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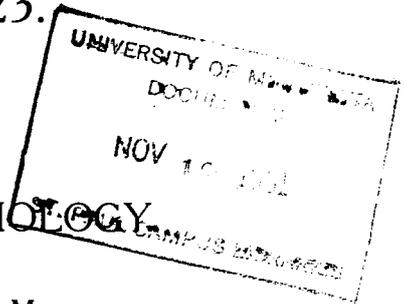
DIVISION OF ENTOMOLOGY

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CUTWORMS, ARMY WORMS AND
GRASSHOPPERS.

May, 1911.

UNIVERSITY FARM,
ST. PAUL, MINN.



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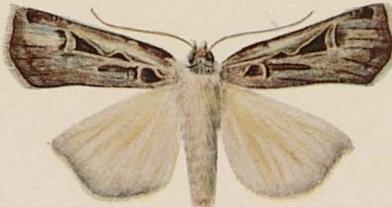
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CUT WORMS, ARMY WORMS, AND OTHERS

CUTWORMS, ARMY WORMS AND GRASSHOPPERS.

CUTWORMS.

Cutworms, represented in Minn. by several species, were so extremely troublesome in 1910, that they have been made the subject of a colored plate in this report, including also the Wheat-Head army worm, *Heliophila diffusa*, Walk, which has been locally very destructive, and also the Zebra caterpillar *Mamestra picta*, and its moth; which, while not a cutworm in the strictest sense, belongs to the same family, *Noctuidae*.

The abundance of cutworms in 1910 may have been due, in a measure, to the cold weather cutting down the weed growth which started in the abnormally warm weather of the early spring, obliging them to turn their attention more completely to cultivated crops. Complaints of cutworm injury began in May, and a few letters were received as late as August. There were more than twice as many complaints in 1910 as in the preceding year. Among the localities affected were Brainerd, Atwater, St. Paul, Ada, Hibbing, Hastings, Grove City, Kimball, Duluth and Sauk Center; showing an unusually wide distribution of these pests over the state. Several species were probably responsible for the injuries. Those shown upon the colored plates were, for the most part, numerous; but they by no means represent all the varieties present during the past two years.

Explanation of Plate:

Figs. 1 and 2—Wheat-Head Army Worm, *H. diffusa*, Walk, much enlarged, and showing variations in color.

Fig. 3—Moth of the same.

Figs. 4, 5, 6 and 7—Different Cutworms, collected in the vicinity of St. Anthony Park; died before reaching maturity, hence not identified.

Figs. 8, 9 and 15—Caterpillar, Moth and Pupa of *Hadena devaestratrix*.

Figs. 10 and 11—The Zebra Caterpillar, or Painted Mamestra and its moth, *Mamestra Picta* Harris.

Figs. 12, 13 and 14—Larva, Moth and Pupa of the Cutworm known as the Subgothic Dart, *Feltia jaculifera*.

We are indebted to Dr. J. B. Smith for identification of the above imagoes. Riley's account of *H. albilinea* probably applies to *H. diffusa* the latter being commonly regarded as *albilinea* and was so figured by Riley.

Cutworms are the larval forms of moths belonging to the family known as *Noctuids*, or Owlet Moths. The first name was given this family because they are particularly night-flyers, most of them remaining concealed during the day; and the second name, on account of the fact that their eyes shine at night, in the presence of a light, to which, by the way, many of the species are attracted. Living normally in sod land, what could be more natural than that, when deprived of this by farm cultivation, they should attack the crop immediately following. They may be, therefore, very severe on crops following sod. The larvae, like the moths, work at night, and conceal themselves, either in the ground an inch below the surface or under some protecting material, in the early morning. Both the moths and their larvae are fond of sweets; and this fact is made use of both by collectors in catching the moths and by the farmer and gardener in killing the "cut-worm" itself. The larvae, when full grown, averages in length about one and one-half inches, and is, as a rule, dull colored, with or without obscure markings (see colored plate). This full-grown larva burrows into the soil a short distance, and turns into a brownish or reddish-brown or mahogany-colored pupa (see Figs. 14 and 15, colored plate). These pupae may winter over, when formed late in summer, or give rise to moths in August and September, which lay their eggs at that time on various plants, or on the ground near their food-plants. The larvae, which hatch in late summer or fall, winter over in some concealed situation, and are ready for business in the spring.

Remedies.

While many birds prey upon cutworms—and although they are eaten by some other insects, and are the victims of parasitic forms, to say nothing of diseases bacterial or fungoid—nevertheless farmers are often obliged to take active means against them in order to save their crops. A bait made of bran mash sweetened with cheap sugar or molasses, and made decidedly green with a liberal application of Paris green, is a very good remedy in a garden. A tablespoonful of this should be put at frequent intervals among the plants subject to attack; not, however, nearer than twelve inches to the plant; for, in case of rain, the Paris green might be washed against the roots, and would injure or kill the plant. The Paris green should be mixed with the bran when the latter is dry. Through cultivation is an aid. Pieces of shingle or board, placed at intervals over the garden, serve as traps under which the cutworms hide toward morning, when they may be found and killed. Frequently the depredator will be found in the morning, within an inch or so of the plant cut, buried an inch under the soil.

