting of a large amount of fruit. However, to detract the bollweevil, the bollworm and injurious insects in general from the fruiting plants, a small plat, located in the center of the field, about the one-hundredth part of the field in size, is not planted till two or three months after the planting of the main patch. The seed to be used for this trappatch may be any kind that produces plenty of squares, as far as concentrating weevils and other grubs is concerned, but if seed from the main crop is to be saved for planting, the seed for the trappatch should be the same as that used for the main crop.

This trappatch offers an abundance of succulent squares late in the season, hence concentrates the bollweevil, the bollworm and many other injurious insects, including the pink cornworm to be there continually attacked by poultry in fallen squares and also, in a measure, as adults. The bollworm goes to hibernate in the ground and a plowing before emergence of the moths begins in the spring, but preferably a few weeks sooner because of other insects present, disposes of it. As virtually all this was pointed out to the Bureau of Entomology as long as 3 years ago, you see it is expensive for the people to allow themselves to be humbugged with their own good money by electing men to Congress that let such things go on even if their special duty is to prevent them.

In this connection it will be well to consider the difficulty encountered in the control of fungus diseases affecting plants in general, and cereal- and forage crops in particular, under the methods advocated by the Bureau of Plant Industry, especially as recent press notices announce the presence of a new wheat disease, said to be caused by a fungus, in Illinois, the area in-

fested being given as 100,000 acres. Giving this as the area infested simply means that there exists no definite knowledge as to how great the infestation may be outside of this area. In the case of fungi the spread is caused by spores being wafted by wind or carried by insects, birds and other means, and in the case of bacterial diseases spread takes place chiefly through virus being carried by insects.

The Bureau of Plant Industry does not claim to possess any means that are feasible to control, in a commercial way, a fungus disease of a cereal- and forage crop while the crop is growing. During this period several generations of spores are developed, the more or less complete destruction of which would mean a more or less complete control of the disease. There is no record of a fungus disease ever having remained confined to a small area, not even for a short time. The Bureau's means of control in the case of cereal- and forage crops are substantially confined to treating the seed with a germicide and to advocate rotation of crops. This, naturally, often proves to be entirely inadequate. As is well known, fungi, as a rule, do their greatest damage during a period of continued heat and moisture, and if such periods do not occur most fungi do but little damage without any treatment being given. Consequently any system of control that even holds out merely a slim chance of economically treating the disease during the growing season should have the most careful consideration of the Bureau of Plant Industry.

The essential principle of such a system was discovered and pointed out by me as far back as 1898 in a treatise published at Mt. Vernon, Illinois, and entitled: The Use of the Gasoline Torch in Fighting Insects and Fungi. I showed there that the blast as given forth by a common plumber's torch is capable of licking off the spores of fungi resting upon a leaf; that, therefore, if for instance this torch be used to lick lice and other insects off of cucurbits, involving in this case more especially the treatment of the lower side of the foliage and of the stems, so difficult to reach with sprays, the spores of fungi present are incidentally also destroyed. Previously, in the same year, I had pointed out

that the use of such a torch was far the most practical means then known of controlling the harlequin cabbagebug, an effort on my part in the fall of 1896 to control this pest, then seriously affecting cabbage and allied plants in the latitude of Southern Illinois, having been the direct cause to make me see the possibilities of the use of flame and heat as given forth by a torch in the control of insects. The season of 1897 was given over to investigations in regard to the possibilities of the use of such a torch on insects, and application for copyright of my first treatise entitled: The Use of the Gasoline Torch in Fighting Insects—was made on November 8, of the same year, the treatise being published the following spring after tests begun in the fall of 1897, had shown flame and heat as produced by such torch to be capable of successfully controlling the San Jose Scale. I pointed then out that while certain biting insects can be readily controlled by the use of arsenicals, other biting insects and most sucking ones can be far more easily controlled by the use of such a torch than by any other way then known. The chinchbug was then very plentiful, and stress was laid upon the possibilities of the torch in the control of this insect. I pointed out that in cool weather, or during the chill of the night and morning in early summer, the chinchbugs hide largely under the clods near the base of the plant and can be destroyed without affecting at all materially the corn they congregate on upon the approaching maturity of the small grain they infest in the spring.

