the Control of Cereal-and Forage Crop Pests

Circular No. 157 February 4, 1920

IN AS much as the European corn borer has become well established in certain parts of Massachusetts and New York, and the U. S. Department of Agriculture is trying to arouse the public to the need of drastic action towards "control and extermination" of this serious pest, and at the same time has virtually no other means of "control and extermination" to offer than destruction of the very large number of food plants this pest inhabits during its period of rest, this is a good time to throw a little light on how the Bureau of Entomology proposes to control certain other important insect pests, especially such as affect cereal-and forage crops, and also on means of control to accomplished this same purpose, as had been described by me during the past 6 years.

A system of control that is claimed by me to effectively control the European corn borer has recently been described by me in my Circular No. 156, and the Secretary of Agriculture, who for the past 6 years has done nothing to make the U. S. Entomologist do his duty in this matter—admit that I am right, or show where I am wrong—was once more asked to make the little man attend to his job.

The essential features of controlling this new pest will be repeated here, chiefly because I shall subsequently show that I had similar means described years ago, and because the essential idea, with modifications, makes possible the effective control of a number of other important cereal-and forage crop pests.

The European corn borer is a moth that develops "at least two generations annually" in Massachusetts. In the case of this insect a female moth emerging in the spring, lays on the average 350 eggs, and a female of the second brood, emerging in July, 550. These eggs are laid in patches of from 5 to 50 on the underside of the leaves, and the hatching young in a few days after feeding upon the surface of the leaves enter the plant to develop therein to a moth.

As for natural means of control, "very few are destroyed by them" (Farm Bul. No. 1046, p. 2). It will readily be seen then, that mere destruction, usually by burning, of its host plants, which is to include "the stubble and upper part of the root," and which host plants include, on suspicion, practically every plant of herbaceous growth such as annual weeds, is necessarily inadequate, no matter at what cost in money and loss of fertility and loss of waterholding power of the soil it may be carried out, to prevent the survival of a considerable percentage of larvae, and consequently is sure to result in heavy loss the following year.

The means of control devised by me, take advantage of the fact that the moths prefer to oviposit on corn bearing a tassel, or just coming into the tassel stage. Most of the corn

in Massachusetts reaches the tassel stage by July 1st. The first brood of moths oviposits during the 3 or 4 preceding weeks. If no corn is then in tassel, and none but early sweet corn is, the moths deposit their eggs upon other plants bearing a green seed head. Such plants are then plentiful among grasses and weeds. My plan provides for a patch of just such grasses or suitable weeds. It is extremely easy to provide such a patch, barnyard grass for instance making an excellent trap plant. This patch is to be mowed closely, cured and baled before any moths are ready to emerge. The less the brood was developed at the time of the cutting, the less necessary will be the baling, since the greater will be the mortality because of the drying up of the food supply, while the insect is yet immature. Naturally, the less seed heads are allowed to be present outside of this patch at ovipositing time through mowing them off previously or subsequently to the beginning of oviposition, and before the resulting inmature stages can survive in spite of the cutting, the better will be the result. We thus control the pest, simply by growing a crop of good hay at a stipulated time.

The second brood of moths emerges during the last week of July—2 to 3 weeks after corn has passed the pollination stage. My plan provides for a trap patch of corn sown rather thinly for fodder at such time that it will be just coming into the tassel stage by this time. This patch will then attract most of the moths for oviposition and thus very largely protect the ear corn against infestation by the comparatively small number of moths that have been allowed to develop on

plants other than the trap patch. This corn grown for fodder or silage is carefully utilized during winter which reduces the pest without any further fuss and fumble to the minimum for spring infestation.

What is wanted now in the interest of the public weal is that the Secretary of Agriculture give the Entomologist a day off from other pressing duties of his office, real or fancied, so that he may have time to define what is what in this method of controlling what, is "probably the most injurious plant pest yet introduced," as described on pages 1 to 11 of my Circular No. 156.

Sucidentally, the Entomologist has been for 3 years wanting to show why such a trap patch of late cotton or corn would not concentrate the bollworm or corn ear worm into hibernating quarters, and by plowing the ground before emergence begins in the spring, keep the bulk of the moths from emerging in any given locality.

If the borer finds its way to sections where it can produce 3 broods, the dates given have to be correspondingly advanced, and an extra sowing of corn made to tassel by about August 20.

In the South, this insect can produce 4 to 5 generations. The dates as given for Massachusetts have then to be still further advanced and the use of trap crops, corn or other suitable crops has to be carried on longer in the fall.

There is every reason to believe that should this pest find its way to the cotton belt, it would prove to be a far more formidable pest to cotton—under the crude method of control

advocated at present by the Bureau of Entomology—than either the boll weevil or the pink boll worm. In that case the first brood of moths can be made to oviposit on a trap patch of grasses, while the later broods, on cotton, could not be controlled except by the means described by me in my Circular No. 152, pp. 1 to 16, for the control of the boll weevil, the boll worm and many other cotton insects, including, as explained on pages 33 to 35 of my Circular No. 152 and pages 12 to 18 of my Circular No. 154, the pink boll worm. This method, in substance, consists in using poultry to pick on the fallen squares containing juicy grubs such as of the boll weevil, and concentrating oviposition of the boll weevil and the boll worm in the late summer to a late sown trap patch of cotton.

The European corn borer would readily breed on sugar cane. The first brood could be allowed to develop on grasses and weeds surrounding the cane field. These grasses and weeds would have to be cut at such time, that no adult can develop. The subsequent generations can be controlled the same as the 4 generations of the sugar can moth borer, described on pages 11 to 16 of my Circular No. 56. In essence, this method of control consists in sowing late corn at intervals and using it for silage and to trap the insect into hibernating quarters.

There are other important insects that can be similarly controlled. One of these is the sorghum midge. "In addition to the many varieties of sweet sorghum, the sorghum midge is known to infest broom corn, kafir, Johnson grass and milo.

In one instance the writer," (Mr. W. Harper Dean) "reared a single adult from the common foxtail grass (**Setaria glauca**) and Mr. George G. Ainslie has also reared the midge from the "**grass Sieglingia sesleroides**" (Ent. Bull. 85, p. 44).