Young plants like cabbage, cauliflower, etc., when not too numerous, when first set out in a small garden, should be protected by paper or tin, or a barrier of some sort, which should extend into the ground an inch or so, and two or three inches above the surface. This can be removed when the plant becomes so tough as not to invite attacks from the cutworm. On large acreages, fall plowing and thorough cultivation afford perhaps the most practical treatment. Cutworms, as stated above, are likely to be especially troublesome the next year after sod. Some farmers, in 1910, reseeded their grain fields with flax on account of the grain being destroyed by cutworms.

The family *Noctuidae* is an enormous one. At least two hundred and thirty-five different species of the group have been captured in this State. Of this list, something like forty-five species are typical cutworms.



Fig. 12. A Cutworm and its work.

THE WHEAT-HEAD ARMY WORM.

(*Heliophila diffusa*, Walk.) AN ENEMY OF TIMOTHY.

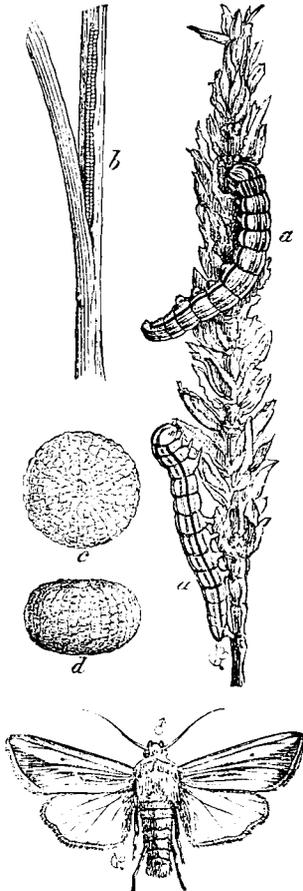


Fig. 13. The Wheat-Head Army Worm, *H. diffusa* a, a worms feeding on head of grain; b, worm on leaf sheath; c, d, two views of egg, enlarged. Below, the male moth. After Riley. Courtesy of J. B. Smith.

About the first of July, 1910, army worms were reported on grain at Detroit, Minn., and a little later a similar report came from Heron Lake.

Following these, and all in July, came complaints from Russell, Canby, Walnut Grove, St. James, Elbow Lake, Windom, Cottonwood, Revere, Marshall, Worthington, Hills, Tyler, Battle Lake, Ashby, Murdock, Stillwater, Ruthon, Hendricks, and elsewhere. (See also map Fig. 17.)

Men were dispatched to the places asking for help; and we were kept busy during midsummer in going from place to place and doing what could be done to instruct farmers in the methods necessary to overcome the trouble. It was found, in every instance, that the original infestation came from old timothy fields—fields that had been allowed to stand for from six or seven to ten years without feeling the plow, and which offered ideal conditions for the increase of the pest. It is probable that this army worm was present and increasing in 1909, though its numbers at that time were not sufficient to attract the attention of farmers. The drouth of 1910 was probably also in part responsible for the devastation then wrought.

These army worms (see Figures 1 and 2 of colored plate) vary in color from green to a very dark brown, or even blackish, but almost invariably show characteristic stripes on sides and back. They are a different species from the army worm which is familiar to the majority of Minnesota farmers, *H. unipuncta*, and which is commonly known as "The Army Worm."



Fig. 14. Head of wheat injured by the Wheat-Head Army Worm. Original.

The Wheat-Head Army Worm, the species under discussion as causing damage in 1910, is not a frequent visitor in Minnesota, or anywhere else for that matter; and it may be many years, barring its possible occurrence in small numbers in 1911, before we shall be troubled by it again. It is widely distributed over the United States, as far west as the Great Plains. When full grown, at which time the caterpillar is about one-and-a-fourth inches long, they go into the ground two or possibly three inches, and turn into mahogany-colored pupae about three-fourths of an inch long, resembling closely Fig. 14 of the colored plate, from which the pale brownish or "clay yellow" moths (Fig. 3 of colored plate) emerge later. The female moth lays its eggs on the leaves (timothy, grasses, grains, etc.); which eggs hatch into the above-named worms. Many of them were found to enter the pupal stage shortly after the middle of July; hence it would seem that it is two-brooded, or at least partially so in Minnesota; but it would appear that the second brood of worms, coming late, after harvest, might meet with difficulty in finding food.

It is not out of the way to say that at least four-fifths of the timothy seed crop in central and southern Minnesota was destroyed last year by this species of army worm, and the timothy materially injured as a hay crop. A conservative farmer, near Marshall, estimated the loss on the hay alone as equaling one-fourth of the crop, or about \$2 on every acre. In the vicinity of Otter Tail, it was roughly estimated that they had nearly destroyed 200 acres. Around Battle Lake, about 1,000 acres were badly damaged. A farmer at Windom states that he lost \$150 on his timothy crop. From Russell a report was received that from 1,200 to 1,500 acres of timothy were practically destroyed. In another section, 95 acres of timothy was reported as a total loss. A statement received from Heron Lake (July 13) was to the effect that the seed of 75 per cent of the timothy acreage had been destroyed.

