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INSECTS NOTABLY INJURIOUS IN 1902.

ST. ANTHONY PARK, RAMSEY COUNTY, MINNESOTA.

UNIVERSITY OF MINNESOTA.

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INSECTS NOTABLY INJURIOUS IN 1902.

THE HESSIAN FLY.

Cecidomyia destructor, Say.

This pest well deserves to head the list as I found it alarmingly abundant over the southern, southwestern and the entire western part of Minnesota. Complaints began to come in about Aug. 5, and from that time on increased in numbers until after Aug. 11, when every mail brought letters relative to this insect. It has been a very favorable year for the fly, an abundance of moisture being highly favorable for its development. The result of its attacks appears most serious where grain is on sandy soil, evidently because, on account of thinner growth, the stalks fall more easily, while on richer soils the ranker growth helps to keep up the weaker plants.

Reports of injury have come from Perham, Mora, Fergus Falls, Little Falls, Crookston, Moorhead, Lake Park, Hawley, Pelican, McIntosh, Alexandria, Beltrami, Litchfield, Maine, Warren, Luverne, Cambridge, Kensington, Stodt, Oswell, Forest City, Glyndon, Gentilly, Liberty, Lynd and Garfield; representing the following counties: Otter Tail, Kennebec, Polk, Clay, Becker, Douglas, Meeker, Marshall, Rock, Isanti, Lyon and Morrison. Personal investigation upon the farms of G. E. Pratt near McIntosh, Eli Benoit near Gentilly, E. J. Grover near Glyndon and Mr. North and G. S. Barnes in Clay county; James Hanna, Forest City, E. J. Scott near Fergus, E. S. Wemple and Eli Dewey same place; Mr. Gruett, Clay county, Henry Bausman, Fergus, A. J. Letson, Philip Rutter, L. Bartlett, A. J. Thompson, J. M. Whighton, George Renzell and W. H. Mitchell all near Alexandria, revealed the fact that loss from this pest ranged from a fraction of one per cent to as high as fifty per cent in a few localities or parts of farms, and Mr. Keefe of Maine stated that his wheat

crop only averaged sixteen to seventeen bushel per acre owing to the Hessian Fly. Mr. G. E. Pratt states that in 1896 he lost almost his entire crop on account of this pest.

In order to give a general idea of the loss caused by this insect I counted upon one field not badly infested, twenty straws down as a result of Hessian Fly injury, in one square yard. In this case the straws standing on the same square yard representing the yield were not counted; but upon another field only slightly injured I obtained a full count, and upon one square yard 423 upright straws were counted, that is, so many heads were harvested. In this area 20 straws were down from other causes than the Hessian Fly injury and 6 straws were picked up containing "flax seeds." This puts the loss in that square yard between one and two per cent which is hardly appreciable. It is true this field was but slightly affected and other portions may have given a much greater count, the North farm for instance, (see Fig. 1) where over fifty per cent of the wheat was down at the time of my visit. To give a further idea of the havoc this pest can cause, I quote from the report by C. L. Marlatt of the U. S. Dept. of Agriculture, in which he states that the loss in the Ohio Valley upon the winter wheat of 1899-1900 amounted to from thirty-five to forty million dollars. The minimum annual damage due to Hessian Fly is estimated at about ten per cent of the product in the chief wheat growing sections of this country, which indicates an annual loss of forty million bushels.

The worst field visited was on the North farm near Glyndon above referred to, where quite fifty per cent of the wheat crop was lost. I believe an average loss of eight per cent for all counties in this state where wheat is raised to be a conservative estimate for this year. The grain has not been universally attacked over the portions mentioned above but, as indicated, almost every locality has suffered a little and some individual fields excessively. The Red River Valley is particularly afflicted and all along the line of the Great Northern Railroad from Alexandria to Moorhead and beyond, fallen wheat could be seen from the train and in such abundance as to indicate great numbers of this pest.

In 1901 the first report of injury came from Otter Tail county where a local miller placed the loss at fifty per cent. It was also reported from St. Peter, St. James, Worthington, Pipestone, Mar-

shall, Willmar, Wadena and Beaver Falls in 1895 and 1896 when the flies were abundant, the loss on the entire crop being estimated at from five to ten per cent and in individual cases as high as twenty-five per cent. Mr. Forbes reports it present conspicuously

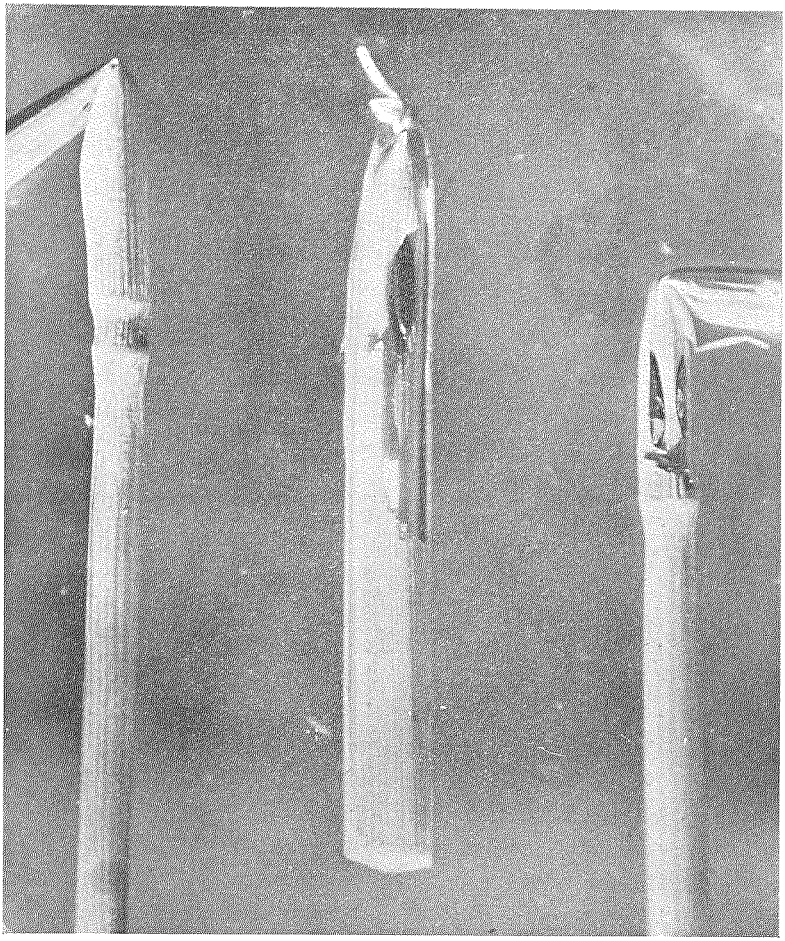

Fig. 2.—Three straws showing work of the Hessian Fly; "flaxseeds" exposed in two straws on right. Original.

in 1897 and 1898, which is evidence that it is on the increase in the state and that it calls for radical remedial or preventive measures. It is all the more insidious as a foe to our farmers from the

fact that its presence is not revealed to them until the injury has been done and the grain is down, and from the further fact that a large number of our farmers are unfamiliar with its work and have been accounting for the falling grain as the result of hail. In fact, I am creditably informed that some sought and obtained hail insurance for grain injured by the Hessian Fly. It is well worth noting that although it is generally on the increase and bids fair to cause much greater injury in the future, its increase like that of many another pest is marked by periods of decrease. It is wave-like, if I may use that expression, for as its numbers expand favorable conditions are created for parasites which infest it, causing them to increase in enormous numbers and temporarily get the upper hand. But their victory is necessarily of short duration and only leads to their own destruction for as they destroy their food supply their own numbers decrease, and again their host, the Hessian Fly, takes another bound forward, for the time at least not much hampered by parasites. Although the parasites of the Hessian Fly are largely common in all localities of the state where the fly is found, the writer having noted their presence in many specimens secured from different points, the farmer cannot afford to neglect certain preventive measures which lie ready at hand in keeping down the pest which bids fair to very materially reduce our output of wheat. In mentioning these measures I wish as a preliminary to state that the individual farmer must use his judgment in their application. He should be guided by the peculiar conditions of his surroundings, conditions which might not occur in the case of another farmer.

1. **Burn the stubble when possible. This is particularly desirable when, from any reason, shallow plowing is unavoidable. If the stubble is left long it will burn easier. Some farmers are willing to go to the trouble of spreading straw from threshing over the stubble, thus insuring the burning and at the same time getting rid of some "flax seeds" which may have lodged on the surface of the straw pile at the time of threshing.**

2. **Fall plowing of the stubble in such a way that the straw is completely turned under.**

3. **All screenings and litter about the threshing machine should be cleaned up and either fed immediately or burned, leaving no**

litter from the threshing on the field. There is no absolute need of burning the straw pile. The flies emerging from "flax seeds" in the center of the pile will never reach the surface.

4. Since the fly lays its eggs as a rule near the locality where it emerges from the "flax seed" it is best not to plant wheat on the same ground two years in succession where rotation is possible. Varieties of wheat that produce a stout stalk are the least affected by this pest.

5. Co-operation is absolutely necessary, for, however careful one

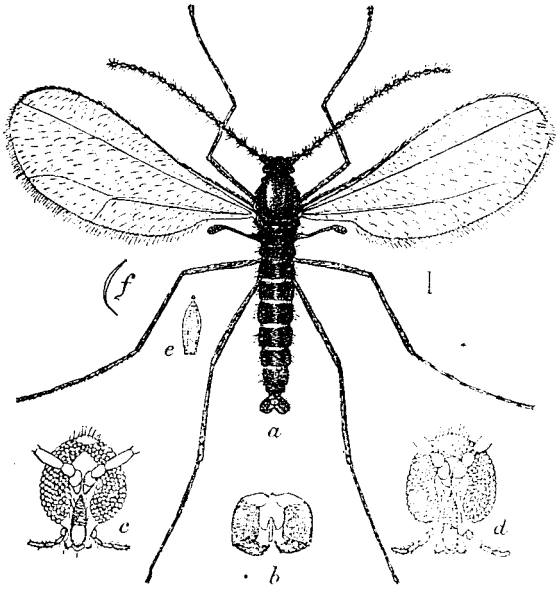

Fig. 3.—*Cecidomyia destructor* (Hessian fly): (a) male; (b) enlarged anal segment; (c) head of female; (d) head of male; (e) scale from leg of male; (f) scale from wing; all greatly enlarged. C. L. Marlatt, U. S. Dept. of Agr. Div. of Entomology.

man may be, if his neighbor is not equally so the latter's fields will afford a supply of this pest for the former. Since this pest issues from the "flax seed" early in May, a stubble field left for corn land and not plowed up to the 10th of May or later has probably discharged its quota of flies ready for mischief before plowing.

APPEARANCE AND LIFE HISTORY OF THE HESSIAN FLY.

The fly is dark colored, much smaller than an average sized mosquito which it somewhat resembles. Each female lays on an average over 200 eggs (generally early in May in this latitude) on the upper surface, usually, of the leaves of the wheat. It is known to also infest to a slight extent barley and rye but I have found its presence hardly appreciable in barley in Minnesota. The eggs are reddish, very small and hatch in about four days, the maggots crawling down the leaf until they get between the leaf and stalk where they feed upon the latter. After a few weeks

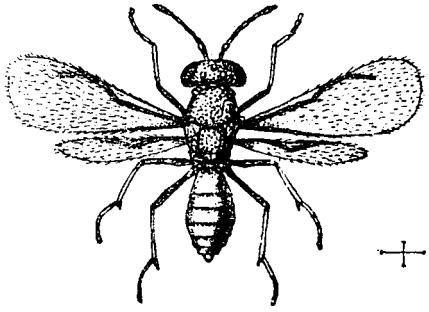

Fig. 4.—Female of *Merisus destructor* Say. Enlarged. Lugger.

each maggot changes into the so-called "flax seed." In this stage, in Minnesota, the insect passes the winter and emerges as a fly in the spring. To the best of our knowledge there is but one brood in this state though this question is a problem the entomologist has promised himself to endeavor to solve next season.* Excessive dryness and heat during the "flax seed" stage is highly injurious, the development being aided by dampness, this pest thus radically differing from the Chinch Bug.

At least seven parasites are found in America affecting this pest; about as many in Russia and ten are quoted in England. The principal parasite is a minute four winged fly *Merisus de-*

*Since writing the above I have been creditably informed that "flax seeds" were found in abundance on wheat five inches high in the latter part of last June on the farm of C. Johnson, near Warren, Marshall county.

structor, Say. (see fig. 4), which so far as we know lays its eggs upon the young larva of the Hessian Fly and emerges a full grown insect from the so-called "flax seed." Minute holes in the sheath at joints infested by the Hessian Fly show where this parasite has emerged, but unfortunately a minute secondary parasite (a species of *Tetrastichus*) reduces the numbers of our little friend *Merisus.*

In a breeding jar kept under natural conditions one species

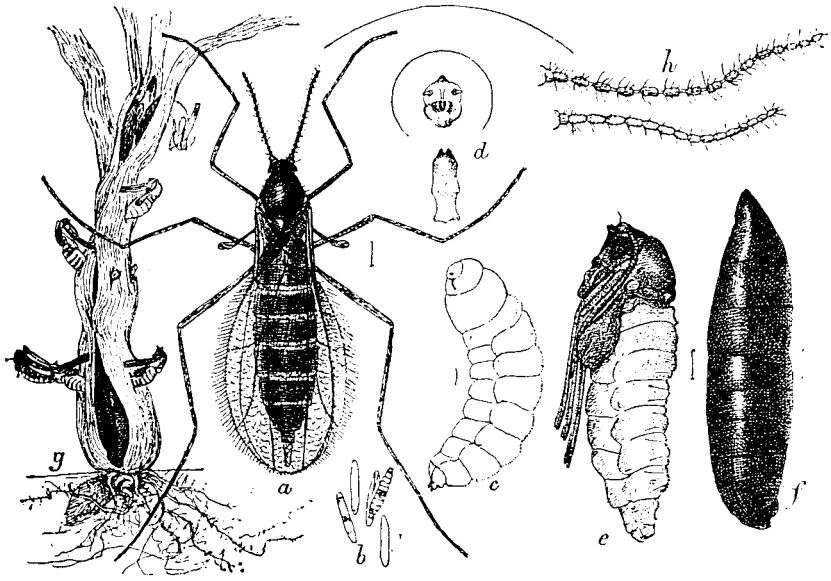

Fig. 5.—*Cecidomyia destructor* (Hessian fly): (a) female fly; (b) flaxseed pupa: (c) larva; (d) head and breast bone of same; (e) puparium; (f) cocoon; (g) infested wheat stem showing emergence of pupae and adults.
C. L. Marlatt, U. S. Dept. of Agr., Div. of Entomology.

of *Merisus* emerged from "flax seeds" in straw Aug. 15th, and more later.

See also Fig. 57 on page 67 at end of this report.

THE CHINCH BUG.

Blissus leucopterus, Say.

In view of all the previous publications from this office relative to this pest, which well deserves second place in the year's list of injurious insects, it is surprising that the entomologist should

have been called upon so often this season to demonstrate the simple and effective means of preventing injury to corn and in some cases to describe such a generally well known insect.

It has been reported this season from Belgrade, St. Augusta, Luxemburg, Carmody, Kimball, Wyoming, Hedrum, Haven Prairie, Big Lake, Forest City, Litchfield, Cambridge, St. Francis, Osseo, Anoka, Farmington, Cedar Mills, Elk River, Mora, Bradford and Lynd, representing the following counties: Stearns, Isanti, Chisago, Dakota, Sherburne, Meeker, Kennebec, Lyon, Anoka, Hennepin, Wright and Waseca. The majority of complaints came from the counties of Stearns, Isanti and Meeker in

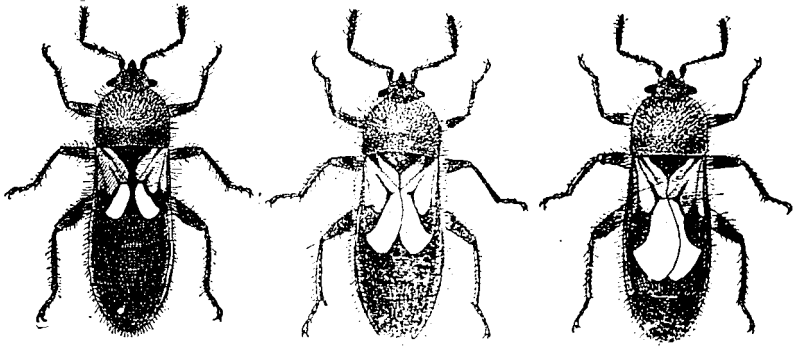

Fig. 6.—Chinch bug (*Blissus leucopterus*) adults of short-winged form—much enlarged (adapted from Webster): C. L. Marlatt, U. S. Dept. of Agr., Div. of Entomology.

the order given. A line starting at Mora and running southwest to Benson and then south to the Iowa boundary would appear to mark the northern and western limit of affected localities in this state. I have not this season (barring an unsubstantiated rumor that a few occurred in the sandy portions of Douglas county) been able to detect it north or west of the above mentioned line, though doubtless there were many affected localities from which I did not hear.