"In the spring the midge appears with the first Johnson grass and sorghum, and as this grass heads considerably before the cultivated sorghum, it may be said that by the time the latter has headed, the midge has become sufficiently abundant on the grass to make the first sorghum infestation a heavy one. In the latitude of San Antonio, Tex., the first midges to be found during the season of 1909, were found actively ovipositing in Johnson grass on May 14. At this date the neighboring sorghum had not headed, and it was not until June 19 that the first brood emerged from the sorghum, which puts the date of this first infestation at approximately June 5" (p. 53). "From what has been said previously in regard to the midge in relation to Johnson grass, it is a self-evident fact that this grass furnishes the key to the situation (p. 55). "The destruction of Johnson grass is one of the most vital factors in midge control" (p. 58).

Destroying Johnson grass will not control the midge, because the midge could no doubt breed in a great number of other grasses if it were deprived of its usual food plant early in the season. Take a similar case: The bollweevil from its introduction into the United States in 1892 to 1913, was not known to feed and breed on anything but cotton, but evidently as the result of trying to starve it out by the early destruction of all of the plants in the fall it was found feeding in 1913 by

Mr. B. R. Coad, of the Bureau of Entomology, on **Hibiscus syriacus,** and actually experimentally reared on this plant by him, and partly also on other plants. Thus "by alternating food plants "(experimentally, which is less favorable than would be the case under field conditions)," it was found that the weevils have a wide range of hitherto unsuspected adaptibility" (U. S. Dep. A. Bull. No. 231, p. 3).

I had shown from this for four years past that with a cottonfield totally infested by the bollweevil in the early fall, destruction of all of the plants, and, in fact, the mere absence of squares suitable for oviposition would force the weevil to accustom itself to breed in plants other than cotton, which of course would in time render the Bureau's old standby of control—early destruction of stalks—entirely inefficient, and make control of the weevil all the more difficult, and that therefore the only sound principle of control rests in concentrating the weevil upon its original and preferred foodplant, and attacking it there by having poultry pick on the fallen squares and secure adults as described in detail in my Circular No. 152, pp. 1 to 16.

In the case of the sorghum midge the abundant supply of Johnson grass always present in the past simply thus far has not forced the midge to oviposit on any grass of second choice to any great extent. "Johnson grass being the first to head and bloom gives the midge a good start and by the time sorghum is headed there is a large brood of midges from the grass to infest it" (p. 55). Exactly—if you let them mature on it. But my plan provides for a large patch of Johnson grass

to be cut before the immature stages therein have sufficiently developed to emerge as adults. Of course the trappatch will be the more efficient the more the seed heads of Johnson grass nearby are made to serve as traps and are finally kept down before adults can develop through pasturing or mowing.

"Johnson grass makes a heavy yield of excellent hay if cut before the seeds are formed . . ." Farm Bull. No. 509, p. 7). It is quite possible to eradicate it in fields planted by itself "without excessive labor or expense. . . . The only expense is for the extra plowing and harrowing and that is more than repaid by the additional crop . . ." (p. 7). Also see Farmers' Bulletin No. 279: A method of eradicating Johnson grass. But as Johnson grass also occurs in mixture with other grasses and weeds where proper shallow plowing and harrowing for eradication cannot be employed, if we were to adopt the Bureau's plan of controlling the sorghum midge by eradicating the Johnson grass, we would have to dig all these scattered root stocks up, simply to have new grass sown through seeds passing through the stomachs of birds and other animals and to find that a large number of other grasses are also capable of sustaining the midge.

That Mr. Dean does not know how to eradicate Johnson grass is plain from the following, under heading of Destruction of Johnson grass: ". . . It should be burned over whenever discovered and such areas plowed in the spring to prevent an early crop of heads" (p. 58). The fact is, such plowing prevents an early crop of heads all right, but keeps the grass growing from year to year" . . . The small isolated patches of the grass

in the fence corners will carry the species over winter in the seed . . ." (p. 581). Exactly. And if these heads were cut in the spring before adults can develop and were subsequently cut whenever they became nearly old enough to mature a crop of adult midges, these same patches would constantly act as traps and keep the sorghum clear to that extent. It will be readily seen that the best results for a given effort are secured by making the trap patch of Johnson grass as far as practicable the only oviposition material for the time being.

There is every reason to believe that it will be possible to work out a similar method of trapping for the control of the wheat midge.

Of wheat insects the Hessian fly stands first, with the joint worm second. The Hessian fly, on winter wheat, can be most easily controlled by providing a trappatch in the fall, having it sprout at the same time as volunteer wheat. This trappatch, and other places where volunteer wheat freely occurs, will thus attract the bulk of the insects. The main crop is sown comparatively late, the date depending primarily upon rainfall affecting the early or late emergence of the flies in the fall as the case may be, and the development of volunteer wheat. The aim naturally is to have the flies oviposit on the trappatch and volunteer wheat while the main crop is sprouting. This trappatch and the places where volunteer wheat freely occurs must be plowed under in the late fall or anyway not later than in the spring before emergence of the flies begins. Thus a field the previous year in wheat may be allowed to carry winter wheat up to the time of the begin-

ning of emergence of the flies in the spring to be then plowed for some crop. This allows of seeding the wheat crop to grass or clover in the late winter the year before and gives grazing during the fall and early spring when otherwise because of insufficient rainfall it might not be possible to secure any profitable returns.

The joint worm, according to official remedies discussed in Farmers' Bulletin No. 1006, p. 12, is to be controlled by letting a stubble of about ten inches stand and plowing this down deeply during the summer and early fall. With the ground usually dry like a brick at this time, this is some job, however a tractor might be said to do away with this difficulty. In any case this with such a quantity of loose combustible matter buried usually will cause this upper layer of soil by breaking the capillary attraction at the depth of the plowing, anyway, deeply, to dry out like a bone, in that case rendering it unfit to grow anything before next spring. Moreover as it is best of farm practice to sow wheat to clover and grass in late winter and early spring, if this plan is followed we have a crop coming on after the wheat is off, where otherwise we have but a pile of trouble to bury the stubble. Why not then sow all the wheat fields to clover and grass and then after leaving a stubble of ten inches, go over with a mower, cutting close to the ground, fitting the mower with an attachment to catch the clippings. These clippings need not be burned. They could be spread on some low ground where the water drains during the winter. This excess of moisture coupled with the thawing and freezing would kill the larvae or pupae within. The less

cold, the more wet must be the location chosen. Also, if the weather be hot and dry as it usually is in midsummer, the mere clipping and drying of the stubble on the bare ground for weeks is likely to kill all or most of the larvae.

A similar case where the Bureau of Entomology as a means of control, recommends the eradication of an early foodplant, and where instead the using of that early foodplant for a trap-patch turns failure into success is to be found in what is their solution of the problem of controlling chalcis fly infestation in alfalfa seed. This problem and its solution, as given by the Bureau is discussed in Farmers' Bulletin No. 636.