Under date of August 27th, 1910, Northrup, King & Co. state that timothy seed had nearly doubled in value. This, however, was in a large measure due to the drouth of last summer. Conditions practically

identical with those in Minnesota prevailed in parts of Iowa and the Dakotas.



Fig. 15. Head of
barley injured by
Wheat - Head
Army Worm.
Original.

Army worms were found to have done much damage to timothy near Worthington by feeding upon the heads. The injury was most severe on high sandy soil.

In every case investigated, as stated above, it was found that the pest had its origin in old timothy fields that had been allowed to run four years or more without being plowed. After the timothy heads are eaten, the worms turn their attention to oats, wheat or corn; traveling in an army from one field to another—hence their name.

They appear to be somewhat subject to the attacks of parasites; and are undoubtedly, in common with other caterpillars, devoured by predaceous beetles, by birds, and die on account of fungous or bacterial diseases. Nevertheless, these factors simply serve to keep them within bounds, and it is absolutely necessary, when a farmer is confronted with a horde of these worms stripping his timothy field, and preparing to march to grain fields, to know what to do and to realize that *whatever is to be done must be done without delay in order to be effective.*

Preventive Measures and Remedies.

Fall plowing and the rotation of crops, sovereign remedies for many field-insects, are valuable here. If farmers would plow up their timothy fields at least once in three years, it would be a help in connection with this or any other insect which found there an undisturbed breeding-ground. Another year, quite possibly, this army worm might not originate in timothy, but be found beginning its depredations on some other crop. Its repression, therefore, appears to be dependent upon proper farm practice. In cases of serious infestation, as in the present instance, when a farmer's crop is threatened by these worms, and the land is in a condition to allow it, he should plow one or two deep furrows across the line of march of the

worms, the steep side of the furrows toward the crop to be protected. The worms collect in the furrows and can be killed with kerosene, or better, with crude oil. If post-holes eight or ten inches deep are made at intervals in these furrows, they form traps into which the worms fall. Or, the ditch or furrow may be partially filled with straw, which may be wet with kerosene and burned after the worms have collected thereon. A farmer can spray a broad strip about the worms, or across their line of march, with Paris green, at the rate of two or three pounds in 100 gallons of water; or arsenate of lead (better than Paris green) at the rate of four or five pounds in 100 gallons of water. Sometimes it is practicable to drag a heavy roller over the advancing worms. Dusting dry Paris green on vegetation about the worms may be resorted to. Fields where they are entering the soil to go through the resting stage should be plowed—harrowing is not sufficient. Co-operation in the attack is necessary; for there might remain on one man's place enough forms to lay waste the entire neighborhood later on, if every one did not take preventive measures. Clean culture along fence rows and elsewhere is desirable, since the worms also feed on plants other than timothy, and may breed on wild grasses by the roadside. Mr. R. L. Webster, of Iowa, who has been working upon this same insect, advises early fall pasturing, allowing stock to eat down infested fields fairly close, between Sept. 1st and 15th, removing stock from such fields by the latter date. He also recommends, when practicable, early fall plowing (during the first two weeks of September), by which young larvae of the second generation are turned under and killed.

The presence of this worm on cured hay does not poison it for stock, as some farmers have supposed.

GRASSHOPPERS.

During the summer of 1910 grasshoppers worked more havoc than for years before. Numerous complaints were received in 1909, but it would seem that these complaints merely indicated that the "hoppers" were gathering their armies, as it were, and preparing to work all the havoc they could in 1910. The accompanying map indicates by crosses the counties from which complaints regarding grasshoppers were received during the above-mentioned two years, and also the number of localities in each county from which inquiries were received; by far the largest number representing complaints sent in during the season of 1910. These crosses represent by no means the entire number of inquiries or reports of injury, since it often happened that many com-

plaints came from a single town. The circles shown mark localities suffering in 1910 from the attacks of the Wheat-Head Army Worm.

The Seventeen-Year Locust or "Harvest Fly"—which is a sucking insect and not a true locust or grasshopper—is often confused with the grasshoppers or true locusts, which have been so unpleasantly prominent of late.

There is no indication at present of an invasion of the Periodical Cicada or Seventeen-Year Locust, though many states to the south and southeast of us have periodical appearances of this insect, which passes the seventeen years (or thirteen years in the case of the 13-year form) of its larval life in the ground. It is not out of place, perhaps, to take this opportunity to advise farmers to avoid accepting unauthorized statements regarding insects, appearing in the daily or county papers, and to read most carefully any communication *authoritatively signed*; for sometimes the heading and the information contained in the letter are quite at variance. While we advance this criticism, it is to be borne

