The Use of the Gasoline Torch in Fighting Insects and Fungi

CIRCULAR NO. 140 (No. 139 continued) APRIL 18, 1914

Entomology Bulletin No. 64, part 1, gives an account of tests made at Barstow in western Texas in 1905 of the destructiveness of a pentatomid bug, known as the Mexican conchuela. The account mentions that an associated species, the grain bug, possessing a capacity for injury of the same character, has destroyed as far back as 1895, 40 acres of peas and 2 acres of lima beans on a certain farm in the territory now infested by the conchuela and has since earned a bad reputation by its destructiveness to wheat and oats in Colorado and elsewhere. The account also sets forth on page 8 how another pentatomid bug, the green tree bug, destroyed in Florida 35 acres of cowpeas, and also a crop of tomatoes. "In general the Mexican conchuela may be said to be almost omnivorous, showing preference, however, for fruits and seeds." (p. 8).

The crops affected in 1905 at Barstow, a short distance south of the southeastern corner of New Mexico, were cotton, alfalfa, grapes, peaches, Milo maize and garden vegetables.

"....Fields devoted to alfalfa are capable of harboring the conchuela in enormous numbers" (p. 3) "....the principal danger....lies in the fact that a choice breeding place is furnished the insects which may multiply to enormous numbers and spread to other crops....In infested alfalfa fields, when the seed is present, the bugs may be seen clinging to the seed clusters, extracting the rich juices by means of their thread-like setae. The seed pod when once fed upon shrivels....Cutting of the alfalfa checks the multiplication of the pest, but also has the effect of driving the bugs elsewhere in search of food...."(p.4). On Milo maize "the conchuelas had been very abundant by August 4, as many as 25 of the insects frequently being noted on a single head...."(p. 5)...."The tendency of the conchuelas to congregate on certain individual peaches was

very marked as has likewise been observed in their occurrence upon the cottonbolls'' (p. 6). ''Garden crops were affected to a considerable extent by this destructive pest....The crops which suffered most were peas, beans and tomatoes'' (p. 7).

The writer, Dr. A. W. Morrill, on page 12 and 13 suggests, as a means of making the raising of a crop of alfalfa seed possible when these bugs shall have spread over wide areas, the construction of a hopperdozer, fitted with revolving fans and operated from behind.

Now a hopperdozer that will serve this purpose, it may be easy enough to construct and to operate. But, in the first place, the pest can multiply on most any other crop where the hopperdozer cannot be used and from where they can go to attack grapes, cotton and other late crops. Then, again, alfalfa and the clovers have a number of serious other enemies, one or more of which may be also present and the aim would have to be to devise a means that would be effective against both. Thus the alfalfa, or clover or timothy on which the conchuela or kindred species may feed and multiply may be infested also with the clovermite and the hopperdozer would be of no use against it. This mite lives upon the surface of leaves of trees and plants. There is no feasible means of control of this pest as a field insect except the use of heat as generated by a torch. This is so because there is nothing that will produce as much killing power against sucking insects as gasoline, or some other substance that may be found to produce the same effect at less cost, turned into heat, and applied under pressure.

Bugs are as a rule more or less gregarious and a single burner torch would in most cases answer to keep the bugs in alfalfa down and also check the mite to that extent. When the alfalfa is cut, the bugs will migrate to anything within reach that suits them. This class of bugs flies readily during the warm part of the day and will attack as readily tall trees as low growing crops. In order to enable the man who has a mixture of crops to defend against these and other bugs, or lice, or scale insects, or fungi, there should be at his disposal an apparatus that will give the widest possible use. If there is anything better than the torch designed by me, I do not know it. This torch is shown on last page.

However, special requirements will call for special types of construction. This alfalfa, or clover, might be attacked also by the alfalfa looper or alfalfa catapillar, and it would then seem best to construct a torch on similar lines as a four-row potato-sprayer; that is, a high wheeled cartskeleton is to support a seat for a driver and furnish room for a 10, 20, or 50 gallon tank, and with it as many leads of burner can be made to be kept going from it as may be desired. And these burners can be arranged as high or as low, and as close or as far apart, blowing forwards, backwards or sidewards, all or part of them, as may be desired. There is no gearing to either of the two wheels and in order to give the apparatus the widest range of usefulness the axle might be constructed of pipe and the wheels could, by using set screws, be spread as far apart or as close together as may be desired, so that the apparatus could be used between rows of corn against the chinch-bug, or against the conchuela on Milo maize or cotton, or any kind of insect on any kind of low growing crop, such as the melon or cabbage louse, not otherwise readily and economically affected by contact poisons, or where these sprays are entirely prohibitive in cost, as for instance against the spring grain aphis. More about construction will be said later.