Soon upon publishing this treatise I found that this same discovery as regards the control of the chinchbug and certain other insects by the use of the plumber's torch had been made also in 1897 by Mr. J. M. Winfree of Nashville, Ill. I soon realized that a common plumber's torch while possessing the essential principle of control, was not the proper type of torch for an economical application of heat, and in 1903 got out the type of torch shown on last page. It was distinct from any other torch in that the airpump was located in the center of the tank, and the handle of the pistonrod was in the shape of a hook. This pistonrod could be locked by means of a pin against movement.

making it possible, after detaching the shoulderstraps, to hook the apparatus from branch to branch in a tree.

One of these torches was sent to the State Entomologist of Illinois and in the fall of that year he made a report. He would not admit that the torch is the best thing for the control of the chinchbug, claiming in another report that the soil barrier and post hole method, consisting of a furrow that has been pulverized with a log drag and in which at intervals postholes have been dug, was a better method. The chinchbugs cannot at all readily make their way over a finely pulverized furrow. In migrating, under this plan, they fall in, but are not supposed to be able to get out. They are supposed to make their way alongside the bottom of the furrow and to fall into the postholes, there to be killed by the use of kerosene or otherwise.

The U. S. Bureau of Entomology Bulletin No. 95, part III, indirectly condemns this plan in two ways, first by not mentioning it at all under means of control, and second by describing there the log drag method in place of it, condemning the barrier method by the statement that "the block (log drag) must be kept in constant use, from early until late and sometimes well into he night" since "often, during the migration, the bugs travel all night." Another method, the coal tar barrier, is, admittedly, "apparently costly and troublesome," requires freedom from dust, presence of which means renewal of tar barrier "quite often." These matters are discussed at length on pages 27 to 31 of my Circular No. 139. The Bureau admits that with the use of a torch "...generally one blast will cause all the bugs to fall to the ground where they can be burned..." The Bureau thus takes the liberty to quote from my copyrighted matter, and on the other hand, as a royalty, the U. S. Humbugologist tells Members of Congress I am wrong on every point. That's a steal pure and simple.

Moreover a torch used for the chinchbug as described also incidentially enables the farmer to get rid of many other insects injurious to corn, and most of these are not affected at all by either the log drag or tar line method. The Illinois State Ento-

mologist said he had used the torch on woolly bear caterpillars just to find that they recover. He did not take the trouble to cage them and await results. He would have found in that case that they do not survive any length of time. He said little or nothing in regard to the effect the frequent slight application of the blast has on soft bodied insects such as lice.

As to fungus control he said he found that the blast licked off a coating of fungus spores on lilac leaves, but found that spores reappeared in a few days. He thus furnished proof, that the blast kills spores of fungi as claimed, for the spores that subsequently appeared had been thrown out by the mycelium working inside the leaf, showing that the leaf had not been injured in destroying previously the spores that had matured upon it.

Of other torches sent out for experimental purposes one was tested by the Cornell University Experiment Station. Prof. John Craig, as mentioned substantially on page 31 of my Circular No. 139, reported he had destroyed the San Jose scale upon medlars without injuring the cambium, but said this torch is too small to treat orchards, trees being often as high as 40 feet. This is correct. But there is nothing in the way to get up any kind of torch for any purpose, that, too, without interfering with any possible patents. The fundamental principle of the inherent success of this method rests in the cheapness with which the killing agent -the blast--can be produced.