Consulting the late Dr. Lugger's reports of '95 and '96 I note that he claims that in 1887, besides many other places, they also occurred in Pine, Crow Wing, Hubbard, Wadena, Todd, Morrison and in '95 and '96 in Morrison, Otter Tail and Douglas counties lying to the west or north of the boundary I have indicated. In 1895 also it is given as "reported" at Vermilion Lake.

In a map contained in Farmers' Bulletin No. 132 U. S. Dept. of Agriculture on page 8, we are startled to see it is given as occurring over the entire state of Minnesota, but as this is really

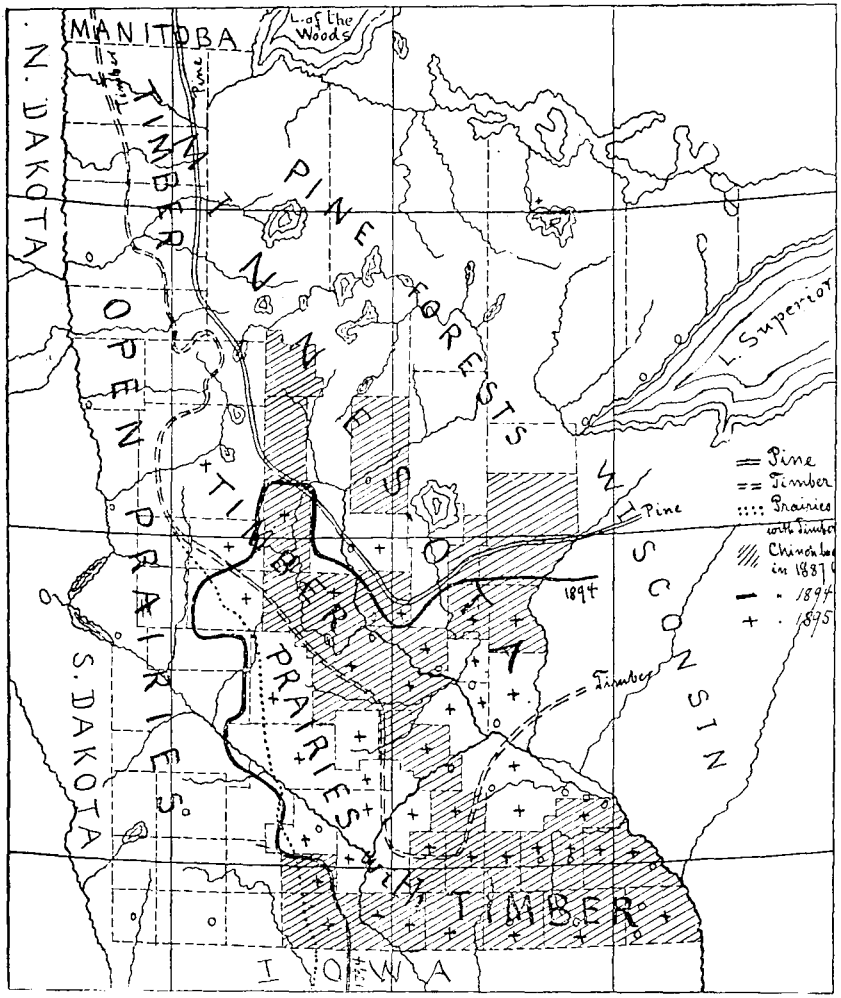

Fig. 7.—Map of Minnesota, showing distribution of chinch bugs in 1887, 1894, and 1895. Also the distribution of pine forests, of deciduous trees, of prairies with timber, and open prairies. Lugger.

a map indicating its range over the United States it is probably intended to convey in a general way its occurrence over a large part of this state and must not be taken too literally. It certainly

seems to be very scarce or lacking along our entire western border from south to north. I looked for it carefully in the counties of Clay, Otter Tail, Douglas, Polk and Itasca and found no trace of it, and met with the statement everywhere in these counties (with the exception of the rumor mentioned above in Douglas) that it was not known to occur. It will be seen then from observations made by both Dr. Lugger and the writer that it is a pest of southern distribution in this state and it is further to be noted that it is found more conspicuously in that part of the state which has become more or less wooded; in other words, in localities where farms are interspersed with woodland affording better chances for hibernation and less likelihood of destruction through burning. Years ago, it seems, this rolling country which is now fairly wooded, was subject to annual burnings. These have ceased allowing the growth of timber and at the same time the increase of this pest.

The Chinch Bug, a native of this country and first living upon wild grasses before grains were placed before it, probably causes greater loss than any other one pest. To give some idea of the extensive injury to be laid at the door of such an insignificant looking insect, hardly more than an eighth of an inch long, we quote from a government report recently issued, "the loss for single States in one season have been estimated at from ten to twenty millions of dollars; that for single years throughout its range at above one hundred million dollars. Large as these figures are, when the actual estimate of shrinkage in the yield of wheat and other grains, not to mention forage crops is made, it will be seen that they are reasonable and probably within the true amount."

In 1871 Illinois is said to have lost $10,000,000, while that State with Iowa, Missouri, Kansas, Nebraska, Wisconsin and Indiana in 1871 lost $30,000,000. In 1874 the loss of above seven States was estimated at $60,000,000. Missouri alone losing $19,000,000. In 1887 Minnesota alone lost over $6,000,000 in the counties affected.

ITS APPEARANCE AND LIFE HISTORY.

The Chinch Bug has been so frequently described that it hardly seems necessary to go into details and we will merely give

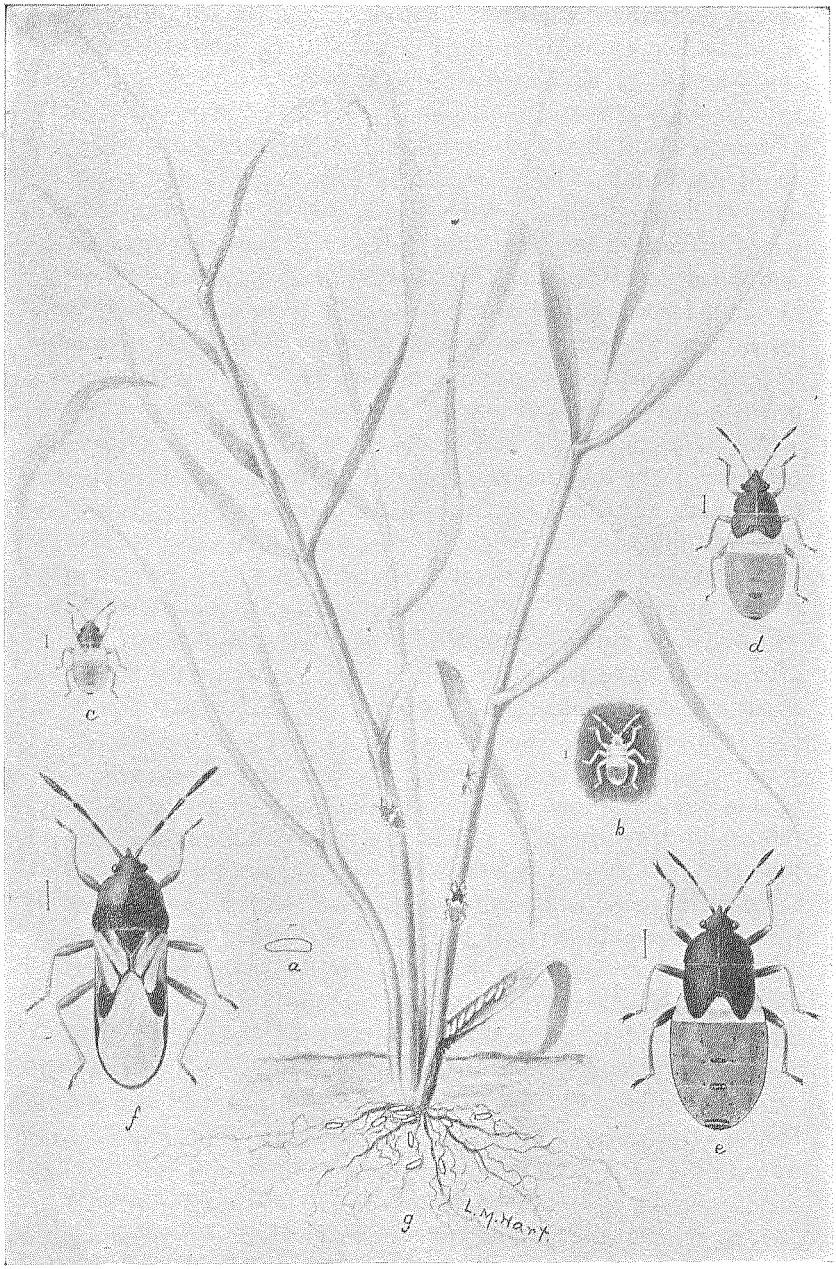

Fig. 8.—Different stages of the chinch bug (*Blissus leucopterus*) enlarged and natural size; (a) egg; (b, c, d, e) young stages; (f) adult. Lugger.

a brief description which with the pictures should be sufficient for those not acquainted with it.

The full grown insect is about ⅛ of an inch long; black with whitish wing covers; a prominent black spot marks the outer edge of each wing cover (a casual observer would call these wings) at about the center. There is, too, a form with short wings and individuals are found between these two extremes, that is with wings of various lengths. The female lays her whitish eggs, one individual depositing nearly 500, but not all in one batch, at base of plant, for the main part on the roots. From two to four weeks are occupied in egg laying. The eggs hatch in about two weeks but may hatch sooner and may take longer. The young larva is reddish and extremely active. As it grows it becomes darker colored and more like adult. In about two months it becomes full grown like its parent. During this two months it is sucking the vitality of wheat, barley, if there is any in its neighborhood, and swarming on the roots of pigeon grass and millet if it is fortunate enough to find it. Oats do not meet with favor unless there is lack of other feed. Millet appears to be its preference, a fact which will be further commented upon later, and even if on the corn it will leave that succulent plant to gather by the thousands about a piece of pigeon grass.

It loves warm sunshine, and cold and wet are disastrous, which latter fact may account for the comparative scarcity of the pest in our State this year, and for the fact that sandy soil where the wheat does not grow rankly and thus allows the sun to reach the soil at its base is worst affected. When the grain is cut or before if it becomes destitute of sap, old, half grown and young Chinch Bugs migrate to the nearest crop which is still succulent. This is generally corn and thousands can be seen migrating to new pastures. It is a curious fact, that, although many are winged at this time they do not fly but for the most part travel over the dusty soil with their less fortunate companions. If they are already in the corn and this has matured they will leave the corn as they do the wheat. This migratory horde will sometimes penetrate to the 15th or 20th row in the corn field and even further, the outer rows appearing frequently almost black with the pest.

Soon after the middle of September the generations raised during the summer begin to seek winter quarters which may be

at some distance from the crop last attacked by them and to be reached only by flight. Places chosen for hibernating are corn shocks left in the field, rubbish and litter of all kinds, fallen leaves in the neighboring timber and Marlatt claims that they can be found by the thousands in the soil at the base of stools of wild grasses where these have not been destroyed by cultivation; he cites it as probably the ancient habit of the species before cultivated crops were in existence. The spring finds them flying from their places of hibernation to cultivated fields. Early in May in this latitude but earlier south of us. At this time they are everywhere; one finds them on his clothing in walking or riding and all in-

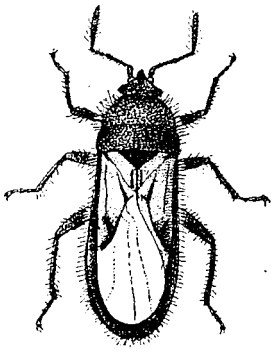

Fig. 9.—Chinch bug (*Blissus leucopterus*), adult of long-winged form, much enlarged (from Webster). U. S. Dept. of Agr., Div. of Entomology.

stinctively seeking the crop which will afford their young sufficient nourishment during their development. This crop is almost universally wheat, and while in the wheat from the very nature of the case they cannot, with our present knowledge, be successfully dealt with. From the fact that they fly at this time there can be no really effectual barrier to prevent their entering the wheat field. I intend to try planting millet next season, experimentally, in a strip, say six feet wide about the wheat field, at the same time that the wheat is sown, and some strips at intervals through the field. Since they are very fond of millet this may be effective as a trap crop and as the bugs would stay on it as long as any sap ran it could be cut just before maturing and burned with the insects before it was quite dry. Not having tried this I cannot speak authoritatively upon its effectiveness. Plant-

ing millet at the same date as wheat may endanger the seed in some soils, but farmers have told me this season that they have raised millet planted that early. Some workers have suggested planting millet between the wheat and corn or about the corn field thus protecting the latter crop. This pest has but few enemies and given favorable climatic conditions increase almost without natural check. A predatory bug is said to prey upon it and among the birds it is claimed that meadow larks and black birds have a fondness for it in spite of its peculiar "bedbuggy" odor so disgusting to man, and the stomach of a single quail examined in Nebraska was found to contain over 500 specimens of this pest all eaten in one day.

OUR EXPERIMENTS AT THE STATION.

On May 28th the Agricultural Department of the Station complained to the Entomologist that the bugs were then threatening to seriously injure some experimental plats in the nursery. I found them then copulating and egg laying, which lasted as late as June 2nd. The wheat was young and the question arose as to how the plats were to be saved. On May 31st, millet was planted around and between the plats. Carbon bisulphide was used June 2nd, canvas covered frames having been made to cover portions of the plats, and we having first tested it on other wheat; the idea being that if we could by several applications kill off the bugs at that time on the wheat the young millet would attract other bugs which might be seeking food from the outside. The treatment was only partially successful and its use was abandoned. The reader will understand of course, that the methods adopted here were practicable only when used on a small scale and could not be applied on large fields. It was then decided to use kerosene emulsion. We had found that one part emulsion to ten parts of water did not injure wheat upon which it was first tried. On June 21st and later the emulsion was used on the experimental plats at the strength of one part to ten parts of water and an examination was made June 30th to note its effects. While some of the leaves around the roots appeared a little burned, on the whole the grain looked very well. A goodly proportion of the bugs were killed by this treatment. Upon July 23rd the emulsion was again applied but to the outside rows only. On July

26th bugs were found in all plats upon the millet which was then well up, and it was also found that the wheat was injured somewhat in spots by the emulsion, but not sufficient to annul the experiment. It was later harvested and threshed. I believe that if the millet had been planted earlier, perhaps at the same time as the wheat the bugs would have been effectually prevented from entering the plats. About July 21st the grain crop on the farm was harvested and the Chinch Bugs migrated to corn in large numbers. At this time numerous complaints began to reach us from farmers in the central, eastern and southern parts of the State. On August 7th at the request of the late John Woodbury representing the St. Francis Milling Company, I went to that place and found the pest in great numbers. Upon the farm of David Stewart the bugs had reached the 15th row of corn as they had also on the farm of W. M. Corbin. Upon the place of John McDonald I found the bugs in corn as far as the 25th row and he stated that he had lost 25% of his Scotch Fife wheat through their injury and that the remaining wheat was hardly marketable. He further stated that July 28th was the date when he first observed the bugs migrating to the corn. We note in this connection that the habits of this pest differ in different latitudes. In eastern Kansas for instance, the migration is about two weeks earlier. Mr. McDonald claimed that where the bugs were congregated about pigeon grass in the corn and elsewhere they could be killed by covering to the depth of three inches with dry sandy soil. This may be so where the soil is very sandy or dusty, but a trial upon my part later, at St. Anthony Park, failed to corroborate this statement. Farmers in this section were shown how to make a dust furrow and tar line and some availed themselves of the information immediately. Thousands, yes, millions of bugs were observed migrating in the vicinity, yet it was reported that the pest was even worse north of St. Francis in Isanti county. On August 14th James Hanna near Forest City was visited; he stated that he would lose at least one-half of a twelve acre piece of fodder corn owing to the injury caused by the Chinch Bug. He further said that much of the injury ascribed to Chinch Bugs was really due to Hessian Fly, farmers in that neighborhood not being so familiar with the fly as they were with the former insect.

REMEDIES AND MEANS OF PREVENTION.

We do not know of any practicable means of killing the Chinch Bugs in the grain at present. In this connection we will say that the sending out of diseased Chinch Bugs has been abandoned, it having been found that the results were not sufficiently practical. The insects however may be trapped and killed without much labor after they leave the grain and start to attack the corn. Plow a furrow around your corn in such a way that the steeper side is towards the corn; drag a small log back and forth in this furrow until it becomes very dusty; it must be kept dusty. With a post augur bore holes ten or twelve inches deep or even less, along the bottom of this burrow at intervals of about a rod. If the furrow is well made the bugs cannot cross it and finally collect in the post holes where they may be killed by kerosene or hot water. In wet weather a dust furrow is impossible. At such times the bugs may be stopped by means of a tar line.