In Entomology Circular No. 137 you find an account of the alfalfa weevil, but you find not even a suggestion as to a remedy. "From what is known of the insect in Europe and in the light of its behavior since its discovery in this country there seems little hope for anything from it but dispersion and destruction (p. 7)....The Utah Agricultural Experiment Station during the season of 1910 carried out a great number of field experiments with different methods of controlling the weevil, but none of these has so far given entirely satisfactory results...." (p. 8). And the account does not give even any 50, 10 or half per cent satisfactory results. And there is admittedly danger of rapid spread. Then again, this weevil may be able to breed on any kind of clover.

As the conchuela's ally, the grain bug, is already infesting the fields of "Colorado and elsewhere", and the alfalfa weevil is apt to show up there in quantity at any time, we have to de-

vise means to combat the two if possible at the same time. Besides there may be other pests to be considered.

The alfalfa weevil emerges as adult in Utah by the end of March and the female lays eggs till early in July (Ent. Cir. No. 137.) These eggs are deposited in the top part of the plant and the young hatching from them make their way to the leaves, shown by an illustration to be mostly at the tops. Now, the hopperdozer suggested by Dr. Morrill against the conchuela could be expected to work to get the grain bug; and it may work to get the weevils, and it may not; anyway, it is much less likely to get the young larvae. These apparently feed on the sunny part of the plant unless the weather be very hot and the bulk of them would be fully exposed to a blast from a multiple torch that might blow down on them. Since hatching begins by the middle of April, the aim would have to be to begin to apply the blast then and keep it up at such intervals and as long as examination shows it to be necessary. This would certainly get the young larvae and may, by injuring or killing outright the adults, make the larvae crop mighty small, and thus solve the problem.

Since setting above to type the report of the U. S. Entomologist for 1913 has come to hand. On page 7 reference is made to the Bureau's plan of controlling the alfalfa weevil. "....At present it is necessary to cut this (first) crop prematurely.... After taking off the premature first crop, brush dragging.... reduces the number of the weevil....The same follows for the third crop."

Why the first crop must be cut prematurely is not stated, but the known aim is to cut the crop at a time when the larvae are most plentiful. This, in experimental work, has a very strong tendency, especially if followed with brush dragging, to drive the adults to other fields not cut so early.

Compare this with Entomology Circular No. 137, p. 3: "If the field is mown over" (meaning the usual time) most of the larvae will of course be shaken off....While some of these perish those that survive and live upon the fresh growth together with those hatching from eggs deposited after the mowing develop sufficient numbers to overwhelm and destroy the second crop...."

Premature cutting of the first crop, then, simply leaves that many more eggs to be deposited into the second crop. And, in the case of the alfalfa weevil at least, the crops do not mature fast enough to prevent a large part of the weevils to develop from eggs laid in the spring or after the first cutting into adults, and many more will in either case reach at least the pupae stage, probably then hidden away in the soil at the foot of the plant. Brush dragging, rough as it is on the plants, will kill a certain percentage of larvae, but is cannot materially affect the adults and pupae.

Then, again, the plan proposed by the Bureau precludes the growing of seed. At the rate the Bureau advocates early cutting to control clover insects pests where is the seed to come from? Over a large territory the conchuela and grainbug attack this crop and seed growing is not advisable there, unless backed by the use of some practicable means of attack. Then the alfalfa caterpillar is threatening the crop and early cutting is advised for it also. Then there is the alfalfa looper, described in Entomology Bulletin No. 95, part VII., feeding on many plants besides clovers. The adult, a moth, is readily attracted to light and could probably be held in check by a traptorch. Then there is, chiefly in the Eastern States, the clover root curculio and the lesser clover leaf weevil, described in Entomology Bulletin No. 85, parts I. and III., the former feeding readily also upon grasses. Any of these may at any time become serious. Their habits are more or less similar. A multiple torch must be considered to be the all around most feasible means of control. This use of a multiple burner would be of special benefit in case of many larvae surviving a cutting. It could be then applied sharply immediately after removing a crop, while the larvae are clustering about the stumps.

Speaking of the alfalfa caterpillar in Entomology Circular No. 133 the writer says on page 7 that "at Indio, California, on July 1st, he found larvae feeding upon sweet clover which strangely enough they seemed to prefer to a patch of alfalfa growing close by. Eggs were also observed to be very numerous upon the leaves of the sweet clover at the same time." It might be possible, therefore, to concentrate this or other clover insects upon patches of sweet clover or some other preferred

food plant, and by making war on the insects here the fields at large might be protected.