As to food plants: "The cloverseed chalcis-fly confines its work entirely to the seeds of clover, bur clover and alfalfa . . . "(p. 3). "Mr. F. M. Webster shows the distribution of the alfalfa-seed chalcis as probably covering the entire United States" (p. 3).

The following list of means of control is given: "Harvesting severely infested crops "(that is, avoid trying to grow a seed crop)," clearing fence lines and ditch banks, winter cultivation, destroying the screenings, burning fences and checkridges, planting clean seeds, cutting the seed crop "(at such time as the most possible can be gotten out of it, whatever that may be)," destroying burclover, cleaning the seeds, and necessity of organized efforts."

As for the value of destroying burclover as a means of control, you read on page 9: "In some localities bur clover grows abundantly and matures its seed pods in early spring. The chalcis-flies thus have already completed the development

of an entire generation in the seeds of these plants before the alfalfa seed pods have developed in the fields. Under such conditions it would be well to destroy the burclover pods by burning the fence lines in the spring. This can frequently be done after the plants mature and before the alfalfa seed crop comes on."

With all vegetation then in sap, it is up to the Bureau to show how "it would be well" to try to burn the fence lines. Palpably what burclover would be growing in fence lines would represent only a small part of the total in the vicinity of the alfalfa field and burning such plants mixed with green ones is out of the question.

If a trappatch of burclover be sown, this will attract the bulk of the flies and if allowed to mature seed it will as stated by the Bureau develop an entire generation to later find its way to the alfalfa. On the other hand if this burclover be cut before the larvae are sufficiently developed as not to be affected by the drying of this food supply through cutting, this will kill them. This, especially if also surrounding volunteer burclover be cut, will, necessarily, to a certain extent ,protect the alfalfa. But with the blooms and young seeds thus cut, the flies then yet emerging from hibernating quarters or from early breeding places, possibly including white clover, not destroyed while in bloom, will oviposit on "clover," probably including white clover, then also inviting oviposition, and intermediate in time of blooming between burclover and alfalfa, hence to protect the alfalfa well, a patch of clover of a kind that is intermediate in bloom between burclover and alfalfa must also be

handled the same as the burclover. Red clover just fills the bill. This clover cut when the alfalfa begins to come well into bloom will then serve as a second check and thus reduce infestation of alfalfa to the minimum.

Not only is this course of thus using a trappatch of clover necessary if alfalfa is to be well protected against the chalcis-fly, but it also necessary if a clover seed crop is to be protected against the clover midge, since such cutting of the trappatch destroys the spring brood of the clover midge and leaves the next cutting free of infestation, offering a splendid opportunity for a heavy seed crop.

Naturally cases where a crop can be protected by growing a trappatch of the same or a similar plant are comparatively rare. Take the case of the smoky cranefly, described in U. S. D. A. Ent. Bull. No. 85, part vii. There is a whole family of craneflies, comprising several genera and many species, each present as adults for a certain period of the year, varying in time of emergence from March to October. There are aquatic, semiaquatic and terrestrial species.

As to records of damage, you find among others: ". . . Dr. S. A. Forbes (1888) reports a very general and serious outbreak of tipulids (**Tipula bicornis**) in grass and clover meadows throughout southern and central Illinois, many pastures and hayfields being almost completely ruined . . . " also " . . . Mr. R. W. Doane . . . states that thousands of acres of wheat and grasslands and clover fields were absolutely striped of verdure" (p. 121).

The eggs are laid into the ground. "The larvae, which

often occur in enormous numbers, as many as 200 having been found in an area covering a little over a square foot, feed upon the roots of various plants. . . . In feeding, these larvae move about in the ground quite freely, as is evidenced by the small molehill-like ridges they leave in going from plant to plant, just under the surface of the ground. They "(Tipula infuscata (a kind to appear as adults in October)" become full-grown about the middle of July, form perpendicular cells about three to four inches underground when they pupate (p. 127). The pupa then by means of the abdominal spines works its way to the surface from which it protrudes two-thirds of its entire length" (p. 128). "The adults . . . are about in great numbers among the tall, rank grass, clover and weeds, from which they rise awkwardly as one approaches, flying but a few yards before alighting" (p. 126).

Natural enemies, at times at least, manifestly do not amount to anything, else we would not have cases of nearly 200 larvae to the square foot. However, the Bureau of Entomology on page 129 gives a list of 86 kinds of birds that, according to the findings of the Bureau of Biological Survey feed on Tipulidae or their eggs. Among the larger birds thus feeding there are varieties of jays, blackbirds, cukoos, and one kind each of nighthawks, woodpecker, grouse, snipe and gull. The inference then simply is that these birds, and other birds, under primitive conditions readily hold the pest in check, but that with most of the lands given over to agriculture the birds do not find even at best the necessary favorable conditions to multiply sufficiently to keep the vast areas protected.

Of "remedial and preventive measures," that is, artificial means of control, the Bureau recommends in the case of Tipula infuscata, "to plow infested sod under in the early fall, and either run the fields into corn, potatoes and such crops, or to leave the land fallow the ensuing summer. Pastures and hayfields, in localities where this species is known to be abundant, should be grazed off by the middle of September, and kept so until late in November, as the adult flies usually congregate in rank growth of grass, clover, weeds, etc., and there lay their eggs" (p. 131).

Thus you have at least one case where the Bureau finds it handy to have some rank growth outside of fields and pastures—growth on waste land as they call it—to serve as oviposition ground, anyway up to late in November. With the pastures and hayfields kept thus grazed not many insects of any kind will stay there—good, bad or neutral—nor will maximum yieds be thus secured or will these pastures and hayfields winter as well or hold water and snow as well as if a heavier growth had been left on in the fall. Besides in the case of the earlier kind this does does not work at all. Most species emerge from March on to past mid-summer and thus lay their eggs where they see fit, live as larvae during summer, pupate and emerge during the first part of the next season. In other words, the Bureau has no remedy for these species at all.

There is, however, a perfectly satisfactory remedy, a remedy evolved along the line of the U. S. Entomologist's pet hobby—the use of natural enemies in the control of injurious insects—

a remedy I had during the past four years specifically shown to be the best means of controlling certain highly important and injurious insects. This remedy consists in the judicious and extensive use of poultry.