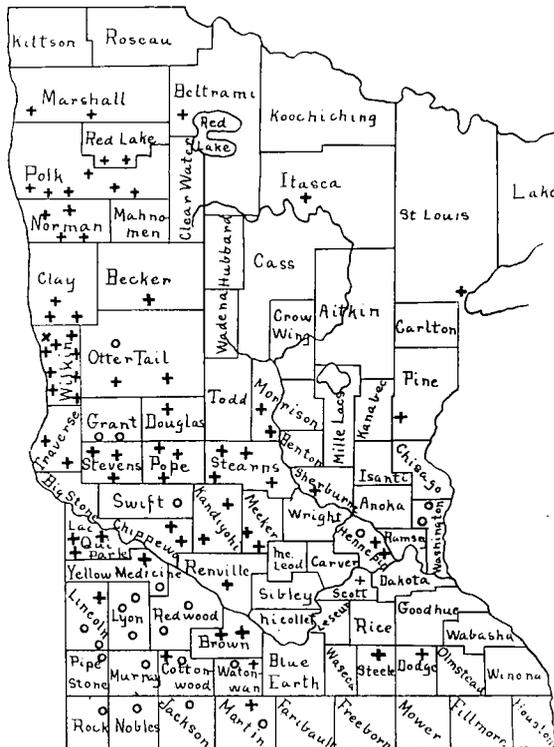
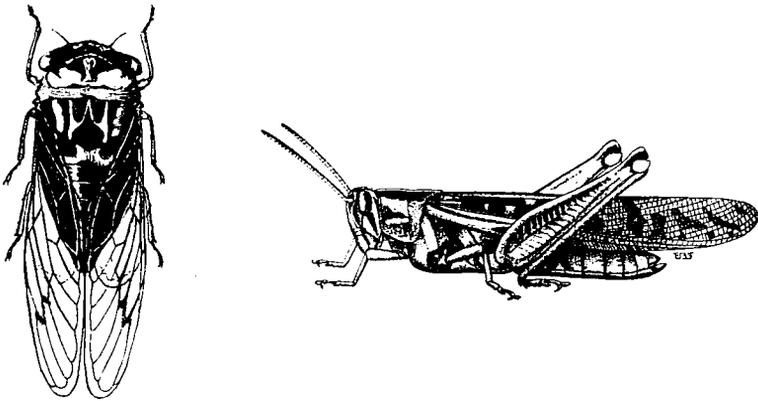


Fig. 17. Map of Minnesota. Crosses show localities from which complaint was received of grasshopper injury. Circles denote localities reporting Army Worm injury.

in mind that the State Press generally has been very helpful in disseminating information regarding insect pests.

One will note, upon looking at the accompanying map, that grasshoppers were pretty well distributed over the state in 1909 and 1910. but that they became much more numerous, and consequently much more destructive, as one went west and northwest from St. Paul; and that in the Red River Valley, throughout its entire length, they were particularly severe. These are all native locusts or grasshoppers, as far as seen; and, when they are numerous at all, loss is bound to be felt in the area indicated. In other words, in a farming locality which one might call a pioneer region, in that it is in the immediate vicinity of large tracts of untilled land, there will always be times of more or less trouble with grasshoppers.



Figs. 18 and 19. Cicada or Harvest Fly, commonly called locust, on left, and a true locust, commonly called "Grasshopper," on right.

Although the yield of flax in this state has been reduced to about two-thirds of the former production, the entomologist does not believe that Minnesota's entire output of grain was materially diminished in 1910 by that year's grasshoppers. But that is not the point at issue at present. The fact that many of our hard-working and deserving farmers in the counties indicated lost anywhere from a fifth of a crop to their entire crop production, and that some were so thoroughly discouraged as to think of abandoning farming in Minnesota, should interest state authorities sufficiently to induce an inquiry as to the cause of these periodical invasions, with a view to finding a remedy. That cause will not be hard to find. Large tracts of land which have reverted to idleness, or which have never been cultivated, held by speculators or others, offer ideal places for the egg-laying of this pest; and there are thousands of acres of such land in the western part of

this state, where owners are absolutely indifferent to the fact that farmers, endeavoring to make a living on the outskirts of these pest-breeding acres, have to make prodigious efforts to secure crops, and frequently fail altogether, because they cannot cope successfully with the hordes of grasshoppers pouring in upon them from the above-mentioned uncultivated acres. There is a grasshopper law in this state; but, inasmuch as the owner or lessee of such dangerous land is not obliged by this law to pay for the plowing, it is ineffective. We have the names and addresses of many of the owners or holders of such land, and a list of their property in Wilkin County; and have written some, only to find—knowing as they do, the weakness of the law—absolute indifference, carried to such an extent in one or two cases that they did not even take the trouble to answer our letters. There are thousands of acres of such land in Wilkin County alone—the undisturbed breeding-ground of millions of grasshoppers. In Andrea Township alone we have a record of over 8,000 acres of such land. Manifestly a county cannot stand the expense of plowing these tracts, even if sufficient men could be secured to properly do the work.

Two ways are open, which would seem to offer at least partial relief from this deplorable situation; one, the work of the individual farmer, properly directed by experts, aimed at keeping the hoppers off his growing crops, and to that end using intelligently, not only well known methods, but others which may be discovered through investigation; and second, the enactment of a more stringent law—something like the grasshopper law of North Dakota, perhaps,—obliging large land-owners to bear the expense involved in fighting this insect. It is planned to have, for the next two or three years, an expert or experts, constantly in the field, with headquarters at a central point in what might be called “the grasshopper district,” and not only trying various new methods available for the farmer, some of which are in mind at present, but also going from place to place where needed by farmers, and instructing them how to properly apply the best-known measures of protection. Such a man or men would be immensely useful to farmers in a stricken locality, beside being in a position, from a constant careful study of the situation, to make valuable suggestions along new lines of control. Further, it has been recommended to the Governor and the State Auditor that there be kept upon the Auditor’s books a sum which shall not revert, but which shall be always available in times of crises, to meet emergencies. For a time there was such a fund, consisting of several thousand dollars, left over from early grasshopper days. This has reverted long since, and at present there is absolutely no money to draw upon if we should have a sudden and destructive visitation of grasshoppers.