On page 10 of his report for 1913 the Entomologist states that the spinach aphis cannot be controlled by any sprayer as yet tested when it occurs on spinach.—Well, and when it occurs on plants other than spinach, is it then also the spinach aphis, or does the spinach merely act as a first class trapcrop for most any old kind of aphis to steer over the critical winter period under its protection? Of course, infestation begins any time after the crop is up in the fall, and continues by influx and breeding upon the plants till frost stops activity. Every experienced gardener well knows that this feeding causes the leaves to assume the shape of in inverted spoon, and that this holds good in substance with all other plants, and that then no spray applied with any kind of sprayer or torch can do its best work. He knows that control would have to begin in the fall, and that the crop is too low priced to stand the expense of a series of applications of the usual contact insecticides, and besides, the foliage, in its normal state, is mostly so flattened against the ground that no spray can readily enter. On the other hand a blast from the torch either of the hand type or multiple type could, because of its low expense, profitably be made to blow in between the leaves and the ground, beginning when the plants are yet small, and before there is any tendency of the leaves to curl up. This, of course, prevents the aphis from getting established. What little injury might be to the plants will be readily outgrown during winter and spring. There is an end to infestation after the hibernation period is once reached, and the treatment has to be all finished by that time. As the crop is to be marketed as early as possible, no treatment is wanted to be given in the spring.

In thus keeping the aphis down on spinach or other suitable crops, this in turn protects the other vegetation in the spring from the infestation that would otherwise come from the spinach—and other fields.

Similarily you heard a good deal to the effect that the cotton red spider spreads from violets in the planter's yard to the cotton. To destroy the violets is no good, because, there are wild plants the spider can hibernate on even better, one being the

wild geranium, another the glechoma. The most feasible plan then is to use the violets as trapplants, and clear the spiders out by repeated slight lickings with the torch.

This principle of utilizing and treating trapplants is applicable in many similar cases.

In reference to the Argentine ant the Entomologist says in his report for 1913 on page 6: "The work on this destructive species consisted largely of an experiment in the extermination of the pest in a town in Mississippi in which it had recently become established. The best results were obtained with the use of a very diluted sweetened solution of sodium arsenite."

With no practicable means offered for the control of this ant in its stronghold in the uncultivated country and on cultivated crops, any extermination in any town cannot be more than temporary. My measures of control at large are described in my Circular No. 138 and also on pages 1, 2 and 15 to 17 of my Circular No. 139.

Now, as to injury to the crop by the blast, just put your mind at ease. On page 7 of Entomology Bulletin No. 64 Dr. Morrill cites a case of conchuelas migrating on July 17, 1905 in Mexico from an adjacent alfalfa field to a ten acre vineyard heavily loaded with fruit. "Each cluster of grapes was attacked by several bugs, the maximum noted on a single cluster being 25". The owner, without consulting Dr. Morrill, had the grapes picked, expecting this loss of food would check the insects to the benefit of the cotton fields. "This step was, however, inadvisable, since the fruit, which was of comparatively small value, would have served as a trap at which the bugs could have been easily destroyed when so thickly concentrated." He does not say how easily and by what means. As he was willing to sacrifice the grapes, it does not look as though he knows of an easy way to fight the conchuela on cotton.

The account does not give any advice as to control on cotton, but promises such advise in a future publication. "As it was, the bugs gathered in groups of hundreds on the trellis posts and on the vines, principally at the forks, where they were destroyed, partly by spraying and partly by use of a gasoline blast torch. The last mentioned method, while effective in its

destruction of the pest, injured the vines to a certain extent in nearly all cases."

Now, if the spray did not injure the vines, why did they use a torch at all? Well, it seems the owner got sick of the expense of using the spray. There is no more need to injure the plants than there is a need to cut yourself, even without using a looking glass, when using a razor. If you have enough gumption you can use a razor without cutting yourself, and if you have not, you have to use a safety hoe. A razor works quickest, and costs the least in the first place and next to nothing in upkeep, but it involves danger of injury. In using a torch there is a general tendency to give more heat at any one time than should be given. The bugs in question would have died probably as well, although slower, had they gotten less heat. I once applied the torch for about 2 seconds to a mature squash bug, without apparently injuring it, then caged it, and in a day or two it was dead. Moreover the adult bugs, which are much more difficult to kill than the immature ones, would in many cases fall to the ground and could be there given enough heat to cause their death within a day or two. This falling off would be the more likely to take place, if the heat be applied early in the morning while they are sluggish, and, moreover, the vines then have dew upon them and are then much less likely to be injured than during the heat of the day. Thus in the case of the alfalfa weevil the use of heat sufficient to cause the death of the adults need not injure the crop at all. But if it did, it would merely affect the tips, and the plant would readily out grow it. At any rate, the larvae require very much less heat. And any larvae that were not destroyed will become adults any time after June 15. These adults then feed upon the fresh growth, but also eat the bark from the stems, thus being by the time the grainbug would be in business in quantity again exposed to attack by a blast, and this up till hibernation time.

Besides, it is quite likely that the adults are attracted to light and thus, being during most of the growing season in the adult stage, this weevil could be controlled by the use of the torch used as a traplight, as described in my Circular No. 139, p. 11 and elsewhere.