In the case of the smoky cranefly you have an insect, which as adults, spend their their time in low-growing vegetation. While more or less hidden during day time, poultry, if given access would stir up many and be able to secure these "awkward flies." Also the larvae, through the small ridges they leave attract the attention of poultry, they being razorial birds. Further, the transformation from pupa to adult takes place with the pupa two-thirds protruding above the surface of the ground, and seems to require a day or two at least, thus the helpless pupa also becomes exposed to attacks by poultry. If a gull, with its large size and rather clumsy habits on land, finds it feasible to include the cranefly in one form or the other in its menu, why should not poultry do so likewise?

It was four years ago in an effort to evolve a practical method of controlling the New Mexico range caterpillar that I first came to realize the great economic good that would result were the inherent possibilities of poultry as insect destroyers more fully developed. I pointed out in my Circular No. 146 that the New Mexico range caterpillar exists as egg, laid in clusters around the stems of weeds and grasses from about October 1 till June 1, being thus exposed to attack by poultry during all of this long time in this form. As the eggs hatch the young caterpillars up till they are about an inch long do not carry any decidedly poisonous hairs and may be

eaten by poultry in quantity with impunity, in as much as robins are known to be able to eat them.

"Robbins . . . seem to feed only on the smaller larvae. The spines of the large larvas are capable of producing much greater urticating effect and are possibly disagreeable to the birds on that account Ent. Bull. No. 85, part V, p. 93). Of course poultry and other birds are expected, and as a matter of fact are, under usual conditions, compelled to eat of these and similar caterpillars only as a part of mixed diet.

The period when the insect is from an inch to two and a half inches long is only about six weeks, when it changes to pupa, usually congregating in clusters among the stems of grasses, in which stage it is known to be greedily eaten by skunks. Why not then also by poultry? And these pupae change to moths that hang during day time in plain view on stems of grasses, simply waiting to be picked off by poultry. These moths, I had pointed out in my Circular No. 146, taken in great quantities alone, might be also injurious because of their hairy covering, but taken with plenty of seeds and grit, as would be the case on the range, it is most likely poultry will find them beneficial eating.

The Bureau of Entomology, instead of aiming to live up to its purpose of promoting entomological knowledge in the broadest sense, did not want to meet the various pending issues, but finally, in 1917, told Hon. John E. Raker, member of Congress from California, who aimed to get at the true facts, that my "plan of control consists in that turkeys be secured in sufficient numbers to destroy the insect. It has been shown,

however, that on account of the poisonous hairs borne by the caterpillars, turkeys will not feed upon it."

When Mr. Raker was told that I had expressly disclaimed that poultry would eat the insect in the nearly grown and full grown caterpillar stage, and that what the Bureau was wanted to define its position on was whether or not poultry will attack the insect in all other stages which take up ten months out of the twelve in a year, the Bureau declined to do so, but said I am wrong on this and all other points I wanted them to define their position on.

That the position is sound is shown by the fact as stated more in detail on page 12 of my Circular No. 155, from D. A. Bulletin No. 124, p. 28, that Mr. Charles Springer of Cimarron, N. M., 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. Cimarron is in the center of range caterpillar infestation.

As grasshoppers live during the cool part of the year, about seven months, as eggs in the soil, it is plain that the turkeys must live during this time on something else and I had pointed out for four years past that the egg clusters of the range caterpillar on weed stems are that the most easily available thing to eat there is. Efforts to have the State Delegation to Congress from New Mexico do something to have the Bureau of Entomology to go into details in these matters were futile. Also as explained on pages 7 to 9 of my Circular No. 154, the State Biologist-Entomologist of New Mexico outright claimed he wanted to be shown that the use of poultry

is practical, said that the whole matter was in the hands of the Bureau of Entomology and that he considered their proposed plan of control—relying on the work of parasitic insects to be better. In practice, apparently, we find Mr. Springer finds my plan pays, and pays big

Parasitic insects are not under the control of man. All that man can do is to introduce suc hinsects. Naturally, when a foreign, injurious insect is introduced without the parasites that keep it in check at home, the introduction of such parasites is highly beneficial and such action is a simple matter of common sense. But such parasites would become extinct were not their host or hosts be kept from becoming extinct.

Among other points at issue Mr. Raker had also asked them to define their position in regard to my method of controlling the bollweevil. I had pointed out, that inasmuch as the bollweevil is adapting itself to go without cotton for a long time and feeding and breeding in plants related to cotton, apparently as the result of the Bureau's plan of control by trying to starve it out by destroying the stalks as early in the fall as no more cotton can be produced because of the ravages of the pest, if the weevil be thus forced to adapt itself to new food plants, it would be indefinitely more difficult to control it on cotton, at least, if restricted to the means of control the Bureau has to offer, since it could breed then earlier in the spring through breeding now on other plants, aggravating subsequent infestation of cotton and could also breed later in the fall on plants other than cotton, causing a heavier survival than if it were confined to cotton as a food plant and

cotton had been left standing till frost thus finally destroying all of what value there originally was in early destruction of the plants as a means of control.

My plan of control provides for an occasional patrol of the surroundings of the cottonfields in the spring by poultry for weevils, and of course also other insects hibernating outside and working into the field, it provides for the occasional examination of these borders and the edges of the field by poultry for weevils and giving poultry the run of the field as squares would begin to fall, the claim being made that poultry would thus both secure adults and pick on fallen infested squares each representing a juicy grub; it further provided for leaving in the center of the field a patch about the hundredth part of the whole to be planted late to cotton, the object being to concentrate the adults in the latter part of the growing season to the abundant squares there produced and, by feeding poultry a little grain there, keep them sufficiently employed to keep down the number of the adults and the grubs in fallen squares, resulting in absolute control of the bollweevil. But Mr. Raker was told my plan consists in that chickens be provided in sufficient numbers to destroy all or most of the weevils as soon as they made their way into the fields.

We were then at war and, in my opinion, if any one thing agricultural was more essential than another to prosecute it, it was an abundant supply of cotton and, as part of doing my bit, I descrbed in detail my system of control in comparison with the Bureau's plan on pages 1 to 16 of my Circular No.

152. The Secretary of Agriculture claimed his department was putting forth every pound of its strength to win the war, but they were deaf to any request on my part to either admit that I am right or show what is wrong.