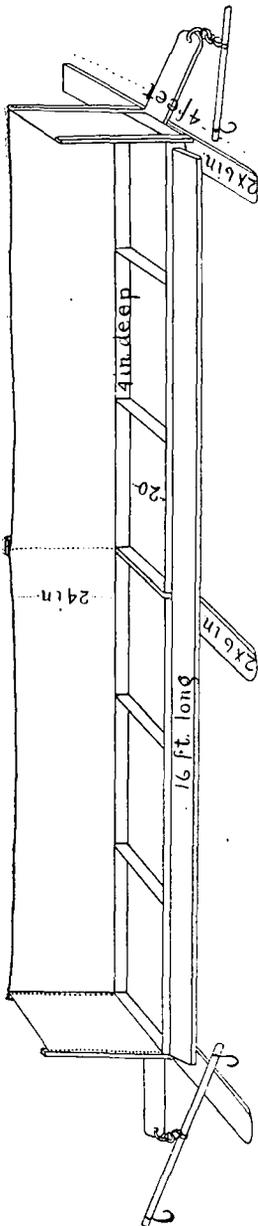


Fig. 20. Plan of Hopperdozer. Urbahms.

In April, 1910, a report was received, from a farmer living at Granite Falls, that the unusually warm weather in March had brought out the young grasshoppers, and that they had been killed by the freeze in April. This would have been good news if it had been actually the case in all parts of the state. Unfortunately, grasshoppers were found hatching in large numbers early in May, when all danger of cold weather had passed; and hopes, based on earlier reports, were doomed to disappointment; for never in the preceding eight years was there so much trouble and so much complaint as in 1910. Twenty or more afflicted farmers in Wilkin County were in correspondence with this division, and men have been in the field assisting them, showing them how to construct and use hopperdozers. North of Wilkin County, near Crookston, Fertile and Beltrami, and also in Otter Tail County and elsewhere, practically the same conditions existed.

Letters complaining of grasshoppers began to reach the office early in June, rapidly increasing in numbers during the month, and continued arriving in large bunches until late in August and even into September; and this division of the Experiment Station was kept busy, both in visiting different localities and in correspondence.

The grasshoppers causing the damage in 1910 have been, as far as observed, the Red-Legged Locust or grasshopper, the Lesser Migratory Locust or grasshopper, the Two-Striped Locust or grasshopper; the latter being extremely numerous, compared with its numbers in former years. Some farmers thought, because they saw swarms of locusts in the air, that they must have been the Rocky Mountain form; but we saw no

evidence of this species, and will have to call attention to the fact that the Lesser Migratory Locust, as well as other forms, probably, have this habit in common with the Rocky Mountain variety. Further, farmers must bear in mind that any grasshoppers can be destructive in proportion to their abundance. They do not need to

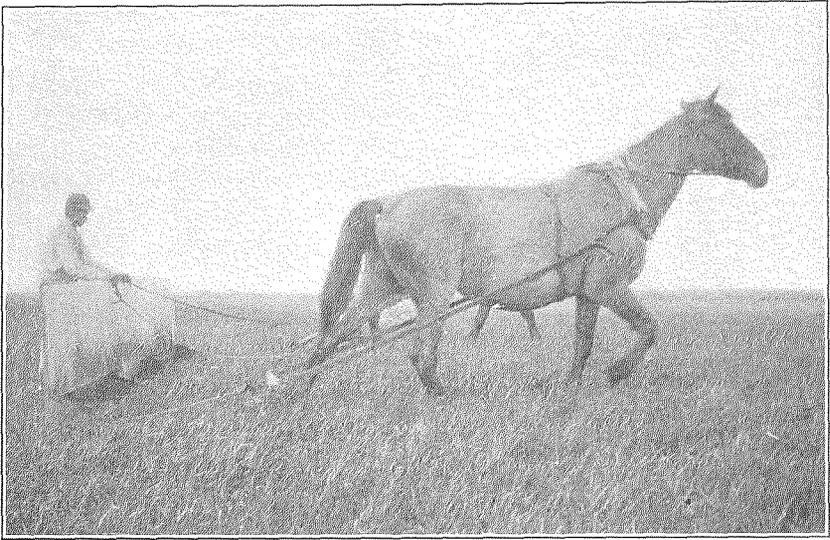


Fig. 21. Hopperdozer at work. Original.

come from the Rocky Mountains in order to be dangerous. The Two-Striped Locust was found very abundant in Wilkin Co. early in July, for the most part full grown and mature. Of the Red-Legged and Lesser Migratory there were more young than adults. At these dates also quite large swarms were occasionally seen high in the air, and coming apparently from the West.

Observations.