Tar can be purchased of the Minneapolis Gas Company for $4.50 per barrel, barrel included; for $3.75 per barrel without container. Pour tar to the width of two or three inches next your corn field or upon the side of the field attacked by the bugs. While this tar line remains sticky bugs will not cross it. The first tar applied will sink into the ground probably and the line will have to be renewed occasionally; that is it will have to be kept sticky. Bore post holes at the side of the tar line away from the corn and the bugs traveling along the line to find a means of crossing will fall into these holes where they may be killed. Even if the bugs have reached the outer rows of corn they may be stopped by the dust furrow or tar line between these outer rows and the remaining corn. The bugs on the outer rows may be killed with kerosene emulsion, one part emulsion to ten parts of water. Pure kerosene may also be used if one does not care to save the corn. It is certainly desirable to kill these bugs on the outer rows thus lessening the bug crop the following year.

It has been claimed that a rope kept saturated with kerosene and placed on the ground on the side of the corn which is being attacked, will form an obstacle which they will not readily cross. Some stock will not eat the stalks covered by the bugs, and even if they did the majority of bugs would escape to perpetuate their

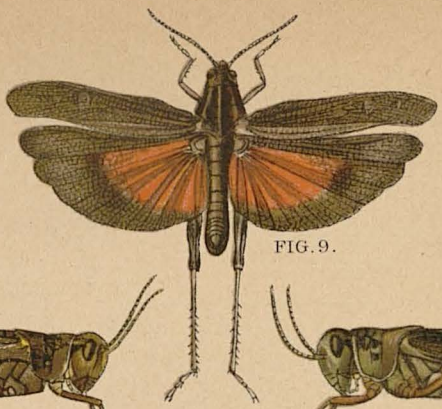

FIG. 9.

FIG. 7.

FIG. 3.

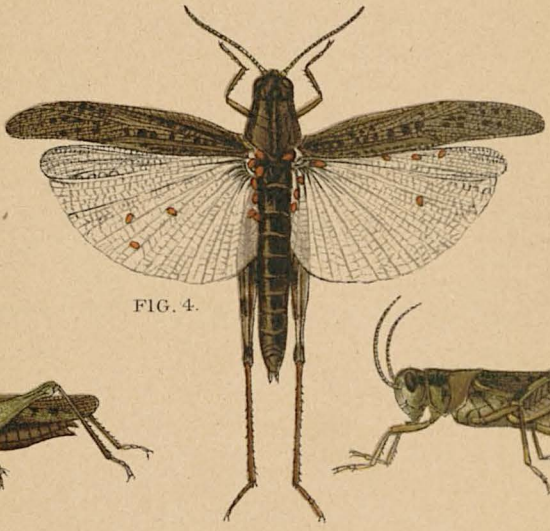

FIG. 4.

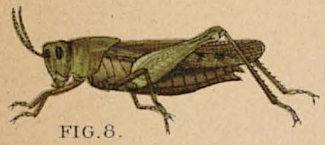

FIG. 8.

FIG. 1.

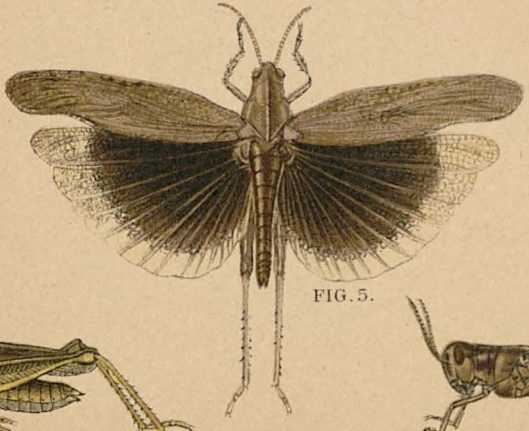

FIG. 5.

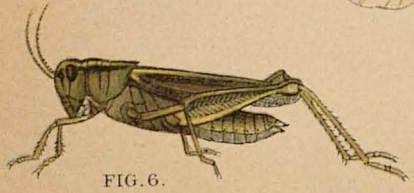

FIG. 6.

FIG. 2.

SOME LOCUSTS OF MINNESOTA

JULIUS BIEN & CO. LITH. N.Y.

kind and thus make trouble for the farmer the following year. Farmers should practice clean farming; that is, in the fall rubbish should be burned as far as possible. The Chinch Bugs hibernate in rubbish collected in corners, in old straw, in hay stacks, in corn shocks left in the field, etc. Fallen leaves in timber also afford winter quarters, and it will be found that grain fields next these sources where the bugs pass the winter will probably be the first to be infested the following spring.

Recipe for Kerosene Emulsion: Dissolve one-half pound of soft or hard soap in one gallon of water, boiling it thoroughly. When the soap is dissolved remove the liquid from the fire and when boiling hot add two gallons of kerosene. This should now be mixed thoroughly by pumping it vigorously through a force pump or spray pump. This may take five minutes. It should be, when properly mixed, like thick cream or clabbered milk. This stock emulsion will keep some time, many weeks in fact, and can be used as desired.

GRASSHOPPERS OR LOCUSTS.

The people of the Red River Valley and of counties adjoining have the unusually wet Spring to thank for freedom from these pests. This year injury from Grasshoppers has been confined to a few localities.

Perham, Otter Tail county which always leads complaints of this kind, sent in the alarm through its county commissioner about June 15th, and the Entomologist at once went to that place. Hoppers were found very plentiful *on the old stubble.* These were all the Lesser Migratory or White Mountain Locust (*M. atlanis*) and for the most part past the fourth molt, although some were found considerably younger. The most threatening area in this vicinity was a tract of unplowed stubble containing 240 acres owned largely by nonresidents, who will not plow. Some farmers were found in this vicinity plowing in order to turn under the young hoppers, but all expressed uneasiness at the near presence of such a large tract of unplowed land, which is always a fertile breeding ground for the local forms of Grasshoppers.

The situation was so serious that upon consultation with the

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The situation was so serious that upon consultation with the

Governor and the Director of the station, it was determined to plow this tract at the State expense and thus not only avert immediate loss but also reduce if possible the numbers of Grasshoppers which would otherwise be on hand to do mischief next year. The most threatening tract (about 200 acres) was then plowed. In the neighborhood of Perham there are altogether about 600 acres of this unused land. Wherever such is found it is a constant menace to farmers who are making every effort to keep this pest within bounds. It would be bad policy for the State to always plow these lands not used and I firmly believe that the only solution to the Grasshopper question is the making of a law which will oblige land owners to plow stubble found to contain Grasshopper eggs in the fall or early in the spring. In every grasshopper infested locality visited this summer the Entomologist met with this request from the farmers. Such a law would put an end to the pernicious practice of the State plowing or furnishing free oil except in exceptional emergencies. Most farmers will gladly plow if nonresident speculators will do the same.

A visit to Otter Tail district thirteen miles from Perham showed a condition entirely different from what prevails in the latter place. Here I found every acre in crops; no stubble land and consequently no Grasshoppers, disregarding the comparative few in grass along the roadsides. It is a matter worthy of note that the losses from locally hatched grasshoppers are confined largely to "pioneer districts," to the frontier of farming land as it were, where conditions are not settled, where property is changing hands or where the population is shifting and where there are very large tracts of land far from market, owned by individuals who either cannot or will not cultivate all their arable land. It is where these conditions prevail that the Lesser Migratory Locust (second only to the Rocky Mountain Locust in destructiveness) gets in its work and always will in favorable seasons unless compulsory plowing is resorted to. These are the conditions which prevail at Gentilly near Crookston, in Polk county, and more particularly in the Hill River district twelve miles northeast from McIntosh in the same county. At Gentilly on June 26th I found the Lesser Migratory Locust abundant and causing injury upon all well drained, sandy ridges where the eggs were not spoiled by wet weather last

spring. On the farm of Eli Benoit wheat next the stubble as well as beans, barley and young flax were eaten.

It was however in the Hill River district near Lindsay P. O. that farmers suffered the most. Here a tract extending one-half mile east and west and two miles north and south was almost swept of vegetation. Young flax, grass, wheat, barley and oats were mowed down and at the date of my visit, June 26th, the farmers

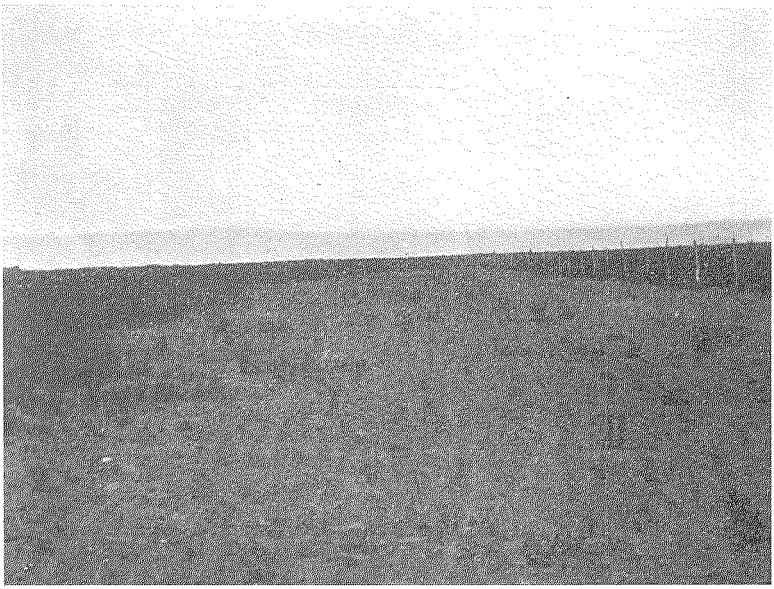

Fig. 12.—View of flax field near Gentilly, one-third of which has been eaten by grasshoppers.

were complaining bitterly of a 300 acre piece of stubble which had been allowed to lie fallow for two years or more and was very evidently the breeding ground of the pest. In places I found the ground brown with young hoppers not yet ready to fly, and the area referred to presented a scene of desolation not easily forgotten. These young hoppers were working south and on each succeeding visit I found their limit to be further south.

Farmers in this neighborhood worked heroically in the fight against the unwelcome visitation and about 800 gallons of oil was distributed by the Entomologist through the county commissoners. This oil was judiciously used, but the numbers of the insects

were legion, and although the hopper-dozers were run back and forth over the grain all day and day after day, and bushels of

Fig. 13.—Young grasshoppers gathering by the thousands on the front of an unfinished store in the Hill River District on a rainy day.

oily corpses dumped upon the road, the pests appeared to be almost as numerous after treatment as before.

With the exception of a slight outbreak near Twin Valley in Norman county, which the Entomologist found to be not serious, an early and limited attack near Glyndon in Clay county and the crisis at Perham which was promptly met by plowing, Gentilly and the Hill River district were the only places known to be seriously affected.

As stated above the Lesser Migratory or White Mountain Locust was the offender and was practically the only locust found on the stubble. In grass and other rank growth (in one instance in a clover field in large numbers and also in timothy) I found the Two Striped Locust *M. bivitattus* (see colored plate); some few specimens of *Chortophaga viridifasciata* (Fig. 14), have also been seen and later the always numerous Red-legged Locusts, *M. femur*

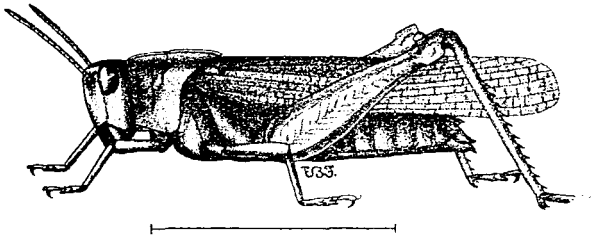

Fig. 14.—*Chortophaga viridifasciata*, form *virginiana*, female. Lugger.

rubrum. The usual quota of Carolina Locusts so often mistaken for the Rocky Mountain species were observed everywhere.

In July I visited this locality again. All the grain had headed but was still in the milk. I then found the hoppers winged and in enormous numbers about one-half mile south of where I had first seen them. They were feeding upon the soft wheat kernels and four out of every ten heads of wheat were being preyed upon by hungry individuals. As far as one could see and observe such small objects in looking out over the grain, grasshoppers could be distinguished by the thousand (see Fig. 11) and it is in the stubble here later, undoubtedly, that eggs were laid. I also learned at this time that the pests had spread further west beyond the broken belt of timber which had formed a temporary western barrier.

My last trip to Hill River was on Sept. 3rd after harvest. I then learned that hoppers were observed laying their eggs late in

July on the stubble. Unfortunately a heavy storm prevented an examination for the eggs. One of the farmers whose loss perhaps represents an average in this district, told me that he had lost about one-third of his wheat crop, nearly one-half his oats and fully one-half his barley through the ravages of Grasshoppers. Serious as this loss is, it must be admitted that the outlook in the earlier part of the season was much more threatening; in other words, the farmers in this district really got larger crops than they had anticipated.

All Locusts, while they vary as to date of egg laying exhibit

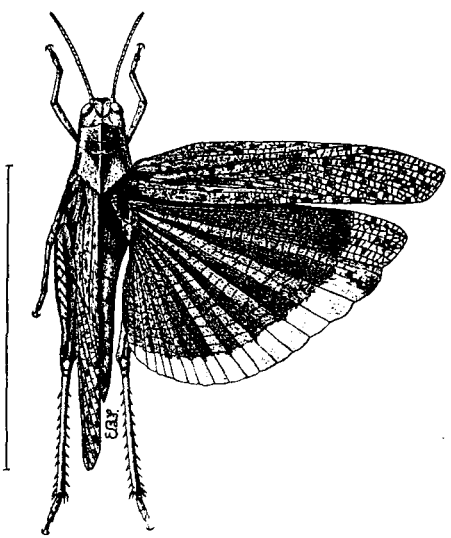

Fig. 15.—*Dissosteira carolina*, female. Lugger.

practically the same method, well shown in Fig. 58. It will be seen that the eggs are laid in a pocket in the surface inch of soil. The young hopper upon hatching invariably works upward. The significance of this fact in connection with plowing is at once apparent, for the plow turns the bottom of the case up, thus affording no exit for the young hopper. Many of our people mistake the large Locust, notably the Carolina Locust, *Dissosteira carolina,* Linn., for the destructive Rocky Mountain variety. A comparison of the accompanyng illustration (Fig. 15) with the excellent colored plate, (Fig. 7) will show the difference between these two. It is well, however, to bear in mind that all hoppers are

injurious, their ability to do injury being directly proportionate to their numbers, but only a few species ever become numerous enough to cause serious injury.

A word about hopper-dozers may not be out of place as I have met a number of farmers not familiar with their construction.

The drawing given, Fig. 16, will explain their structure almost without the use of words. The material is galvanized iron. The pan may be 8, 12 or 16 feet long. The larger pans are divided into compartments by soldered partitions, thus preventing the oil from running to one end on sloping ground and spilling. The back of the pan is about 4 inches high and the front is turned up about 3 inches. A 4 inch board is fastened to the under side of the pan at each end, the broad surface acting as a runner. These

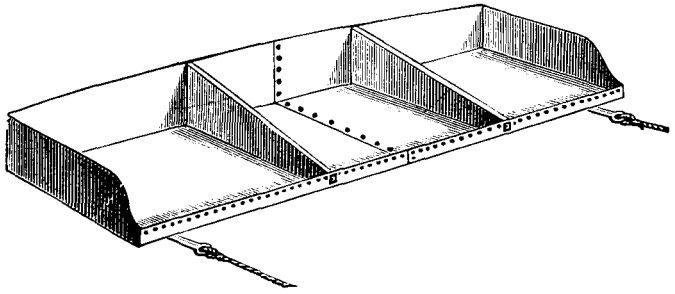

Fig. 16.—Large hopper-dozer with partitions (after Riley).

pieces project in front and to them ropes are tied for drawing the machine. Early in the season one horse is used, later when the hoppers get more active two are used, one at each end, so that the insects, startled by the horses, will jump for the main part towards the center and be caught by the pan. Uprights two feet long at the back of the pan, not shown in figure, support a white cloth which serves to attract the Locusts and to prevent their flying completely over the hopper-dozer. In this connection it may be said that it is economical to use but little oil. That is, if water to the depth of two inches say, is placed in the pan and enough oil poured upon that to make a thin film, it will be quite as effective as if it were all oil. For, even if the grasshopper barely touches the oil and then hops out, he is sure to die. Some of the farmers in the Hill River district used as many as 12 or 15 gallons of oil daily, whereas if water had been used as above indicated, five

gallons probably would have been all that was necessary. Every farmer in districts likely to be affected should have a hopper-dozer ready for use in the spring and not postpone the making of one until the pest is upon him and every one, including himself, is too busy to stop for the work. These machines can be used until the grain is fully one foot high without injuring it. They cost all the way from $4 to $16, depending upon the size, the weight of the iron and the cupidity of the firm making it. It should be borne in mind that as useful as the hopper-dozers are, they should be regarded in the light of a make shift for use in an emergency, since fall plowing when properly done by *all* farmers in a neighborhood is a sure method of extermination.