This capacity of the torch as a trap becomes of importance in the case of an insect like the clover root borer, the adult of which is but little in evidence and the immature stages of which work below the ground. Since alfalfa and clover escape from cultivation, that is, provide volunteer plants to breed in, and as this beetle is known even now to be able to breed in some leguminous plants other than clovers, the chances that "the only preventive measure yet tried that gives any promise of success is summerfallowing as soon as the (clover) crop is removed" (Ent. Cir. No. 119, p. 5) will be of real practical value are very slim chiefly because alfalfa is wanted to stay for a number of years and would thus act as a breeding ground. This beetle, it is quite likely, can be trapped with a torch and that is therefore at present the most promising means of control.

Of course birds might keep it in check. But birds, like the rest of us, want a home. The burning of all shelter near fields as a means of protection against insect pests is so often advocated by the Bureau of Entomology, it looks like they do more to keep the birds down than all the bird butchers put together. It is of course true that such shelter provides hibernation places for injurious insects, but it is also manifestly equally true that it does so for their parasites, hence must be considered as neutral ground, at least as a rule.

There is a number of insects infesting the stalks and roots of several important crops, such as the cotton stalk borer, the corn stalk curculio and the sugarcane borer. There is usually nothing in the way of a satisfactory means of control known. Most of these insects have a well defined flying season, and in common with many other injurious adults fly at night, and using the torch as a light trap will be found on the whole to be the most satisfactory means of control.

Entomology Circular No. 152 treats on the rice water weevil and methods for its control. The chief means of control, as there given, "consists in the practice of draining and allowing infested rice fields to dry sufficiently at the proper time or before the attacks of larvae have greatly weakened the plants...." (p. 19).

This plan is not favorable to an extension of rice growing, or

of growing rice at the lowest cost, because it wiuld be often difficult to re-flood the fields.

In addition, as a means of control, "considerable numbers of weevils can be captured at lights and destroyed" (p. 20).

This latter point is made more clear on page 18. As early as on page 6, however, reference to this is made by stating, that while the adults "show no inclination to fly during the day and even refuse to expand the wings on being tossed into the air.....that they can fly for long distances is clearly proven by their attraction to artificial light at night."

In tests made to exploit, if possible, this inclination to fly to light "a portable acetylene outfit was used to furnish light, being operated near ricefields 1 mile from town (Crowley, La.)"

"Some of the best results were as follows, the weevils being taken on a cloth screen that was provided for the purpose of inducing them to alight: On the night of May 26, 1910, Mr. Van Dine started the light at 8 o'clock and captured over 40 weevils in the first 15 minutes. Later the breeze increased and only strong flying insects came to the light."

"Starting the light at 8 o'clock on July 19, after a day of heavy rains, Mr. Hood collected 24 weevils in 45 minutes. But on the night of July 29, which was clear and warm with slight south breeze, he placed the light in the middle of the rice field and caught 125 weevils between 8 and 9 o'clock."

You find reference made to the use of the gasoline torch as a traptorch at night, substantially as described by me as long ago as 1903, on pp. 8 to 15 and pp. 22 to 24 of my Circular No. 139. You read there on pp. 11 and 12 that while this torch does not make a bright light the very first catch I made consisted of 1500 insects—that being the number estimated by the official Entomologist at Washington, to whom it was sent. Hence the poor catches of weevils at Crowley were not due to any lack of light. The trouble, rather, was, there was a superabundance of it, whereas, as explained on page 12 in the case of the torch, all is dark around it, causing the insects to bump their heads against the red hot burner and become disabled and drop into the pail below. This with the improvements suggested on pp. 13 and 24 would result in a greatly increased catch, probably resulting in making it possible to catch tobac-

co hornworm moths in large quantities when they are plentiful.

As near as can be seen, the Bureau's outfit at Crowley required the attendance of one person. This makes it quite expensive, and the few weevils caught probably represented a trifling part of the total number present. With the torchtrap designed by me you put enough gasoline in the tank to enable it to burn the time desired, you hang it up on a tree branch or a light tripod made out of 1x2 stuff, and that is all the work there is to it.

This kind of torch might now be in use for years and the rice weevil kept under perfect control at trifling cost had the Bureau seen fit to duly investigate the evidence I presented to them 11 years ago. For my part it was about the same to me whether or not the gods are fighting against stupidity in vain: I realized I would be the biggest fool of all to try to force my way through then, and decided the thing to do was to wait till the people would get sick of the kind of investigations the Bureau was dishing up, and do not yet see why I should change my mind.

There is now also the alfalfa midge established in southern Arizona and New Mexico. Being, in my judgment, a sawfly, there is nothing in the way of direct control in sight except that it might be trapped in quantity by the use of the torch or else attacked in its larval stage with a multiple torch.

Of course, anything that kills an injurious insect will, generally speaking, also kill the beneficial ones present, and the torch is no exception. You have to know what you are trapping, or leave the trap alone. This is work for the Bureau of Entomology to investigate and the work was there for 10 years past.