In addition to field work with the farms in 1910, laboratory observations have been made which may be of interest. A solution (arsenite of soda) in successful use in South Africa has been tried.



Fig. 22. Hopperdozer at work, front view. Original.

1. It has been found that young hoppers, freshly hatched, can live from four to five days without food, under trying conditions—a fact which is not particularly encouraging to farmers.

2. A very young hopper will average, in traveling on hard soil, about one foot every five minutes. They make about one foot at a jump, rest awhile and jump again. On soft soil their rate of travel is very much less than on hard—only a very few inches every five minutes.

3. Fig. 25 shows the successive stages in the hatching of a grasshopper, and its freeing itself from the enveloping membrane, or so-called “amnion.” Fig. 1, breaking through the egg-shell; Fig. 2, a few minutes later; Fig. 3, still later; Fig. 4, freed from the egg-shell, but still wrapped in the “amnion”; Fig. 5, kicking off the “amnion.” The length of time required in this process varied from about four minutes to fifteen, possibly dependent upon the amount of moisture present in the soil containing the eggs.

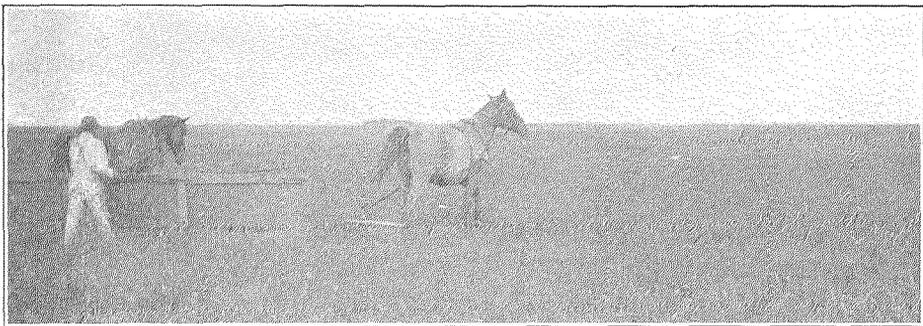


Fig. 23. Another view of working hopperdozer. Original.

Remedies and Preventive Measures.

(1) **THE PLOW AND THE HARROW** are the most important enemies of grasshoppers. A faithful use of the plow on the part of all farmers in a neighborhood, and all land-owners, will materially reduce the numbers of this pest in any given locality. As is well known, grasshoppers lay their eggs in late summer and early fall, in pockets made by the female, an inch or an inch-and-a-half deep. These eggs, which are about $\frac{3}{16}$ of an inch long, and yellow or brownish, hatch in the spring, in normal years between May 1st and May 15th, or thereabouts. These pockets are turned over by the plow, preventing the escape of most of the newly-hatched hoppers. Consequently late fall or early spring plowing (five or six inches deep) is one of the best remedies against these insects. Evidently, there must be co-operation on the part of all farmers in a neighborhood, in this important matter. Where deep plowing is impossible, a faithful harrowing would help shallow plowing by more effectively breaking up the egg-masses and exposing the eggs to the varying changes of the weather. The plowing of roadsides in the late fall or early spring, where there is serious infestation, is desirable.

(2) **PLOWING UNDER YOUNG HOPPERS.**—Young hoppers just hatching can sometimes be taken care of by plowing them under, beginning on the outside of the field in which they are hatching, and plowing toward the center. This turns many under, and by depriving them of almost all food, makes it much more difficult for them to reach the edge of the plowed piece, where they might damage a valuable crop.

(3) **CRIDDLE MIXTURE**—When grasshoppers are young, or half-grown, a poisonous bait, known as the Criddle Mixture, has proved effective in many parts of the country. This consists of one part Paris



Fig. 24. Scooping out the dead hoppers. Original.

green and about 100 parts of fresh horse-manure, by measure. Enough water is added to make the mass soft without being sloppy. It can be taken to the field on a wagon or stone-boat, and scattered about by means of a paddle. One might think that turkeys and other fowls, in picking over such material for bits of undigested grain, might be poisoned. This, in our own experience, does not seem to be the case. It would probably be dangerous if used in proximity to small chickens.

(4) **BURNING YOUNG HOPPERS.**—It is sometimes possible to burn over a tract swarming with young hoppers, and thereby save an adjoining crop. This burning, however, must be done with care, and the farmer must decide whether he is doing more harm to his hay crop than he is getting benefit thereby.

(5) **POISONED BRAN**—Garden truck to which chickens do not have access may be protected to some extent by mixing bran with water, to the consistency of chicken-feed; adding Paris green until the mixture has a greenish color (2 parts Paris green to 25 parts bran, by measure), sweetening with cheap syrup or molasses, and strewing the same amongst the plants; taking care not to place it directly against a plant. Spraying garden vegetables and other plants with arsenate of lead, 4 pounds to 100 gallons of water, would also serve to protect them.