Fig. 17 shows a model of a new kind of hopper-dozer invented by a Minnesotan. The driver sits behind at end of the

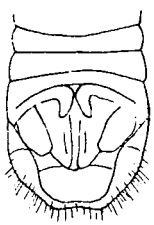

Fig. 18. — *Melanoplus spretus;* dorsal view of end of male abdomen.

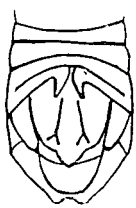

Fig. 19. — *Melanoplus atlanis;* dorsal view of end of male abdomen.

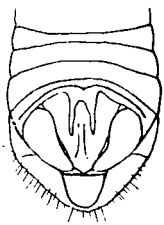

Fig 20. — *Melanoplus femur-rubrum;* dorsal view of end of male abdomen.

pole and two horses push the machine ahead of them. A strong fan blows the young hoppers against the bottom of rollers which crush them, the rollers being cleaned automatically.

There are times when the hopper-dozer can be used to better advantage than at others. A cold raw day, for instance, does not offer favorable conditions. Again, when hoppers are completely winged and fly a long distance when disturbed which, by the way, is after most of the injury has been done, dozers are of practically no use. It was to farmers owning hopper-dozers that oil was furnished free by the Entomologist, each farmer applying to his county commissioner for an order for oil on a local dealer. The price of oil ranged all the way from 9 cents per gallon including the barrel at Minneapolis to 11.1-3 cts. at Perham without container; 14¾ cents in barrel lots with barrel at the Standard Oil Co.'s Warehouse in Crookston; 15 cents at Gentilly; 14 and 15

at McIntosh, and 20 cents at Twin Valley where they claimed to have no cheap grade.

I take pleasure in acknowledging helpful co-operation upon the part of Mr. Sawyer at Perham, Mr. Remi Fortier at Gentilly, Mr. McCarty at McIntosh and Mr. E. L. Tomtengen at Fossum,

Fig. 21.—A Robber-Fly destroying a Grasshopper, enlarged. Original.

county commissioners, who assisted me in my work at these various points.

Figs. 18, 19, and 20, show differences in details of structure of the abdomens of male specimens of the Rocky Mountain Locust, Lesser Migratory Locust, and the Red-legged Locust which help to distinguish them.

NATURAL ENEMIES OF GRASSHOPPERS.

Like many other pests the increase of Grasshoppers is retarded by parasites, both animal and vegetable, and by predatory enemies which do much to lessen their numbers. The greater the number of hoppers the greater the number of enemies to prey

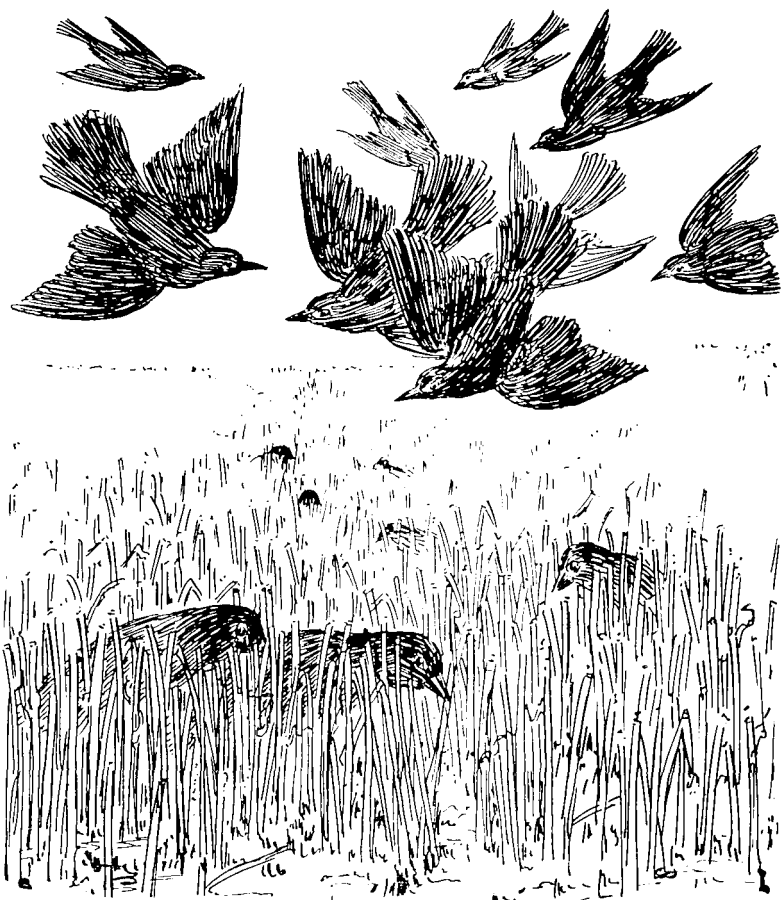

Fig. 22.—Blackbirds coming to the feast. **Original.**

upon them. It is a notable fact that wet weather casts a gloom over these insects. As though they foresaw in it their own danger, they are sluggish and inactive, thus giving the grain a chance to grow. At such times bacteria and fungus diseases carry off

very many. It is at these times that they gather in numerous numbers upon fences, telegraph poles and buildings. Our illustration,

Fig. 23.—Crows in stubble field.

Fig. 13, shows the front of an unfinished store in the Hill River district which was almost covered by Grasshoppers upon a rainy

Fig. 24.—A frog eating young grasshoppers in stubble field. Original.

day early in the season. Among the numerous foes to Grasshop-

pers can be mentioned the Red Mite which fastens itself on their wings and other parts of the body (see Fig. 4 of colored plate), predatory Beetles, Robber Flies, (see Fig. 21) *Tachina* parasites, Flesh Flies and Bee Flies, and, as an internal parasite, *Gordius* or the Hair Snake, which popular belief used to regard as a metamorphosed horse hair. The writer has seen a specimen of *Gordius* in California emerging from a large Locust common in that State.

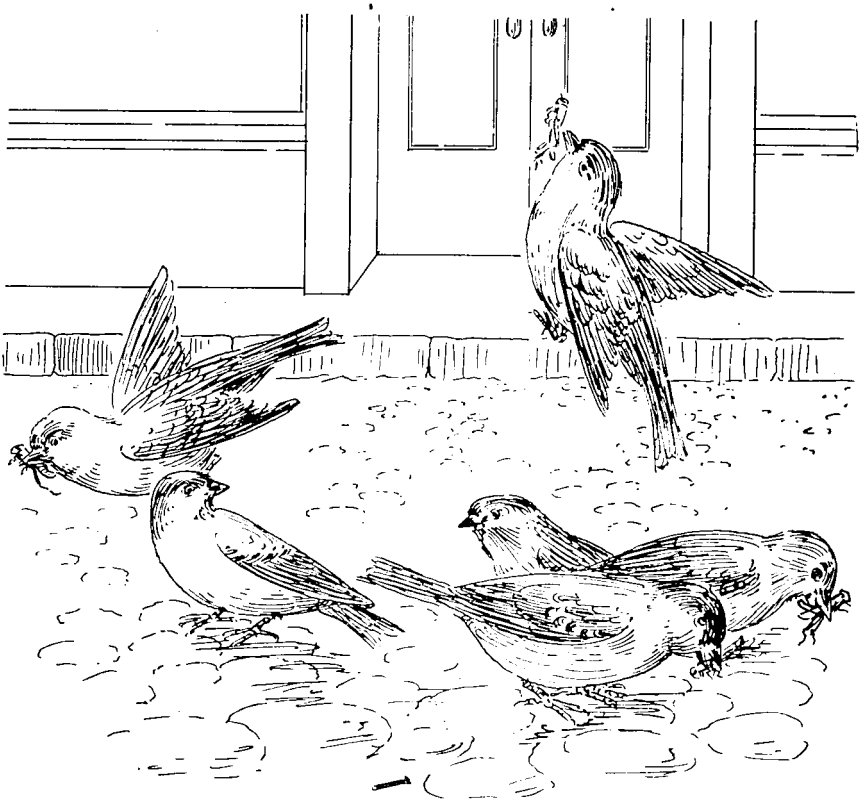

Fig. 25.—English sparrows catching grasshoppers in the streets of Crookston. Original.

Turning to vertebrate enemies we note poultry, Prairie Chickens, Hawks, Black Birds, Crows, Meadow-larks (the writer observed an Oriole helping himself this summer) some Gulls and Terns, Frogs, Snakes and Skunks. I have even observed the much despised English Sparrow catching quantities of them in the streets of Crookston.

Natural enemies, however, are not sufficient and farmers should know the best methods of combating a pest which is at times so serious.

PROTECTIVE AND REMEDIAL MEASURES.

Fall plowing of stubble or early plowing of the same in the spring before May 10th is the safest, best, and simplest method known to prevent the young hoppers from issuing from the egg cases. Co-operation in this, as well as in the treatment of all insect pests is absolutely essential. If one farmer plows and his neighbor does not, the work of the first is thrown away.

Young hoppers while very small, before they are large enough to avoid the plow, may be plowed under. It is advisable in this case to begin at the edge of the field and plow towards the center.

When infested pastures cannot be sacrificed to the plow the hopper-dozer can be well used. Vegetable gardens lying within

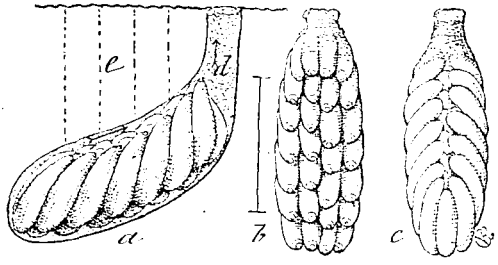

Fig. 26.—Egg-mass of Rocky Mt. Locust—(a) from the side, within burrow; (b) from beneath; (c) from above; (d) indicates the natural exit for young locust if the soil is compact, and the dotted lines (e) the direction of exit in loose soil; enlarged (after Riley).

an affected area, may, if the locusts are not very numerous, be saved by spraying something distasteful to the insects, like a well shaken mixture of kerosene and water or kerosene emulsion, upon plants not injured by such an application, or by poisoning with Paris Green vegetables whose parts reached by the poison are not used as food.

Wheat land in which Grasshoppers are numerous should be carefully examined in the fall for Grasshopper eggs, which are found near the surface of the soil not more than an inch from the top. Any doubt which the farmer has may be removed by sending the

objects suspected to be eggs to the Entomologist at the Experiment Station.

Before closing the discussion on Grasshoppers, I wish to call attention to an error which sometimes creeps into the press. The Entomologist was reported this summer as having gone north to "combat the Seventeen Year Locusts." To the best of my knowledge that insect does not occur within this State, though we have

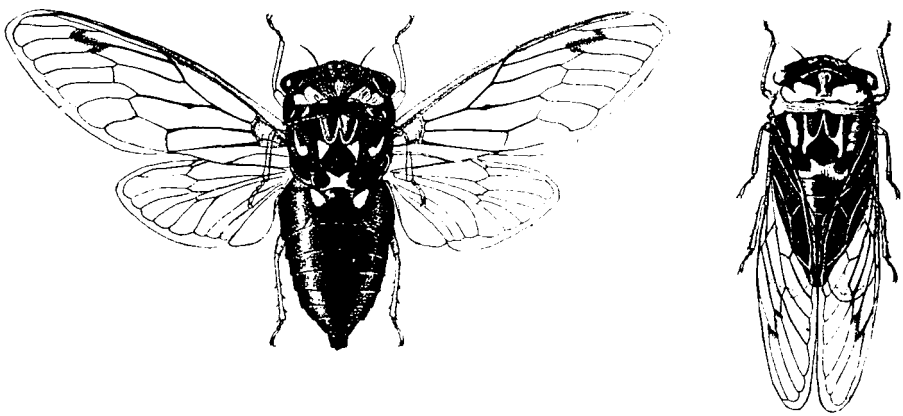

Fig. 27.—*Cicada tibicen* Linn. Male and female. Lugger.

several forms resembling it. It looks like the accompanying figure, is not a true Locust, but a *Cicadid,* belonging to the great order of Bugs, one group of insects.

What we commonly call Grasshoppers are really Locusts belonging to the order *Orthoptera,* Family *Acrididæ,* and the true Grasshoppers are the more slender, greenish insects with long

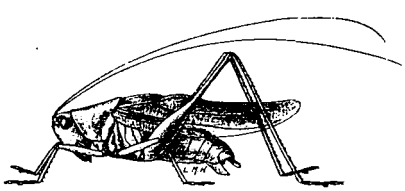

Fig. 28.— Common Meadow Grasshopper (*Orchelimum vulgare*), male. **Lugger.**

horns or feelers seen on bushes and herbage generally, (Fig. 28); nevertheless we will probably go on calling Locusts "Grasshoppers" to the end of the chapter.

EXPLANATION OF COLORED PLATE.

The colored plate found at the beginning of this article has been prepared in order to show farmers the exact appearance of some of the more common locusts of the State, a few of which are so closely allied as to be difficult to distinguish by an amateur.

Fig. 1. Lesser Migratory or White Mountain Locust (*M. atlanis*). Somewhat enlarged.
Fig. 2. Young (pupa) of same; slightly enlarged.
Fig. 3. Red-legged Locust (*M. femur-rubrum*); enlarged.
Fig. 4. Same, enlarged, wings spread, showing parasitic mites.
Fig. 5. Carolina Locust (*D. carolina*); pale form.
Fig. 6. Two-striped Locust (*M. bivittatus*); reduced.
Fig. 7. Rocky Mountain Locust (*M. spretus*); slightly enlarged.
Fig. 8. Green-striped Locust (*C. viridifasciata*); reduced
Fig. 9. Coral-winged Locust (*H. tuberculatus*); reduced.

THE HORN FLY.

Haematobia serrata, R. Desv.

A small fly resembling the House fly but considerably smaller which attacks the shoulders of cattle and the back near the tail causing irritation, sore back and rawness of the flesh; dark colored

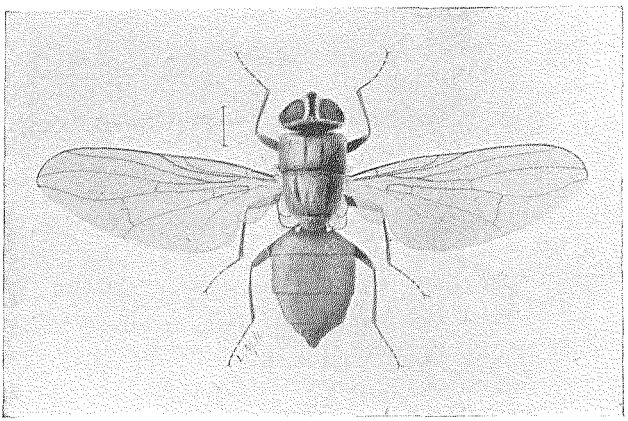

Fig. 29.—Horn fly (*Haematobia serrata*). Lugger.

animals appear to be the worst affected. Eggs are laid in freshly dropped manure, the flies darting to the manure, ovipositing, and

immediately returning to the cow or steer. The habit these flies have of resting on the horns, if horns are present, has given them the above name. It should be noted, however, at this time they cause no injury whatever but have simply chosen a secure retreat where they cannot be disturbed. Their position while biting is characterized by more or less extended wings; when resting on the horns the wings are closer together pointing backward.

This fly introduced into this country about 1886, has become very numerous and troublesome in this State. The writer has met with it at St. Anthony Park, Alexandria, Fergus Falls, and Luverne and has received reports of its occurrence in various localities. It appears to be generally distributed over the State and bids fair to become a very noxious pest. With a view to finding

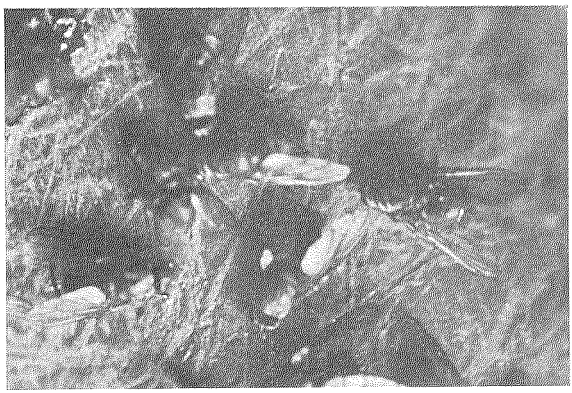

Fig. 30.—Horn Flies on horn of cow, enlarged. Original.

some effective means of keeping it from the cattle, the Entomologist tried several experiments this summer at the station with good results. The various patent preparations on the market are good as far as they go, but quite expensive and not lasting. A cow sprayed at milking time will stand quiet enough, but a few hours later the effect of the "fly cure" has gone. I am further informed by a well posted dairyman that when these remedies are used in sufficient quantities to produce a lasting effect they injure the skin of the animal upon which they are applied.