This use of a multiple torch I had advocated as far back as 1903 against such insects as the Hessian fly when in the larval stage. Many of this class of flies get exceedingly numerous sometimes. In 1903 I was called upon to clear by the use of a torch two 10 and 12 foot plum trees covered with larvae. Specimens sent to Chief Howard were reported as being larvae of a sawfly.

"……the larger part of the fall brood of Hessian fly appears and is gone within a week ……" (Ent. Circ. No. 70,

p. 14). "The eggs are generally placed in the grooves of the upper surface of the leaves.....The young larva as soon as it is hatched makes its way down the leaf and behind the sheath." (p. 3.)

This hatching, in the case of the fall brood, occurs usually during cool weather, uually while the nights are quite long, and the total effective temperature for each day is not great, hence development will be slow and if a multiple torch be made to play at intervals of 2 or 3 days during the critical period upon the plants, there is no good reason why the bulk of them should not be destroyed at small cost.

Ground beetles are considered to be normally carnivorous and, like most sawflies, beneficial, but when abundant will, as described in Entomology Bulletin No. 82, part II in the case of the slender seed corn ground beetle, attack corn and do great damage. There is every reason to believe that these insects normally live on all kirds of animal food they can get, and when short attack any vegetation from young weeds up to oats and corn, attracting merely special attention in the case of corn by being compelled to live upon one kind of plant that affords with the usual incident prompt destruction of young weeds a very meager supply of food at sprouting time over good sized areas. These beetles are readily attracted to light and constituted nearly all of the first catch I ever made with a torch, as described on page 11 of my Circular No. 139. The traptorch is probably the best thing to control the maize bill bug. It also, is used early in the season in fields that were the year before in cowpeas, probably the only satisfactory means to control the cowpea curculio.

Speaking of the conchuela and its partner, the grain bug, when a crop of alfalfa, wheat, oats or some other crop they have been attacking is cut, or is maturing, the adult bugs, being strong fliers, readily fly to other crops, and are in a position to select the one best suited to their fastidious taste. At Barstow in 1905 "shortly after the 10th of July (Ent. Bull. No. 64, p. 6), coincident with the cutting of alfalfa, the bugs were noticed on the fruit of these (peach) trees." ("Fruit of the earliest varieties in their first fruiting season"), "which was just beginning to ripen. The trees soon became very heavily infested, and on

July 20 it was not uncommon to see from 10 to 15 on a single peach and in one instance 20 were counted. The tendency of the conchuela to congregate on certain individual peaches was very marked, as has likewise been observed in their occurrence upon cotton bolls....but all on the attacked trees were ultimately destroyed. The injured fruit became shrunken in spots and spongelike to the touch, finally falling to the ground...."

For control on peaches Dr. Morril recommends fumigation. "Peach trees when pruned in accordance with the practice of the leading growers are low enough to permit handpicking of all the fruit" (evidently presupposing the use of short stepladders) "and are correspondingly easy of fumigation." He recommends the use of a cheap tent, and as fumigants he recommends tobacco stems, pyrethrum, or bubach. This is supposed to soon stupify the insects and cause them to fall to the ground "where they can be easily and quickly killed....This method of fumigation is inexpensive and has the further advantage of requiring but a few minutes' work for each tree" (p. 14).

I deny that this method of control is inexpensive. Also peach foliage is very likely to be affected by the fumes. Then, again, these peaches will act as a constant means of concentrating bugs and there would be no end to fumigating while ripening fruit is on.

The only practical way, for commercial purposes, is to apply heat with a torch, and apply the heat with a little gumption. Avoid using the torch during the heat of the day and this for two reasons: First, high temperature causes tree and fruit to give off moisture more rapidly for the time being than the roots can assimilate. Apply the torch therefore in the morning, the earlier the better, or in the evening. This work could be done even during the night, same as hydrocyanic acid gas fumigation is carried on during the night. There will be more or less dew upon the foliage and fruit which will prevent practically all injury, if the torch is kept moving. Second, the higher the temperature the more apt are the bugs to fly off when they feel the blast approach. In fact, in that case, you have to work going backwards, so as to come upon the bugs with the blast suddenly.

On the other hand, the tendency of the conchuela to congregate on certain individual peaches, and cotton and other fruit—which habit to thus congregate seems to be common to most bugs of this class—makes it easier to that extent to reduce injury from the use of the torch to the minnimum, because the rest of the plant does not receive any treatment at all.