(6) **HOPPERDOZERS**.—These, though not giving complete satisfaction, are regarded as one of the best helps; in fact, almost the only help, for a farmer upon whose crops the grasshoppers are pouring from adjacent unplowed fields. Hopperdozers are made of sheet iron, generally 16 feet long (though they may be shorter), and the drawing

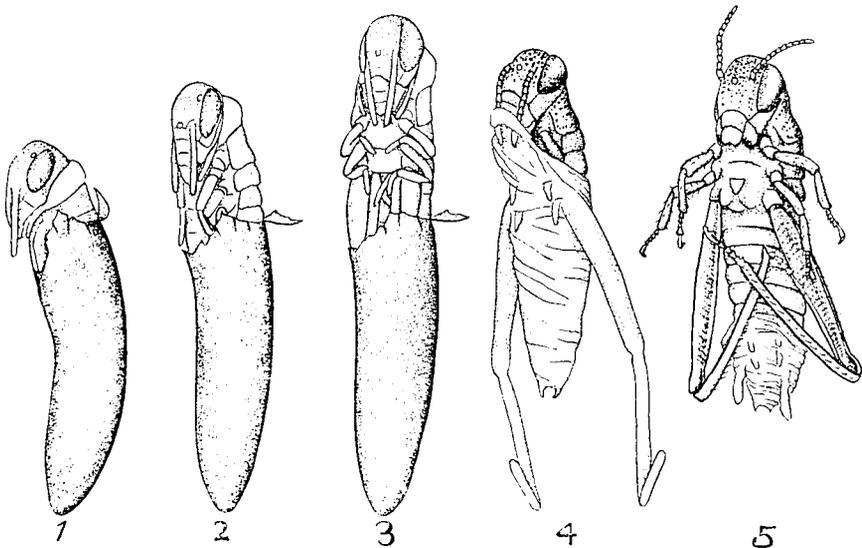


Fig. 25. Five stages in the hatching of a grasshopper. Original.

which accompanies this article illustrates a general plan. The upright part behind may be canvas or cloth, or of sheet iron. With the details suggested by Fig. 20 farmers should be able to construct one to suit their needs, and possibly improve upon the plans given. I might say, in this connection, that a horse at each end is better than one horse in the middle. When wanted for use, a little water is placed in the pan and also thrown against the canvas-cover back, if canvas is used. This back is then drenched with kerosene, and about two quarts of the oil are poured on the water in the pan. The machine is driven back and forth over fields of young grain or flax being eaten, and bushels of the insects are killed in this way. This work is best done when the day is bright and warm, and before the insects reach full size. Even though a grasshopper may jump out of the pan, if he has been in the kerosene, he is doomed.

(7) **PLOWING A STRIP TO CHECK ADVANCE OF YOUNG HOPPERS.**—In case a farmer is located next to an immense tract of unplowed land, whereon grasshoppers are hatching in large numbers and threatening to overrun his crops, manifestly he cannot do the impossible—in other words, plow all the reverted or unused land;—but he might plow a strip of this infested land several rods wide, along the side of his own land, thereby forming a barrier which it would be difficult for the very young hopper to cross, and thus giving time to prepare other means, (hopperdozers, for instance) to use against them.

(8) **THE MINNESOTA GRASSHOPPER LAW.**—This is strikingly ineffective, as stated above, and we would do well to follow the example of North Dakota in this respect. The method of procedure under the Minnesota law is as follows:



Fig. 26. Experimenting on small scale with arsenite of soda. Original.

Complaint of the infested land should be made in the fall, to the State Entomologist, or to the Board of County Commissioners, or both, accompanied by specimens of eggs. The entomologist examines the land; and, if conditions justify it, he recommends to the Board of County Commissioners that the land be plowed. The County Board serves notice on the owner or lessee of infested land, requesting him to plow within a certain time. If he fails to do this, the county plows the land; and, if said plowing benefits him in raising crops immediately after, assesses him to refund the money paid.

It is evident that, under the provisions of this law, the county will have to pay most of the bills for plowing. If our farmers think this law should be made more stringent, and the owner of said property be made to pay for the plowing in any event, they should make an effort to secure an amendment to the present law to that end.

The North Dakota law, given below, is more stringent in that the expense of plowing is made a lien upon the land, and the record owner or incumbrancer of said land must pay the cost of plowing.

Revised Code of North Dakota, 1905.

ARTICLE 27.—DESTRUCTION OF GRASSHOPPERS.

Sec. 2108. *Duty of County Commissioners.*—The Board of County Commissioners shall have power, and it shall be their duty, to order the plowing of land, and such other means as they deem expedient, wherever and whenever they deem it necessary to cause the destruction of grasshoppers and Rocky Mountain locust's eggs; and said plowing and other means shall be done at the time and in the manner directed by said Board of County Commissioners by the owner or incumbrancer, if any, of said land immediately after receiving notice thereof from said Board of County Commissioners.

Sec. 2109. *Notice, how and when served.*—Where the owner of the land on which said Board shall have decided plowing must be done for the purpose herein specified, cannot with reasonable diligence be served with notice within the state, it shall be sufficient to serve the said notice by publication thereof for two successive issues in the official newspaper nearest said tract.

Sec. 2110. *Must plow in five days.*—If the owner or incumbrancer, if any, shall fail to plow said tract or tracts as ordered and directed by said Board of County Commissioners, within five days after notice as herein provided, then, in that event, said Board of County Commissioners shall cause said tract or tracts to be plowed, or so much thereof as may be by them deemed necessary, and audit and pay for said work out of the general fund of said County, upon warrant as in other cases made and provided.