As the Argentine ant is spreading rapidly over the Southern States, the Bureau had been invited by Mr. Raker to define its position, and they did it in this way: "The Argentine ant is an insect that makes its nests in buildings . . . Mr. Reinlein's plan is to use a plumber's torch to drive the ants, which he believes will carry their eggs and larvae with them into the open, where it will be devoured by poultry." Every word is a lie. The natural home of the Argentine ant is outside. Invasion of houses takes place chiefly during the periods of scarcity of food outside, and they can be easily killed or driven away inside by the use of poisoned sweets, the more quick acting the better, I claim, which is also contrary to the teaching of the Bureau. Slow-acting poison will kill a larger number before the ants get wise, and leave for more healthy surroundings, which is outside where, under my plan, poultry can be made to attack them. These ants prefer the excretions of aphids and coccids to all other food, and spend much of their time fostering these injurious insects and protecting them against their natural enemies. I never advised the use of a torch against this ant in buildings of any kind including greenhouses. Outside, poultry given the chance in quantity, so that they can tackle the big undertaking, will subdue them, since the nests of the ants in summer are very shallow, merely deep enough to exclude light and water. I had pointed out, how-

ever, that poultry can be helped in getting a start by using a suitable hot air blast torch, something of the kind shown on last page, not a plumber's torch. The vibrations given forth by the torch will drive the ants out of their nests, together with the eggs, larvae and pupae.

To refresh the Entomologist's memory of what his assistants have found in this matter, I quote: "In case of danger the workers' first instinct appears to be to remove the young (eggs, larvae, pupae) to a place of safety and they rearily sacrifice their own lives in order to accomplish this" (Een. Bull. No. 122, p. 40).

I had shown for the past four years that inasmuch as Louisiana is the original breeding ground of this ant in this county, and this ant very greatly increases the numbers of the mealy bug on sugar cane, and the Bureau of Entomology has no tangible means of control at all against the ant on sugar cane or growing crops in general, the use of poultry is the only available solution of the problem. Every insect thus eaten not only means food saved for man, but also means poultry produced.

In the control of insects affecting cereal-and forage crops poultry grown on an extensive scale has a very wide range of usefulness. This point is pretty well discussed on pages 8 to 15 of my Circular No. 155. I had shown as far back as my Circular No. 147 that there is no better way to control the Rocky Mountain locust at large than by maintaining flocks of poultry to patrol the large stretches of low-priced and usually nonagricultural land, also subsequently pointed out the possi-

bilities of poultry in the control of many highly injurious timber insects, including the gipsy and brown tail moth of New England.

There is another class of insects affecting cereal and forage crops made up of sucking insects. Of these the spring grain aphis is a good representative. It is now well understood that if nothing is done in the southern-most points where this pest starts in the spring, it does its greatest damage by producing there a progeny that spreads in vast numbers to the North. As was pointed out by me in detail in my Circular No. 144, pp. 12 and 13, the Bureau has nothing in the way of direct control other, than plowing infested patches of fields under spreading straw over the patches affecteed and burning it, or use a 10 per cent kerosene emulsion that kills admittedly only about 50 per cent, according to the Bureau's claims, at a cost, years ago, of $4.00 per acre. None of these means of control is satisfactory.

I had shown as far back as 21 years ago that for sucking insects there is nothing more feasible as a means of control than the use of heat by a gasoline torch, and in my Circulars No. 140, 141, 147 and subsequent Circulars how torch outfits might be constructed that furnish a blast for sucking insects on any kind of vegetation.In the case of the grain aphis, for instance, some such wheeled frame as that of a hayrake could be fitted with a tank holding gasoline and having any desired number of leads to blow a hot air blast through the grain plants. An automobile truck is better. Morevover, I pointed out as far as 21 years ago that such a blast also destroys the

spores of fungi that may be on a plant. This use of a blast thus offers the only feasible means to attack fungus diseases on a growing grain and forage crop. The Bureau of Plant Industry was wanted all along to investigate this.

I had shown in my Circular No. 147 how these same fittings could be used to help make up an outfit applying a hot air blast too tall trees. Thus, for instance, we now have the for pearthrips seriously threatening the orchard industry. The use of a hot air blast is moreover not only feasible against the adults of the pearthrips as they appear at the blooming time, but also for the destruction of the larvae several weeks later. These, by being given a slight licking, drop to the ground, where a licking at close range kills them. This matter is fully explained in my Circular No. 147, pp. 8 to 13.

However, during the past 30 years certain other sucking insects have come into prominence as plant pests in general and fruit-and seed pests in particular. The most important of these are found in the group of bugs known as stink bugs." Their increase in damage is traceable to bringing large tracts of pasture lands under cultivation, with the consequent increase in succulent food supply and the incident curtailment of the breeding places of birds, probably the most important natural enemies of theirs. Of these bugs only two have thus far done great damage, while others may do so at any time if not checked by suitable means of control.

The two bugs in question are the Mexican conchuela (Pentatoma ligata) and the grain bug (Pentatoma) Chlorochroa sayi). The first of these, with reference made to the grain

bug, is described in Entomology Bulletin No. 64, part I, 1911, and their habits were discussed and better means of control than given by the Bureau were pointed out by me on pages 1 to 16 of my Circular No. 140, 1914.

Of the two pests the grain bug was the first to come to notice with a record of having destroyed in 1895 40 acres of peas and two acres of lima beans in Reeves County, Tex. (Ent. Bull. 65, p. 2), but subsequently the conchuela attracted the more attention of the two. The grain bug has recently been described in U. S. D. A. Bulletin No. 779.

In making tests to control the conchuela Dr. A. W. Morrill, the agent of the Bureau of Entomology making the tests, also incidentally made use of a gasoline torch After saying that the bugs had in a certain test case in Mexico, for the time being congregated in a vineyard of about 10 acres, and that each cluster of grapes was attacked by several bugs, and that the maximum number noted on a single cluster was 25, he says the grapes were picked by the owner without consultation with him. "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. 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 the 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." (p. 7.)

Admittedly the grapes were picked prematurely. If sprayed, this quite likely interferred with their eating qualities. The expenses, I pointed out in my Circular No. 140, p. 8, were many times that of using the torch. I also pointed out that there was no need to injure the vines or fruit, if present, since the application of heat could have been made lighter, but be made repeatedly. These bugs, moreover, readily drop during the cool part of the day. The application could have been given during the night, or anyway early or late in the day when the dew is on, with the bugs sluggish and more liable to drop, to be killed at the ground at close range.