At that time the lime-sulphur spray for the San Jose scale had not come into general use in the Eastern States. This spray went a long way to economically control this pest and also fungus diseases, but as subsequently described in my Circulars No, 139 to 154, especially on pages 11 to 14 of my Circular No. 147, torches can be constructed for orchardwork along the line of tower spraying outfits that will enable several men to attack insects and fungi, and do this work with surprising ease, cheapness and all around efficiency, winter and summer.

For instance California and the Eastern States are now being overrun by the pear thrips. I pointed out in detail on pages

9 to 11 of my Circular No. 147 and elsewhere that where this insect is present in injurious numbers it can, appearing as the adults do at blossoming time, in a few days destroy all prospect of a crop, and thus requires prompt action. I showed that such action by the use of the official remedy, the nicotine-sulphate spray, is expensive and difficult, expensive because the spray in itself is expensive and because under this plan the work must be done within a certain short period, involving the use of an expensive apparatus for a comparatively short time, and difficult because the insect has a large range of food plants and because even a thorough application is usually not a decided success and calls for a second application. One very plain reason for this is that this spray has to be applied with force. This naturally knocks many adults off before they get enough to be killed. I showed that under the method of using heat it is possible to give frequent slight, swift lickings, doing away with the injury often caused by the spray. One thing in this connection the Bureau of Entomology has all along been too bashful to touch upon. It is to what extent a spray given at the blossoming time has upon the fertilization of the blooms.

The use of a torch, unlike the nicotine-sulphate spray, is of particular advantage when the insect is in the larval stage, I showed in my Circular No. 147 that whereas the torch method is the best all around method to control sucking insects and fungi. there is ordinarily no need to make any great effort to attack the adult pear thrips except when swarms arive from outside sources or when certain kinds of fruit trees and bushes, when in bloom, act as special attractants, or when other insects then present, as for instance the canker worm, call imperatively for immediate action. I showed that as the young larvae develop on the leaves there is a period of about 4 weeks during which it is possible by the application of small amounts of blast to lick off spores and insects. Many, in fact most of these insects drop before they are apparently seriously injured. However investigation would show that nearly all die in a day or two I showed that whereas a good many larger larvae will drop. it would be well to have

poultry handy by to pick them up. However, I also showed that this is not necessary. I showed that the ease, swiftness and cheapness with which the blast can be applied makes if feasible to lick the ground with the blast, thus disposing of all the fallen larvae.

The Bureau of Plant Industry lays stress upon the need of controlling fungi, and the Bureau of Entomology lays stress upon the need of controlling insects, and the two of them show you many killing agents and many apparatus to meet the requirements for applying these killing agents under the many varying conditions that occur. At the same time the Bureau of Plant Industry extolls the blessings of proper landscape gardening around the home, of proper flower-gardening around the home, of the home fruit garden, and the home vegetable garden, all of which means growing a great variety of vegetation from tall trees, down to grass.

As in a general way each plant has its insect- and fungus enemies, if tall trees are affected these trees in home grounds usually are not accessible to the heavy power-spraying outfits these Bureaus recommend, whereas with or without the help of a ladder as may be suitable. you can treat tall trees with the type of torch shown on last page. You might have some cabbages affected with worms. These usually can be killed easily with arsenicals and, if no other trouble is present, this is a very good, if not the best way. But these cabbages, or your melons, or peas, or rosebushes might be infested with aphids or other sucking insects. In that case under the Bureau's plan, you have to use some of their contact insecticides. If onion thrips, or other thrips, pear thrips for instance, is present, under their plan you have to know how to make and apply nicotine-sulphate solutions; and for fungi other stuff, depending upon whether it is the dormant or growing season. Whereas the use of a torch as shown on last page serves all these manifold purposes far more easily and cheaply, than any other method under the circumstances. If the Bureau of Plant Industry and Entomology do not want to admit this, let them go ahead and show why.