Sec. 2111. *Expenses a lien upon Land.*—Immediately after the said accounts are audited and paid by said County Commissioners, it shall be the duty of the County Auditor to certify to the County Treasurer the amount so expended upon each piece and parcel of land, which certificate shall contain the name of the record owner or incumbrancer of said tract, a true description of said land, the amount paid by the county for plowing done thereon; and the County Treasurer shall thereupon enter said amount against said land as taxes are entered against said land, and the said amount shall constitute a lien upon said land prior to all other incumbrances, and shall bear interest at the rate of seven per cent per annum from date of entry by the County Treasurer, and collection thereof may thereafter be made and enforced in the same manner as delinquent taxes are enforced and collected against real property.

Sec. 2112. *Payment out of general fund.*—When the Board of County Commissioners shall deem the plowing of state land necessary for the purposes herein specified, they shall order the same done, and payment therefor may be made out of the general fund of the county, upon warrant as in other cases provided; provided, however, that no growing crops shall be destroyed under the provisions of this article; provided, further, that when the Board of County Commissioners shall deem it necessary to cause plowing upon government land held by resident claimants, or other means to cause the destruction of grasshoppers and Rocky Mountain locusts, said claimant shall be liable to the county in a civil action for all moneys necessarily expended in carrying out the directions of the Board of County Commissioners for the purpose herein specified.

Testimony as to Conditions.

The following extract from a letter, taken from a large number of similar communications, received in 1910, is fairly indicative of conditions in the western and northwestern part of our state.

“Everdell, Minn., June 25, 1910.

“The grasshoppers seem to be very numerous, and already it is claimed that they have done and are doing damage. A number of farmers are trying to work against them with the hopperdozers, but the trouble is that there is so much land not being cultivated, growing grass; and it seems that they are very numerous on such land, and the trouble is that they breed on such land and afterwards go to the grain on the cultivated land.

“The situation here is fierce. This will be the third successive year that the grasshoppers have been doing damage on a large scale, and if there is anything that you can do through the state to help the farmers in this locality, it ought to be done.”

Reference has been made above to the fact that the grasshoppers doing the damage in 1909 and 1910 were not the Rocky Mountain variety; and it was further stated, that for some reason the latter form has not been seen in its usual haunts for many years.

The Lesser Migratory Locust, *M. atlantis*.—one we have with us all the time, capable, as we have seen, of doing great injury when occurring in large numbers, and with somewhat the same habits as the Rocky Mountain form.—is so closely akin to the latter that some entomologists regard them as almost identical, the latter possibly a long-winged variety of the former. The casual observer, noting them in the field, certainly could not distinguish the one from the other.

“MINNESOTA INSECT LIFE.”

This publication, edited by the State Entomologist, is issued upon the first of April, May, June, July and August of each year. Its object is to place before farmers, nurserymen, fruit-growers, gardeners and housekeepers, timely items, which will be of value in suggesting methods of preserving their property from the attacks of insects. The first issue was June 1st, 1910, and hence there were but three numbers in that year. This year (1911) there will be five numbers, beginning April 1st.

The name and address of any citizen of Minnesota, wishing copies of Minnesota Insect Life, will, upon request made to the State Entomologist, be placed upon our mailing-list, and copies will be mailed free of charge as soon as published. The contents of the 1910 issues, listed below, will give an idea of the nature and scope of the publication; which, by the way, is in no sense a bulletin, but merely intended to get certain facts before the public quickly, when most needed.

April: Spraying; Self-boiled Lime-sulphur; Spraying Machine Manufacturers; Insecticide and Fungicide Manufacturers; The Plum Curculio; Strawberry Pests; Codling Moth; Bordeaux; Grape Pests; Black Leaf; A Good Contact Insecticide; Naked Snails or “Slugs” in Cold Frame, Greenhouse or Gardei; “Sow Bugs” or “Wood Lice”; Grasshoppers; Plant Lice in Spring; Items.

May: Protection of Seed Corn; Summer Work With Grasshoppers; “Red Spider”; Ants in Garden and Household; “Buffalo Bugs.” Carpet Beetles, “Buffalo Moths”; Elm Borers; The Oak Twig Pruner; Mosquitoes; Chicken Hawks; Hems of Interest.

June: Cutworms, Striped Cucumber Beetle and True Squash Bug; Oyster-shell Scale and Scurfy and Seale; House Fly; Strawberry Weevil; Spraying Compounds and Spraying; Green Cabbage Worm; Grasshoppers; Bee Pasturage; Stalk Borers in Flower-Gardens; Plant-Lice or Aphids; Item of Interest.

July: More about Grasshoppers; On the Successful Raising of Asters; The White Grub in Lawns; Mites and Lice of Chickens; Tent and Forest Caterpillars; The Cabbage Maggot; Jiggers; Items of Interest.

August: The Grasshopper Situation; The Army Worm; Black Flies and Mosquitoes; Ants in House and Garden; Spraying and Spraying Machinery; Cockroaches; The House or Typhoid Fly.