The aim must be to give the bugs one or more swift lickings at a time and repeat this rather than to try to kill them on the spot. Besides, there is a whole lot more than low-down peach trees to be considered. The conchuela and the grain bug are liable to attack and breed in anything that is suitable. You might have in your yard rosebushes, or a philadelphus, or a syringa (lilac) or citrus fruits in bloom or fruit, or a clematis (paniculata or viginica) as a porchvine, or a bed of petunias or heliotrope, or, of trees, a paulonia, or a large blooming chestnut, or an accacia, and any of them, when in bloom, and some, as the paulonia, also, when setting seeds, may be simply covered with the pests. You might not care to go to any great trouble to save the crop of blooms, but the fact remains that any of these plants or trees simply acts as a trap and at the same time as a means of multipliction and would be abandoned when no longer attractive in favor of other food plants, such as garden truck, all kinds, sizes and shapes of fruit trees (except nuts), grapes, cotton, corn and grain in general. Hence you want some apparatus that will make it possible to attack them cheaply and effectively under these multivarious conditions. In a general way the torch designed by me and above referred to would be what you want. For treating trees you cannot climb this apparatus is to be used in conjunction with a fruitpicker's ladder, or with a stepladder, folding, or solid, built perferably upon sled runners.

And, moreover, it has long been known that there are other sucking insects attacking cotton and other important crops in other parts of the world, and these may get a foothold in this country, and should therefore upon arrival be met by suitable means of control.

How best to control these bugs and other sucking insects that may be also present, then or at some other time, when they attack commercial orchards, or cottonfields, or vineyards, or

citrus-groves, is altogether another question. Fumigation, all things considered, will not do. When you use a torch on fruit like peaches you might spoil the outside of the fruit a little by the repeated slight lickings you are advised to use, but you spoil only a small fraction as much as the bugs would spoil if you used no torch and used anything else you might think would do instead.

As to control of conchuelas in cottonfields: Reference has been made above to Dr. Morrill's observation that they show a tendency to congregate upon certain individual cotton bolls. Thus, a handtorch of the knapsack type would lick them off on these without touching the rest of the crop. However, I am satisfied that a very large part of the bugs that otherwise would go to cotton could be concentrated upon Milomaize, or upon corn, and especially sweet corn, if these latter do well there.

On page 3 of my Circular No. 139 you will find reference, made to my experience in 1897 (not 1907 as stated there and also on page 2 by mistake) of the adult harlequin cabbagebugs concentrating upon the tassels of sweetcorn, feeding upon the pollen. I published this observation soon after, and tried to get the Bureau of Entomology and some Southern Entomologists to fully investigate this point. The Bureau did nothing, and one entomologist did at least so much as to say, in effect, that to claim, that an insect that has never been observed (to his knowledge at least) to feed on anything but cruciferous plants, such as cabbage, does feed upon a radically different type of plant, is an absurdity on its face.

Well, they feed upon the pollen of sweet corn just the same, and on the pollen only, as claimed.

It does not follow from this that I want to maintain that there could be no better way of congregating the adults. this the more as there can be no pollen in the spring when it would be especially desirable to get rid of the hibernated adults. In the South where many cruciferous plants of commercial value stand outside all winter I would suggest to so time a batch of mustard or other highly attractive plant to act as a trap that it will bloom at the time of emergence and then secure the adults

by hand or by the use of the torch. In the North I have found ruta bagas highly attractive. Some roots kept over winter and set out in the spring would throw up flower shoots and thus provide a means of close concentration. Or cabbage stumps from last fall's crop might be planted among the spring crop. All these would send up shoots on which the adults would be exposed. Similarily stumps from the early crop might be planted among the late crop. This would cause seed stalks to shoot up, attracting and exposing the adults to ready view.

On page 5 Dr. Morril makes reference to the occurrence of conchuela upon Milo maize, his observations beginning on August 11. The crop was then nearing maturity and nothing was thus observed as to what attraction the blooms exerted upon the bugs. As it was, the owner stated that by about August 4, they "had been very abundant, as many as 25 of the insects frequently being noted on a single seedhead." It would seem therefore that by planting rows of Milo maize through the cotton, the bugs could be conveniently concentrated, and then destroyed by the use of the torch. The rows might be planted at varying dates. The torch works much quicker and cheaper than handpicking, if it be used during the cooler part of the day, and with maize in ample supply to work on, this will offset any littly injury to bloom and seed by the blast.

For control of conchuelas on grapes grown low a knapsack torch would be the thing, as it is for many other grape troubles, as described on pp. 20 and 21 of my Circular No. 139.

Reference has already been made on page 31 of my Circular No. 139, that to apply heat to medium and large trees, or to hopvines, special outfits would have to be designed to apply the heat economically and effectively. The Bureau thus far had nothing to say about this, or anything else.

Although the knapsack torch will, with a good pressure, work with the burner swayed three feet or more above the gasoline supply in the tank, the aim will always have to be to get into use, as far as possible, an apparatus that will carry the gasoline supply at an elevation higher than the object to be treated. This is the more easily carried out because a little gasoline runs a long time and the outfit to carry the supply could be constructed correspondingly light.

We will assume a large number of tall trees, say 40 feet, of sufficient value to warrant some expense for treatment is seriously affected with some louse, scale insect or caterpillar. The use of arsenicals is very often neither practicable nor effective against caterpillars, the several reasons for which you find on pp. 17 and 18 of my Circular No. 139.