On pages 39 to 41 of my Circular No. 151 you find an account of how torches can be constructed largely out of fittings such as would make up a tower blast torch outfit, that will make it possible to apply heat to insects affecting cereal- and forage crops that require a contact insecticide as does the spring grain aphis or the spinach aphis, detailed information being given on pages 12 and 13 of my Circular No. 144 and elsewhere. The Bureau has no feasible means of control, whereas it is easy to fit up a cart or some light automobile truck with a tank supplying gasoline under pressure and feeding any desired number of burners. And this same method at the same time destroys the spores of fungi that come in the way of the burners, thus keeping down the fungus diseases affecting these crops.

As for freeing the seed grain of fungus spores this can also be secured by the use of a blast, by letting the seed slide slowly down over a wired screen and letting one torch, or, better, two or more torches from different directions, play upon the seed, thus licking it clean. This does not injure its germinating qualities and costs only a small part of the Bureau's plan.

There are several important other insects mentioned in the Entomologist's report that call for consideration here. Of new pests there is the Japanese beetle, mentioned on page 5. It is a very general feeder having thus far been recorded from a total of 41 plants. "The insect attacks the ends of sweetcorn and in the movement of green corn to market can be scattered to various parts." "It appears that the beetle was brought into this country in shipments of Japanese iris during the summer of 1911. ...Some 625 acres are now heavily infested... and it is scatteringly found over some 7000 to 10000 acres, with outlying infestations over not less than 25000 acres... The immature stages are passed in the soil where the larvae feed on decaying vegetable matter. The adults appear by midsummer, continuing until cool weather in the fall. During hot days the beetles are strong fliers, which adds much to the danger of their spread..."

Let us see: 25000 acres is about 39 square miles. A circle with a radius of 3½ miles would about include this area. Thus

the Entomologist wants us to believe that in about 7 years with the beetles strong fliers during hot days the pest had kept anywhere within this area and he speaks at that of "an attempt at eradication" when the pest is probably spread over a far greater area and when it breeds on many cultivated plants and weeds including grape, apple, cherry, buckwheat, sweet potato, and corn, and with the list now incomplete.

The beetles seem to expose themselves to view during day time, hence on low growing crops could be secured by poultry and the fact that the larvae feed upon decaying vegetable matter in the soil means that they are hidden on the top of the soil right below that layer of decaying vegetable matter where they, and also the resulting pupae, can be readily found by poultry, In addition there is reason to believe that during warm dark nights the adults swarm and are attracted to a torch used as a trap in conjunction with a bait and could be easily trapped.

There is, however, yet another and a very efficient means of control. It consists in concentrating the adults to tassels of late sown corn, especially sweetcorn. As "the insect attacks the ends of sweetcorn" there is in the first place, no good reason why, with the preferred food supply short as the insect becomes more generally distributed. it should not attack readily field-corn But with the beetles strong fliers during hot days from mid-summer till fall, it will, with corn a favorite food plant, be possible to attract the adults to tassels of late-sown corn, especially sweetcorn, when such tassels are in the pollination stage. A little such corn sown two weeks apart so as to provide tassels from mid-summer till fall will decidedly concentrate the beetles. If this corn be then rolled down, poultry given access, could do the picking off, otherwise it has to be done by manual labor.

The U. S. Entomologist is now likely to right away shout: "Theory." He has done so before time and again when a member of Congress wanted to be shown both sides of the issue. As a matter of fact, in a similar case, as far back as 21 years ago I had shown that while there is no better way to combat the immature stages of the harlequin cabbage bug than the use of a hot-

air-blast torch and while it is an insect feeding normally only upon cruciferous plants such as cabbage, turnip and horseradish, the adults congregate largely, especially during hot weather, upon tassels of sweetcorn and can there be picked off by hand or by the judicious use of a blast, approaching them going backwards to cover them quickly and effectively with the blast. The Bureau has since then published the statement that the use of a torch is effective and practical in all stages except the egg, giving no credit to me for priority, this action constituting a deliberate infringement of copyright.