Various simple compounds were tried at the Experiment Farm. These, with results, are here given. Rancid lard, not ef-

fective. Lard 1 lb. with oil of Pennyroyal 10 c. c. (one tablespoonful) and oil of Eucalyptus 10 c. c. added,—effective for twenty-four hours or longer, but expensive. Pennyroyal costs $1.75 per lb. and Eucalyptus Oil $1.20 per lb. Lard 1 lb. mixed with 4 oz. of Pyrethrum, quite effective, in one case affording exemption to one of a herd for three or four days. This also is somewhat expensive. It must be borne in mind, that an animal so treated among a large number not treated, is hardly a good criterion, for the flies would doubtless be much more persistent in their attack were there not more inviting backs present in abundance. Lard with oil of Pennyroyal and oil of Eucalyptus was also used on

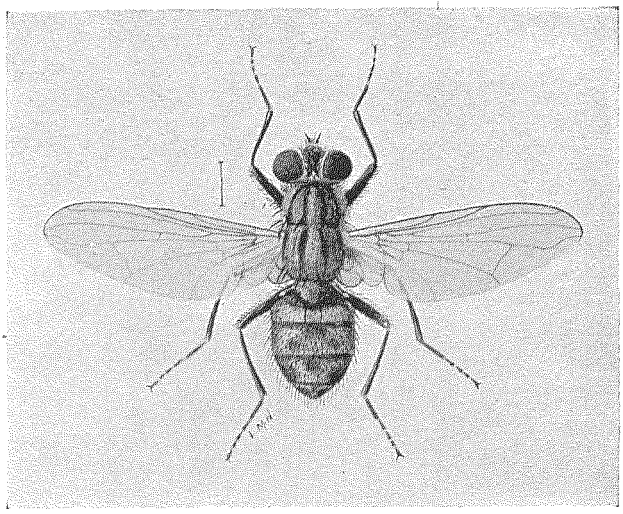

Fig. 31.—Stable fly (*S. calcitians*). Lugger.

a family cow to find effects of isolation, with good results for twenty-four hours, "but did not keep them all off." Lard 1 lb. kerosene ½ pint, mixed thoroughly until a creamy mass was formed, gave excellent results lasting two or three days. This was used on a few herd cattle and upon a family cow; in all cases it worked well. All of the above combinations were applied with a cloth or with the bare hand, smearing each animal over back, shoulders, hind quarters, neck and flanks. About ⅜ of a pound was used for each full grown creature. Manifestly the use of any or all of these on a large scale would be impracticable, so we

turned to fish oil. Fish oil costs in Minneapolis 45 cents per gallon in barrel lots; 48 cents by the half barrel and 60 cents for a single gallon. This vile smelling oil was used alone, being sprayed on the steer and was not very effective compared with the solution we prepared by adding one part kerosene to three parts fish oil. One man can spray an animal with this in two or three minutes provided the animal is held to prevent its moving about. An examination of a steer two days after treatment with this mixture (1 part kerosene, 3 parts fish oil), showed it to be absolutely free from flies, while other cattle not treated all about it were suffering.

If I were keeping two, three or four family cows I should not hesitate to use the kerosene and lard mixture mentioned above.

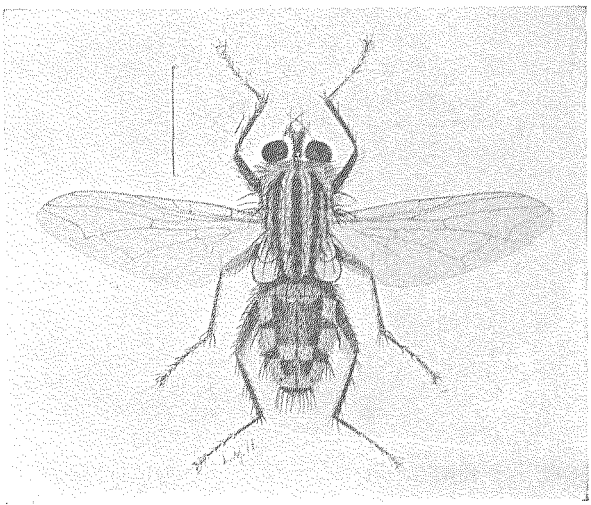

Fig. 22.—Blow fly (*S. carnaria*). Lugger.

A large herd could be better treated, of course, with the spray pump and the more disagreeable fish oil and kerosene mixture. The lard used in these experiments was rancid, perfectly good for the purpose but not saleable for culinary use. Not only Horn Flies but the Stable Fly, *Stomoxys calcitrans,* Linn., and the common Green Bottle, *Lucilia cornicina,* Fab., and Flesh flies, *Sarcophaga carnaria,* Linn., were effectually kept at a distance by the treatment referred to above as the best.

Treatment in the case of very large herds is naturally beset with difficulties. Moist weather, by keeping the dung moist for a longer period is most favorable for the development of the Horn Fly, while any method of destroying the dung will lessen the chances for its successful increase. A decoction of a species of Smart Weed (*Polygonum pennsylvanicum*) was tried, one pound in three quarts of water boiled down to two quarts, with absolutely no results. It is to be hoped that none of our farmers will be

Fig. 33.—A species of Smart Weed (*Polygonum pennsylvanicum*).

led to follow the example of a gentleman living at Hills, Minnesota, who unwittingly applied machine oil to a valuable horse with very serious consequences, the hair coming off completely and leaving the skin in a raw, sore condition. We realized no bad effects in this way after treatment with the above compounds.

This year the Horn Fly began to be troublesome early in August. A few individuals can still be observed about the cattle at this date, Oct. 6th. It is perhaps of interest to note the fact that while Flesh flies and Green Bottles frequented the surface

of comparatively fresh and drying dung in egg laying, the Horn fly visited it for the same purpose only just as it struck the ground, it required a quick eye to note their actions before they were back again upon the cow.

Prof. Weed, in Bulletin No. 28 from Mississippi, speaks of the noticeable fact of black cattle being more affected than light-colored animals, and states that he found a mixture of crude Cotton Seed oil or fish oil and pine tar mixed, two parts of former to every one of the latter, successful. It took him half a minute

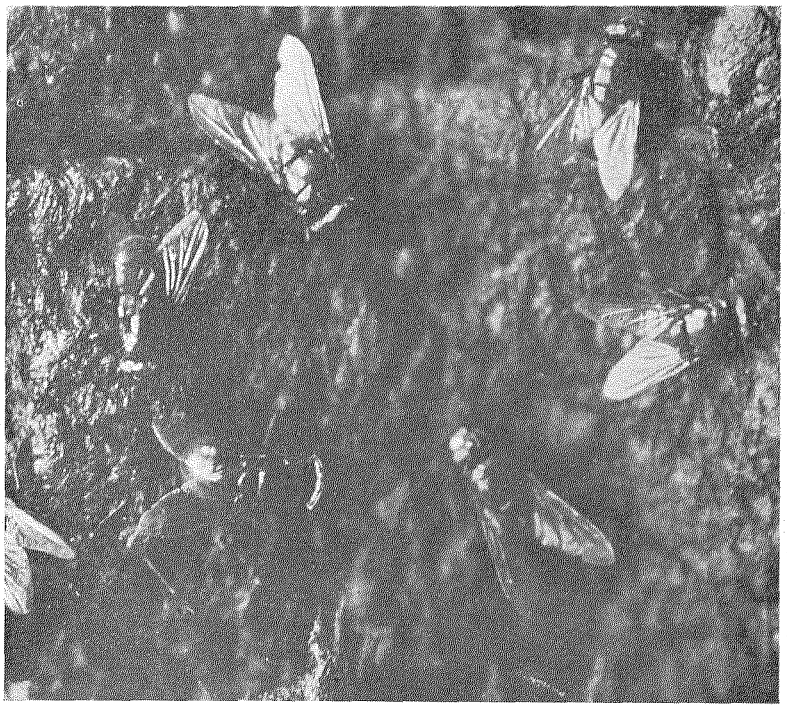

Fig. 34.—Green-bottle Flies ovipositing on dung, enlarged. Original.

to apply this to each animal, using a large paint brush for the purpose. The cost of the application exclusive of labor was three-fourths of a cent per head. He claims that the efficacy of this lasts for a week or more.

From another source it is learned that it is practicable to mix lime copiously with dung in small stock yards, and perhaps also

in pastures where cattle gather in one place for shade. In a report by Messrs. Riley and Howard in 1889 the statement is made that a spadeful of lime on a cow dung will kill all the larvae therein.

To kill the flies, Mr. Weed, in 1895, used a mechanical mixture of kerosene and water (2-10 in Kerowater Sprayer). The milch cows of the Station herd were sprayed with this daily for seven days, effort being made to have the spray hit the flies. The pests were killed in this way and their numbers so reduced that after the seventh spraying practically no flies could be found nor were they again numerous that season. Kerosene Emulsion, one part emulsion to 6 or 8 of water, would probably accomplish the same results.

A NEW STRAWBERRY PEST.

Harpalus pennsylvanicus, De G.

This beetle hitherto so useful in eating noxious larvae that we have unhesitatingly accepted him as our friend and classed him for years under the head of beneficial insects, has this year for the first time apparently in Minnesota developed a most reprehensible habit, which bids fair to put him under the ban. It seems that though preeminently carnivorous in taste it is enough of a vegetarian to eat the seeds of the rag weed, (*Ambrosia*). From the seeds of this humble plant it was but a step to eat the seeds of the strawberry, a patch of which plants may have been near at hand. After tasting the pulp of the strawberry in eating the seed we can hardly blame him for acquiring a fondness for this luscious fruit.

On July 10th I received the following letter from Mr. Henry Grinder of Hinckley: "Dear Sir:—Can you tell me any way to get rid of the Black Beetle which is eating my strawberries? He works at night. The seed of the berry is all he seems to care for, he cracks that and eats the kernel of it. They hide in the mulching between the rows in the day. They are very plentiful this year. Is there anything I can put on the plants that will drive them away and not injure the berry? They have destroyed over two-thirds of the berries. Please let me know if there is anything I can do to stop them." Later, under date of July 13, he again

writes as follows: "I have grown berries here for four years and this is the first year they have troubled the strawberries."

In response to my request for specimens of the insects doing

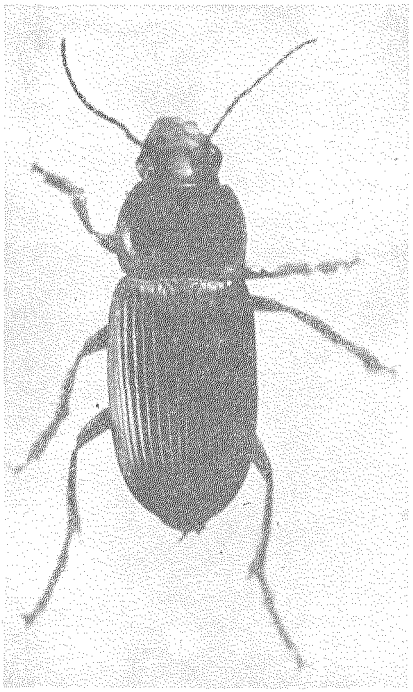

Fig. 35.—*Harpalus pennsylvanicus*, enlarged 4 times. A. G. Ruggles.

the injury, he sent me some specimens of this beetle. It was hard to believe that this well known friend had developed such a trick,

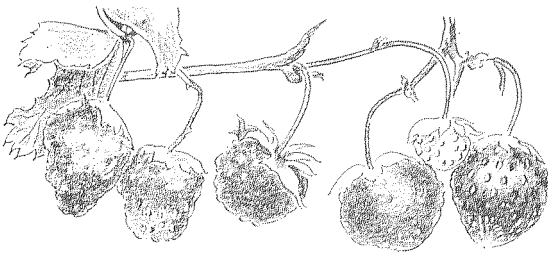

Fig. 36.—Strawberries showing the work of *Harpalus*. On the extreme right an uninjured berry (after Slingerland).

but investigation of the literature on *Harpalus*, revealed the fact that our little friend had shown this bad trait elsewhere.

In Ohio in 1900 members of this genus (*H. caliginosus*) were reported as injuring strawberries, and probably attacked strawberries before that date.

In 1892 *Harpalus ruficornis* caused trouble in the same way in Holland, and Miss Ormerod mentions the same injury in England in her Reports for 1894, '95 and '97-'99.

REMEDIES.

There are various ways of combating this pest in the strawberry patch. They work entirely at night and during the season of their abundance it is barely possible that the lantern trap may be effective, though I have not had any experience with the same. It is worth trying. The lantern trap consists of a pan two-thirds full of water upon which water a generous layer of kerosene has been poured. This pan is put upon a post in the strawberry patch about two feet above the ground, say, and above the pan is suspended a lantern; or the lantern rests upon a brick placed in the pan. The beetles attracted by the light fall into the kerosene and are killed. Several such traps put about the strawberry patch might materially reduce the number of beetles. Bran mixed with water, sweetened with molasses and poisoned with Paris Green if distributed under boards and other protected situations in the strawberry patch is also said to be fairly effective. It would of course be fatal to any fowl which had found its way into the strawberry patch.

Some berry raisers have put cheap meat such as lights from sheep, or calves, in basins, the basins being sunk in the ground up to their top. They are examined every morning and the beetles which fall into the pans collected and killed. This insect became at one time such a serious pest in Pennsylvania that children were employed to go through the strawberry patches and pick the beetles from under the mulching and elsewhere! Fifteen or twenty dollars or even three times those sums spent in this way, if it will save two or three or four hundred dollars on the strawberry crop is money well expended. Another suggestion is to place boards throughout the strawberry field and look under them every morning, catching and killing the beetles found there. If there is anything like Rag Weed growing about the strawberry patch it should be destroyed.

LAWNS INJURED BY GRUBS.

Lachnosterna rugosa, Melsh.

"What shall I do for my lawn?" is a somewhat common question here on the part of citizens, who see dead patches appearing in the green grass about their houses. These patches of sod have been killed and loosened from the underlying earth by the "White Grub," larva of the above named beetle.

LIFE HISTORY.

Both beetle and larvae are shown, much enlarged, in the photograph facing this page.

The egg is laid amongst the roots of the grass. The grub requires more than a year to attain its growth and at approach of cold weather is said to burrow quite deeply, beyond the reach of frost. As this would take it some six feet or more below the surface in this State, I have doubts of the accuracy of this statement. The pupal stage is passed under ground. The Beetle flies at night, for the most part, burying itself just below the surface toward morning where it passes the day to emerge again in the evening. Since it is principally males which are attracted by lights, lantern traps are not particularly useful as a measure against this pest.

My attention was first called to its presence about June 16, by noting the appearance of the lawn in front of the horticultural building at the Experiment Station, where I am told it causes trouble every year. I at once endeavored to find some means of combating it. The grass was drenched with kerosene emulsion, one part of emulsion to six of water. This injured the grass without killing the grubs. One part of emulsion to ten of water was tried with the same results. Tobacco water was also tried, ½ pound of stems steeped in one gallon of water was used without injuring either the insects or grass. Finally I turned to bisulphide of carbon with better results. I found that one ounce of bisulphide of carbon placed in a quite shallow pan and put under a tight box whose cubic capacity was 3458 inches, said box having been inverted over a dead patch of grass, killed all the grubs in the patch in three hours without in the slightest way

injuring the green grass with which the gas came in contact. In round numbers this is one part of the liquid to 1900 parts atmosphere.

An effort was made to use a large cloth covered frame four inches deep by four feet ten and ½ inches by thirteen feet ten inches previously employed in experimenting with Chinch Bugs, in order to cover a larger area of lawn. Under this 3 oz. 6 oz. and 8 oz. of bisulphide of carbon were used at different times, with exposures of three hours each time, this resulted in only a partial success as regards killing the grubs. Lack of success was undoubtedly due to the fact that the frame was not tight, the gas must not only have escaped through the cloth but the corners of the frame were badly jointed and we experienced difficulty in properly banking the edges next the sod with earth. I have no doubt, however, but that a frame entirely of wood with tight joints could be made of the same dimensions which would be as effective as the small box, under which the gas worked so successfully. In the case of the small box the criticism is made that it covers only a small area at a time. This is quite true, but if the injury is met with treatment as fast as it appears a small box is better than a larger one; furthermore, this treatment is not possible until the presence of the grub is made evident by the dying grass. Bisulphide sells for from 12 cts. to 15 cts. per lb. in 5 lb. lots in Minneapolis. Only one grade quoted here. Taylor's "Fuma" Carbon Bisulphide has been quoted in Cleveland, Ohio, at 10 cts. per lb. in 50 lb. cans.

Robins are very fond of this grub and can frequently be seen listening intently for any sound from beneath the sod which will betray the presence of the delicate morsel. Once heard it takes but little effort on the part of the bird to pull the grub from its retreat.

WOOLLY APHIDS.

ON APPLE: *Schizoneura lanigera,* Hausmann.