Alfalfa is given by Dr. Morrill as the crop the conchuelas are most likely to congregate on in largest numbers in the spring, and he points out that with no means of control practiced, the bugs will multiply there unchecked. As a means of control, he suggests leaving a border of alfalfa all around at cutting time, on which the immature forms will congregate, to be killed by kerosene emulsion. This, of course, is awfully expensive on such a bulky crop; also may make this alfalfa nearly or entirely unfit for feed. The use of a knapsack torch, as shown on last page, or a mounted outfit having several burners, would be much better. Moreover, the adults will not stay there, not only because other crops will offer as good or better food, but also because this permits of a much more free distribution of their eggs.

Thus is the case cited: "Shortly after the 10th of July, coincident with the cutting of the alfalfa, the bugs were noticed on the fruit of these (peach) trees, which was just be-

ginning to ripen. The trees soon became very heavily infected, and on July 20 it was not uncommon to observe from 10 to 15 on a single peach, and in one instance 20 were counted. . . . (E. B. No. 64, p. 6.) For control on peaches Dr. Morrill recommends fumigating the trees with tobacco under tents, since "jarring is likely to shake off the fruit, and many of the bugs will escape by flying." The aim of this fumigation is not to kill the insects, for tobacco smoke does not kill them. "It stupifies them, causes them to fall to the ground, where they can be easily and quickly killed" (p. 14).

This, be it understood, is merely a proposed means of control. The U. S. Entomologist is not anxious to have it made clear that this is merely dishing up a theory. In practice it is well known that peach foliage is very sensitive to fumigation, especially during daytime, when the foliage is dry, and the smoke is then especially likely to cause the fruit to drop prematurely. Even during daytime, when the ground under the trees is "neat as a pin," there will be trouble finding the dropped bugs to be killed, supposedly by crushing with the foot. Suppose you have 100 trees to fumigate—and the fumigating must be done, usually, repeatedly— how many tents will you need to have a ghost of show to kill any appreciable part of the whole? Then again, these bugs may attack vegetation, wild or cultivated, too tall to be covered by a tent, or attack shrubbery and plants growing wild, where the use of a tent is not feasible, aside from the cost, thus multiplying unchecked.

On pages 13 and 14 of my Circular No. 140, I pointed out

that the use of a torch of some such type as shown on last page, is the most feasible means of control to clear vegetation of all kinds. The particular type of torch shown can be hooked from branch to branch in a tree, thus enabling the operator to treat tall trees after removing the shoulder straps. However, for tall vegetation on a large scale, such as commercial orchards, I pointed out, on pages 10 to 14 of my Circular No. 147, some torch outfits with a tank mounted high on a wagon and having 4 leads, which thus permits of having one of two men lick the side of a row each; the bugs, during the cool part of the day will drop, to be killed by a licking at close range on the ground by the two other men. As far as possible, of course, it is better in the case of these bugs, to use some specially attractive trap crop, such as grain sown in rows at such time as to head just then and attract the bugs.

For control on alfalfa, Dr. Morrill suggests the construction of a hopperdozer on page 13. But the insects are either liable to drop off or to fly off when disturbed by a machine. I had pointed out in my Circular No. 140, p. 3, as a better way that some high-wheeled cart could be fitted with a tank to feed several burners to lick the field over. But I shall later show that giving poultry, on a large scale, the run of the field, is far the best all-around means of control on alfalfa.

According to observations made by the Bureau at Barstow, in West Texas, in 1905, the conchuelas were most plentiful on Milomaize during the first week in August, as many as 25 of the insects frequently being noted on a single seedhead (p. 5). Evidently a tank mounted on some light motor truck

to supply several gasoline burners with hose and pipe to take, say 4 rows at a sweep, involving the use of 5 persons, would make quick work. If this Milomaize were rolled down so that poultry could pick the bugs off, this would be the most advantageous way. Evidently what is wanted is some suitable trap crop that would concentrate the bugs as they leave the alfalfa, and where the seedheads are low enough that poultry can readily get at the bugs. Strips of dwarf millet, sown at intervals so as to have some of it heading in succession during the season, would probably be an excellent trap crop of this kind. Such a course is especially advantageous where attractive fruit, such as peaches or grapes, is to be protected.

"The principal natural food plants of the conchuela are the mesquite and related leguminous plants, the beans being the object of attack" (p. 8) "under conditions in Western Texas . . . with the mesquite-covered surrounding districts as a stronghold, these insects probably will become established in the alfalfa fields each year . . ." (p.12). This is a honest admission that it is at least doubtful that much can be accomplished by ". . . destruction of weeds in the fall and otherwise hindering the successful hibernation . . ." (p. 11). As these bugs hibernate mostly under trash on the ground, giving poultry the run of the surroundings of the fields is manifestly the most feasible means of control at this period of the year.

The grainbug seems to be hardier than the conchuela, having been reported from as far north as Montana and Eastern Idaho, indicating that the insect can stand much cold, if

the precipitation is limited. It does not occur along the gulf coast of Texas, which would indicate that in a territory with a mild winter but a high rainfall, it is held in check in summer by fungus diseases. The insect appears to be at present most troublesome, per capita wealth, in New Mexico. The insect occurs in Eastern and Western Washington, and Northern Oregon, indicating that a mild, wet winter does not hurt it.

"The vital damage is caused by the piercing of the newly-formed heads of cereals and the feeding on the liquid contents, by which the formation of the grain is prevented, or its weight greatly reduced" (U. S. D. A. Bulletin 779, p. 1). Just a few samples: ". . . in May, 1903, one farmer in Arizona wrote that there was an average of about 10 bugs to each head of barley in his 40-acre field . . ." (p. 2) "In July, 1913, a correspondent wrote from Cloudcroft, N. Mex., that the grainbug had ruined 12 acres of rye on his ranch . . ." (p. 3). "Mr. H. E. Smith records that at Roswell, N. Mex., in 1913, at least two-thirds of the barley heads were ruined in a field that normally would yield from 40 to 60 bushels per acre. At Portersville, Texas, in 1913, the wheat in a 150-acre field which promised a yield of from 50 to 60 bushels, threshed only 22 bushels of very inferior grain per acre. . . . In one instance . . . a carload of oats averaged only 18 pounds per bushel."

The insect is well established in Utah and Colorado, in Colorado among many other points reaching an altitude of 9,300 feet at Silverton. No reason, then, why it should not find favorable conditions to exist permanently in Oklahoma, Arkansas, Missouri, Nebraska, Wyoming, Tennessee and Ken-

tucky, agricultural states supposed to be now free. Conditions for getting established seem right, also, in other states now free as long as the winters are comparatively mild and the summers rather dry, hence the need of effective means of control.