To carry a tower elevated to that height from the ground and allow of a wide range of work by enabling it to go over rough ground, it would not be too much to space the wheels 16 feet apart.

Assuming the whole outfit to be constructed of iron, it could be built up with the end in view of making it possible to use as much as possible of the several parts in putting up some smaller apparatus that will be necessary where the high outfit is not needed and cannot be used because of its width.

Thus, for axles, pipes could be used, and the wheels could be held in place by the use of set screws. The wagongear proper, clamped to the axles, and the tower, could be used only for this outfit, but the gasoline tank, pipes, hose and burners could be detached and with some slight alterations, together with the wheels, be used to get up a smaller, lower outfit having the wheels 12 or 8 feet apart. Again, this would furnish most of the parts needed to get up a two wheel multiple burner of any desired width for treating insects on lowgrowing crops such as alfalfa, wheat or oats. As the wheels can be clamped where wanted, cultivated crops like potatoes could be easily treated by constructing a two-wheel apparatus drawn by one horse with the wheels running in the rows on either side, and, say, 4 burners stationary or manipulated by hand as may be required. The potatobug is easily poisoned, but a blast blowing over a row of potatoes would lick off most of the fungus spores.

Farmers' Bulletin No. 557 treats on the potato tubermoth. The means by which the Bureau intends to control this insect is what I wish to call attention to. The insect feeds upon solanaceous plants and tobacco. To "insure success" in control "the first measure consists in the maintenance of clean methods of cultivation. This implies that all infested potato-plants and solanaceous weeds such as the groundcherry,

bull nettles, horsenettles and volunteer potato plants, growing in the same vicinity as the potatoes must be destroyed. This can be done by prompt burning as soon as insect infestation is manifest....." (p.13.)

Now, the adult, a moth, seems to be a good flier, able to readily cover miles to find foodplants. As tobacco grows wild in many places, this makes it still more impracticable to keep down the breeding material. The other proposed step of control, croprotation, is of no value, if the adult can fly for miles.

Of course, when affecting stored potatoes, control by fumigation can, as is claimed, take place.

"Care in digging is advisable in order not to cut into the tuber or leave the dug potato in the field over night where reinfestation could occurr" (p. 4.) From this it would seem, that the moth is nightflying and possibly could be trapped in quantity with the torch. Also, since, "the eggs are laid upon the leaves or on other parts of the plants and the minute caterpillars or worms quickly bore between the surfaces of the leaves or into the potatoskin, which they mine in every direction, finally devouring the exterior" (p. 1) it would seem that keeping the plants well dusted with a mixture of parisgreen and flour, or airslacked lime, especially near the base of the plant, would destroy many of the worms.

The greatest value of the several types of torch apparatus referred to will probably be found to consist in their ability of licking off the spores of any kind of vegetation at a cost of only a small part of any other treatment known, and thus make it possible to largely prevent the enormous losses in the sections of the country where the rainfall is ample and even abundant. and to that extent makes possible the production of heavy crops.

The Bureau of Plant Industry never made any definite statement in regard to the use of the torch as a fungicide.

On page 32 of my Circular No. 139 you find reference made to a statement by the State Entomologist of Illinois in a report having not at all any aim at boosting the use of heat, either as an insecticide or fungicide, and which is to the effect that the flame in a test in the fall of 1902 licked the spores off of a lilac plant and that in a few days new ones had cropped out. This.

if the leaf was not injured, was only natural, and this in itself proves that the heat necessary to destroy spores need not injure the leaf, at least not materially.

Thus far the Department of Agriculture has deliberately declined to define its position in regard to the use of the torch as either an insecticide or fungicide, at least they have taken no action at all in regard to my Circulars since the issuance of my Circular No. 134, of December 21, 1912, and they have carefully avoided to touch the essential features of my Circulars from No. 117 on, dating back to December 3, 1910.

On page 5 of his report for 1913 the Entomologist states that experiments in the handpicking of the early appearing bollweevils and of the first infested squares gave in the Mississippi Delta an average increase in yield of $3.22 per acre.

As far as this plan is to be followed, it will be up to the farmers to see whether they can hire the abnormal help required to do this work on the plantations at large, without having to pay higher wages than was necessary to secure the needed help for experimental work.

The whole thing is antedeluvian, and the Bureau knows it.

As to the possibility of some simpler means of accomplishing the destruction of hibernated weevils, the bollweevil oracle speaks thus on page 43 of Farmers' Bulletin No. 344: "The idea of attracting weevils to a few early plants or traprows seemed hopeful at one time. Practical work in the field ,however, has shown that nothing whatever can be expected from this means. The difficulty is that the early plants exert very little attraction ....."