Was found this season in a few instances on young stock. This, the Woolly Louse of the apple, is one of the worst pests the orchardist and nurserymen have to deal with. It is found not only upon branches but also upon the roots where it forms gall-

like swellings. The woolly colonies on the branches can be seen during the entire summer and even late in the fall. They particularly affect water shoots, which, of course, are not allowed

Fig. 38.—Woolly Aphid (*S. lanigera*) on young apple.

to grow in a well kept orchard or nursery. Northern Spy stock is said to be immune.

During the summer the wingless females produce living young, females like themselves and without wings. Toward Fall

winged individuals begin to appear and later after a brood of males is produced the minute eggs are laid in crevices in the bark, on young shoots, etc. These eggs will give rise to a new generation the following season and it behooves the nurseryman to rid his stock of all Woolly Aphids before the egg laying stage is reached. See also Figs. 59 and 60 on page

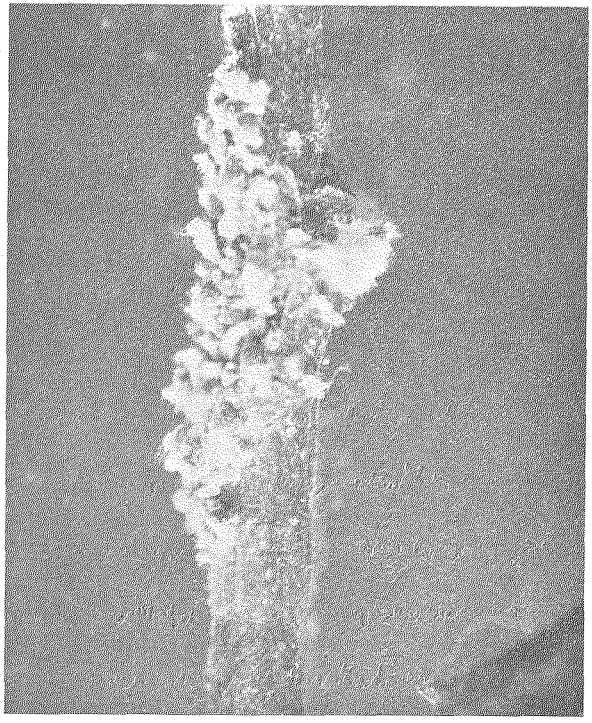

Fig. 39.—Woolly Aphid on apple twig; enlarged.

REMEDIES.

The branch form can be kept in check by occasionally spraying with kerosene emulsion, one part to eight of water, or resin wash. Recipe for Resin wash: Boil 4 lbs. resin and 3 lbs. carbonate of soda (common washing soda) in one gallon of water until all the resin is dissolved. Then add gradually four gallons of warm water stirring all the time and continue the boiling until the mixture is the color of molasses. For Woolly Aphids use one

part of wash to six of water; for any other Aphid one part wash to ten or twelve of water; for Mealy Bug the same.

All sprays must be applied warm and with force in order to penetrate the woolly covering.

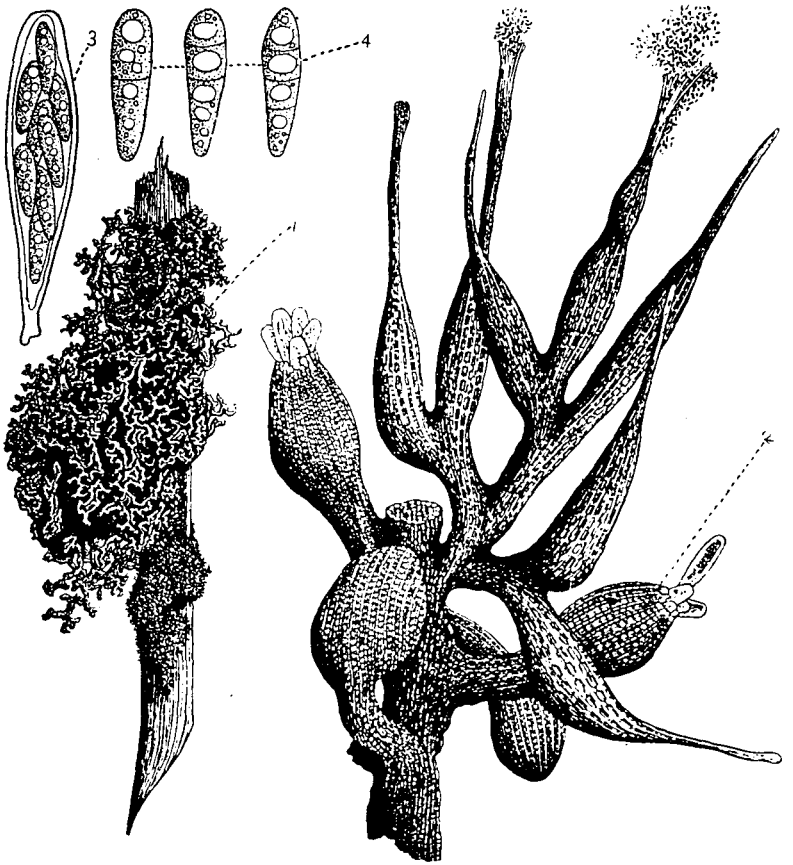

Fig. 41.—Spongy Fungus (*Scorias spongiosa* Schw.), found in the honey dew of *Schizoneura*: (1) natural size; (2) portion of fertile branch much enlarged; (3) *ascospores;* (4) three *sporidia* (from Ellis' Pyrenomycetes).

For the root form, bisulphide of carbon is now used. (Care should be taken not to injure the tree with this agent; consult the Experiment Station). Strong soap washes are also used on roots of nursery stock, etc.

ON ELM: *Schizoneura americana,* Riley.

Observed in a few instances on Elm trees.

ON ALDER: *Schizoneura tessellata,* Fitch.

A clump of Alders on the boulevard on the west side of the Lake of the Isles about sixty yards from the Peavey Stone Foun-

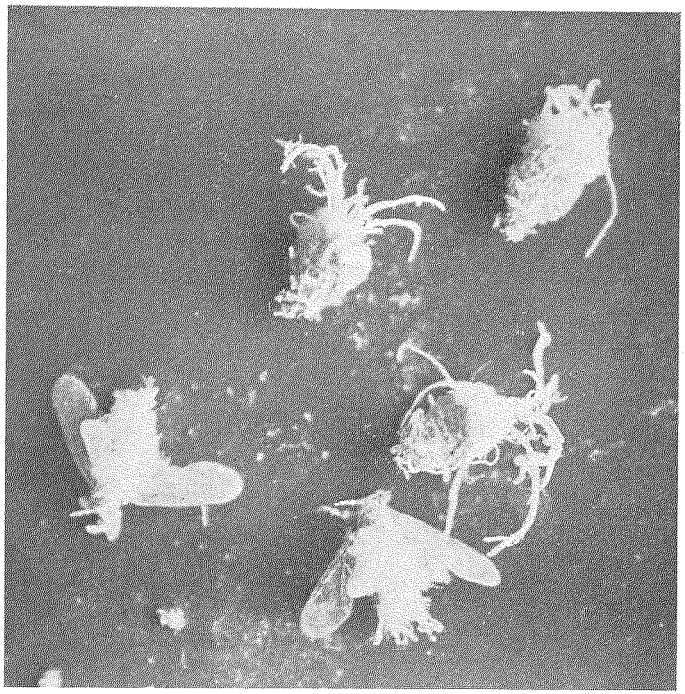

Fig. 42.—*S. tessellata,* winged and wingless individuals, much enlarged.

tain, Minneapolis, have been badly infested this season and are apparently dying as a result of injury from this insect.

This pest is commonly known as the alder blight. Like almost all plant lice, it elaborates a so-called honey dew from the sap of the tree, which exudes from two tubes on its back, and this honey dew, dropping on the leaves and branches below the insect, forms a favorable culture for a dark fungus growth, giving that part of the tree a blighted appearance, and it was from this fact,

probably, that the insect is called alder blight. Directly under the colonies of the insect, where the honey dew is the thickest, a thick, sponge-like fungus grows, which is said to grow nowhere else.* A pest of this sort is hard to eradicate, and calls for most radical treatment. The destruction of the worst affected trees and repeated sprayings with some such agent as kerosene emulsion, resin wash or whale oil soap, a treatment of the roots with the same agent would probably in time exterminate them. As will be seen from the photograph, they are a striking looking insect, for, while the bodies are dark green or black, they are so covered with this white woolly growth that the colonies look, for all the world, like patches of snow upon the branches.

In October I found the young swarming over the trunks and it would seem as if the Alders in that vicinity were doomed unless measures are taken for their relief.

THE STALK BORER.

Hydroecia (Gortyna) nitela.

The Caterpillar of this moth has been extremely troublesome this season. I found it in tomato vines, in hollyhocks, catalpa, golden glow, etc. It has also been known to work in potato,

Fig. 43.—*Gortyna nitela* Gu. From Div. of Entomology, Dept. of Agriculture.

aster, dahlia, castor bean; in short any plant with soft center is apt to suffer. It is even reported as attacking twigs of apple, peach, currant, etc., and is to be classed as a general nuisance.

Mr. Freeman of the University has identified this fungus as *Scorias spongiosa*, Schw. Harshberger, in Vol. 3 of the Journal of Mycology, reports it as occurring in the honey dew of *Schizoneura imbricata*, found on the Beech.

I obtained pupae from hollyhocks on the 11th of August, the adult emerging from them in the breeding cage Sept. 7th. The young Caterpillar on emerging is purplish with light stripes running along its body. As it gets older it becomes duller colored, and about midway of its length the color is such as to make that part appear diseased.

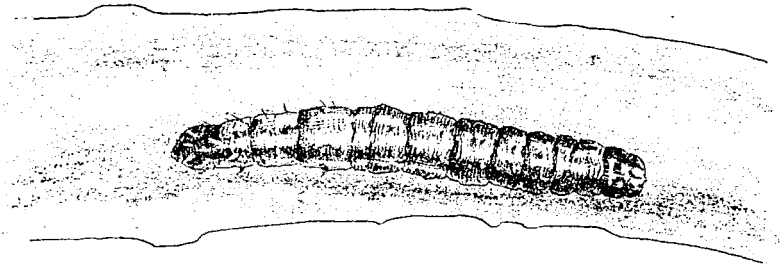

Fig. 44.—The larva of the Stalk Borer, enlarged.

Mr. T. L. Libbey of 8th St. S. E. Minneapolis, whose tomatoes were sorely threatened last summer, hit upon an ingenious method of killing the borer without injuring the vine. He had tried to reach the borer by introducing a wire into the mouth of its burrow, but found that the stem was so irregular in its growth that it was bruised and injured by this process. He then tried chloroform, injecting with a medicine dropper about one teaspoonful into the burrow and plugging the hole with cotton that the fumes might be retained in the burrow. This worked like a charm, killing the borer and beyond a slight browning of the vine at the point of application, no injury was occasioned.

The use of noxious gases such as those of chloroform and the more universally used bisulphide of carbon to kill fruit pests are becoming quite common. The latter gas has been used successfully in California against the Peach Tree Borer and no doubt would have been as efficacious against the Stalk Borer as was the much more expensive chloroform.

A SCARABEID INJURING CORN.

Ligyrus gibbosus, Dej.

On Aug. 7th the Entomologist received from Mr. J. W. Shu-

gard of Merriam Park a complaint that a Beetle was at work at the roots of his sweet corn and that in consequence the corn was wilting and the ears not maturing. One corn plant was sent to the Station which had at its roots 20 Beetles, pupae and larvae. Careful examination of this plant, however, failed to disclose any material defacement by the Beetles and I was led to conclude that the nature of the soil had encouraged the withering of the corn. A visit to Merriam Park later, however, convinced me that this was not the case particularly as the season has been a wet one and

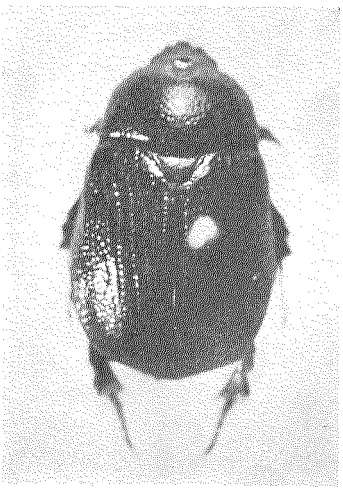

Fig. 45.—*Ligyrus gibbosus*. From a pinned specimen; 4 times enlarged.

a careful study of the various hills assured me that the Beetle was to blame. While no corn stalk examined was actually bored into still there was evidence of slight gnawing of the stalk and a part of the roots had evidently been bitten off.

Mr. Shugard's experience with a lantern trap is interesting as showing the futility of such contrivances often advertised as a "sure cure" for all sorts of insect pests.

In four nights of trial in August he secured only 63 specimens of insects. 54 of these were moths; the remainder with one exception were small insects, the exception being a beetle. Neither the moths nor the small insects were sent to me by Mr. Shugard. Only one individual then of the larger number of beetles

which were flying in that vicinity, according to the statement of Mr. Shugard, was caught in the trap.

A most thorough trial of lantern traps has been made by the Cornell Experiment Station, to see whether they would accomplish all that the advertisers claim, and any orchardist or farmer thinking of buying one of these humbugs is advised to read the Cornell bulletin before purchasing.

This Beetle has been reported by Webster as feeding upon roots of carrots, by Weed as injuring corn in Mississippi and by Forbes as guilty of the same trick along with *L. rugosa,* in Illinois causing the corn to wither and turn yellow about the time it should be maturing.

The species under discussion was reported in 1898 as injuring corn in both Wisconsin and Louisiana. In Bulletin No. 33, Div. of Entomology, U. S. Department of Agriculture, F. H. Chittenden reports it as injuring the roots of Sun Flower and Sweet Potato in Ill., and the roots of the former plant in Neb., also roots of celery, carrots and parsnips in Indiana. The same bulletin quotes Prof. Bruner as stating that it has been quite destructive to sugar beet in localities in western Nebraska.

In view of what we know of the habits of this family I was not surprised to receive a letter from Mr. Shugard under date of Oct. 30, stating, in reply to certain inquiries mailed him, that in 1900 "cleanings from a horse yard were spread upon this plat of ground to the depth of about 2 inches and the yard was cleaned up every 3 or 4 weeks." He stated, further, that in 1901 a light application of horse manure was made, and that in the spring of 1902 about 3 inches of horse and cow manure was used.

MOSQUITOES.

A country containing as much water area as Minnesota will always suffer to a greater or less extent in localities with this troublesome pest, though it is well to bear in mind that it is not the deep ponds or lakes which favor its increase. In other words, since the larva or "wiggler" or "wriggler" as it is called, gets its food from the bottom and its oxygen from the surface and in consequence spends much of its time oscillating between these two

points, deep water would be a very undesirable feature. As the human family know only too well it appears to reserve its energy for use on them. The adult, at least the female does all the biting, the mouth of the male not being adapted to piercing the skin and sucking blood. An Italian worker, however, claims that in two species, the males also suck blood.

As to the length of life of the adult Mosquito, no general statement can be made, several having been kept alive for three weeks; evidently the natural life of the perfect insect lasts from 8 days to 3 weeks. This statement is only a general one; climatic conditions probably have great influence upon the duration of life.

Though our pretty lakes are not infested, their irregular shore lines where little shallow pools occur are ideal places, and where ever swampy land is found in the State, there as the reader probably knows, mosquitos occur in countless numbers. Further, only a handful of water being necessary for the development of several hundred individuals the following places, very apt to be overlooked, afford fertile sources for infection; drains, ditches, shallow ponds, puddles, post holes, depressions under sidewalks, watering troughs where water remains unchanged for some time, muddy holes made by the feet of cattle about watering troughs, water tanks, fountain basins where the use of the fountain is not and in fields and meadows, marshy places in meadows, uncovered sufficient to keep the water in motion and renewed, old basins, tin cans, bottles, etc., in rubbish heaps; a broken bowl or an old coffee pot lying unnoticed under a bush may be the source of hundreds. The fact that one-half pint of water in a cow's track in the meadow, may, if the water remains there ten days, or even if it almost all dries up and is then renewed by a slight shower, be the source of several hundred mosquitoes probably accounts for so many of these insects in land where apparently no water is present. Furthermore, the writer has a suspicion that inasmuch as water is not absolutely essential to the vitality of the egg, our mosquitoes like the Salt Marsh Mosquito, may lay their eggs in localities where their instinct tells them water will come later. Out of twenty-five or more species known to occur in the United States we find in Minnesota *Culex consobrinus, C. impiger, C. pungens, Anopheles quadrumaculata,* and probably others not yet described.

In Press Bulletin No. 15 issued by this department May 24th, the life history of the Mosquito tribe was quite fully discussed and need not be repeated here since a copy of that bulletin can be obtained by any citizen of the State for the asking.