In practice this happens to be of but little consequence, because as a matter of fact I have since then devised a much better way of control. I showed that, in as much as the immature stages congregate upon the under side of the leaves in colonies and have to be looked after separately involving much time, a much better way consists in concentrating the adults, in plain view for action upon them. This can easily be done, if only care is taken that some cruciferous plants are allowed to bloom and seed at intervals during the growing season. The adults will then congregate upon the seedheads, and poultry given access will pick them off, making the control of this highly injurious insect in a way automatic.

Plainly sound as this method is, it, with all else I have ever written, according to the U. S. Entomologist, is all wrong. The Bureau of Entomology was created to promote entomological knowledge in its broadest sense.

"The so-called grape mealybug has become troublesome in parts of California... This is a difficult insect to handle, since it secrets itself under shreds of bark where sprays cannotreach it readily" (Ent. Report 1918, p. 2). Yes, sprays such as the Bureau has been using cannot reach it readily, but a blast from a hot air torch can do it easily and cheaply, and it was shown to the Entomologist for many years that this is so in the case of many insects that are similarly concealed. Moreover the grape is subject to several troubles that cannot be nearly as well handled with anything than a torch. A blast from a torch is the

very best means to control the grape leaf hopper. During the early part of the season before breeding is well under way it is just under these shreds of bark that the hibernated hopper seeks protection against cold and wet, at which time an application is most effective. Again, even in the drier sections of California the growers have to fight fungus, in this case the kind known as Oidium. The blast of a torch licks off the spores of this fungus and does away with the much more expensive use of sulphur, now relied upon to relieve this trouble.

The alfalfa weevil is on page six shown to have extended its range considerably, as usual, and on the other hand is credited with being held in check "materially" by important natural enemies. I had shown on page 11 of my Circular No. 151 from D. A. Bulletin No. 107, p. 57, that, given the chance, poultry is the best possible control measure imported or otherwise, and this would then work also on most other alfalfa insects, including grasshoppers.

Finally on page 9 of his report the Entomologist speaks about 'sweetpotato weevil eradication and control.' This insect has recently been discussed by the Bureau of Entomology in Farmers' Bulletin No. 1020. Records as there given on page 8 show that the weevil was present near New Orleans, La,, as far back as 1875 and at Manatel, Fla in 1878. It appears, serious damage did not occur to any great extent until recent years. This, considering the long time since its original introduction, brings up the question of food plants. "..,the insect breeds exclusively on sweet potatoes and closely related plants such as morning glory and bindweed..."(p. 16). The "closely related plants" include the whole botanical family of Convolvulaceae. Under Figure 5 is shown a Florida beach being overrun with the beach morning glory. to give a little idea of what job it is to carry out the proposed means of control by "keeping down volunteer sweet potatoes and all plants of the morning glory family, cultivated or wild" (p. 24) In Figure 6 is shown a "corner of a vacant lot in southern Florida, showing mat of wild or volunteer sweet potato vines badly infested hy the sweet potato weevil. "

There is every reason to believe that the damage to cultivated sweet potatoes has become pronounced chiefly because the wild food plants have become more and more excessively infested. To eradicate the wild convolvulaccae, granted it were feasible, simply means, aside from driving the then there existing weevils to cultivated sweet potatoes, to make that much room for some other plants that may breed insects or fungi affecting some other crop. It will be found to be indefinitely more feasible to keep these convolvulaceae reasonably free of the weevils when you stop to consider what poultry on a large scale can be reasonably expected to accomplish. This all the more as sweet potato vines are apt to become infested by the mealy bug, and especially as the territory known to be infested by the sweet potato weevil is largely infested by the Argentine ant, which, as is well known, fosters these insects. With this ant capable of breeding anywhere in rotting vegetable matter, and preferring, whenever available, the excretions of aphids and coccids to all other foods, you can readily see that the Bureau's plan of using poisoned sweets to control this ant, aside from its many drawbacks cannot begin to touch this pest at large and that control at large of this ant is only possible by a systematic and extensive use of poultry, this all the more as poultry in small numbers cannot hold its own against the ant, since the ant attacks the hatching chicks, which in turn proves that poultry is by nature an enemy of the ant, as claimed by me as long as four years ago in my Circular No. 147. pp, 26 to 28.