The foodplants, mentioned in U. S. D. A. Bulletin 779, p. 4, include wheat, barley, rye, oats, milomaize, kaffir corn, cotton, buckwheat, peas, beans, cabbage, tomato, lettuce, Russian thistle, mallow, sheepweed and many others, showing the insect to be able to feed upon plants far apart botanically. The list there given fails to specify two important food plants, namely, alfalfa and mesquite. The insect produces 4 generations in such locations as the Imperial Valley, in California, to 3 generations or less in its northern range.

The fact that the grainbug has the mallow (**Malva parviflora**) for one of its original foodplants, indicates that this pest, in cotton fields, is able to become a first class pest, and probably is so already in the Imperial Valley, judging from what the U. S. Entomologist says in his report for 1918, p. 11 "Other work on cotton insects (other than the boll weevil) has been carried on at . . . El Centro, Cal., the recent developments of cotton in the last locality, in the Imperial Valley, necessitating careful watch for cotton pests."

Of course, it is not necessary to "watch for cotton pests" after once there "were developments." But it is up to the Entomologist to carefully watch whether there are not better means of control than he is now dishing up. If it is not his

business to also watch what I am dishing up, I want to be shown.

The conchuela is already officially admitted to be a first class pest of cotton. My plan of controlling the cotton boll-weevil, and also the bollworm, provides for the use of poultry the year around, and includes the use of a trappatch of late-sown cotton. These plants in the latter part of the season, because of their succulency, concentrate the weevils, and will also concentrate the conchuela and allied bugs, where poultry can pick them off. This, then, usually obviates the need of attacking the bugs on the older plants with a hotairblast torch.

Much is said on pages 28 to 32, about natural enemies. The cold fact is, the pest has persistently, rapidly increased, in spite of them, calling thus for more efficient means of control by man. The means of artificial control given on pages 32 and 33 are all impracticable.

"The obvious method for controlling the grain buk is the destruction of their adults when they are concentrated in their hibernating quarters. This is best accomplished in the late autumn, during the winter or in the early spring by plowing under or burning all weeds and rubbish in and about cultivated fields . . . In many instances, however, the grain bug adults migrate from considerable distances, and this circumstance necessitates a systematic clean-up community campaign in badly infested areas . . ." (p. 32).

Nothing doing, and for several reasons: Dr. A. W. Morrill admits that mesquite is a stronghold to the conchuela. Why not, then, such and similar growth also to the grain bug?

Where the flight of insects to hibernation quarters has been carefully studied, as it has been, for instance, in the case of the bollweevil, an insect normally not much given to flying, it has been found that specially suitable hibernation quarters, such as woods, exert influence to distances of miles, hence mere destruction in and about the cotton fields will not amount to very much. In the majority of cases the fields affected by the grain bug are surrounded by land that is not and usually cannot be farmed. Were the hibernation quarters, not covered by shrubby growth, as far as possible be plowed us, this would destroy the natural and usually at best rather scanty cover of vegetation, consisting mostly of native drouth resisting grasses. It has never soaked into the thick skulls of the Entomologist and such of his men as are willing to side with him in saying I am wrong on every point, that nature abhors bare ground, and covers it with such vegetation as is suitable, called usually weeds. In truth these plants try to remedy the harm done by man in destroying the better plants that formed the original covering, and which are more slow in establishing themselves than the plants called weeds. The lands affected at present by the bugs in question are mostly grazing lands, cultivated fields being operated either under irrigation or dry-farming methods. If the range has been kept grazed too close by overstocking, this also in a lesser degree than plowing and burning, superinduces the establishment of less desirable plants. Thus in reference to sheep weed (snakeweed, Gutierrezia) you read on page 23 of U. S. D. A. Bulletin No. 211: Factors affecting range management in New Mexico: "In

response to the often-repeated question of how to get rid of the snake weed, there is but one method economically possible, and that is to give the grama grass a chance and it will crowd out the snake weed." In reference to the Russian thistle, you read on page 24: ". . . Ordinarily it does not seem to be able to crowd out the native grasses, but in the dry-farming areas, where the sod has been broken or the land deserted for any reason, it usually takes the ground completely. It also takes badly overstocked places on the range, especially where sheep have been held too long. Whether the native grasses will be able to crowd their way back into such areas or not, still remains to be seen. If they are not, then the importance of this pest is increased many times." . . . "Whatever may be said of the undesirability of weeds on a range, there is one thing to be said in their favor. Any vegetable covering in an arid region is better than none, since such a covering prevents, to some degree the removal of the soil." . . . "To the observer from a humid climate perhaps no one characteristic of the arid regions of the Southwest is so startling as the evidence on all sides as the forceful action of water as an erosive agent. And this in a land where water is the one thing that is everywhere lacking." . . . "showers are mostly torrential in character." . . . "Let such a downpour occur on what seems to be a flat plain, and in a few minutes the lower levels are flooded, and the roadbed of any obstructing railroad is apt to suffer severely . . . no one factor is so efficacious in producing erosion on the arid grazing lands as the more or less complete removal of their already scanty cover of plants by overstocking it . . ."

(p. 25). Yes, except, of course, the plowing up or burning over, as recommended year in and year out by the learned men of the Bureau of Entomology.

The grain bug, hibernating as it does largely in shrubby growth needed as a soil covering, can be effectively fought during hibernation by encouraging the expanse of the poultry industry. "The hibernating adults . . . generally are found directly underneath the material composing their hibernating quarters or in loose material on the surface of the ground" . . . (U. S. D. A. Bulletin, 779, p. 27). Thus poultry will find them just where they look for other food, both animal and vegetable.

"The adults of the grain bug are very numerous locally during the time of their emergence from hibernation in April and May. In one instance 30 adults were found under a single "cow chip" about 6 inches square; and a total of 175 adults were found under the dead weeds along a 20-foot space of an irrigation ditch" . . . "A half grown chicken devoured 8 adults during a single day when placed in a large outdoor cage with these insects. It has been commonly reported by farmers that a diet of grain bugs often kills barnyard fowls, but these reports have not been verified" (p. 32).

Poultry are not expected to live on a diet of grain bugs, or of range caterpillars when in the larval stage, or any other one animal food, or a mixture of them, since that is clearly contrary to their nature, but they normally want a mixed diet, animal, vegetable and mineral. Cage a man without food, except horseradish, and he will live longer if he leaves the horse-

radish alone. But give him water to drink, and meat and other food that is not flavored, and he will want to eat of the horse radish in preference to eating his food unflavored. A chicken forced to be without food excepting grain bugs might live longer by leaving them alone, but taken with other food and including grit, the grain bugs can be expected to form a healthful part of the whole.