The conditions here in this State and the bearing they have upon the life history of mosquitoes is being made a subject of study by this department, the date of appearance of the first brood, and the last, what species are represented, their method of hibernation, unsolved problems as to eggs, larvae, etc., as having a bearing upon the question of lessening the evil.

The best means to reduce the pest in any neighborhood is to drain and fill up as rapidly as possible all marshy places in the vicinity. The introduction of fish into shallow ponds affords a means of killing mosquitoes, for fish feed upon the larvae and pupae.

The evening of the shore line of ponds, making the same regular and thus destroying small inlets and wet depressions has also been suggested.

An effective remedy, but not a new one, is the application of kerosene to the surface of pools, drains, ponds, ditches, open cess pools and the like. Prof. L. O. Howard, U. S. Entomologist has brought this method into prominence, but beyond the establishing of certain important details, he does not claim any special originality in its use. It is said that one ounce of oil to every 15 square feet of surface will not only kill all the larvae, pupae and eggs in the water treated, but is fatal also to the adult female mosquito whose instincts prompt her to lay her eggs upon the surface of the water in spite of the presence of kerosene. The oil may be simply poured upon the water, preferably upon the windward side, and allowed to spread, or it may be sprayed. An objection to spraying is the fact that some oil is wasted and that vegetation is unnecessarily killed. Under some circumstances, however, spraying is certainly the best method, and in the case of low, hummocky land with water in innumerable small holes all over the field, it would be manifestly a herculean task to pour oil in each hole, and the spray is resorted to as the best and quickest method, new vegetation quickly taking the place of that killed by the oil.

How often should one apply the oil? It would seem that this is a matter easily determined by observation, for as long as a film of oil can be seen upon the surface, no further treatment will be necessary, and the volatility of the oil must be dependent in a great measure upon meteorological conditions. It has been suggested that one application every four weeks during the summer is sufficient. I believe that a more frequent treatment, perhaps

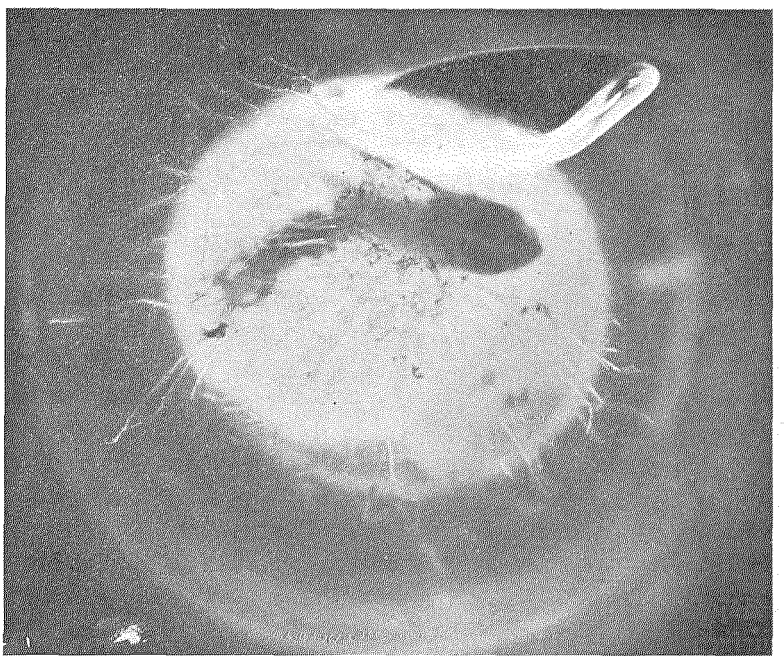

Fig. 46.—Pupa of Mosquito killed by fungus, enlarged.

once in three weeks is safer in this vicinity. As to the date of first application, that too is easily determined by observation. As soon as the wigglers are first seen or even earlier when the adult mosquitoes are noted about the water preparing to lay their eggs, then the oil should be applied. It is claimed that this method can be used with safety in the case of large tanks, the water in which is intended for drinking purposes, providing the water is drawn from the bottom of the tank, or a better way perhaps is to put a screen over such tanks. It is very evident that there must be co-

operation in this work, for it would profit but little if one citizen should treat all the stagnant water upon his place, while his neighbor across the fence leaves untouched, pools and ditches capable of producing millions of mosquitoes. It is interesting to learn that this pest must not necessarily feed upon warm blood. They have been observed puncturing dead fish and hovering about turtles when the latter were on the land. They appear to have a special predilection for beer and wine, and have been kept alive for some time on slices of banana. Evidence in the possession of Entomologists points to the probability that all Mosquitoes were originally vegetable feeders and that the blood sucking habit is an acquired one. Like other insects they are at times affected by fungus diseases which must lessen their numbers considerably. The accompanying photograph illustrates a pupa killed by a fungus growth. The writer found that many taken from a pool contaminated with sewage died in this way. In fact it is reported that fungus disease has been successfully introduced into ponds last summer for this purpose. The statement in the press that mosquitoes "are attracted by red and black colors and abhor yellow," must be regarded with some suspicion until it is corroborated by scientists. It is generally believed that mosquitoes do not fly very far from the place where they hatch. This has been disproved, at least of many of the species, and even if they do not the same result will be attained, that is their dissemination, through the agency of the wind. It is of further interest to learn that the larva or wiggler of some species have been known to live through winter and not to have been injured by frequent freezing. In fact, on the night of Nov. 16th the water in an out-of-door breeding jar which contained a larval mosquito froze solid. On the 18th the ice melted, disclosing our Culicid, not only none the worse for its freezing, but turned into a very active pupa.

The writer attempted with kerosene to abate the mosquito nuisance this last season in a neighborhood quite badly infested. A map was first made showing all the ponds and marshes in the vicinity, and the first application of oil was made May 24th (a little late possibly as subsequent events proved). The same ground was gone over again June 16th by an assistant in the absence of the Entomologist, and again on July 30th and again, the

places which were observed to contain larvae, on August 13th. This experiment was only partially successful. That is, immunity for a time was reported, but inability to be personally on the ground and make application more frequently, allowed the pest to emerge in large numbers during mid summer. An insurmountable difficulty, however, which presented itself was the presence in the neighborhood of vast marshy tracts where it was impossible for a man to walk, much less a horse hauling a heavy spraying outfit. *Until such places are drained and filled residents in such localities must expect more or less trouble.* Yet much might be done in the immediate vicinity of the house. Five gallons of kerosene and a little watchfulness will do wonders. Mosquito larvae and pupae were observed in the vicinity of St. Anthony Park in pasture pools as late as October 30, at which time imagos were plentiful, and larvae, or "wigglers," were found November 6.

Unidentified wigglers were collected August 11th, and kept under natural conditions in breeding jars, with water from the pond where they were captured, until September 5th, at which date all were dead. During that period from August 11th to September 5th, over three weeks, *none emerged.*

As to repellant applications for face and hands. Prof. Jno. D. Smith, of New Jersey, who has done and is doing much work in the line of mosquito experimentation, advises the use of Oil of Citronella, which he says absolutely keeps off all kinds of mosquitoes. All who have used it at his request, writes Dr. Smith, are loud in its praise. Caution must be used to avoid getting it in one's eyes. The writer has tried some laboratory experiments with Phinotas oil, simply to corroborate the published statement that one part of oil to 10,000 parts of water will kill mosquito larvae and pupae. This oil, made and sold by the Phinotas Chemical Company, is a secret compound which is undoubtedly superior to kerosene, and also more expensive, it being quoted at 40 cents per gallon. It was found that one part of the oil to 12,000 parts of water killed larvae and pupae. Phinotas oil sinks to the bottom in globules, which almost immediately rise, spreading out in a film on the surface, and forming as they rise a fine, white "precipitate," which permeates the water, killing all small organisms it comes in contact with. The accompanying photo-

graph will illustrate the action of the oil, and the appearance of the water at intervals of a few moments after application. Figs. 1, 2, 3, being taken within one minute of each other, and Fig. 4 a little later.

A sample left with the Station Chemist was reported as being a coal-tar creosote product, with a specific gravity of 1.03. The white "precipitate" observed when Phinotas is added to water (see photos), is the material separation of phenol derivatives.

The use of oil of some sort in this connection is no new thing. Kerosene, it is reported, having been applied for this purpose as early as 1847, and some kind of oil unknown to the writer was suggested apparently as early as 1812.

ROACHES, COCKROACHES, CROTON BUGS.

Ectobia (Phyllodromia) germanica.

This offensive household pest, almost world-wide in its distribution, so common in large cities, and known under the names given above, needs no special description. Families living in flats perhaps are greater sufferers than others, because no mat-

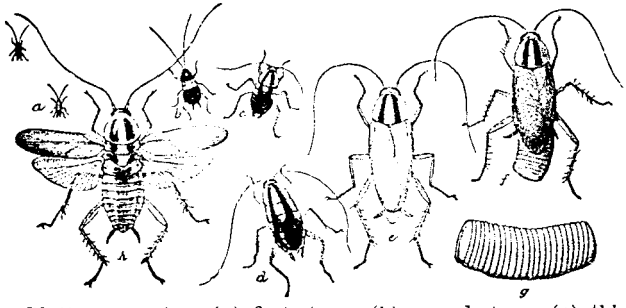

Fig. 49.—*Blatta germanica;* (a) first stage; (b) second stage; (c) third stage; (d) fourth stage; (e) adult; (f) adult female with egg case; (g) egg case enlarged; (h) adult with wings spread. All natural size except g. From "Household Insects," published by U. S. States Div. of Entomology.

ter how energetic one occupant may be in his efforts to exterminate the pest, if the other families in the flat make no attempts in this direction, the Roaches soon return to their old quarters. Many repellant poisons have been suggested, but this particular species seem very wary of poisoned baits. Undoubtedly the most

effective remedy is treatment with hydrocyanic gas, but this is so dangerous an agent, being fatally poisonous to human beings, that the Entomologist would only advise its use under most extreme precautions. Cir. 46, Second Series from the United States Department of Agriculture, Division of Entomology, describes this process in detail. Another gas, also poisonous, but not so deadly, bisulphide of carbon, can be effectively used where the insect infests small rooms which may be completely sealed. An Italian worker says that one part of the liquid bisulphide to every 10,000 parts of atmosphere, will kill all and every insect the gas comes in contact with. The writer has practically corroborated this in some work, as yet unpublished; but it should be noted that to do this the liquid must be of the best quality, and not the cheapest grade, which leaves a residue upon evaporation.

The Department of Agriculture recommends one part of bisulphide to every 1,000 cubic feet of room space to kill Roaches.

Another remedy suggested is burning Pyrethrum in a closed room. The writer has used a phosphorous paste with fairly good results, placing small bits of the paste about the sink in the kitchen and other places frequented by this pest.

Firms which sell bakers' supplies generally carry in stock a patent powder, said to be extremely effective in this direction. A family known to the Entomologist have driven Roaches away or exterminated them by the persistent use of powdered borax in the kitchen. This was dusted in all cracks and crevices about the room daily (particularly in the evening) for two weeks, care being taken to use it liberally along the entire length of mop board wherever there was a crack large enough to hide a Roach, and its use was persisted in for some time after all insects had apparently disappeared.

This insect at one time was called *Blatta germanica;* see Fig. 49.

CARPET BEETLES, CARPET MOTHS, BUFFALO MOTHS.

Anthrenus scrophulariae, Linn.
Attagenus piceus, Oliv.

Specimens of both the above carpet pests have been sent to

me during the past season, and I heard many complaints of Buffalo Bugs from housekeepers. Both of the above species were introduced from Europe, the former about 1874, and the latter as late as 1854, though it was not until 1879 that Dr. Lintner reported the latter as a carpet pest in connection with the first

Fig. 50.—Carpet Beetle, *A. scrophulariae,* and its work, showing beetle, larva, moulted skins of larvae and excrement, enlarged. Original.

named. Though their food habit may vary slightly in different localities, they both somewhere feed upon carpets, and remedies for both may be discussed under one head. It is well to note that many or most of the remedial and protective measures may also be used against the various species of clothes moth. In the adult state Carpet Beetles are found upon flowers. In addition to

Fig. 50, an excellent drawing (Fig. 61) of this pest will be found on page 69 of this report.

REMEDIES AND PREVENTIVE MEASURES.

Midsummer house cleaning of infested houses (we mention such a deviation from the old prescribed custom with fear and trembling), or two house cleanings each year (and from the man's standpoint this is a very unpleasant thought) is desirable, and should be most thoroughly attended to. If carpets are used they should be thoroughly beaten, and, if possible, sprayed out of doors with some such liquid as benzine or gasoline, and well aired afterwards. Rooms should have their bare floors thoroughly swept, washed with hot soap suds, and all cracks dusted with kerosene or benzine. If possible, it is desirable in bad cases to lay tarred paper on the floor before laying down the carpet. Should the carpet show any spots at any time during the year after such a treatment, affording evidence of the pest, we are advised by the United States Department of Agriculture to lay a damp cloth smoothly over the places affected, and iron with a hot iron, thus creating steam which will pass through the carpet and kill all insects below. The use of rugs on bare floors, or even rugs upon matting, is preferable to the use of carpets, for obvious reasons. In protecting furs and feathered goods and woolens from the ravages of these pests, one should proceed in the same way as in the case of protection from insect moths, viz. storing in tight chests or closets, with a supply of Camphor or Naphthaline balls, and frequent examination during the summer months. Chests lined with tarred paper, which paper is to be replenished each season, are useful.

It must be borne in mind that neither Camphor, Naphtha nor tarred paper kill the insects or their eggs, hence these must be eliminated before storing the goods. Where one can have access to cold storage woolens and fur can be protected, for none of these pests work in a temperature below 40 deg. Fah. Frequent beatings of furs, furniture cushions, woolens, etc., during the spring and summer, say in May, June, July and August, in this climate, would be of material help in case of such goods as cannot be well stored. Bisulphide of carbon affords a ready means

of killing these pests in a confined space; the writer has used it and has heard of its successful use elsewhere. A saucerful of this agent placed upon the top of woolens in a tight chest or trunk twice or thrice during the season, and allowed to evaporate during 24 or 30 hours, will invariably kill all insects in such chest or trunk. The liquid volatilizing and the heavy gas sinking through the fabrics, carries death as it goes. This liquid and gas is extremely inflammable. Housekeepers need no caution in this direction as regards Benzine and Gasoline, for all are aware of these qualities in the two latter agents.

The excellent practice of storing woolens and furs which have been thoroughly freed from eggs and from larva of these pests, in paste-board boxes, which are afterwards throughly sealed by pasting paper over the cracks, is well known.

BLISTER BEETLES ON WINDSOR BEANS.

Macrobasis unicolor, Kirby.

Windsor Beans upon the University farm were attacked this year by numbers of these beetles. They fed upon both the flowers

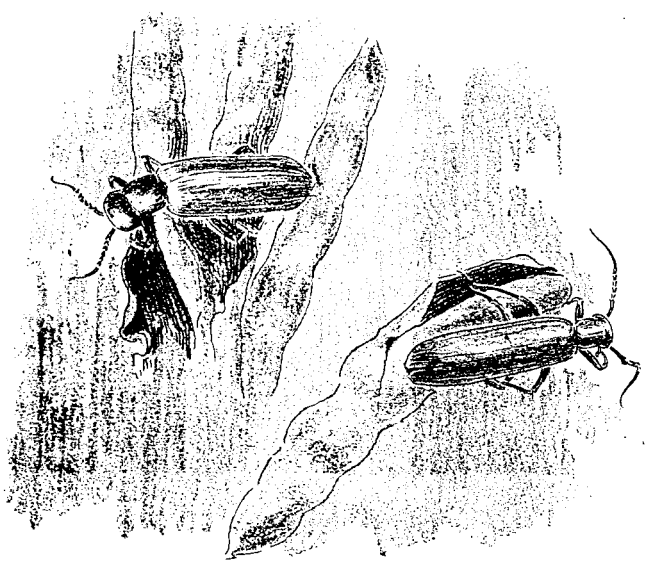

Fig. 51.—*Macrobasis unicolor* injuring beans.

and leaves. These insects can be controlled by several applications of Paris Green, dusted dry or sprinkled on the plant in liquid form. When Paris Green is used in water, take two tablespoonfuls of the poison to one pailful of water. If a quart of lime water or milk of lime is added to the water it will further insure the safety of the foliage.

The family *Meloidae* to which these Beetles belong has a curious characteristic, viz., although the adults are destructive to plants their young, hatching from the eggs laid in the ground, feed upon destructive insects or their eggs.

The species under discussion *M. unicolor,* is very active as a larva in eating the eggs of grasshoppers, and this fact should bid us pause before destroying the adults, unless the injury caused by them is very serious.

THE PLUM GOUGER.

Coccotorus scutellaris, Lec.

This Snout Beetle is probably the worst enemy of the fruit raiser in Minnesota, not excepting the Plum *Curculio.*

In September specimens were received from Luverne, with the statement that they had gathered upon the outside of sacks which had been filled with plums. The above picture, from a report of the late Prof. Lugger, illustrates this species very well.