I had shown as far back as my Circular No. 43, September 26, 1905, from investigations recorded on page 110 of Entomology Bulletin No. 51 relative to gradual attraction of hibernated weevils to squares, that weevils, emerging as they did in that case from within the field (at Victoria, South Texas) move so little about that one-fourth had failed to gather upon trap-plants close by (cotton growing from last year's stumps) having squares, many fully four weeks old. This is merely the best possible proof of the Bureau's claim that they are perfectly satisfied to feed upon one or more less advanced plants if they happen to find these first.

I had all along contended that the first step in weevil control is a field clear of weevils, and that this can be accomplished by plowing that field, whether it was in cotton or other crop, so that any weevils present are safely buried during the hibernating period. Being then numbed none could crawl out even if only slightly buried by accident, and any weevil that might not have been buried at all and that might become active because of warm weather setting in would go outside of the field in search of food, and finding none would secrete itself outside of the field. Hence infestation, under my plan, starts from without.

Although there are additional proofs, the claim that the weevils settle originally at the edge was proven as long ago as February 18, 1905, in my Circular No. 32 from a table on progress of infestation given in Entomology Bulletin No. 51, p. 115. The infestation, as subsequently learned through Dr. Hunter, had started from a cottonseed house near the corner where infestation first was noticed on August 6. Infestation, therefore, did not start "some time in July" as claimed on page 115, and the inference I had originally drawn from that claim that infestation was due to influx from other fields, becoming heavily infested, was not correct, but infestation had been going on since spring, yet even then was by August 6 confined to a small area. The field, apparently, was late in setting squares.

Previous to the issuance of my Circular No. 117 I had held that because of this evident original settling at the edge of the field it would be possible to let the weevils breed in the row or rows at the edge, and secure them by the picking off of the most advanced squares. The Bureau, without giving any specific reasons, on the other hand claimed that this plan does not work.

I concluded, then, that there was somewhere a rub, and in my Circular No. 117 I was able to show for the first time where the rub comes in. I showed there that with the setting of squares, and incident commencing of oviposition, the female would require 2 to 6 clean squares per day, and that this would mean that the bulk of the weevils would have to start almost immediately in search of uninfested plants all over the

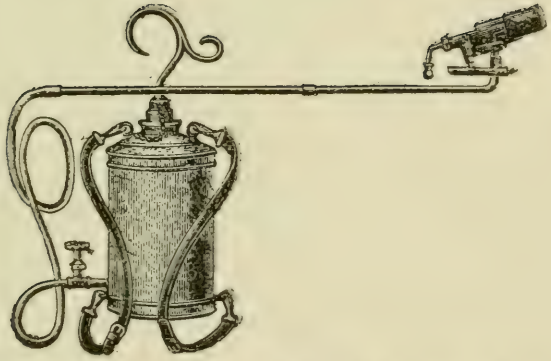
field, and that to prevent this the only way consisted in picking the weevils off daily at the edge of the field after squares have begun to form. Before this time, dusting the outer rows with arsenate of lead would be helpful.

This feature was gone over much more in detail in my Circular No. 127. My Circular No. 137 treats on the weevil problem as a whole and specifically points out on page 7 that letting newly emerged weevils feed upon squares at will means letting them get beyond control. This point you find pretty fully discussed on pp. 4 and 5 of my Circular No. 139. The essential feature for success in control is that under this plan there are no adult weevils and weevilinfested squares scattered all over the field to pick up, the latter mixed with normally shed uninfested squares, but the work is confined to the outer rows for the rest of the emergence period—about three weeks—and this securing of the adult weevils could probably be greatly facilitated by the use of a knapsacktorch. On pp. 29 and 30 and 33 to 35 you find the reasons why fall destruction of the stalks, as recommended by the Bureau, is necessarily ineffective.

And during all this time I was working to the end of having Congress in general and the Chairman of the House Committee on Agriculture in particular, insist on a full ventilation of this matter. The closest I came to it thus far was in a letter from the present chairman, Hon. Asbury F. Lever, written December 17, and received by me December 29, in which he said that "my information is that the officials of Department of Agriculture have never received any circulars from you in reference to the bollweevil."

I thereupon sent him three letters from Chief Howard in which he acknowledged the receipt of a number of circulars. As a matter of fact, there were 12 sets of my Circulars No. 137, 138and 139 sent through him to entomologists working under him, and he was told that the object of this was to make it as handy as possible for him to get his forces ready to hammer me down—if he wanted to undertake the job, as otherwise I would hammer him down. Mr. Lever was told this, and was asked to return the letters sent him, but they did not come back, nor was anything heard from him otherwise.

Of course copies of this Circular No. 140 will go to various members of the Department of Agriculture, and, for my part, they are, as always in the past, expected to make a statement up to the minute.



THE REINLEIN KNAPSACK GASOLINE TORCH

PATENT NO. 739,221; SEPTEMBER 15, 1903

Distinct in having the pump located in center of tank, with the handle operating the pump formed like a hook, and capable of being locked against movement by means of a pin, thus, by removing the straps, making it possible to hang it about in trees or on a ladder.