"Early in the season the immature stages of the first generation of the grain bug are concentrated on the tender plants of Russian thistle and other native plants growing in the waste areas of cultivated fields. At this time the multiplication of the species may be restricted greatly by spraying these areas with a strong insecticide or chemical, thus killing insects and other obnoxious food plants in one operation" (p. 32).

Such a plan is not at all practicable or desirable. A chemical that would destroy the food plants would also injuriously act upon the soil, and thus either prevent the growth of all plants, or permit only those of poorest food value to gain a foothold. Moreover, the insects emerge irregularly, hence could not be killed all in one application, with the result that those emerging subsequently would be forced to congregate upon the cultivated crops. But the large areas that would have to be treated and the comparatively small yield usually secured on fields in arid regions render the incidental expense utterly prohibitive. On the other hand, poultry given the run will keep on picking these insects off right along, with other kinds. Besides, if natural enemies are to be a factor at all, they must have a place to hibernate and breed.

"Hand picking . . . may prove practical" . . . (p. 3). Assuming any hand work is practicable, which in general it decidedly is not, the use of a hot air blast would do this work many times faster. A number of torches operated from a vehicle work relatively still faster, with less damage to the crop. But with poultry kept going the year around, they will usually take care of the bugs as a matter of course.

"It has often been suggested that a hopperdozer might be employed to collect the adults and nymphs of the grain bug while they are feeding on the heads of the grain. An operation of this kind, however, would be complicated by the fact that the insects generally drop to the ground when closely approached. Then, too, at the time when most of the injury by the grain bug occurs, the condition of the grain is such that the passage of any collecting machine would result in considerable damage to the crop" (p. 33). "In grain fields the feeding is confined to medium sized and rapidly growing heads of immature seed. After the grain reaches the "dough" stage the insect ceases to feed upon it . . ." (p. 23). "The grain bug adults are very conspicuous objects in the field, owing to their large size and tendency to seek the upper part of each plant when feeding or resting on the grain heads. On clear days . . . at least 95 per cent of the adults present in the vicinity may be seen without moving any part of the plants. When disturbed, however, most of the adults immediately drop to the ground and seek cover" (p. 24).

All this shows that the most feasible way to attack the grain bug on grain consists in the use of poultry on an ample

scale to handle the work, and do this the year around. To have poultry thus available in a paying way it is necessary to give poultry the run of the surroundings of the fields, that they may be able to pick up most of their sustenance in the winter, a matter that may have to be regulated by law, since these surrounding lands may belong to somebody else. This kept up in the spring and, if necessary, during the summer, as long as bugs in quantity feed on the forming heads, holds the pest in check.

When the grain crops are harvested the bugs go to other food plants then forming heads, such as late grain, milomaize and volunteer grain. As near as feasible, poultry can be used to pick them off. The use of a gasoline outfit on a truck is naturally far the most feasible artificial means of control where poultry cannot reach them. With steps taken to have trap crops heading up till frost, where poultry can get at them, this will greatly decrease their chances for damage the following year. Probably some suitable variety of millet, sown at successive periods, will answer well for traps. The aim must be to concentrate the bugs upon low growing vegetation for attack by poultry or the torch, and thus keep tall vegetation, such as peach trees or grapes, free of them.

Indications are strong that this pest will rapidly become of great importance in California—unless soon checked by proper measures, as here outlined—the mild winters, the dry summers and great variety of food supply being specially favorable to its multiplication. At present the pest is reported from southern and central California.

There is also danger that a new wheat thrips, described in the Journal of Agricultural Research, Vol. No. 3, or other related species, may become very plentiful and widely diffused, and become first class pests of wheat and other grain crops. The species in question, while preferring wheat, can readily subsist and reproduce on several strong growing grasses. These, indeed, seem to be the original food plants of the species, and under primitive conditions the insect seems to have been readily kept in check both by parasitic insects and a lesser supply of succulent food after midsummer. This thrips occurs in all parts of Kansas, and in some adjoining territory. There are 4 to 5 generations a year.

"Thrips were common . . . appearing in swarms on young wheat in early March, 1914. By the first of April the larvae, now nearly grown, were cutting the shoots severely. . . . By the middle of May, when the wheat was heading, the second brood of larvae readily infested the young heads, feeding upon the stamens, pollen and pistils, and later attacking the integument of the grain . . . as soon as volunteer wheat pushed up in early September the thrips were found in all parts of the field. . . ." (p. 222).

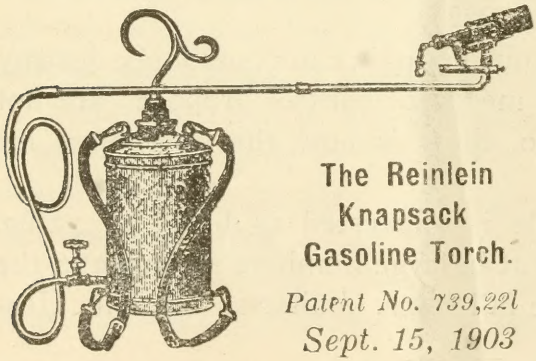
These insects, if numerous enough, can completely destroy a grain field. The official means of control proposed are not worth anything; and, if so, there is now the door open for their unlimited increase.

Burning of the stubble is suggested as being of value. But the insect is then present in large numbers as pupae in the ground, to emerge with the fall rains, similar as does the Hes-

sian fly, and attack the wheat. Besides, the wheat, for best results as to soil conditions and rotation, should have been seeded at the close of the preceding winter to clover or grass. Also, the insect can feed and breed in the grasses surrounding the field.

Instead of following the Bureau's plan in this and other cases by trying to control the insect by producing conditions as unfavorable for multiplication as possible by the destruction of food plants, it will be found infinitely better to fight the insects by the use of a trap patch, same as described for the Hessian fly, and, if necessary, by attacking the hibernated adults as they oviposit on the young wheat in the spring with a multiple torch. Such use of heat is the only contact insecticide cheap enough to be used on a grain or forage crop.

Upon the issuance of my Circulars No. 155 and 156, Hon. Gilbert N. Haugen, Chairman of the House Committee on Agriculture, had been asked to guard the interests of the public by having the Department of Agriculture define its position in regard to the points at issue. If the Department of Agriculture made any reply of any kind, I have not heard of it.



The Reinlein Knapsack Gasoline Torch.

Patent No. 739,221
Sept. 15, 1903