The Plum Gouger is a reddish brown Beetle, with peculiar minute tufts of hair on its upper surface. The Beetle not only punctures the formed fruit, but also the ovary of the flower before the petals form. The egg-laying is a curious process, a round hole being made in the fruit into which a single egg is dropped. This is practically true of all the members of this great group of Snout Beetles, containing nearly or quite 25,000 known species, the beak, in the female at least, being used to prepare a place for the egg, and sometimes to push it to the bottom of the hole. The puncture soon heals, closing in the egg. Unlike the Plum Curculio, this Beetle larva feeds not only upon the flesh of the plum, but bores into the pit and eats the kernel. It changes to a Beetle in time to seek winter quarters near by. Plums which drop prematurely as a result of this injury should be collected and destroyed. From the fact that the grub is en-

closed in the fruit there is no use in spraying; this is on the assumption that this species always puts its egg into the fruit Forcibly jarring the tree early in the morning is advised, catching the beetles which fall on a sheet or similar contrivance, and burning them. The trees will have to be struck quite forcibly in order to dislodge the beetles. The gathering and burning of all

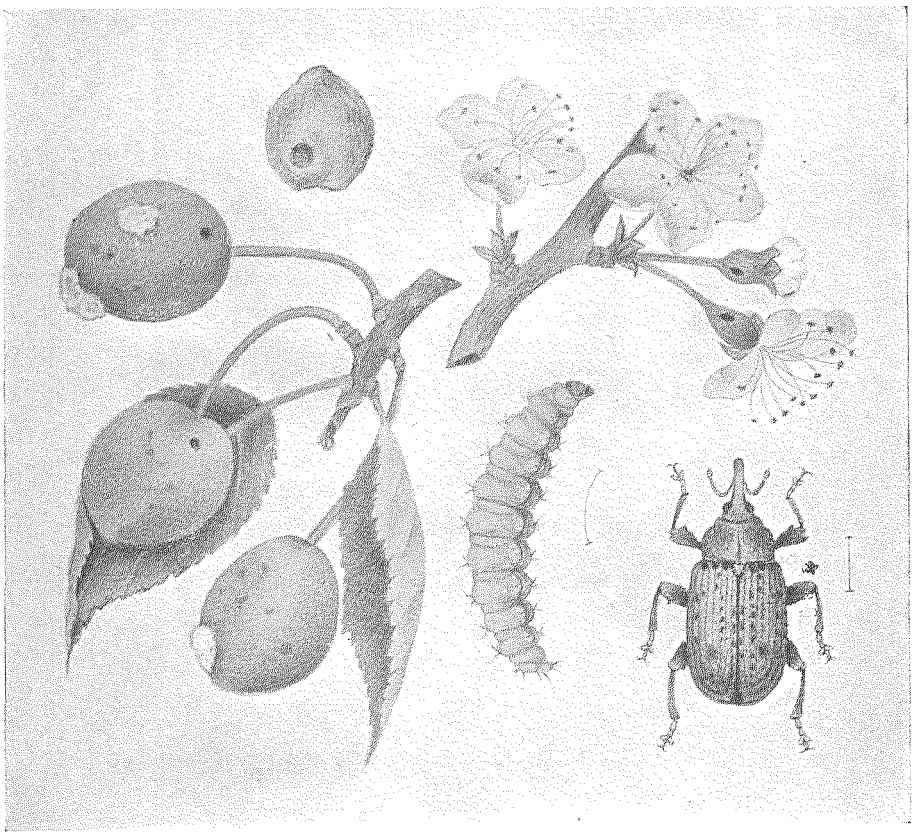

Fig. 52.—*Coccotorus scutellaris* Lec. Lugger.

rubbish about the orchard will, by destroying some of the places used for winter quarters, tend to reduce its numbers.

Note: Wherever in this report a line is found by the side of the picture of an insect, it denotes the actual size of the insect figured.

THE TARNISHED PLANT BUG.

Lygus pratensis, Linn.

Specimens of this insect were sent me May 7, 1902, from

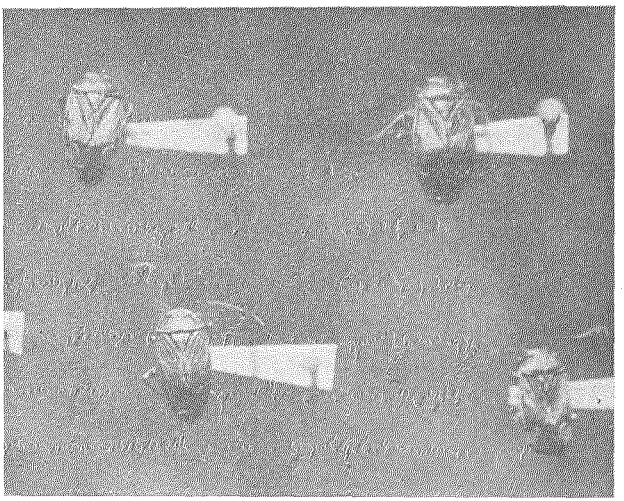

Fig. 53.—The Tarnished Plant Bug (*Lygus pratensis*); four pinned speciments enlarged three times.

Brooklyn Center, with the statement that they were injuring the

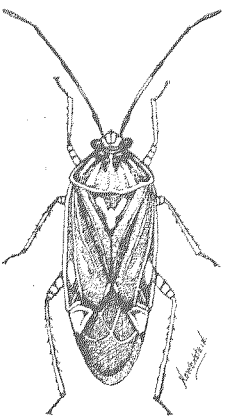

Fig. 54.—*Lygus pratensis* Linn. Much enlarged. Lugger.

Currants (blossoms, petals and leaves) plum trees, flowering

shrubs, and to some extent, the ash trees. On May 16th the party wrote again that they "had nearly all left the currants"; on June 5th they were reported as "having gone," and the statement was also made, "we will only get one-third of a crop of currants."

This insect frequently causes both petals and leaves to wither and fall, sometimes killing the branch on which they occur. One can take advantage of its sluggishness early in the morning, and shake them from the bushes at that time onto sheets placed below, and then destroy them. Since they become very active as soon as they are warmed up by the sun, gathering them in this way is confined to the early morning.

They are reported as injuring many kinds of fruit beside currants, viz., strawberries, plums, apples, quince and cherries. The injury caused is not protracted; that is, its attacks are not lasting. It measures about one-fifth of an inch in length, and resembles the pictures accompanying this article.

THE MELON APHIS.

Aphis cucumeris, Forbes.

These lice attacked melons and cucumbers on the farm of George Jacobson, Luverne, Minn. Various remedial measures are mentioned for this pest, none of them easy of application when a large field is to be treated. Spraying the underside of leaves with kerosene emulsion, one part to twelve parts of water, or dusting Pyrethrum with a bellows onto the underside of leaves are both suggested. More reasonable, however, is the suggestion to destroy all the old vines and rubbish on the melon patch, and plant some crop other than melons or cucumbers there the following season. Frequently the attacks of this pest are not of long duration, the plant yielding a crop in spite of the visitation; parasites, too, kill many of them.

CORN LOUSE.

Aphis maidis, Fitch.

Another pest found in the State difficult to combat. There

is a root form and a branch form of this Louse. No artificial remedies are practicable.

The Entomologist would suggest rotation of crops; also feeding affected stalks to stock before the Aphis has laid its eggs.

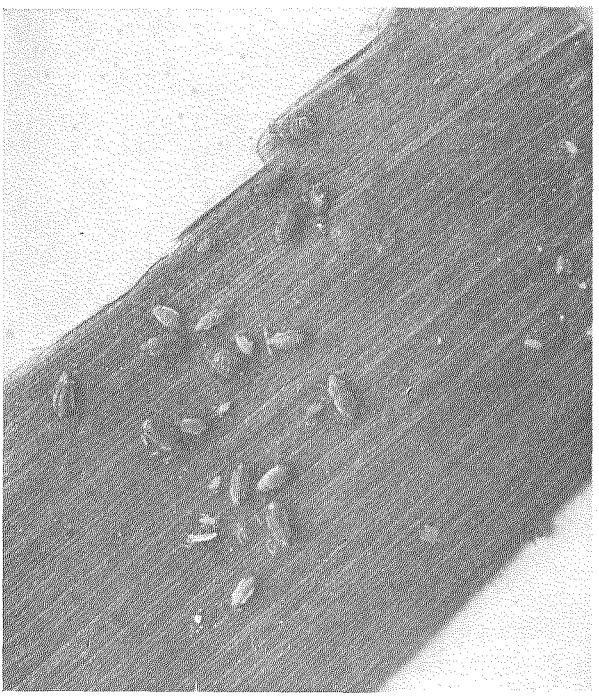

Fig. 55.—Corn Plant Louse, much enlarged.

For garden corn, kerosene emulsion, one part to twelve, will readily relieve the trouble.

The Corn Louse is said to winter in the ground, and to produce wingless generations on the roots. The farmer is urged not to plant corn on the same ground two years in succession if he is much troubled by this insect. This, of course, means rotation of crops, as suggested above.

THE NEW YORK WEEVIL.

Ithycerus noveboracensis, Forster.

Specimens of this large snout beetle have been received this summer with statement that they were injuring apple and plum trees.

The Beetle is about two-thirds of an inch long, gray, with small black spots and white lines on its back. It is extremely destructive, feeding upon various kinds of fruit trees, but particularly upon plum trees in the spring, in May or June, eating

Fig. 56.—*Ithycerus noveboracensis* Forst., eating bark and leaves of plum. Lugger.

buds, leaves and twigs. The egg it is said, is deposited in a hole made in the bark by the female. It is evident that remedial measures are most advantageously applied before the eggs are laid. It is therefore suggested that as soon as the Beetles are observed they be destroyed by frequent jarring, catching them on a sheet or white cloth beneath the tree, and destroying them. As an auxiliary to this leaves and trees may be poisoned with Paris Green, using the same proportions with lime as recommended in discussion of "Blister Beetles on Windsor Beans." Fig. 62, on page 69, also represents this beetle.

Other injurious insects occurring during the past season were as follows:

Scolytids, on box elders.

Various Jassids, or "Leaf Hoppers."

A number of scale insects, various forms of plant lice, the usual quota of Cabbage Worms; a Mite, on box elders.

Ptinus fur on sacks of flour stored in elevator.

Tribolium confusum, in flour.

An *Anthomyd* causing the death of crop beans by boring in the stalk.

Box Elder Bug *(Leptocorisa trivittata);* a very few reported in Meeker and Big Stone counties.

The borer known as *Saperda cretata; Lyctus striatus* boring in timber, etc.

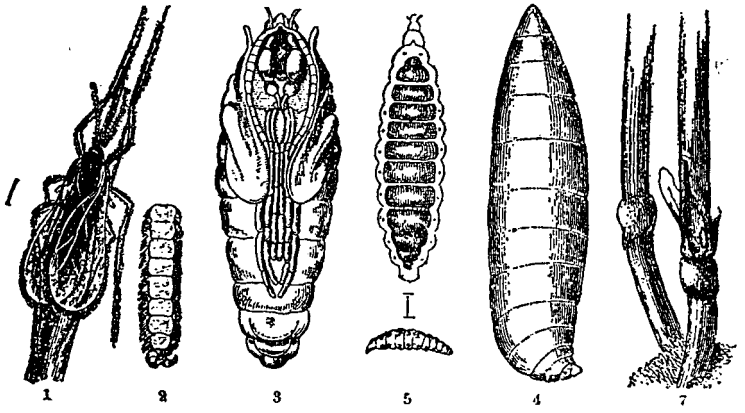

Fig. 57.—Hessian-fly: (1) adult female; (2) abdomen of male; (3) pupa removed from puparium (flax-seed); (4) puparium; (5) larvae; (7) puparia in position. All enlarged excepting 1. (After Taschenburg).

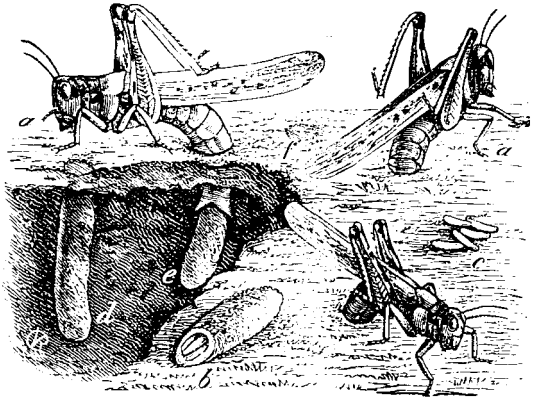

Fig. 58.—Rocky Mountain Locust: (a, a, a) female in different positions, ovipositing; (b) egg pod extracted from ground, with end broken open; (c) a few eggs lying loose on the ground; (d, e) show the earth partially removed, to illustrate an egg-mass already on place, and one being placed; (f) shows where such a mass has been covered up. (After Riley.)

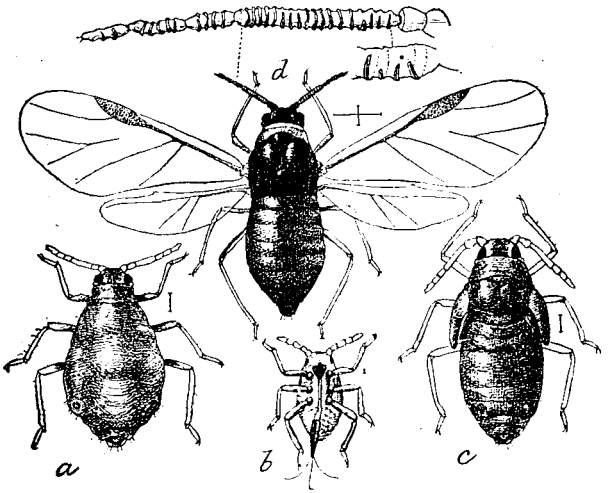

Fig. 59.—Woolly aphis (*Schizoneura lanigera* Hausm.)—(a) agamic female; (b) larval louse; (c) pupa; (d) winged female with antenna enlarged above; all greatly enlarged and with waxy excretion removed. After Marlatt, Division of Entomology, Dept. of Agriculture.

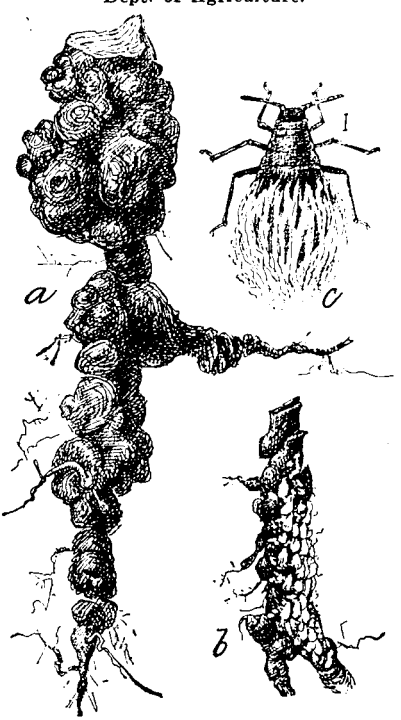

Fig. 60.—Woolly aphis.—(a) root of young tree illustrating deformation; (b) section of root with aphides clustered over it; (c) root louse, female; (a and b) natural size; (c) much enlarged. After Marlatt, Division of Entomology, Dep. of Agriculture.

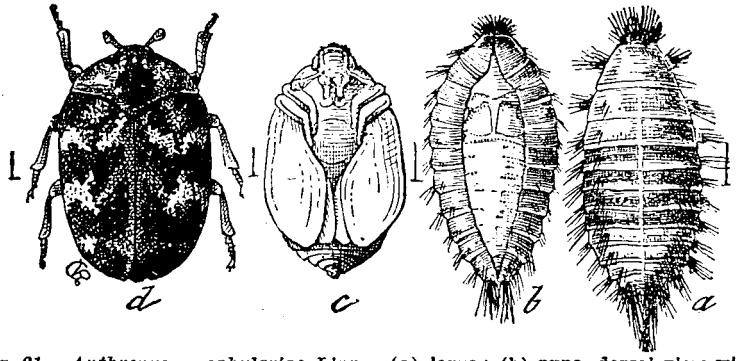

Fig. 61.—*Anthrenus scrophulariae*, Linn.—(a) larva; (b) pupa, dorsal view with split larva skin surrounding; (c) pupa, ventral view removed from skin; (d) beetle—hair lines showing natural size (after Riley).

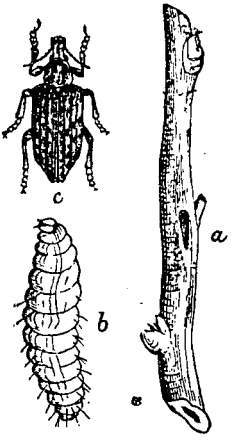

Fig. 62.—*Ithycerus noveboracensis* Forst.—(a) hole made with her jaws by female for insertion of her egg; (b) larva; (c) adult.

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