Of course it is very good practice, as recommended by the Bureau, to have, if otherwise practical. pigs eat up the remnants of the sweetpotato crop. Also there is little doubt that arsenicals early in the season are helpful as claimed, but unless the uncultivated convolvulaceaa are taken care of, there is everyreason to believe that with a female liable to lay as many as 300 eggs and four generations a year, there will as the wild food plants become more and more heavily infested, be a constant heavy dispersion from these wild foodplants to cultivated crops, and that if thes wild foodplants are kept reasonably clear by the

use of poultry, the cultivated plants are kept easily free by the use of poultry also.

"Weevils in all stages may be found in buried roots along the gulf coast during the winter" (p. 5). As it is the toppart of the root that is infested, poultry can readily get at the weevils by scratching. "The red and yellow colors of this insect on the metallic blue background of the body are undoubtedly of a warning nature." Hence, possibly, poultry might be cautions about attacking the weevils. There appears to be no good reason, however, why they should not readily eat the larvae and pupae. "..The larvae on hatching tunnel through the vines to the roots, the vines die and frequently the roots become badly riddled and filled with excreta, imparting such a bitter taste that even swine will not eat them,.."(p. 12). Which counts against the use of swine, but poultry is apt to find these larvae to be choice morsels.

Should poultry not do this work sufficiently satisfactory, or not be available, the use of a hot air blast applied with some such torch as shown on last page will prove of more benefit than anything else that can be used in the way of artificial control. In that case the operator will find it expedient to carry a stick in the left hand to raise and move the vines a little, exposing the weevil to the direct blast. Incidentally this treatment to that extent keeps down other insects, and is especially of value against insects that require a contact insecticide spray, which, with vines, is exceedingly difficult and expensive to use.

It can be put down as an axiom that the rate of spread of an insect is controlled by its food- and breeding supply. Thus in the case of the bollweevil official tests have shown that hibernated weevils upon touching young cotton without squares moved only 0.35 foot per day; and I was able to show from an official test, that even after squares had been set: weevils do not move more than necessary to secure squares, in one case an infestation beginning at about the time of the setting of squares having been confined by August 6 still to a small area, evidently because of the small number of weevils causing the original in-

festation in that case. Yet with uninfested squares more or less completely absent, the weevils have been known to readily pass over non-cotton-producing territory 40 miles wide without difficulty. Hence while the sweet potato weevil apparently is a weak flyer, there is no reason to expect that in case of insufficient breeding material on wild plants, it would not assiduously hunt for the more suitable cultivated sweetpotato plants that may have been kept protected in a way by the use of arsenicals, and find them even if they should be a good many miles away.

Contrary to a statement on page 20 of this Circular Senator Thomas P. Gore and Representative Asbury F. Lever are no longer chairmen of the Congressional Committees on Agriculture, having with the majority in Congress passing to the Rebublicans been superseded by Senator Asle J. Gronna and Representative Gilbert N. Hangen.

According to the U. S. Entomologist I am wrong on every point. Naturally he will not want to agree with me when I say the country owes him for his extra work done as humbugolist at least a six month's course of treatment at some first class penitentiary to get the humbug bacillus out of his system. In any case, I do not propose to worry my head off. If the Governors of the states chiefly affected, their Officials in charge of Agriculture and their State Delegations to Congress do not want to take any interest in the matter, I simply shall bide my time till the public has of the U. S. Entomologist's humbugology had its fill.

Under date of December 16, 1918 Secretary of Agriculture Houston handed to the Governors at their meeting at Annapolis, Md., a lot of sugarcoated talk about the beauties of co-operation in matters agricultural, but all efforts in the past to get him to order Chief Howard to discuss the issues involved were futile.